



Engineering Design Standards and Specifications Manual

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PREFACE

The Town of Innisfil Engineering Design Standards and Specifications Manual (Town Standards) is intended to provide clarity to Engineers, Landscape Architects, Developers, and Contractors that are designing or installing municipal infrastructure within the Town of Innisfil (“Town”). The Town Standards are to be used as a guide to provide infrastructure design that meets Town approval. The Town Standards are not intended to replace sound engineering principles or relieve the Engineer of their responsibility for the design.

The Town Standards were prepared with a vision to ensure that the design of all municipal projects supports future growth, is environmentally responsible, considers operation and maintenance impacts, improves accessibility for those with disabilities, and utilizes sound engineering principles and practices.

The Town Standards reflect current design and construction practices and the evolving requirements of the Town, its residents, as well as its partners in the development and construction communities. In the preparation of this document, the Town has incorporated the latest applicable municipal, provincial, and federal legislation, guidelines, policies, and criteria.

In particular, there has been substantial progress made in the area of stormwater management. As a result, key revisions have been made to reflect the intent and objectives of the most recent version of the following documents:

1. *Lake Simcoe Region Conservation Authority Technical Guidelines for Stormwater Management Submissions, latest edition.*
2. *Nottawasaga Valley Conservation Authority Development Review Guidelines, Stormwater Management Technical Guide, latest edition.*
3. *Nottawasaga Valley Conservation Authority Development Review Guidelines, Stormwater Management Pond Planting, latest edition.*

1.1. INTRODUCTION

These standards and specifications are intended as a guide to ensuring good engineering basis and consistent designs for all municipal and development projects within the Town of Innisfil. These standards are to be read in conjunction with the Town of Innisfil Engineering Design Standard Drawings as well as the Ontario Provincial Standard Specifications and Drawings (OPSS & OPSD). Where there are any apparent conflicts or discrepancies, the Town Engineering Design Standards, Specifications, and Standard Drawings shall take precedence.

The Town reserves the right to request additional requirements and modifications to the engineering designs beyond the Town's standard guidelines. The engineering standards are not intended to cover all possible design considerations, and they may change before this document is updated. The design engineer should communicate with the Town's engineering staff and have regard for their recommendations.

All infrastructure projects, including those for private developments, shall conform to the Town of Innisfil's engineering standards and guidelines unless otherwise directed by the Town. For further clarity, the Town's engineering design standards apply to all development applications and permits, including but not limited to Site Alteration Permits, Plan of Subdivision applications, and Site Plan applications.

The information provided in this manual is not intended to relieve the Developer or the Engineer of their responsibility to submit a finished product of competent engineering design and construction. For any form of consideration made to deviate from Town standards, the Engineer must submit a detailed proposal outlining the deviation, with the necessary justification and analysis, for consideration by the Town prior to formal engineering submissions.

If there are any preliminary concerns that are not addressed within this document, the designer is to coordinate a pre-consultation meeting with the Town's Engineering and/or Planning staff to resolve any issues prior to the commencement of the engineering design.

1.2. ENGINEER'S ROLE

The design, all required engineering drawings, and associated reports must be signed and sealed by a qualified Professional Engineer, licensed to practice in the Province of Ontario.

1.3. SUPPORTING STUDIES AND REPORTS

The following studies and reports may be required to support the design. It should be noted that the information provided is the minimum requirement and the studies and reports may need to include further details depending upon site-specific conditions. The following list is not intended to be all-encompassing. Additional reports or studies may be required at the discretion of the Town. The Engineering design shall incorporate the information and/or recommendations of the supporting studies and reports. The supporting studies and reports listed in this section are to be included in the initial development application submitted to the Town. A list of all reports or studies required to be submitted may include, but is not limited to:

1.3.1 Geotechnical Report:

The Geotechnical Report shall be prepared to examine and confirm subsurface conditions including soil type(s) and stratification, groundwater levels, depth to bedrock, soil bearing capacity, permeability, conductivity, and presence of any contaminants. The report shall

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address the adequacy of the Town's standard minimum pavement structure and sub-drainage system or recommend an increased pavement structure if conditions warrant.

The report shall assess the suitability of native soils for trench backfill and building foundation construction. It shall also address requirements for imported fill as well as construction methods for the use of both native and imported materials.

The report shall discuss the requirements for pipe bedding as well as engineered fill where necessary for building construction.

The report shall be accompanied by a scaled drawing showing test pit and/or borehole locations complete with a detailed test pit and/or borehole log. During detail design stage an update of the Geotechnical Report may be required and will be confirmed by the Town.

The report shall be signed and sealed by a qualified Professional Engineer licensed to practice in the Province of Ontario.

1.3.2 Hydrogeological Assessment:

Hydrogeological studies for proposed projects must be conducted by a qualified Professional Engineer and/or Geoscientist to characterize the groundwater regime from a site-specific and regional perspective in order to address issues related to (as applicable):

- a) Impacts to existing well water supplies within the project area. If impacts to the site or neighbouring properties are anticipated, a private water well survey is required as determined by the Hydrogeological report. A private water well survey may also be required at the Town's discretion;
- b) Soil permeabilities and associated properties where the design of septic systems are concerned;
- c) Groundwater impact assessment to area aquifers from construction activities and/or discharge of waste or wastewater;
- d) Test wells and associated testing in accordance with Ministry of the Environment, Conservation and Parks (MECP) D-5-5 guidelines to address water taking impact sustainability;
- e) Impacts to nearby surface water bodies; and
- f) Specific technical review of well field or wellhead capture zones.

For general road and servicing construction, the report should consider the depth of services and identify likely areas where dewatering will be required, the rate of dewatering, requirements for dewatering, permits, and the strategy to achieve the required groundwater levels. If dewatering is necessary, the report should contain sufficient data on groundwater quality and temperature of the receiving watercourse.

Where applicable, the report should also provide an assessment of the use of sump pumps for building design.

1.3.3 Stormwater Management Report (SWM):

The Stormwater Management Report is to provide details and supporting calculations associated with the design of the minor and major drainage systems as well as the required source, conveyance, and end of pipe controls required to achieve the minimum standard targets established by this document as well as the Conservation Authority.

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At a minimum, the following details must be included in the Report:

- a) Background Information;
- b) Stormwater Management Targets and Objectives;
- c) Pre-Development and Post-Development Drainage Areas
- d) Stormwater Quantity and Quality Control
- e) Storm Drainage System Design
- f) Design of End of Pipe Controls
- g) LSRCA Volume Control, Phosphorus Control and Water Balance
- h) Erosion and Sediment Control;
- i) Stand-Alone Operation and Maintenance Manual
- j) Calculations, Tables, Figures, Digital Modeling, and Drawings

The Stormwater Management Report is to adhere to the latest version of the following guidelines:

The Ministry of Environment, Conservation and Parks (MECP) Stormwater Management Planning and Design Manual.

Comprehensive Stormwater Management Master Plan, Town of Innisfil.

Lake Simcoe Region Conservation Authority Technical Guidelines for Stormwater Management Submissions.

Nottawasaga Valley Conservation Authority Development Review Guidelines, Stormwater Management Technical Guide.

Nottawasaga Valley Conservation Authority Development Review Guidelines, Stormwater Management Pond Planting.

Low Impact Development Stormwater Management Planning and Design Guide, CVC and TRCA.

Lake Simcoe Protection Plan.

Innisfil Our Place Official Plan.

1.3.4 Traffic Impact Assessment (TIA)

The Traffic Impact Assessment (TIA) refers to the generic requirement to address the potential traffic impacts of a proposed development on the existing road network. The traffic impact assessment will be in the form of a Traffic Impact Brief or Traffic Impact Study, whichever is deemed appropriate based on the thresholds contained herein and in consultation with the Town's Engineering Department. The following guideline is intended to provide directions to the developer with respect to establishing the appropriate scope of traffic impact assessment required.

A **Traffic Impact Brief** is a reduced scope traffic impact assessment, usually required for small-scale developments where little or no impact to the adjacent road network is anticipated.

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A **Traffic Impact Study** is a comprehensive traffic impact assessment, usually required for medium and large-scale development where greater impacts to the adjacent road network are anticipated.

Electronic copies of all native, editable traffic modelling software (e.g. Synchro/SimTraffic, ARCADY, etc.) to be included with each TIA submission. Traffic reports typically have a shelf life of less than three years. However, significant changes within the study area may shorten the life of document if they were not accounted in the impact assessment or if major updates to the Town's Official Plan or Transportation Master Plan have been made.

Traffic Impact Brief:

For developments expected to generate less than 50 vehicle trips during the peak hours (total of inbound and outbound trips), a Traffic Impact Brief may be considered, provided that the site of study area characteristics are not such that would otherwise indicate that traffic or other transportation issues/concerns are likely to arise given the proposed development.

A Traffic Impact Brief has a reduced scope in the context of the anticipated trip generation of the development, and hence reduced the potential for impacts that may result. A Traffic Impact Brief should address the following:

1. **Study Area:** Inventory the existing road system to which the development fronts and/or in the immediate area of the development. This should include the number of lanes, speed limits, urban/rural cross-sections, etc. The study area is to be confirmed with the Town prior to commencing the assessment. At least one site visit is to be conducted to assess traffic safety and operational issues within the study area, lane configurations, sight distances, and other relevant factors.
2. **Proposed Development:** Detail the proposed land use and phasing/completion year. Provide an overall plan illustrating the proposed access locations, the internal road network, building locations, parking, etc. as applicable.
3. **Site Traffic:** Based on the land uses, determine trip estimates for the most appropriate peak hours. Typically, these will be the weekday AM and PM peak hours of the adjacent road, although for commercial, entertainment, religious, institutional or sports facility uses, a weekend peak may be more appropriate. The trip estimates should be based on published trip rates, data from other representative sites, or based on sound engineering ("First Principles"). Actual Peak Hour Factor (PHF) to be used for existing intersection analyses. A PHF of 0.90 is to be employed for proposed or future conditions.
4. **Site Access Assessment:** The site access should be reviewed in consideration of the volume and type of vehicles to be generated by the site, and the proposed access location and configuration. Town Standards are to be referenced as applicable.

5. Sight Line Assessment: At each access point, the sight distance requirements should be determined based on appropriate standards (MTO or County), and the availability of sight distance determined from actual field measurements or engineering plans.
6. Parking & Circulation: The proposed parking supply should be confirmed as adequate in consideration of the corresponding Town parking requirements. The internal road and circulatory system should be reviewed in the context of the type of vehicles to be served (including emergency vehicles, garbage collection or other appropriate design vehicles) and the need for access internally. Swept path analysis to be conducted and resulting diagrams to be attached to the Traffic Impact Brief. Approval from the Town must be obtained before proceeding with the selection of proxy sites for parking justification studies.
7. Documentation: A letter report should be prepared to detail the findings related to the above. Relevant maps, graphs, tables, and figures should be provided. The Traffic Impact Brief should be able to provide a conclusive statement that the proposed development will not adversely affect the operations or the safety of the adjacent road system, and that the development plan (including the access, parking area, and internal circulatory system) is adequate to suit the site traffic. The letter and drawings shall be signed and sealed by a qualified Professional Engineer licensed to practice in the Province of Ontario.

Traffic Impact Study:

For developments expected to generate 50 or more vehicle trips during the peak hours (total of inbound and outbound trips), a Traffic Impact Study is required for review and approval by the Town. A Traffic Impact Study may also be required for a development that will generate less than 50 vehicle trips during the peak hours if the site of study area characteristics are such that traffic or other transportation issues or concerns may have to be addressed to accommodate the development.

A Traffic Impact Study should address the following:

1. Study Area: The study area should extend far enough, within reason, to contain all municipal and provincial roads that will be noticeably affected by the traffic volumes to be generated by the proposed development. The study area is to be confirmed with the Town prior to commencing the assessment. The Town reserves the right to establish the study area as may be deemed necessary. At least one site visit is to be conducted to assess traffic safety and operational issues within the study area, lane configurations, sight distances, and other relevant factors.

A description of the existing transportation system in the study area, using a combination of maps and other documentation, should identify relevant information, such as:

- Existing parking areas, existing roads, number of lanes, on-street bike lanes, traffic signals, posted speed limits, and other important signage;

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- The lane configurations and control of the key intersections/roundabouts to be considered in the study;
 - The provision of on-street parking in the vicinity of the development site and the potential for this to impact key intersections being analyzed;
 - Existing transit routes, stops and terminals, and the future Metrolinx GO train station;
 - Other traffic controls and transportation facilities; and
 - Other features of interest such as designated trails, walkways, etc.
2. **Horizon Years & Period of Analysis:** The horizon years should coincide to the anticipated full build-out of the site, in addition to five (5) and ten (10) years beyond full build-out. Interim horizon years must also be considered as necessary for the staged implementation of the identified road system improvements. For large developments where five (5) and ten (10) year design horizon beyond full build-out is not feasible, the design horizon can begin at the period of anticipated initial occupancy but requires written approval from Town staff.
 3. Typically, the weekday AM and PM peak hours of the adjacent street will constitute the peak hours to be addressed. However, in the case of commercial, entertainment, religious, institutional or sports facility use, the weekend peak hours may be more appropriate. During the initial consultation process with the Town, the Consultant should determine the selected peak periods for analysis.
 4. **Existing Traffic Volumes:** Figures illustrating the existing traffic volumes and turning movements for the study area roads and intersections are required. Traffic volumes may be acquired for the Town, County or MTO, from other transportation studies in the area, or through traffic counts. To ensure representation of existing conditions, traffic count data should be no more than 3 years old. If a school is situated within the study area or is deemed to influence traffic volumes, traffic counts shall be collected during periods when the school is operational. It is preferable that traffic counts be collected during periods when higher traffic volumes are anticipated, based on the characteristics of the study area. Actual PHF to be used for existing intersection analyses.
 5. **Future Road Network & Background Volumes:** Future traffic volumes should be prepared for each horizon year, with consideration for annual growth rates to reflect general growth in traffic in addition to the growth specific to new development. A PHF of 0.90 to be employed for proposed or future conditions.

General growth can be estimated based on historic growth in area traffic volumes, and/or future projections of area population and employment. Consideration can also be given to other area transportation studies and/or traffic models as appropriate.

All significant developments under construction, approved or in the approval process and that are likely to contribute additional traffic volumes within the horizon period, should be

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identified. The trips that are expected to be generated by these developments should be included in the future background volumes (trips can be established from a corresponding Traffic Impact Study or based on the land uses and published trip generation rates). Town staff should be consulted to establish the approved/active development proposals within the study area.

Future transportation improvements to the study area road network that are currently being considered should be identified. These improvements should be described to a level of detail sufficient to assess their implications for travel to/from the development site. In each case, identify the status and anticipated date of implementation for consideration in the Future Background and Future Total traffic conditions. The Traffic Impact Study should consider the findings and recommendations of the Town of Innisfil Transportation Master Plan to ensure consistency.

6. Proposed Development: The Traffic Impact Study should provide a full description of the proposed development, including the following as applicable:
 - Municipal address (if applicable);
 - Existing and proposed land uses;
 - Total development area and summary by use (e.g. type and number of residential units, commercial gross floor area, etc.)
 - Anticipated tenants;
 - Planned phasing and build-out period

A site plan, concept plan, or similar, is to be included in the Traffic Impact Study document. If the proposed development is to be constructed in phases, describe each phase and the proposed implementation timing for each.

7. Site Traffic – Trip Generation: Unless advised by the Town, trip generation estimates are to be based on the proposed land uses, size of development and trip generation data from:
 - The ITE Trip Generation Manual (most recent edition);
 - Trip generation surveys conducted at similar developments/proxy sites; or
 - “First Principles” calculations of anticipated trips to/from the site.

Where appropriate, it may be justified to reduce the base trip generation estimates to account for pass-by trips, internal/shared trips (in the case of a multi-use development), travel demand management practices, and transit use. The resulting estimates are referred to as “new” vehicle trips. All trip generation assumptions employed in the calculation of the “new” vehicle trips should be supported and well documented.

Sensitivity analysis should be undertaken where trip generation parameters have the potential to vary considerably and most probable values cannot be readily identified (i.e. the exact tenant or use of commercial space is not known). A trip generation table should be provided in the report to summarize the land uses and sizes, with the corresponding trip

generation rates and the resulting number of trips. For large developments that will be phased in over time, the table should identify each significant phase separately.

8. Site Traffic - Trip Distribution & Assignment: Trip distribution assumptions should be supported by one or more of the following:
 - Transportation Tomorrow Survey (TTS) data;
 - Origin-destination surveys;
 - Comprehensive travel surveys; or
 - Existing/anticipated travel patterns

Engineering judgement should be utilized to determine the most applicable of the above methodologies for each particular application. It is advised that Town staff be contacted regarding the trip distribution assumptions for site traffic requirements.

Trip assignments should consider logical routings, available and projected road capacities, and travel times. Trip assignments may be estimated using a transportation demand model or “hand assignment” based on knowledge of the proposed/future road network in the study area. The trip assignment should also take into consideration varying assignments for pass-by trips, link-diverted trips and internal trips.

9. Future Total Traffic Volumes: Future total traffic volumes are to be presented, representing the culmination of the future background traffic volumes and the site generated traffic volumes for each horizon year.
10. Traffic Impacts: An evaluation of the key signalized and unsignalized intersections within the study area for all relevant peak periods for the existing and future planning horizons (both with and without the subject development traffic) is required, and summaries are to be provided in a tabular format (e.g. level of service, volume to capacity ratio and delay). The level of service (LOS) for overall signalized and unsignalized operations to be LOS D or better with volume to capacity ratio (V/C) of less than 0.85. For individual movements, LOS E or better with V/C of less than 0.85 is considered as acceptable. The intersection capacity/operational analysis should be completed using Synchro/Sim Traffic Simulation Software or the like. Any modified simulation software parameters should be documented and discussed. The objective should be to ensure that no new problem movements are created by the proposed development and that existing problem movements are not worsened to an unacceptable level with the addition of site generated traffic. Where intersections are closely located, queueing assessments should be included with respect to appropriate storage, queue encroachment, back to back left turns, etc.

Should operational issues result, means of mitigation and the operations with consideration for such, are to be presented (e.g. introduction of traffic signals, additional through lanes, turn lanes, etc.) Appropriate warrants for improvements and associated operational review worksheets should be appended to the report.

11. Site Access Assessment: The site access should be reviewed in consideration of the volume and type of vehicles to be generated by the site, and the proposed access location and configuration. Town standards are to be referenced as applicable. Access points should be evaluated in terms of capacity, safety and adequacy of queue storage capacity.

Should operational issues result at the site access, means of mitigation and the operations with consideration for such, are to be presented (e.g. introduction of traffic signals, additional through lanes, turn lanes, etc.) Appropriate warrants for improvements and associated operational review worksheets should be appended to the report.

12. Sight Line Assessment: At each access point and at each intersection where a new road is proposed, the sight distance requirements should be determined based on appropriate standards (MTO or County), and the availability of sight distance determined from actual field measurements or from engineering plans.
13. Parking & Circulation: The proposed parking supply should be confirmed as adequate in consideration of the corresponding Town parking requirements. The internal road and circulatory system should be reviewed in the context of the type of vehicles to be served (including emergency vehicles, garbage collection or other appropriate design vehicles) and the need for access internally. Swept path analysis to be conducted and resulting diagrams to be attached to the Traffic Impact Study. Approval from the Town must be obtained before proceeding with the selection of proxy sites for parking justification studies.
14. Documentation: The structure and format of the Traffic Impact Study should follow the guidelines outlined in this document as applicable. This format will facilitate review, discussion, and communication. Relevant maps, graphs, tables and figures should be provided. The study and drawings shall be signed and sealed by a qualified Professional Engineer licensed to practice in the Province of Ontario.

1.3.5 Noise and Vibration Study (NVS):

The Noise and Vibration Study shall review all potential noise and vibration sources and evaluate the requirements to achieve compliance with MECP guidelines, NPC-300 guidelines, considering air conditioning systems complying with NPC-216, applicable zoning by-law, as well as this document.

For attenuation of noise, the report should identify any mitigating measures to ensure that the sound level in the outdoor living area does not exceed 55 dBA. The receiver for the outdoor living area shall be assumed to be placed at a distance of 3.0 m from the rear wall of the house, at the midpoint of the rear yard width, and on the basis that the rear house wall will be set at the minimum lot line setbacks in accordance with the Town's zoning by-law.

Where noise fences are proposed, the report should detail the locations and height required to attain acceptable noise levels.

A post-construction survey or report may be required by the Town to confirm that acceptable noise levels have been achieved.

For railway traffic, the report should also identify foundation requirements to attenuate vibration.

The report should consider the construction activities typically expected and provide guidance on the development of a pre-construction survey of adjacent buildings and structures.

A pre-construction survey of adjacent buildings and structures may be required when expected construction activities could potentially cause structural and/or cosmetic damage. The survey should identify cracks and other defects in existing exterior and interior walls. A portable seismograph is to be used to take such readings in the field during construction with which to measure “peak particle velocities” generated, if required.

If a damage complaint is made during or following construction, an individual post-construction inspection is required by a qualified person. The post-construction inspection shall be compared to the pre-construction survey to determine the validity of the complaint. The developer and/or contractor shall be liable for all verified damage complaints.

1.3.6 Environmental Impact Study (EIS):

The Environmental Impact Study shall be prepared by a qualified professional and will assess any potential impact of the proposed project upon the natural environment including, but not limited to, wetlands, woodlots, and natural habitats for threatened and/or endangered species. The report shall also characterize the impact and make recommendations for mitigation, if necessary. Additional details and requirements can be found in the Town’s Official Plan.

1.3.7 Environmental Site Assessment (ESA):

For any lands that are to be dedicated to or purchased by the Town, an Environmental Site Assessment will need to be completed.

If required, a Phase I ESA shall be undertaken by a “qualified person” as defined in O. Reg. 153/04 (or the latest revision thereof) and a report shall be completed in accordance with the requirements set out in the same regulation as well as the guidelines published by the Canadian Standards Association (CSA).

The report shall include, but not be limited to:

- a) Confirmation of Insurance coverage;
- b) Certification that the person undertaking the assessment and completing the report is a “qualified person”;
- c) The “qualified person’s” opinion as to whether a Phase II ESA is warranted based on the findings of the Phase I ESA;
- d) If the “qualified person’s” opinion is that a Phase II ESA is not required, the report shall expressly include a statement that “in his/her opinion and based on the findings of the Phase I ESA, a Phase II ESA is not necessary”; and
- e) Confirmation that the report may be relied upon by the Town in making the decision to accept ownership of the property.

1.3.8 Archaeological Report:

The Archaeological Report shall assess any significant historical features on the site and recommend a mitigation plan if necessary. The study shall follow the Ontario Ministry of Culture guidelines for determining the archaeological potential of the area impacted by construction. As

a minimum, the report shall follow the requirements of a Phase 1 Archaeological survey and proceed with Phase 2 and 3, if necessary.

The Archaeological Report shall also consider “Built Heritage” and provide an inventory of any historically or culturally significant structures within the affected area. The Innisfil Historical Society shall be contacted during the preparation of the report and the report shall include any comments they may have on the affected area.

1.3.9 Functional Servicing Report (FSR):

The Functional Servicing Report (FSR) shall assess and describe the adequacy of the existing and proposed water distribution network, sanitary sewer servicing, storm sewer systems, and stormwater management features to satisfy the demands of the proposed development or the demands of an existing site that is undergoing significant alteration.

The FSR is intended to ensure that the proposed development or existing site that is undergoing significant alteration can be serviced for the intended use, and that all onsite and off-site servicing requirements are clearly identified. The report shall include, as required:

- a) fire flow calculations;
- b) domestic demand;
- c) sanitary flows for allocation;
- d) plant capacity; and
- e) confirmation of pipe sizes.

The FSR shall incorporate all relative existing information including Town standards, reports, studies, record information in addition to site-specific and staging information. The Functional Servicing Report shall identify how the land will be serviced, focusing on the following:

- a) Geotechnical Investigation;
- b) Area and Site Grading;
- c) Transportation Network and Roadways;
- d) Water Distribution System;
- e) Sanitary Sewer System;
- f) Storm Drainage System Major / Minor;
- g) Utilities (Gas, Electrical, etc.);
- h) Public Open Space; and
- i) Sustainability.

1.3.10 Additional Reports:

The Town may require additional reports and/or assessments for proposed developments or existing sites undergoing significant alteration, such as, but not limited to:

- a) Sun and Shadow Study;
- b) Odour Study;
- c) Sign Evaluation Study;
- d) Spill Contingency Plan; and
- e) Foundation Survey Report.

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All engineering drawings submitted to the Town must meet the following requirements;

- Drawings are to be neat, legible, and in metric units.
- A scale bar shall be included on all engineering plans
- The engineering drawings and CAD files must be georeferenced to NAD83 / UTM Zone 17N, CGVD28;78.
- All engineering drawings submitted for approval must be sealed, signed, and dated by a professional engineer licensed to practice in the province of Ontario.
- The file size for each drawing must be less than 5MB

1.5. GENERAL REQUIREMENTS

All Site Plan/Subdivision submissions to the Town must include the following;

- Electronic copies of all native, editable model files used in all analyses, e.g., Visual OTTHYMO (.voprj), PCSWMM/SWMM5 (.inp/.pcp), Synchro/SimTraffic (.syn/.hst/.sim), AGI (.agi), etc., that were used to generate the engineering drawings and reports. When submitting your models for review, package all of these native files and any associated modeling files, PDFs of reports or plot outputs alone will not suffice.
- The Town's comment matrix in Excel format with responses to each of the Town's comments. The applicant shall also specify the "Actions by Consultant" to indicate compliance or require further discussion.

Reports and studies that were previously conducted for the development application are valid for no more than 3 years from the date of publication unless otherwise directed by the Town.

The CAD files of the accepted engineering drawings are to be submitted to the Town. All xrefs must be included in the package and the CAD files must be georeferenced to NAD83 / UTM Zone 17N, CGVD28;78.

The latest Town's engineering standards are applicable to the first detailed design submissions for new developments.

The latest version of codes, regulations, guidelines, and policies shall be applied in the design of new development.

1.6. SUBSURFACE UTILITY ENGINEERING INVESTIGATIONS

The use of subsurface utility engineering (SUE) investigation is encouraged when there is insufficient underground information, and the congestion of utilities is present. The Town may request a SUE investigation if insufficient existing underground information provided. A copy of the SUE investigation, including the electronic files, is to be provided to the Town.

1.6.1 Quality Level Surveys

The collection and depiction of existing subsurface utility data shall be used to provide guidance, when the Town expects the various quality levels D through A. Quality levels are explained as following;

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- Quality Level D – Information derived from existing records or oral recollections.
- Quality Level C – Information obtained by surveying and plotting visible above-ground utility features and by using professional judgement in correlating this information to Quality Level D.
- Quality Level B – Information obtained through the application of appropriate surface geophysical techniques to determine the existence and approximate horizontal and vertical position of subsurface utilities.
- Quality Level A – Information obtained by exposing and measuring the precise horizontal and vertical position of a utility at a specific point.

1.6.2 Test Pits

Test pits, where requested, will be carried out to obtain information regarding the location and depth of existing utilities prior to commencing construction.

1.7. TOPOGRAPHICAL SURVEYS

Topographical surveys must be conducted for all development projects and utilized to guide the site's proposed design. Each survey must be signed and sealed by a licensed Land Surveyor. The topographical survey must accurately represent the site's current conditions and be dated within three years of the initial detailed design submission.

1.8. CONSOLIDATED LINEAR INFRASTRUCTURE ENVIRONMENTAL COMPLIANCE APPROVALS

Consolidated Linear Infrastructure Environmental Compliance Approvals (CLI ECAs) are required for public municipal sewage collection systems and stormwater management systems within the Town.

Prior to acceptance of the stormwater infrastructure and facilities by the Town, the applicable CLI ECA forms (SW1, SW2, and SW3) shall be completed, signed, and provided to the Town. A separate CLI ECA submission for the water and wastewater infrastructure shall be submitted to InnServices.

Privately owned stormwater infrastructure may require a direct submission to the Ministry of the Environment, Conservation and Parks (MECP). Developers are responsible for contacting the MECP to confirm submission requirements

1.9. METROLINX CORRIDOR:

Where a project is located within an area subject to various Metrolinx Policies the Project Engineer is required to contact Metrolinx and confirm requirements for the site. General information can be obtained on the website:

www.gosite.ca/engineering_public

Typical works requiring confirmation are related to (but not limited to):

- Stormwater Management
- Crash Berms
- Noise Attenuation
- Ground Vibration

1.10. BARRIER-FREE CONSIDERATIONS:

All design projects throughout the Town of Innisfil must give due consideration to the Accessibility for Ontarians with Disabilities Act (AODA) and must incorporate ways to remove barriers for the public.

1.11. REVISION INFORMATION:

The Town of Innisfil recognizes that revisions and updates to this document will be required from time to time.

A complete list of revisions is included in Appendix A. It is the responsibility of the designer to obtain and make use of the latest version of this document available at the time of design.

Any person may request a change or revision by submitting a written request to the Manager of Engineering using the form provided in Appendix A.

1.12. APPROVED MATERIALS:

Products that are for use in public infrastructure jobs including roads, water systems, sewer systems and traffic related products must be approved by the Town. The Town has developed a list of products that have worked well in the past and have included these products in our Lists of Approved Materials found in Appendix B.

The Town does not have the resources to properly test and evaluate the many products in the marketplace. The Town has decided to adopt the Designated Sources for Materials (DSM) from the Ministry of Transportation (MTO) which is available from The Road Authority (TRA) web site as acceptable products for use in the Town of Innisfil. The MTO and the TRA have extensive resources to test and approve new products. Products that are currently on the Town's Lists of Approved Materials will be grandfathered and these products can be used even if they are not on the TRA's website.

The Town reserves the right to remove products or add additional products if staff has enough information to support the change.

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SECTION 2.0: ROADWAYS**2.1 GENERAL**

This section specifies the requirements for designing, constructing and restoring roadways and driveways within the Town of Innisfil. Amendments to the Ontario Provincial Standards are contained within these standards and should be read carefully to ensure compliance during construction.

2.2 DESIGN**2.2.1 Classification**

All roadways shall be classified in accordance with the Town's Official Plan and the classification of each roadway shall be confirmed with the Town prior to the commencement of engineering design.

All roadways are to be designed to urban standards unless specific approval is received from the Town. For land development projects, new roadways designed to rural standards may only be considered for estate residential or industrial developments and must be approved by the Town before the detailed design stage.

Rights-of-way shall be a minimum of 20 m for window streets and local streets, 26 m for minor and major collectors, and 30 m for arterial roadways. The Town recognizes that these standards may not coincide with the minimum right of way information contained within the Official Plan; however, these standards shall take precedence.

Where a development adjoins or incorporates an existing County Road or Town arterial roadway as per the Town's Official Plan, the Developer shall deed to the County or the Town the required widening, which may be in excess of 20 m.

2.2.2 Pavement Design

The minimum pavement structure for the various road classifications is provided in the table below:

Table 1A – Minimum Pavement Structure – Layer Thickness

Layer	Roadway Classification				
	Local	Minor Collector	Major Collector	Arterial	Industrial
Surface Course	40 mm	40 mm	40 mm	40 mm	40 mm
Upper Binder Course	-	-	50 mm	50 mm	50 mm
Lower Binder Course	60 mm	60 mm	50 mm	60 mm	60 mm
Granular Base Course	150 mm	150 mm	150 mm	150 mm	150 mm
Granular Subbase Course	400 mm	400 mm	450 mm	450 mm	500 mm

Table 1B – Minimum Pavement Structure – Layer Materials

Layer	Roadway Classification				
	Local	Minor Collector	Major Collector	Arterial	Industrial
Traffic Category (OPSS.MUNI 1151)	B or C	B or C	C or D	D	D
Surface Course	SP 9.5 or SP 12.5	SP 9.5 or SP 12.5	SP 12.5 or FC1	SP 12.5 FC1 or FC2	SP 12.5 or FC1 or FC2
Upper Binder Course	-	-	SP 19.0	SP 19.0	SP 19.0
Lower Binder Course	SP 19.0	SP 19.0	SP 19.0	SP 19.0	SP 19.0
Granular Base Course	Granular 'A'	Granular 'A'	Granular 'A'	Granular 'A'	Granular 'A'
Granular Subbase Course	Granular 'B' Type 'II'	Granular 'B' Type 'II'	Granular 'B' Type 'II'	Granular 'B' Type 'II'	Granular 'B' Type 'II'

Notes:

1. SP 9.5 Cat. "C" mixes may be used as a surface course on Local and Minor Collector Roads when approved by the Town. An asphalt mix design shall be provided to the Town for review prior to accepting any changes.
2. Changes to the asphalt lift thickness may be considered on a site-specific basis. Lift thickness will be confirmed based on the asphalt mix gradation and nominal maximum aggregate size (NMAS). Where thicker lifts are required, the Contractor may request to substitute a SP 19.0 mix for a SP 25.0.
3. Granular materials must conform to OPSS.MUNI 1010 and the Town of Innisfil Engineering Design Standards and Specifications Section 2.5.1.

Tables 1A & 1B identify the minimum pavement structures. However, the Town will require the geotechnical engineer to recommend the depth of granular base, and type and thickness of asphalt based on site conditions for each project.

The pavement structures identified above are a minimum and the actual pavement structure may need to increase as a result of the following:

- Local conditions such as soil type or water table;
- Anticipated traffic loading;
- To ensure that there will be no half load restrictions on collector, arterial, or industrial roadways; and
- Any other requirements identified in the geotechnical report.

The Town will consider, on a case-by-case basis, the use of geogrid products as a component of a pavement design strategy. Geogrid products shall be a minimum of a biaxial grid. All recommendations must be made and sealed by the geotechnical consultant with supporting design documentation provided to the Town. Alternatives to a specified design using a geogrid product will not be approved based on properties alone. Proposed design alternatives shall be sealed by a geotechnical professional with supporting design documentation provided

SECTION 2.0: ROADWAYS

to the Town. Geogrid shall not be used as an attempt to remediate weak subgrade as a result of poor construction practices, including but not limited to, improper compaction procedures.

2.2.3 Geometric Elements

The following geometric standards shall be applied:

TABLE 3 - Geometric Standards for Road Design

ROAD CLASS (CROSS-SECTION)	ROW WIDTH (m)	MAXIMUM POSTED SPEED (km/h)	PAVEMENT WIDTH (m)	MIN./MAX. GRADE (gutter) (%)	MIN. HORIZONTAL C/L CURVATURE (m)	VERTICAL CURVATURE MIN. 'K' VALUE		MIN. TANGENT BETWEEN HORIZONTAL CURVES (m)
						Crest	Sag	
Arterial (Urban)	30	80	14.0	0.5/5	340	50	30	120
Collector (Major – Urban)	26	70	14.0	0.5/6	190	25	25	80
Collector (Minor – Urban)	26	60	12.0	0.5/6	190	15	8	80
Industrial (Urban)	26	50	10.0	0.5/6	40 (See Note 1)	15	12	50
Industrial (Rural)	26	50	8.0	0.5/6	40 (See Note 1)	8	12	50
Local (Urban)	20	50	8.5	0.5/7	20	8	6	50
Local (Rural)	20	50	7.0	0.5/5	30	8	12	50
Local (Rural)	18	40	8.0	0.5/5	30	8	12	50

Notes:

1. Shall provide pavement widening on horizontal curves as per *Geometric Design Standards for Ontario Highways*.
2. On rural roads, the cross-section will change to urban where centreline grades are equal to or greater than 5%.
3. "Sawtoothing" of a roadway is not acceptable and will require approval by the Town on a case-by-case basis.
4. K values less than those listed above may be considered for stop approaches with artificial lighting.
5. Minimum gutter grade along curved portion of the road shall be 0.7% where the road bend exceeds 45 degrees.
6. At 90 degrees bends, angled bends and road widening may be required on a case-by-case basis as directed by the Town.

SECTION 2.0: ROADWAYS

2.2.4 Vertical Curves

For local streets, all changes in grade of 2% or more shall be accommodated through the use of a vertical curve.

For all other road classifications, a change in grade of 1% or more shall be accommodated through the use of a vertical curve.

2.2.5 Crossfall

Finished roadways shall have a minimum crossfall of 2%.

2.2.6 Curb Radii and Daylighting Requirements

The curb return radii, measured from edge of pavement, and daylighting requirements at intersections shall be in accordance with the table below:

TABLE 4 - Minimum Curb Radii and Daylighting Requirements

ROAD CLASS	INTERSECTING ROAD CLASS	MIN. CURB RADII (m)	DAYLIGHTING (m)
Local	Local	9	3
	Collector (Minor & Major)	9	5
	Arterial	9	10
Collector (Minor & Major)	Local	9	5
	Collector (Minor & Major)	12	10
	Arterial	15	10
Arterial	Local	9	10
	Collector (Minor & Major)	15	10
	Arterial	(See Below) ¹	15
Industrial	Any Other Class	18	15
Site Plan	-	9	N/A ²

- 1.0 A compound curve shall be provided in accordance with TAC Geometric Design Guide for Canadian Roads and MTO Design Supplement to accommodate a Wb-15 vehicle.
1. Daylighting is not required for site plan developments.

2.2.7 Cul-de-Sacs

Where cul-de-sacs are used, a minimum radius of 20.75 m at the property line and 15.0 m at the edge of pavement shall be applied.

Cul-de-sacs are to be provided at all dead ends, where there is no proposed connection to an existing street.

2.2.8 Community Mailboxes

Provisions shall be included in the design for community mailboxes. While the final locations are subject to approval by the Town and Canada Post, the designer must propose locations that are conducive to the pedestrian and vehicular movements anticipated in the area. As a result, placement on collector or arterial roads should be avoided. Further, mailboxes are to be located a minimum of 30.0 m from the edge of the road allowance at any intersection, preferably on a lot line and giving consideration to other aboveground features such as streetlights, fire

SECTION 2.0: ROADWAYS

hydrants, transformers, etc. Community mailboxes must have direct sidewalk access and are to face the sidewalk (if present). In rural areas, where sidewalk is not present, access is to be provided from the roadway. All Mailboxes must conform to Canada Post's Standard Drawings and Specifications (Aug. 2014 or latest version).

2.2.9 Transitions

Where a new street is to connect to an existing street, whether the design includes an extension of the existing street or connects at an intersection, the design shall extend along all existing streets for a sufficient length to provide a satisfactory transition. In the case of an intersection, the distance must be equal to the greater of the required stopping sight distance or the turning lane development lengths, if applicable, for all legs of the intersection.

2.2.10 Curb and Gutter

For local streets, standard barrier curb as per OPSD 600.040 (single stage) or 600.070 (two-stage) is permitted. Semi-mountable curb as per OPSD 600.060 may be used provided full barrier curb is not required to convey stormwater within the road allowance. Curb cuts in residential areas shall be in accordance with OPSD 351.010.

For collectors, arterials, and industrial streets, standard barrier curb as per OPSD 600.040 (single stage) or 600.070 (two-stage) is required. Curb cuts in residential areas shall be in accordance with OPSD 351.010.

Concrete curb and gutter shall be in accordance with OPSS.MUNI 353, with the exception that all concrete shall be supplied in accordance with the "Performance Specification Alternative" of OPSS.MUNI 1350 and shall meet the requirements of CSA A23.1, Exposure Class C-2, with a minimum compressive strength of 32 MPa at 28 days.

Curb ramps shall be provided at all sidewalk intersections with curb line. The transition from curb ramp to full curb shall be carried out over a length of 0.6 m and the dropped curb shall extend 0.3 m beyond the width of the sidewalk. If the resulting full curb between two sections of dropped curb for a sidewalk will result in a full curb section less than 1.0 m in length, the dropped curb shall be continuous, and the sidewalk panel widened to be continuous along the curb line.

All curb ramps shall include tactile walking surface indicator plates (truncated dome type) which conform to the most recent versions of OPSS 351 and OPSD 310.039. Tactile walking surface indicators shall be set to final elevation according to the manufacturer's instructions. The lip between the concrete sidewalk surface and the tactile walking surface indicator plate shall not exceed 3.0 mm at any point.

Curb and sidewalk shall be extended across commercial and industrial entrances unless the entrance is signalized or is aligned with a municipal street on the opposite side of the street. Curb cuts in commercial and industrial areas shall be in accordance with OPSD 350.010.

Concrete deficiencies and surface defects including, but not limited to, scaling, mortar flaking, aggregate popouts, cracking, and heaving shall be removed and replaced at no cost to the Town.

SECTION 2.0: ROADWAYS**2.2.11 Sidewalks**

The requirements for a 1.5m wide concrete sidewalk shall be confirmed with the Town prior to commencing the roadway design. Sidewalks shall be constructed in the locations shown on the typical road cross-sections.

All sidewalks are to be constructed in a manner that provides maximum assistance to individuals with limited mobility and without creating hazards to individuals who are visually impaired. A maximum sidewalk grade of 7% and a maximum crossfall of 4% will be permitted. However, the designer should strive to limit the grade to no more than 5% and the crossfall to 2%, where possible.

Sidewalk construction shall be in accordance with OPSD 310.010.

Sidewalk contraction joints shall be sawcut, not formed. Contraction joints must be equally spaced at maximum 2.0 m intervals. Expansion joints to be constructed in accordance with OPSS 351 and spaced at maximum 12.0 m intervals, unless otherwise approved by the Town.

All sidewalks are to be constructed on a properly compacted foundation of a minimum of 150mm of Granular 'A' or approved equivalent compacted to a minimum of 98% Standard Proctor Density.

All sidewalks must have a minimum offset of 1.0m from edge of sidewalk to the side slope of the roadside ditch.

Concrete sidewalk shall be in accordance with OPSS 351, with the exception that all concrete shall be supplied in accordance with the "Performance Specification Alternative" of OPSS.MUNI 1350 and shall meet the requirements of CSA A23.1, Exposure Class C-2, with a minimum compressive strength of 32 MPa at twenty-eight (28) days.

Concrete sidewalk ramps shall be installed as per OPSD 310.030, 310.031, or 310.033, where applicable and OPSD 310.039 regarding tactile walking surfaces.

At the intersection of two sidewalks or where the sidewalk turns 90° to intersect the curb line, 1.0 m chamfering shall be provided.

Where sidewalk is provided adjacent to the curb and gutter, the sidewalk width is to be increased to 1.8 m.

At the discretion of the Town, wider sidewalks (1.8 m or greater) may also be requested to accommodate large pedestrian volumes or shopping carts, etc.

Concrete deficiencies and surface defects including, but not limited to, scaling, mortar flaking, aggregate popouts, cracking, and heaving shall be removed and replaced at no cost to the Town.

2.2.12 Grading within Right-of-Way

The boulevard area from the curb to the property line shall be graded to provide positive drainage toward the roadway at a minimum of 2% and a maximum of 8%.

SECTION 2.0: ROADWAYS

For roads having a rural design cross-section (i.e. estate residential or industrial), the area between the edge of the road shoulder and the street line shall be graded and the ditches cut with slopes of 3.0 m horizontal to 1.0 m vertical from the edge of the shoulder to the bottom of the ditch and from the bottom of the ditch to the original ground. In fill areas over 1.5 m measured vertically from the edge of shoulder to the toe of slope, the fill slope shall not be steeper than 2:1. The ditch shall be located at the toe of the fill slope.

The height of sod located between the back of curb and the “forward” edge of the sidewalk should be installed at an elevation equal to or slightly less than the sidewalk surface.

In areas where erosion control is required, aesthetically pleasing options such as reinforced sod are to be used rather than rip-rap, where possible.

2.2.13 Road Crossing and Entrance Culverts

The minimum sizes for entrance and road crossing culverts are 400 mm and 500 mm, respectively.

The conveyance capacity of the culvert must be sufficient to ensure that the maximum depth of ponding as indicated in Section 4.6, Table 7 is not exceeded.

Where the conveyance capacity of the minimum size culvert is not sufficient, a larger diameter culvert is to be sized using the cross-sectional end area calculated by the rational design method. Detail drawings and calculations shall be submitted for approval by the Town.

The minimum length of culvert shall be that which is required to extend from centre of ditch to centre of ditch with matching slopes not exceeding 3:1.

The minimum length of entrance culverts shall depend on the width of the entrance but shall extend no less than 1.5m on either side of the entrance.

Headwalls or end treatments will only be permitted where a 3:1 slope cannot be achieved. Because the use of headwalls or end treatments will only be permitted in exceptional circumstances, their design must be approved by the Town on a case by case basis.

The minimum depth of cover for all culverts is 300 mm unless otherwise indicated by the Town.

Culverts shall be constructed with granular bedding and backfill in accordance with OPSD 802.014 or 802.034.

Refer to Appendix B for a list of approved materials.

2.2.14 Driveway and Entrance Design**2.2.14.1 Grades**

The maximum grade for driveways and entrances shall be 7% except in site-specific cases that receive written approval from the Town. This maximum grade is not recommended and should be employed only in exceptional cases where conditions prohibit the use of lesser grades. The minimum grade permitted is 2%. Maximum grade change shall be 4% at curb or sidewalk and 1% per 2.0 m average.

2.2.14.2 Location

Urban

All residential driveways shall be located in accordance with the setbacks as identified in the Zoning By-law and the offsets as identified in Appendix C – Minimum Offset Matrix.

On corner residential lots, the edge of the driveway is to be a minimum of 4.5 m from the end of the daylight triangle.

Non-residential entrances shall not be located within 15.0 m of any intersection and any ramps shall have a minimum level stopping distance of 6.0 m provided between the ramp and the street.

Rural

On rural roadways, the end of the driveway culvert shall not be closer than 1.5 m from the extension of the side yard property line.

The same conditions apply for rural non-residential entrances as those listed for urban non-residential above.

For both urban and rural situations where frontage or other limitations interfere with standard locations, site-specific solutions shall be provided for review and approval by the Town.

2.2.14.3 Driveway Pairing

Pairing of driveways is required for all residential lots with a frontage of less than 14.0 m and where the road grade does not exceed 2.5%.

2.2.14.4 Existing Road Classification and Access Point

The entrance from a new development must align with the road classification of the existing public roadway to which it connects. If the driveway links to an existing local roadway, it shall be designed with local roadway standards.

A single entrance shall be provided for new site plan developments, unless otherwise directed by the Town. The entrance location shall be coordinated with Town staff and supported by a traffic analysis completed by the consultant.

2.2.14.5 Driveway Width

For a residential driveway, the minimum width is 3.0 m and the maximum width shall be equal to 60% of the lot frontage to a maximum of 9.0 m between the street line and the curb line.

For a non-residential and high-density residential, two-way entrance, the minimum width is 7.0 m measured at street line. Site-specific zoning regulations apply.

Water service/curb stops are to be a minimum of 1.0 m from the edge of the driveway.

2.2.14.6 Radius

For non-residential entrances and high-density residential, the minimum curb radius is 9.0 m, but may need to be greater to accommodate truck traffic and emergency service vehicles. The end of the curb radius at street line should not extend beyond property line.

SECTION 2.0: ROADWAYS**2.2.14.7 Driveway Edging**

For residential driveways, raised edging using concrete curbing or other materials along the sides of the driveway is not permitted within the Town road allowance, but may be constructed on private property.

2.2.14.8 Medians/Islands

The use of medians or islands at intersections and entrances for signalization, entrance/exit control, or aesthetics will be considered by the Town on a case by case basis.

2.2.14.9 Driveways and Parking Areas

For residential driveways, between the back of curb and property line, the driveway entrance shall have a minimum of 150 mm of Granular 'A' and 50 mm HL3 surface asphalt or another hard surface as approved by the Town.

For non-residential entrances and commercial parking areas, the minimum pavement structure shall be 300 mm of Granular 'B', 150 mm of Granular 'A', 50 mm HL4, and 40 mm HL3. For fire routes, the minimum pavement structure shall be 400 mm of Granular 'B', 150 mm Granular 'A', 60 mm HL8 and 40 mm HL3.

A more stringent pavement structure may be required and must be confirmed by the Geotechnical Engineer.

2.2.15 Walkways

The Town has various types of walkways and different requirements for each. It is recommended that the requirements for walkways be discussed with the Town prior to commencing the engineering design. The following provides general requirements for three typical walkways.

Pedestrian Walkways and Park Maintenance Pathways

Where the walkway block is to serve only pedestrians or where it is to be used as an entrance to an Open Space Block or Park Area and may be used by maintenance equipment, the walkway is to be 3.0 m wide with a 1.5 m high chain link fence along each side of the walkway block. The walkway shall be concrete for the full 3.0 m width with no crown or reverse crown. In general, the sidewalk standards under Section 2.0 shall apply. No bollards or entrance gates will be required at street line. (See TOISD 404).

Walkway/Service Corridor

Where the walkway block also incorporates watermains, sanitary sewers, or storm sewers, it shall have a minimum width of:

- 9 metres for one sewer (sewer centered on the easement)
- 12 metres for dual sewer installation
- 6 metres for a watermain (watermain centered on the easement)
- 10 metres for one sewer with a watermain (3m easement limit to watermain, 2.5m clearance between watermain and sewer and 4.5m sewer to easement)
- 12 metres for dual sewer installation with a watermain

SECTION 2.0: ROADWAYS

The above easement widths are minimum requirements and may be increased depending on the depth and size of the pipes within the easement and/or soil conditions, topography, or operational needs. The Town may consider a reduced easement width on a case-by-case basis, provided the applicant presents adequate justification for the reduction. Please see Section 5.13 for additional information.

A maximum of 2 ha of major flow drainage area can be conveyed through a walkway or service corridor. The corridor shall have a 1.5m high chain link fence along each side. It shall include a 3.0m wide concrete walkway and landscape strips along each side.

The depth of the services beneath the walkway is to be approved by the Town. If excavation for maintenance would impact on the footings of adjacent homes or buildings, then an easement is to be provided adjacent to the walkway or the footings of those buildings is to be extended or a combination of the two (2) measures. This impact will be assessed by a qualified geotechnical engineer and the proposed solution described in the "Geotechnical Report".

The spacing of the trunk services shall also be considered and, if necessary, the walkway block is to be widened to accommodate all services. The horizontal separation of services is to meet the recommendations of the MECP and the centreline of the service must not be closer than 1.5 m from the limit of the walkway block. (See TOISD 401).

SWM Pond Maintenance Access/Walkway

Where the walkway is intended to be used by pedestrians but the main objective is for maintenance access to SWM pond features such as sediment forebays, spillways, or outlet structures, the access/walkway from the street into the facility is to be 8.0 m wide, including a 4.0 m wide asphalt surface equivalent to that of a local street, including granular base, or other hard surface as approved by the Town, and a 2.0 m wide landscaped strip will be provided along each side. Once inside the facility, the access/walkway width is to remain at 4.0 m and a 3.0 m buffer strip is to be provided between the access/walkway and private property. (See TOISD 401). For industrial developments, the Town may consider an alternative pavement structure for the SWM Pond maintenance access route.

A pedestrian access gate shall be provided at street line, with a minimum clearance as noted in the detail drawing.

The minimum and maximum grades permitted for maintenance access/walkways are 0.5% and 3.0%, respectively except the portion of the access/walkway in a SWM Facility that extends down into the forebay. A maximum grade of 10% can be used for this purpose.

2.2.16 Multi-Use Trails

Multi Use trails shall be created as identified in the Town's Trails Master Plan. Location and width of the trails must be discussed with the Town during pre-consultation stage. Trail signage to include TOISD 815, Rb-71 and Rb-73.

2.2.17 Fencing

Standard 1.5 m galvanized chain link fence with top rail shall be placed along all walkways, steep slopes, adjacent to commercial properties, between stormwater management facilities and private property, and elsewhere as required by the Town. Fencing of 1.2m height will be considered on a case-by-case basis.

Standard 1.8 m galvanized chain link fence with top rail shall be placed adjacent to institutional properties, open spaces, and in parks. The mesh shall be placed facing Town property.

The Town will require that a 1.8 m high wood privacy fence be installed between development property/lots and existing residential properties, between residential and agricultural, between residential and commercial properties, between residential and institutional properties, or between commercial and institutional properties. Where the residential lot is fronting on travelled road the wood fences must terminate at the front line of the house, and if fencing is required, continue to the front property line as a chain link fence (maximum height of 1.2m) so that it does not impact the visibility of the front yard to drivers.

Gates for access from private property to municipal or EA property are not permitted to be installed in any fence. Further, no gates shall be permitted in an acoustical fence, unless written approval is received from the Town.

The requirement for, location, and extent of acoustical fence shall be defined in the noise and vibration study and must be accepted by the Town. The maximum height of an acoustical fence shall be 2.15m. Structural drawings, along with all relevant load calculations, must be prepared and stamped by a licensed professional engineer.

If the noise and vibration study concludes that additional height must be added to the acoustical fence to achieve the required noise levels, this must be accomplished by installing the fence atop a berm. Requests for fence heights exceeding 2.15m and alternatives to the use of a berm will be evaluated on a case-by-case basis, and must be supported by adequate technical justification from the applicant.

Acoustical fences that are maintained, repaired, and replaced by the Town shall require a minimum 2.0m easement for the Town's access.

Where an open space block, park, or stormwater management facility is adjacent to a municipal road allowance, a fence will not be required unless necessary as part of a park development plan or as a result of slopes in excess of 3H:1V.

Generally, fences are to be placed at a 0.15 m offset from the common property line on the development property side, unless otherwise specified on TOISD411 and/or approved by the Town.

Refer to TOISD 401 to TOISD 411 for fencing and gate details.

In rural areas, and only where written approval is received from the Town, the installation of highway fence (farm fence) as per OPSD 971.101 and OPSS.MUNI 771 may be permitted.

2.2.18 Signs and Pavement Markings

2.2.18.1 Street Name Signs

Double unit street name signs of an approved design, green in colour (high intensity Scotchlite grade) with high intensity white Highway Gothic lettering, shall be erected on 3.6 m (1.2 m lower channel and 2.4 m upper channel), double-slide, "U-Channel" galvanized steel posts, embedded 0.9 m in the ground. Street name signs are not to be mounted on

stop sign posts, but may be strapped to streetlight poles using aluminum brackets if the poles are properly positioned and upon receiving written approval from the Town.

Street name signs installed on posts must be installed using a breakaway system.

Street name signs are to include "911" emergency address ranges, as provided by the Town.

2.2.18.2 Traffic Signs

Signs of the standard type approved by the Ontario Ministry of Transportation Ontario Traffic Manual shall be mounted on 3.6 m (1.2 m lower channel and 2.4 m upper channel), double-slide, and "U-Channel" galvanized steel posts, embedded 0.9 m in the ground. All signage must be installed using a breakaway system. The signs shall be located as required by the Town after a By-law is passed for their installation.

2.2.18.3 Pavement Markings

Upon completion of the final asphalt and upon notification by the Town, pavement markings shall be painted conforming with the Standards of the Ontario Ministry of Transportation, Ontario Traffic Manual Book 11 (Pavement, Hazard and Delineation Markings) at all intersections, school crossings, walkways, bike lanes and railway crossings to clearly indicate the proper traffic zones, lanes and stop lines.

Durable pavement markings complete with glass beads are to be utilized unless otherwise stated in the Contract Documents. Pavement markings applied to new asphalt may require two applications. The second application shall not be applied until the first is tack free. Pavement markings are to conform to OPSS 710 and OPSS 1712 to 1715, inclusive.

All pavement marking removal required to prepare the area for final pavement marking shall be done by abrasion, unless otherwise stated in the Contract Documents.

Local streets do not require centreline pavement marking, but stop bars are required with a minimum of 15.0 m of centreline marking.

2.2.19 Public Transit

The designer shall confirm with the Town if there will be any requirements for the provision of public transit facilities within the development prior to the commencement of the engineering design.

At a minimum, arterial and collector roads are to be designed to accommodate the potential installation of 9.0 m long concrete bus stop waiting pads between the sidewalks and curb. These bus stop areas are to be provided on both sides of the street, with a maximum spacing and distance from intersections as provided by the Town.

2.2.20 Bicycle Lanes

The requirements for bicycle lanes are to be discussed at the planning stage and within the Traffic Impact Study.

At a minimum, on any street where the average daily traffic volumes in one direction of travel exceed 5,000 vehicles, bicycle lanes must be provided. This can be accomplished by providing an exclusive 1.5 m wide bicycle lane on both sides of the street or by providing a minimum 3.0

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m multi-use trail on one side of the street. All bicycle infrastructure whether on the road or off the road shall be in accordance with *Ontario Traffic Manual* Book 18.

For major collector or arterial streets with average daily traffic volumes less than 5,000 vehicles in one direction, the Town may still require the provision of bicycle lanes in accordance with the overall Transportation Master Plan and Trails Master Plan.

Dedicated bicycle lanes are generally not required on local streets unless noted in the Transportation Master Plan and Trails Master Plan.

The design for the bicycle lanes shall be in accordance with the Transportation Association of Canada (TAC) *Urban Supplement to the Geometric Design Guide for Canadian Roads*.

The designer shall confirm with the Town if there will be any requirements for the provision of bicycle lanes prior to the commencement of the engineering design.

2.2.21 Other Site Plan Considerations**2.2.21.1 Parking Design**

When designing the layout of parking lots, the designer shall consider the turning requirements for delivery vehicles and emergency vehicle access. They should also take into account queue development at the entrance, pedestrian flow through the parking area, and dropped curb with ramps at convenient locations for wheelchair accessibility.

The designer shall meet the parking requirements identified in the Town Zoning By-law as well as setbacks from property line.

2.2.21.2 Grading

The grading of parking areas should not be less than 1.0% and not more than 5.0% . Grades perpendicular to parked vehicles should not exceed 4%. The grading shall provide for an overland flow route to an adequate drainage outlet without exceeding a ponding depth of 0.3 m anywhere on the parking lot.

The minimum pavement structure for parking lots shall be in accordance with Section 2.2.4.11.8.

2.2.21.3 Parking Spaces and Laneways

The standard parking space dimension, perpendicular to the direction of traffic, shall be 6.0 m long by 2.75 m wide. Laneways between rows of parking shall be 6.0 m wide for two-way traffic and 4.0m wide for one-way traffic, subject to any approved changes to the Town's Zoning By-law. The 6.0 m parking stall length can be reduced to 5.7 m if there is suitable overhang at the curb line. The parallel parking stalls shall be a minimum of 7.0 m long and 2.75 m wide (excluding the width of the gutter).

Internal private condominium roadways shall have a minimum width of 6.0 m edge of asphalt to edge of asphalt.

Barrier-free parking spaces are to be provided at a ratio of 1:30. Where the application of this ratio results in a fraction of a parking space, the required number of spaces shall be increased to the next whole number. Each space is to be 3.0 m wide with a 1.5 m access

aisle. All barrier-free parking spaces are to be signed with the accessible parking symbol painted on the asphalt of each space and with the By-Law sign posted in front of each space.

All access ramps to sidewalks shall be located so that they are in line with the access aisle and not obstructed by any parking space.

Parking spaces are to be delineated with 0.1 m wide yellow paint lines.

2.2.21.4 Layout

The parking lot layout shall provide an area for snow storage that does not impact accessible parking; does not reduce the total parking spaces by more than 5%; and has consideration for the features of the landscaping plan.

Where monolithic curb and sidewalk is used in a parking area, the minimum width of the sidewalk is to be increased to 1.8 m if a car bumper may overhang the curb.

2.2.21.5 Security and Lighting

Parking areas are to be located in highly visible areas of the site. For illumination of parking spaces, aisles, and driveways, the lighting shall be arranged to divert the light away from adjacent properties and streets and shall be downcast. See Section 3.3.2.2 for additional design criteria.

2.2.21.6 Fire Routes

A 6.0 m wide fire route, measured edge of asphalt to edge of asphalt, with a clear radii of 9.0 m (inside), 12.0 m (centreline), and 15.0 m (outside) must be provided and shall have a minimum pavement structure of 450 mm Granular 'B', 150 mm of Granular 'A', 80 mm of HL8, and 40 mm of HL3. The fire route is to be signed and no parking signs installed as required.

The fire route must also be designed to meet any and all requirements under the Ontario Building Code.

The Town's largest emergency vehicle must be able to safely perform ingress and egress maneuvers to and from the development site without any conflicts or obstructions

The fire route design is subject to approval by the Town and the Fire Department.

2.2.21.7 Landscaping

All landscape plans shall be prepared by an accredited professional Landscape Architect in good standing with the Ontario Association of Landscape Architects (OALA). The Landscape Architect shall coordinate and liaise with all other consulting professionals to ensure accurate representation of the site and the proposed development.

Existing vegetation should be incorporated where grading, drainage, and species allow for continued health of the vegetation. Existing vegetation which provides screening between residential areas and commercial/industrial/institutional and collector/arterial roads should be prioritized for retention. All healthy perimeter trees, defined as those immediately on the shared property boundary or on adjacent property with a canopy overhanging the property boundary, must be protected, unless written approval is provided by adjacent landowners for removal or unless it is deemed to be a road safety issue by the Town.

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Landscaping shall be provided for the control of noise, wind, erosion, glare, and aesthetics. Natural features such as trees should be preserved and incorporated as much as possible into the design.

Refer to Section 8.0 for additional information.

2.2.22 Roadway Surface Maintenance and Rehabilitation

For the surface maintenance and rehabilitation of rural roadways, and only where approved by the Town, single or double surface treatment as well as cold in-place recycling with expanded asphalt may be permitted.

Surface treatment is to be completed in accordance with OPSS.MUNI 304 and OPSS.MUNI 1103. Cold in-place recycling with expanded asphalt is to be completed in accordance with OPSS.MUNI 335. At the discretion of the Town, surficial cracking of an asphalt roadway may be temporarily sealed through traditional route and seal methods (OPSS MUNI 341). Other methods may be recommended by a Geotechnical Engineer.

Upon completion of the Town of Innisfil asphalt inspection, a course of remedial action may be provided which may include, but not limited to, the utilization of asphalt reinforcement geosynthetics for pavements.

Crossings made on an existing roadway should be reinstated with fill materials approved by a geotechnical engineer, or unshrinkable fill up to sub-grade followed by the existing adjacent pavement structure. Where the existing pavement structure cannot be mimicked, or where unshrinkable fill extends into the frost penetration zone, frost tapers should be incorporated. Frost tapers should be a minimum of 10H: 1V in the direction of the roadway (parallel to road centerline). The existing asphalt should be milled to allow the new asphalt to be lapped at least 0.3 m with a tack coat.

2.3 SCHEDULING OF WORK

The contractor shall provide the Town with a detailed work schedule prior to the start of construction. The schedule should include all major project tasks, start date & task duration, and updates should be provided to the Town regularly, and during any significant scheduling changes. The schedule should also reference any project restrictions including; but not limited to, Reduced Load Periods, the limitations of the Town's Noise By-law, including no weekend work (unless a Saturday Noise Exemption Permit has been obtained), preventing unnecessary disruption to public traffic, deadlines for temperature sensitive work such as hot mix asphalt paving and concrete placement, etc.

The contractor shall schedule temporary restoration of the roadway to follow closely behind trench backfilling. Unless otherwise noted, permanent restoration may be delayed until all trenching has been completed.

All work should be scheduled in a way that excavations are not left open when adjacent to, or on an open lane of traffic at night, or when work is inactive.

The Contractor shall notify the Town within 48 hours prior to the start of construction, placing granular material, concrete, or hot mix asphalt.

SECTION 2.0: ROADWAYS**2.4 MAINTENANCE**

The contractor is responsible for maintenance of all Services in order to ensure the safety of vehicle traffic and pedestrians during construction, as well as during the maintenance period outlined in the contract.

In this section a Service is defined as; roads, curbs, gutters, sidewalks, buried infrastructure, drainage works, lighting, landscaping, erosion and sediment control measures, and any other works outlined in the project contract or plans and specifications.

Maintaining Services includes but is not limited to the following;

- Rectify, replace, or repair any Service not constructed in accordance with the approved plans and specifications.
- Maintain roads in a mud and dust free condition and free of debris and obstructions.
- Ramp all maintenance holes and catch basins with hot mix asphalt as required.
- Maintain adequate and safe traffic control measures to ensure the safety of workers, vehicles and pedestrians.

2.5 MATERIAL SPECIFICATIONS**2.5.1 Granular Material & Soils**

The requirements of OPSS.MUNI 1010 shall apply for all granular material used to construct, restore, and maintain roadways and driveways except where amended herein.

The contractor shall provide to the Town the confirmed source of granular material or materials, a minimum of two weeks prior to construction. A sample of each material should be obtained and tested in order to confirm conformance with the contract and plans and specifications.

2.5.1.1 Granular A

OPSS.MUNI 1010.05.02 (amended) – The Contractor shall supply Granular A produced by:

- a) Crushing quarried bedrock (100% crushed).
- b) Crushing quarried bedrock (100% crushed) including Reclaimed Asphalt Pavement (RAP) up to 30% by mass.

The blending of RAP with granular material shall only occur with the use of cold feed bins or a procedure approved by the Town. Prior to using granular material with RAP, QC/QA samples shall be obtained to determine the amount of asphalt-coated particles using MTO Test Method LS-621.

Granular A produced from naturally deposited sand, gravel, and cobbles may be permitted subject to receiving written permission by the Town.

2.5.1.2 Granular B

OPSS.MUNI 1010.05.03 (amended) – The Contractor shall supply **Granular B Type II** produced by:

- a) Crushing quarried bedrock (100% crushed).

Granular B Type I produced from naturally deposited sand, gravel, and cobbles, or quarried bedrock may be permitted subject to receiving written permission by the Town.

OPSS 1010 for Granular B Type I is amended as follows:

TABLE 5 - Amendment to OPSS.MUNI 1010

Sieve	Percent Passing by Mass
4.75 mm	20 – 90
1.18 mm	10 – 80
300 µm	2 – 55
150 µm	0 – 25

2.5.1.3 Recycled Materials

In some cases, the Town may permit the use of granular materials produced from Reclaimed Concrete Material (RCM). RCM may contain RAP up to a maximum of 30% by mass. Prior to using RCM, the contractor must receive written approval from the Town. Prior to using materials that contain RAP, QC/QA samples shall be obtained to determine the amount of asphalt-coated particles using MTO Test Method LS-621.

The Town does not permit granular products that contain glass or ceramic material.

Granular material shall not contain more than a combined total of 0.5% by mass of deleterious material. Deleterious materials include but are not limited to, wood, clay, brick, clay tile, gypsum, gypsum plaster, and wallboard.

2.5.1.4 Testing and Sampling

The contractor must provide the source of granular materials no later than two weeks prior to the start of construction. The contractor will be responsible for Quality Control (QC) testing unless otherwise noted in the contract documents. The Town may retain a Materials Testing & Inspection firm to conduct regular sampling and Quality Assurance (QA) testing on all materials from both the source, and project sites. Granular material shall be sampled and tested to confirm gradation, as well as the Maximum Dry Density, and Optimum Moisture Content at a minimum frequency of one sample for every 1,000 tonne of material placed, unless otherwise approved by the Town. Additional sampling and testing may be required due to changes to the supplier, or inconsistency of the imported material.

Sampling procedures shall be in accordance with the Ministry of Transportation Laboratory Testing Manual, Test Method LS-625 Guidelines for Sampling of Aggregate Materials.

Testing procedures should conform to the Ministry of Transportation Laboratory Testing Manual and / or the applicable CSA, ASTM, or AASHTO specifications.

2.5.2 Hot Mix Asphalt & Warm Mix Asphalt

The requirements of OPSS.MUNI 1150 and OPSS.MUNI 1151 shall apply to Hot Mix Asphalt (HMA) and Warm Mix Asphalt (WMA) materials used to construct, restore, and maintain roadways and driveways except where amended herein.

The contractor shall provide the Town with the confirmed source of hot mix asphalt materials a minimum of two weeks prior to construction. A sample of each material should be obtained and tested to confirm conformance with the contract, plans and specifications.

2.5.2.1 Asphalt Cement

Performance Graded Asphalt Cement (PGAC) shall be supplied from an MTO Designated Source for Materials supplier and meet the requirements of OPSS.MUNI 1101 as amended herein.

Asphalt cement shall meet the Performance Grade PGAC 58-34XJ for local and collector streets, as well as non-commercial driveways.

Asphalt cement shall meet the Performance Grade PGAC 64-34XJ for arterial and industrial roads, as well as commercial driveways.

Reference *Town of Innisfil Engineering Design Standards and Specifications Manual Appendix E: Asphalt Special Provisions* for detailed specifications regarding asphalt cement, sampling and testing.

2.5.2.2 Asphalt Aggregates

Asphalt aggregates shall conform to OPSS.MUNI 1001 and OPSS.MUNI 1003.

The use of steel slag or blast furnace slag in asphalt mixtures is not permitted.

2.5.2.3 Asphalt Mix Designs

Mix designs shall be completed in accordance with OPSS.MUNI 1150 and OPSS.MUNI 1151. Superpave mixes shall be used unless otherwise specified and/or approved by the Town. The Town may choose to perform an Independent Check of any submitted mix design in accordance with OPSS.MUNI 1151 and LS-316 or LS-318 (WMA), prior to approving the submitted mix design. At the discretion of the Town, a plant-produced trial batch of the proposed mix may be required prior to the approval of the submitted mix design.

Mix designs shall be submitted to the Town a minimum of two weeks prior to the start of paving. Unless otherwise stated in the contract documents, the mix design submission shall include, at a minimum, the following:

- a) A letter from the project Geotechnical or Materials Engineer confirming that the proposed mix conforms to the Town specifications.
- b) All documents listed in OPSS.MUNI 1150.04.02.03 and OPSS.MUNI 1151.04.05.
- c) Laboratory testing results that confirm the physical and Superpave consensus properties of the aggregates are in conformance with OPSS.MUNI 1001 and OPSS.MUNI 1003, except as amended in this document.
- d) Warm Mix Asphalt mix designs shall include additional documentation on the warm mix additives including the name and location of the supplier, PGAC test results confirming the materials will meet the Town's PGAC specifications, type and dosage of the warm mix additives, and any additional recommendations from the supplier on mixing and compacting the warm mix asphalt.

OPSS.MUNI 1150 is amended as follows:

TABLE 6 - Amendment to OPSS.MUNI 1150

Mix Type	Asphalt Cement Content (Min. %)	RAP (Max. %)
HL-1	5.2	15
HL-2	6.0	15
HL-3F	5.8	15
HL-3	5.3	15
HL-3HS	5.3	15
HL-4	5.3	20
HL-8	5.0	20
MDBC	5.0	20
HDBC	5.0	20

Note: Marshall mixes are only to be used when the Contractor receives written permission from the Town. Marshall mixes will generally be accepted in areas without regular traffic including but not limited to, driveways, walkways, maintenance roads, and parking lots.

OPSS.MUNI 1151 is amended as follows:

TABLE 7 - Amendment to OPSS.MUNI 1151

Mix Type	Asphalt Cement Content (Min. %)	RAP (Max. %)
SP 9.5	5.6	15 (Note 1)
SP 12.5, FC1, FC2	5.1	15
SP 19.0	4.9	20
SP 25.0	4.5	20

Note 1: SP 9.5 may contain up to a maximum of 20% RAP when used for HMA padding, or curb infill during two stage curb construction.

OPSS.MUNI 1151 is amended by the addition of the following:

The amount of Reclaimed Asphalt Pavement (RAP) allowed in a mix shall be calculated using the Binder Replacement Method as noted below:

$$\text{Binder Replacement, \%} = \frac{(\% \text{ Asphalt Cement Content of RAP} \times \% \text{ RAP by Mass in Mix})}{\% \text{ Total Asphalt Cement Content of Mix}}$$

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Unless otherwise stated in the Contract Documents, a maximum of 15% RAP is allowed in Surface Courses, and a maximum 20% RAP is allowed in Binder Courses, by Binder Replacement.

Processed RAP which is ready for use shall be tested in accordance with LS-282 or LS-292 to determine the average asphalt cement content and average gradation of the extracted aggregates.

The Contractor shall allow access to the Town or their representatives to monitor the production of asphalt mixtures. If requested by the Town, the Contractor shall supply copies of the asphalt mix production records that will identify the proportions of RAP added to the mix.

2.5.2.4 Asphalt QA/QC Testing

The requirements of OPSS.MUNI 310, OPSS.MUNI 1150, and OPSS.MUNI 1151 for Hot Mix Asphalt sampling and testing shall apply except where amended herein.

The contractor shall, upon request, allow the Town, contract administrator or their representatives to enter upon the premises of any of the material manufacturers, suppliers, plants, laboratories, or equipment for purposes pertaining to the work, to carry out such inspection, sampling and testing as specified or requested by the Town, contract administrator or their representatives.

Prior to the start of production of HMA, the QA Technician must sample each aggregate identified in the approved mix design, including RAP, to conduct Aggregate Density Testing. Additional samples shall be taken immediately after the completion of 10,000 tonnes of HMA. Voids in Mineral Aggregate (VMA) shall be calculated based on the combined Bulk Relative Density (Gsb) of the blended aggregates tested by the QA Laboratory, and the Bulk Relative Density (BRD) of the HMA samples obtained on site.

Frequency of HMA sampling shall be in accordance with OPSS.MUNI 310 Table 6.

Bulk samples of loose hot mix asphalt shall be obtained from the paving operation and divided utilizing an on-site splitting device such as a "Quartermaster" or similar product. The split samples shall meet the minimum mass requirements stated in OPSS 310.

Core samples shall be a minimum of 150mm in diameter. Coring shall only be completed when written permission is provided by the Town.

Any disturbed area due to sampling procedures must be repaired immediately after sampling. HMA and compaction requirements for filling sample holes shall be the same as the adjacent undisturbed pavement. Sample holes shall be clean and dry prior to filling and shall be compacted using a mechanical self-powered compactor.

Samples shall be tested by a Canadian Council of Independent Laboratories (CCIL) certified laboratory to confirm that the HMA conforms to the Town specifications;

SECTION 2.0: ROADWAYS

- a) For Marshall mixes, samples shall be used to determine compliance of asphalt cement content, aggregate gradation, air voids, flow, voids in mineral aggregate, and stability requirements.
- b) For Superpave mixes, samples shall be used to determine compliance of asphalt cement content, aggregate gradation, and Superpave mix properties in accordance to AASHTO M323.

OPSS.MUNI 310 is amended as follows:

All Acceptable results will remain as Acceptable. Borderline results will be reviewed on a project specific basis, however in most cases will be considered Rejectable and warrant removal of the asphalt or a payment reduction as instructed in writing by the Town.

2.5.2.5 Track Coat

Tack coat materials shall meet the requirements of OPSS.MUNI 1103.

The Contractor shall provide safety data sheets (SDS) and additional documentation describing the type of emulsion, supplier, and applicator, to the Owner at least 5 business days prior to the first use of tack coat.

Tack coat shall be applied continuously and uniformly to the entire pavement width using a self-propelled or tow-along pressure distributor at the application rates specified in OPSS.MUNI 310. Tack coat shall be applied to concrete curb faces using a handheld pressure applicator acceptable to the Owner.

Acceptance of tack Coat shall be based on the following:

- a) Visual Observation of Application
- b) Laboratory Testing:
 - i. Residue by Distillation (LS-216 and ASTM D6997)
 - ii. Penetration of Bituminous Materials (LS-200 and ASTM D5)

2.5.3 Concrete

The requirements of OPSS.MUNI 1350 shall apply to ready mixed concrete materials used to construct, restore, and maintain any concrete object located within Town property or R.O.W. including but not limited to curb, sidewalk, and structures.

The contractor shall provide to the Town with the confirmed ready mixed concrete supplier a minimum of two weeks prior to construction.

Concrete suppliers shall provide a valid Certificate of Ready Mixed Concrete Production Facilities as issued by the Ready Mixed Concrete Association of Ontario (RMCAO).

The Town requires a minimum of 24 hours notice prior to placing concrete.

2.5.3.1 Concrete Mix Design

Mix designs shall be submitted to the Town a minimum of two weeks prior to concrete placement. The mix design submission shall include the following:

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- a) A valid Certificate of Ready Mixed Concrete Production Facilities as issued by the Ready Mixed Concrete Association of Ontario (RMCAO).
- b) A summary of all materials, and sources used in each mix including, but not limited to; cement, supplementary cementing materials (slag, fly ash), coarse and fine aggregate, water, chemical admixtures, and air entrainment.
- c) A certificate or letter verifying the compatibility of the admixtures to be used in the concrete, if admixtures are supplied from different manufacturers.
- d) Target air content (%) and slump range (mm).
- e) Test data confirming the scaling resistance of concrete surfaces when the concrete mix is used to construct curb or sidewalk. Testing shall be in accordance with CSA A23.2-22C or MTO LS-412.

The Town may request additional documentation of the materials used in any concrete mixture before placement, or any time during the maintenance period. When requested in writing from the Town, the contractor shall supply testing results that confirm the gradation, physical requirements, and scaling resistance of the materials conform to OPSS.MUNI 1002.

2.5.3.2 Concrete QA/QC Testing

Concrete sampling and testing should be in accordance with CSA A23.1:19/CSA A23.2:19 - Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete. QC/QA sampling and testing shall only be performed by a Canadian Council of Independent Laboratories (CCIL) or American Concrete Institute (ACI) certified technician. Laboratory testing shall only be completed by a CCIL certified lab.

The contractor shall arrange for on-site quality control testing which shall conform to the **minimum** frequencies below:

- a) **Compressive Strength** – Not less than one set of three cylinders for every 100m³ of concrete placed, with no less than one test for each class of concrete placed on any one day.
- b) **Slump** – Not less than the first five loads per mix per day, plus one test for every air test that is completed.
- c) **Air Content** – All concrete mixes should be tested for air content (whether air entrained or not). For classes C-2, C-1 and C-XL, the first five consecutive loads shall be tested to confirm consistency. Thereafter, testing may be performed every third load.
- d) **Temperature** – Temperature readings should be recorded every time a sample is taken for any of the aforementioned testing requirements. Temperature should be recorded to the nearest 0.5°C.

2.6 ROADWAY CONSTRUCTION

The contractor shall construct all Town roadways and driveways in accordance to the specifications in this section. This section contains amendments to the OPSS and should be read carefully to ensure compliance during construction.

SECTION 2.0: ROADWAYS**2.6.1 Grading**

Grading shall conform to OPSS.MUNI 206 except where amended herein.

Grading shall conform to the Town of Innisfil Standard Details (TOISD), and project drawings and specifications.

Grading tolerances are as follows:

- a) Subgrade / Trench Backfill +/- 20mm of proposed elevation.
- b) Granular Subbase (Granular B) +/- 15mm of proposed elevation.
- c) Granular Base (Granular A) +/- 10mm of proposed elevation.

2.6.2 Subgrade Preparation and Trench Backfilling

The use of site excavated inorganic soil is generally acceptable for use as a trench backfill, providing:

- a) Backfilling operations are carried out in a strict conformance with the requirements of OPSS.MUNI 401, using earth compacting equipment of appropriate type, size, and weight;
- b) The minimum compacted density within 1.0 metre of the final subgrade is to be compacted to 98% of the Standard Proctor Maximum Dry Density (SPMDD), with in-situ moisture content within 2% of the optimum value; and,
- c) Soil moisture content higher than the optimum value, is better suited for trench backfilling below the upper 1.0 metre of subgrade, as the degree of compaction required at this depth may be relaxed to 95 % SPMDD. The addition of water may be required, particularly during dry summer conditions, subject to the discretion of the Geotechnical Consultant and/or Town Inspector.

During construction, a geotechnical consultant must inspect the condition of the roadway subgrade and supervise the installation of pipe bedding/embedment and the backfilling of all trenches within road allowances and easements.

The Geotechnical Consultant shall be present during trench backfilling and consolidation operations, ensuring that OPSS.MUNI 401 is strictly adhered to. The Geotechnical Consultant is to certify that he/she, or his/her designate, has conducted a sufficient number of tests to obtain a comprehensive summary of the degree of compaction achieved, and that all works were constructed in accordance with OPS.MUNI 401.

The Geotechnical Consultant's personnel must be on site at all times when two mainline or service construction crews are working. When there are more than two crews working on the site at the same time, additional personnel may be required.

The Town of Innisfil requires a compaction test on every fill layer placed. Testing of the roadway subgrade, granular materials, and asphalt shall be performed at a frequency not exceeding 20 linear metre intervals, utilizing a "Z" pattern which will ensure the testing of the entire roadway width. As a minimum, one compaction test on every fill layer within lateral service trenches is required. Backfill shall be placed to a minimum depth of 900 mm above the crown of the pipe before power operated tractors or rolling equipment shall be used for compacting. Fill layers placed shall not exceed 300 mm in thickness (loose). The results of all field density tests obtained shall be plotted on plan and profile drawings and provided to the Town.

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Prior to placing granular materials, the road subgrade shall be heavily proof rolled to ensure uniform support for the pavement structure. Other elevations of the roadway may also be subject to proof rolling when requested by the Town. For proof rolling, a 20-tonne gross mass vehicle with pneumatic tires shall be used. The vehicle shall make a minimum of three separate passes to subject every point of the surface being inspected. Each pass shall not exceed an offset of more than one tire width and the speed of the vehicle shall be within 2 km/h and 5 km/h. Where elastic movement in excess of 25 mm that does not exhibit significant cracking is observed, the surface shall be scarified and allowed to dry prior to re-compaction. Once the material has dried and is re-compacted, another proof roll shall be completed. Where permanent rutting in excess of 25 mm is observed, or where elastic movement in excess of 25mm with significant cracking is observed, the surface shall be deemed as defective. Defective areas shall be removed and replaced as specified below.

All soft areas shall be excavated and backfilled with similar site available material and compacted to the required density specified in the approved drawings and / or geotechnical report. When on site material cannot be utilized, imported granular material such as Select Subgrade Material (SSM) or Granular B as per OPSS.MUNI 1010 may be substituted if approved by the Town. Frost tapers shall be provided at the perimeter of all repaired areas where site similar material was not utilized. Frost taper slopes shall be no steeper than 10H:1V in the longitudinal direction (parallel to the road centreline), and 4H:1V in the transverse direction (perpendicular to the road centreline).

All sub-excavated areas within the roadway should be clearly noted on the as-recorded drawings. The records should include the limits of excavation (length, width, and depth), what material was used as replacement, and if any subgrade stabilization methods were utilized (geogrid, geotextile, lime treatment, etc.).

The subgrade shall be shaped to conform to the required longitudinal grade and cross-section and shall have a cross-fall of 3% from the centreline of roadway to each side unless otherwise approved by the Town. If considered necessary by the Town, the subgrade shall be re-compacted with suitable mechanical compaction equipment as required to produce a solid base for the road granular.

The final subgrade certification is to confirm that the final subgrade condition is equal to or better than that anticipated in the preparation of the pavement design. The certification letter is to display the Professional Engineer's Stamp for the Geotechnical Consultant.

The findings of the compaction reports and the aforementioned certification, in a form acceptable to the Town, shall be forwarded to, and acknowledged by the Town, prior to placement of the granular road materials.

2.6.3 Road Subdrains

Subdrains shall be a minimum 100 mm diameter and installed as per OPSS.MUNI 405. Subdrains shall be provided on both sides of the roadway for the purpose of draining the granular road base to a suitable outlet. Refer to Materials List in Appendix B for approved materials.

SECTION 2.0: ROADWAYS

In general, the subdrains are to be connected to catch basins. When a subdrain is extended to discharge above grade, the last 3.0 m section shall be rigid pipe with a rodent grate and marker provided.

The connection of other piping and drainage systems such as sump pumps to the subdrain system is not permitted.

The Town may, at their sole discretion, order that all or any portion of the installed subdrains be inspected using CCTV equipment according to OPSS.MUNI 405.07.08 and OPSS.MUNI 409.

2.6.4 Placing Granular Materials

The requirements of OPSS.MUNI 314 shall apply for the placement of granular material except where amended herein.

The requirements of OPSS.MUNI 501 shall apply for compaction except where amended herein.

Granular materials shall only be placed on a properly prepared subgrade that has been inspected and approved by the geotechnical engineer and the Town. Prior to placing granular material, the contract administrator shall confirm that the prepared subgrade meets the aforementioned grading tolerances.

Remove and replace any areas where the materials have become segregated prior to compacting. For roadway base or subbase construction, lift thickness shall not exceed 150mm. Granular material shall be compacted to 100% SPMDD, unless otherwise specified in the approved plans and specifications.

2.6.5 Asphalt Pavement Construction

The requirements of OPSS.MUNI 310 shall apply for constructing, repairing, or replacing hot mix asphalt pavements except where amended herein.

Paving of both binder and surface asphaltic concrete courses is not permitted within the Town from November 15 through to March 31 of the following calendar year, inclusive, without prior written permission by the Town. In all cases, no paving shall be carried out when ambient temperatures at the surface are below those noted in OPSS.MUNI 310 for both binder and surface courses.

Prior to paving works, the contractor shall schedule a site meeting with the Town, Contract Administrator, and the Project Materials Testing Consultant. During the site meeting the existing surface conditions shall be inspected and the Contractor shall provide a detailed work plan to ensure the quality of materials and workmanship.

Saw cut existing asphalt full depth in neat, consistent, parallel lines and at 90° angles. Diagonal or meandering cuts are not permitted. Ensure saw cut edges are clean and vertical. Where the edge of a trench or cut is within 1.2 m of the edge of existing pavement, the asphalt shall be removed to said edge of pavement. This provision applies to all asphalt surfaces.

All abutting edges of existing pavement shall be prepared and coated with tack coat prior to placement of new asphalt. Tack coat shall be placed by the use of a mechanical (pump driven)

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spray wand that is capable of being heated for cold weather operation and applying the tack coat in a consistent uniform application. All longitudinal joints and transverse joints shall be tack-coated prior to placement of the adjacent pass of asphalt. No asphalt shall be placed on the tack-coated surface until the tack coat has cured. Tack Coat Materials, Sampling, and Application shall be in accordance with OPSS.MUNI 310 and OPSS.MUNI 1103.

The use of a Material Transfer Vehicle (MTV) is required when placing any asphalt mixture on a roadway. Where the use of an MTV is not practical due to physical constraints, the hot mix asphalt must be delivered with live bottom trailers. The physical restraints shall be identified at the pre-pave meeting and the Contractor shall receive written permission by the Town prior to eliminating an MTV from the scope of work.

The Contractor shall construct durable longitudinal and transverse joints. Any joint cracking occurring within the Warranty Period shall be deemed to be a deficiency and all costs associated with remedial work shall be the responsibility of the Contractor.

At all cold longitudinal and transverse joints in the new HMA pavement under-compacted material at an unconfined edge of the new asphalt mat shall be removed (a minimum 150mm from the unconfined edge) and a straight, clean vertical face constructed.

Longitudinal joints in the surface course shall be parallel to the demarcation between the driving lanes (i.e. line paint), wherever feasible, at an offset of 100 mm to 150 mm from the centerline of the demarcation (approximately 1.5 m away from the inner wheel path). The joint shall not be placed in the wheel paths. The compacted asphalt density at any joint shall be at least 91% Maximum Relative Density (MRD) when measured using a nuclear densometer or by checking percent core compaction.

After final compaction, each course of HMA shall be of uniform texture and shall be free of segregation, fat spots, oil spills or any other defects. Defective areas shall be removed and replaced by the Contractor with acceptable hot mix of the same type and compacted to the satisfaction of the Town. When segregation is observed, the Contractor shall be immediately notified verbally, and shall take immediate corrective action. If the segregation continues, the Town may then issue a Stop Work Order until the problem is corrected.

Daily compaction tests for quality control purposes, using a nuclear densometer shall be performed at a minimum frequency of once per road, and no less than one test per twenty (20) linear metres. Daily compaction results shall be provided verbally to the on-site Inspector, followed by an email copy of the report to the Contract Administrator, and the Town within twenty-four (24) hours.

Compaction testing of the placed HMA shall meet the requirements of OPSS.MUNI 310 Table 10. Percent compaction shall be determined by comparing the density obtained using the nuclear densometer with the Maximum Relative Density (MRD) of the respective mix sample.

2.6.6 Gravel Surfaces

Gravel surfaces shall be constructed and restored as shown on the Contract Drawings or specified in the Special Provisions.

Granular material shall be placed in layers not exceeding 150 mm and compacted to 100% SPMDD. Prior to compaction each layer shall be graded to ensure a smooth surface.

A geotechnical consultant must be presented to confirm the degree of compaction during construction.

2.6.7 Surface Treated Areas

Surface treated areas shall be constructed or restored as shown on the Contract Drawings, or as directed by the Contract Administrator.

Surface treatment shall conform to OPSS.MUNI 304.

Hot mix asphalt may be used to patch surface treated roads.

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3.1 GENERAL

The location of all utilities must be established and resolved in conjunction with the Town and the Utility Companies, while generally following the locations shown on the typical road cross-sections.

Compaction of backfill for utility trenches shall be 95% Standard Proctor within boulevards and 100% for driveways and road crossings.

Design Engineer is required to prepare the Composite Utility Plans, secure approvals by all utility companies, including InnPower, and include in the set of Engineering Drawings being part of Subdivision Agreement. Composite Utility Plans must be available for review the latest at the 2nd submission of engineering drawings.

For information of all designers – as required by the Ontario Building Code, all residential properties must be equipped with the Electrical Vehicle Charging outlet. Design Engineer must familiarize himself with the most current charging facilities required by different manufacturers of the electric or hybrid vehicles. The additional load on the electrical system must be included in design of the entire network, including transformers and power cables. Joint consultation with InnPower and Town staff is required at the initial stage of designs.

Utility crossings shall be 1.0m minimum horizontally and 0.25m minimum vertically from any service connection (distance is based from the outside edge of utility crossing to the outside edge of the service connection).

3.1 UTILITIES

3.2.1 Telecommunications

Telephone, cable, and fibre optic services shall be underground in locations as shown on the typical road cross-sections and shall be installed by an approved utility Contractor.

3.2.2 Hydro

Hydro service shall be underground in locations as shown on the typical road cross-sections and shall be installed by Innisfil Hydro or an approved Contractor.

3.2.3 Gas

Gas service shall be underground in locations as shown on the typical road cross-sections and shall be installed by the Gas Company or an approved Contractor.

3.3 STREETLIGHTING

3.3.1 General

All roadways are to be lit, unless written approval is received from the Town. Streetlights shall be provided throughout all developments and may be required on roadways bordering developments if deemed necessary by the Town.

All entrances from site plans and private developments are to be lit, unless an exemption is approved by the Town.

All fire routes are to be lit, unless written approval is received from the Town.

SECTION 3.0: UTILITIES, STREETLIGHTING, AND TRAFFIC SIGNALS

A qualified engineering consultant shall prepare the streetlight design, including photometric layouts using an approved computer lighting program such as AGI 32, AutoLux, or equivalent.

All drawings must be sealed by a registered electrical Professional Engineer, licensed to practice in the Province of Ontario. Any attachments to hydro poles must have Hydro Authority approval and comply with Regulation 22/04 (or the latest revision thereof). All roadway lighting design and construction is subject to Electrical Safety Authority (ESA) inspection and approval.

The Transportation Association of Canada (TAC) "Guide for Design of Roadway Lighting", Volumes 1 and 2 provide comprehensive design guidelines and may be used for lighting devices for roadways and associated facilities.

3.3.2 Design Criteria**3.3.2.1 Within Public ROW**

Lighting design criteria for roadways, sidewalks, pedestrian walkways, and bikeways on public rights-of-way within the Town of Innisfil shall be based on the "American National Standard Practice for Roadway Lighting", ANSI/IES RP-8-22, or the latest revision thereof.

The lighting system shall provide the average maintained light levels and meet the recommended uniformities and veiling luminance ratios as indicated in the above-noted standard.

"Luminance" criteria may be used for determining light levels on straight and level roads that have a minimum length of ten (10) luminaire mounting heights.

"Illuminance" criteria to be used for intersections, curvilinear road sections, pedestrian walkways, and bikeways.

Refer to ANSI/IES RP-8-22, or latest revision thereof, standard design criteria for luminance, illuminance, and pedestrian conflict area classifications requirements

Intersections shall have an illumination level equal to the sum of the recommended average illumination levels for each of the intersecting roadways. If it is not practical to achieve this level due to geometric constraints, then a minimum level of 50% higher than the recommended level for the main roadway may be acceptable, subject to the Town's approval. Alternatively, Town may request to follow Table 8 in ANSI/IES RP-8-14, or any update of this standard.

SECTION 3.0: UTILITIES, STREETLIGHTING, AND TRAFFIC SIGNALS

For illumination of crosswalks (mid-block or at intersections) refer to Section 5.3 of ANSI/IES RP-8-22, or the latest revision thereof.

Light levels shall be increased by 50% through school areas, libraries, recreation centres, medical centres, railway crossings, bridges and any other location where increased conflict is possible. The street lights shall typically be serviced with underground wiring in ducts between poles. The luminaires shall be alternated between circuits to maintain 50% illumination upon loss of one circuit feeder.

Light fixtures shall be cut-off type to reduce light pollution and shall be dark sky compliant.

Light source for roadway lighting shall be long life (minimum 100,000 hours).

Power supply shall be coordinated and arranged with the Supply Authority from the nearest feasible location. Power supply shall be unmetered and the street lights shall operate at 120 volts 60 Hz AC. Maximum voltage drop at the end of the lighting circuit shall not exceed 5% of the supply voltage.

The design drawings shall show all surface features, all street light pole complete with ID#, all power pedestals complete with ID#, the individual conduits from the power pedestal to the light-emitting diode (LED) lights, the conduit from street light pole to street light pole, all utility road crossings with dimensions from the road crossing to either a side lot line or a street light pole, and dimensions from the street light pole to the lot lines where the street light pole is not opposite a side lot line. The LED street light ID# shall include the type of LED lighting fixture, the circuit number, and the power pedestal number to which it is connected. The Legend shall include duct sizes and an explanation of the street light symbol/ID#s.

On the single line drawing, there should be an electrical schematic for each power pedestal showing the transformer (complete with InnPower ID#) that supplies power to the power pedestal, the power pedestal cabinet contents (service breakers, service panel, grounding rods, etc.), each circuit and all of the LED street lights (complete with ID#) connected to that circuit with conductor lengths from the pedestal to the first light and from light to light, and all electrical components inside the LED street light fixtures. It should be noted that the maximum conductor length is 100 m.

Lighting calculations shall be prepared for all outdoor site lighting and forwarded to the Municipality for approval.

All luminaires are to be provided with ANSI C136.41 compliant dimming photocontrol allowing at least three different settings for dimming levels and start times.

Refer to Appendix B for a list of materials and specifications.

Streetlight designer should contact Town and confirm full set of criteria before the start of design.

3.3.2.2 Site Plans

Lighting design criteria for roadways, sidewalks, pedestrian walkways, and bikeways for site plans within the Town of Innisfil shall be based on the “American National Standard Practice for Roadway Lighting”, ANSI/IES RP-8-22, or the latest revision thereof.

Lighting should be controlled by automatic switching devices such as timers or photocells. The outdoor lighting shall be reduced by 75% after normal hours of operation until dawn.

Parking Lots

Parking lot illumination has to address good visibility for drivers and pedestrians, provide good colour rendition for security identification, and leave sufficient impact for customer attraction.

The recommended light levels for high activity community shopping developments are:

- Average maintained illuminance level 2.0 fc (20 lux) minimum. This could be increased up to 5.0 fc (50 lux), as is common practice for current commercial developments;
- Uniformity, average to minimum 4:1.

The minimum recommended light levels for parking lots are:

- Minimum horizontal illuminance level 0.2 fc (2 lux);
- Uniformity ratio, maximum to minimum 20:1.

Roadways

The recommended light levels for the site roadway zones are:

- Average maintained illuminance level 0.9 fc (9.0 lux);
- Uniformity, average to minimum 6:1.

Pedestrian Walkways

The recommended light levels for pedestrian walkways up to and surrounding any commercial buildings are:

- Average maintained illuminance level for medium activity areas 2.0 fc (20 lux) and high activity areas 4.0 fc (40 lux);

- Uniformity, average to minimum 4:1.

Site Restrictions

The recommended light levels projected onto a residential property (spill light) shall not exceed 0.1 vertical foot candles, measured line-of-site at the property line.

Light pollution, nuisance, and disability glare shall be restricted by use of full cut-off luminaries.

Pylon Signs

Externally illuminated pylon signs shall have the light source aimed downward towards the sign.

3.3.3 Lighting Configurations and Pole Offsets

All streets are to employ a staggered streetlight configuration with pole offsets from EP as per TAC criteria or on shoulder rounding.

In urban areas behind the face of a barrier curb with design speed of 70 km/h or less, pole offsets may be reduced to 1.5 m.

In rural areas where TAC pole offsets outside the clear zone are not possible, frangible breakaway bases may be used. Frangible bases are not permitted at intersections and areas where pedestrians are expected.

Pole offsets that are identified on the Town's Typical Road Cross Sections take precedence.

Lights at signalized intersections should be combined with joint-use traffic signal poles wherever possible.

On curved roadways, the light poles should be positioned on the inside of curves, if possible. Alternatively, light poles may be placed on the outside of curves, but shall be kept out of the vehicle overrun area (the extension of the tangent in the direction of vehicle travel).

Streetlights and power pedestals should be located on the extension side lot lines where possible.

The inclusion of smart functionality in streetlight design may be required. This will be reviewed on a case-by-case basis as directed by the Town.

Refer to Appendix C for minimum offsets for streetlights from other aboveground infrastructure.

3.3.4 Materials

All materials used for street lighting must be CSA approved. Refer to Appendix B for a list of Materials and Specifications.

SECTION 3.0: UTILITIES, STREETLIGHTING, AND TRAFFIC SIGNALS**3.3.5 Installation**

The installation of the street lighting system shall be in compliance with ESA, CSA, the Hydro Supply Authority requirements, the Town's standards and specifications, as well as the manufacturer's installation instructions.

Ducts

Ducts shall be solvent welded together in trenches with minimum cover of 750 mm. Ducts shall be surrounded by 80 mm of brick sand and warning tape to cover width of trench.

Road crossings to be carried out by directional bore method using thickwall PVC duct.

Where open-cut road crossings are necessary, ducts shall be concrete encased. Installation as per OPSD 2100.06 and OPSS 603.

Cables

Cables to be continuous without splices and shall be installed after trenches are back-filled.

Installation Specifications as per OPSS 604.

Fuses

Fuses in pole handholes as per OPSD 2255.020 and OPSS 617.

Grounding

Ground rods to be installed at power service disconnect (minimum 2 rods), at every fifth (5th) lighting pole, and at the last lighting pole in each circuit.

Installation Specifications as per OPSS 609.

Poles

Installation Specifications as per OPSS 615.

Brackets and Luminaires

Installation Specifications as per OPSS 617.

Power Service Disconnect

Installation Specifications as per OPSS 614.

Dimming control

Specifications as per ANSI C136.41. DIM-4 adjustable control.

3.4 TRAFFIC SIGNALS**3.4.1 General**

Traffic signal design is to be prepared in accordance with M.T.O. Traffic Manual Book 12 and the appropriate M.T.O. and electrical design codes. All work shall be performed in accordance with the current edition of the Ontario Electrical Code,

SECTION 3.0: UTILITIES, STREETLIGHTING, AND TRAFFIC SIGNALS

including all appending bulletins issued by the Electrical Safety Authority (ESA) which are applicable to the work. All work shall be governed by Federal, Provincial and Local laws and by-laws pertaining to the work, as well as by the latest issue of CSA Standards pertinent to the work. All electrical work is subject to inspection by the Electrical Safety Authority. In the event of a conflict between regulations, the strictest regulation shall apply.

In addition to accommodation of traffic flow, the signalized intersection design shall include pedestrian requirements and accessibility features. All signalized crossings must be designed in accordance with the TAC “Guidelines for the Understanding, Use, and Implementation of Accessible Pedestrian Signals”. Accessibility features must include gentle grades for sidewalks, drop curbs (painted yellow), and directional lines in the sidewalk to provide guidance for the visually impaired. Pedestrian crosswalk features shall include single head “walk/don’t walk” heads, countdown heads, and audible pedestrian heads with tactile push button.

It is the Contractor’s responsibility to ensure possession of the most recent drawings, PHM-125 drawings and Town of Innisfil standard drawings prior to the commencement of construction. Any modifications to the proposed plans must receive pre-approval, be redlined, and documented with the Town of Innisfil.

3.4.2 Materials

Unless otherwise provided for in the contract or contract drawings, all materials shall be new and of a uniform pattern throughout the work. All materials or components or custom equipment shall be CSA approved, where applicable, and comply with the requirements of the ESA with respect to their application. Unless indicated otherwise in the Contract Documents, materials for items covered by MTO specifications shall meet the requirements of the applicable MTO material specifications.

Materials not specified but which are indicated elsewhere in the Contract Documents as being required (including minor accessories such as connectors, fasteners, tape, etc. which are considered incidental to the Work) shall be standard construction grade materials supplied in accordance with CSA Standards to suit the application as required by recognized trade practice or supplied in accordance with the applicable MTO material specification. The Contractor shall submit Shop Drawings of the following upon request, for the Agency's review and approval:

Concrete Poles	Signal Brackets	Decorative Poles
Luminaires (All Types)	Vehicle Signal Heads	Pre-set Anchors
Luminaire Mast Arm	Pedestrian Signal Heads	Steel Poles
Signal Mast Arm	Tactile Plates	Power Supply
Ground Plate	APS Pushbutton	Electrical Chamber

Shop Drawings may be reviewed by the Agency and Hydro Authority to ensure conformity with the design concept of the project and compliance with the contract documents.

SECTION 3.0: UTILITIES, STREETLIGHTING, AND TRAFFIC SIGNALS

Prior to submission of Shop Drawings to the Agency, the Contractor is required to review Shop Drawings. By this review, the Contractor represents that they have determined and verified field measurements, field construction criteria, catalogue numbers and similar data, and that it has checked and coordinated each Shop Drawing with the requirements of the contract documents. The Contractor shall indicate the review of each Shop Drawing by stamp, date, and signature of an industry competent person.

The Contractor shall take due diligence in reviewing the requirements and specifications before the purchase of any equipment to ensure compatibility and to meet Agency requirements.

3.4.3 Electrical Code, Rules And Regulations

All work shall be executed in strict accordance with ESA and CSA Standards, the Ontario Electrical Safety Code (OESC), and the latest revisions thereto, including all applicable bulletins.

All work shall comply with and be performed in accordance with Federal, Provincial, and Local laws and by-laws relevant to the work, as well as the latest issue of CSA standards pertinent to the work.

Should it become necessary to perform work within close proximity to energized hydro lines, as defined by Section 188 of O. Reg 213/91 (Construction Projects) under the Ontario Occupational Health and Safety Act, the Contractor shall arrange authorization with the appropriate hydro authority. The Contractor must ensure that qualified personnel authorized by the hydro authority perform the work. Any costs associated with these arrangements and the engagement of qualified personnel shall be borne by the Contractor.

3.4.4 Adjustment Of Equipment

All equipment shall be installed in a neat and orderly manner to the satisfaction of the Owner. Minor adjustments to equipment, deemed necessary by the Owner to enhance the appearance of the Site, shall be executed at the Contractor's expense.

The Contractor shall also perform minor adjustments to any equipment that can be optimized for performance, as required. All such adjustments shall be carried out to the satisfaction of the Owner at the Contractor's expense.

Signal heads shall be installed in a manner that does not obstruct the visibility of existing signal heads. The Contractor shall make necessary adjustments to equipment during nighttime conditions to ensure optimal performance, with all such adjustments carried out at the Contractor's expense.

The Contractor shall promptly report any discrepancies or omissions observed by staff to the Agency for resolution.

3.4.5 Traffic Signal Heads

All signal heads supplied under the contract shall be LED. All LED signals shall comply with Standards Drawings, Ontario Traffic Manual Book 12, Ontario Traffic

SECTION 3.0: UTILITIES, STREETLIGHTING, AND TRAFFIC SIGNALS

Manual Book 12A, Highway Traffic Act, Ontario Provincial Standard Specifications, Canadian Standards Association certification, and shall meet or exceed Institute of Transportation Engineers specifications. All LED modules shall have an incandescent appearance, ensuring no individual LED is visible in regular daylight, avoiding a pixelated appearance. All LED modules shall be Electrical Testing Labs (ETL) verified as per Intertek's directory of LED Traffic Signal Modules Certified Products (latest revision). All LED modules shall have a minimum warranty of 5 years from the date of activation.

All vehicle and pedestrian housings shall be constructed of yellow polycarbonate UV-stabilized material with yellow square, cowl, or tunnel visors and matte black interiors, as approved by the Agency and as shown in OTM Book 12 and OPSS 2460. Backboards shall be made of UV-stabilized polycarbonate material or an Agency-approved equivalent, suitable for mounting vehicle signal heads on plumbizers or double arm pipe brackets, as indicated in the drawings. Signal heads shall be supplied with necessary bird stops and neoprene gaskets on the top of the head only.

All signal heads shall include 500mm brackets (as indicated in the signal drawings for center median poles and pedestrian signal heads), T-Type Nipple plumbizers, clamp mount Versa-Brac, cushion hangers, or other mounting hardware, which shall be aluminum with cast aluminum fittings and stainless-steel mounting hardware. All fastening components shall be stainless steel screws, washers, nuts, and bolts.

The Contractor shall use black powder-coated pipe brackets at decorative pole locations at no additional cost. All vehicle signal heads on mast arms shall be mounted with a plumbizer and must have two full-size reinforcing plates mounted at the bottom interior of the red section and top interior of the amber section, at a minimum. Additionally, vehicle signal heads shall include a safety feature of an aircraft cable as per Standard Drawing.

All non-operational signal heads shall be covered with 'Traffic Jackets', complete with mounting hardware. Inactive vehicle signal heads on plumbizers can be tilted facing down with the LED indication not visible to road users. Inactive pedestrian signal heads can be turned to face the pole with the LED indication not visible to road users.

The bird stop shall only be installed on the top head frame, and the washer shall comply with OPSD 2524.01.

3.4.6 Vehicle Signal

Vehicle signal heads may include Highway, Oversized Highway, Type 1, Type 2, Type 9, Type 11.

3.4.7 Programmable Signal

Optically programmable traffic signal heads may be utilized to provide precise lane control for traffic signal displays. The Contractor shall submit a Shop Drawing or detailed specification sheet for the programmable traffic vehicle signal for pre-approval.

Additional types of programmable vehicle signals may be specified.

3.4.8 Pedestrian Signal

The housing equipment shall be constructed of square polycarbonate material. The Contractor shall supply and install the equipment as itemized in the tender items. The “Bi-Modal Walk” and “Don’t Walk” Pedestrian LED signal head sections shall be integrated within a single unit, superimposed in the same housing. All LED pedestrian signals shall comply with TAC, HTA R.R.O. 1990 Regulation 626 Traffic Control Signal Systems, and shall resemble the outline/symbol as specified in OTM Book 12, subject to approval by the Agency. The Pedestrian Countdown Signal (PCS) head section shall feature a transitional countdown display during the “Flashing Don’t Walk” phase only and remain blank at other times. All PCS units shall meet or exceed ITE specifications, resemble the outline/symbol as specified in OTM Book 12 and OTM Book 15, and must be approved by the Agency. The countdown displays shall have an incandescent appearance, ensuring no individual LED is visible in regular daylight.

3.4.9 Bicycle Signal

Bicycle signals shall utilize LED modules and comply with HTA specifications. The LED modules shall exhibit an incandescent appearance, avoiding a pixelated look. All LED modules shall come with a minimum warranty of 5 years from the date of activation. Bicycle signal housings shall be constructed of black UV-stabilized polycarbonate material, equipped with black tunnel visors, and shall not include backboards.

3.4.10 Traffic Signal Mast Arms

The Contractor shall supply and install traffic signal mast arms in accordance with the Contract Standards Drawings, OPSS 2460, OPSD 2501.01, and OPSD 2501.02, as applicable.

Single-member mast arms shall be constructed of spun aluminum or black powder-coated material (as required) and shall comply with the specified drawings. Mast arms shall be equipped with hot-dipped galvanized steel collar pole face plates and adjustable pole back plates. The thickness of these plates shall adhere to the manufacturer’s requirements.

The Agency may also request straight single mast arms for pedestrian crossovers (PXO) or cross rides, which do not have a rise. These arms shall be requested as per contract drawings and provided at no additional cost.

The Contractor is required to install a ¼"-20 set screw between the mast arm and mounting shoe to prevent rotation of the mast arm.

A joint site visit with the Agency representative and Contractor is required to finalize mast arm lengths after the completion of all pole bases.

3.4.11 Traffic Signal Poles

The Contractor shall supply and install traffic signal poles in accordance with the applicable Town of Innisfil Standards and OPSS MUNI 615, and shall be CSA certified as required.

The Contractor shall field drill all apertures on steel or aluminum poles at the appropriate locations for internal wiring and the attachment of mast arms, brackets, and pushbuttons. All apertures shall be treated with zinc-rich or galvanizing paint and fitted with a rubber grommet. All hand hole cover screws shall be treated with anti-seizing lubrication.

Steel Poles

All steel poles shall be hot-dipped galvanized and possess the strength and rigidity to withstand, without failure, the accepted design and pressure standards for Southern Ontario. All traffic signal steel poles shall as per MTOD 2435.020 be as indicated in the signal drawings, or an agency-approved equivalent. Combination traffic signal/streetlight poles shall feature octagonal base mounting as per OPSD 2232.010.

Pushbutton Poles (With Footing)

Pushbutton poles shall be 1.5 meters in height, constructed of aluminum, and installed with a concrete footing. Pushbutton poles shall comply with OPSD 2558.00, and the footing shall adhere to OPSD 2200.041. The Contractor shall supply black powder-coated pushbutton poles at no additional cost unless otherwise specified within the tender items.

3.4.12 Pushbuttons

The Contractor shall supply and install pedestrian pushbuttons on the poles that are part of the traffic signal system as indicated in the signal drawings. The pushbuttons and interface modules shall be installed in accordance with the manufacturers' specifications. Pushbuttons shall be installed using the drill/tap method and fastened with ¼"-20 stainless steel machine screws or as specified by the manufacturer. All openings around the pushbutton and the wiring aperture shall be sealed with outdoor clear silicone. A 1-2/C #12 AWG riser cable shall be installed in the riser conduit from the pushbutton to the splice point.

Town is not responsible of providing sigs. Pushbutton signs supplied by the Contractor shall comply with the OTM Manual unless otherwise instructed. Pushbuttons shall have a minimum warranty of five (5) years. Approved equivalents must be pre-approved by the Agency, and the Contractor must provide detailed specification sheets and drawings or cut sheets.

Pedestrian and Bicycle Pushbutton

Pushbuttons shall be rectangular, yellow in colour, flush mounted onto the pole and have a tactile arrow appropriately aligned with the crossing and a latching LED once activated.

Pushbuttons attached to wood poles shall have a modular cup/housing to allow conduit access.

Pushbuttons attached to round aluminum poles shall include the modular cup/housing to allow conduit access and flush mounted to the pole.

Accessible Pedestrian Signal (APS) Pushbutton

APS pushbuttons shall be yellow in color, capable of operating over a single pair of wires, and equipped with a vibrating tactile arrow with an audible tone. They shall feature a latching indicator, a confirmation tone with vibration upon activation, extended push functions, SDLC capabilities, cuckoo and Canadian melody tones, and shall be AODA compliant. The pushbuttons shall include pedestrian crosswalk signage with instructions for pedestrian operation as per Agency standards.

3.4.13 Traffic Controller Installation / Reconfigure Modifications

The Contractor shall install the traffic cabinet, controller, hardware, and other equipment supplied by the Agency in accordance with the signal drawings and applicable standards to ensure the intersection is fully operational. The Contractor shall connect all field signal circuits and vehicle detector run wires as specified in the cabinet wiring diagram. The Contractor shall perform “Flash-out” and “Conflict Monitor” field checks prior to energizing the signals for operation. The Contractor’s electrician shall sign and date the Conflict Monitor sheet prior to the final energization of the permanent traffic signals.

The Contractor shall ensure that the connection of any existing or new traffic systems communications cables, hardware, and related devices are always fully operational and maintained.

It is the Contractor’s responsibility to ensure functional signal operation compatible with the timing and phasing of the provided controller unit. Any modifications required to a new or existing cabinet to achieve fully functional traffic signals shall be made by the Contractor. If necessary, the Contractor shall arrange for training and support from suppliers or manufacturers at their own expense.

The Contractor shall be capable of completing same-day modifications to an existing cabinet as required. For example, when a new phase such as a left turn phase is implemented, the Contractor shall have a qualified electrician perform tasks such as re-wiring cabinet outputs, adding load bays, deactivating load bays, and making appropriate field/signal wiring outputs. Other tasks may include pole replacements or swaps. In all scenarios, the Contractor shall provide paid duty police officers at their own cost to manage intersection traffic while the signals are off.

The Contractor may be required to install a pole-mounted controller where necessary. The controller shall be installed as indicated in the drawings and in accordance with OPSD 2510.010. The Contractor shall provide all applicable steel strapping, bolts, conduits, and couplers. The Contractor may also be required to supply and install the cabinet skirt as directed by the Agency.

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The Contractor shall document all tests and checks completed within the Traffic Signal Maintenance Report (TSMR) on the day of activation.

The Contractor shall document any special cabinet hard wiring modifications on the cabinet drawing with a red pen and notify the Agency of such changes.

3.4.14 Fire Pre-emption Evp/tsp Installation

The Contractor shall supply and install fire pre-emption equipment as directed. The Contractor shall install the manufacturer-recommended cable, terminators, connectors, control unit/card, and connect all equipment to ensure a fully functioning pre-emption system, regardless of the system type.

The Contractor shall prepare the equipment and system for testing by the Agency's maintenance contractor. For new signal installations, testing shall be completed before the signal activation date. The Contractor shall provide appropriate staff as required to support the Agency's maintenance contractor during testing.

All testing shall be conducted by third party independent contractor and the Agency's Maintenance Contractor is responsible for QA testing before sign off/handover.

The Contractor shall supply and install Emergency Vehicle Pre-emption equipment as detailed within the tender items. The Contractor shall supply and install 3/C #20 AWG Global Traffic Technologies (GTT, formerly 3M) SPEC 138 pre-empt cable from each signal pole to the traffic controller, as shown in the drawings. Adequate spare cable shall be left coiled at the detector location and in the signal cabinet for final connection by the Agency's forces.

The Contractor shall also supply and install GTT Opticom 721 Detectors, with mounting brackets, at each location as shown in the drawings. The detectors and detector cards may also be supplied by the Town/Fire Department.

3.4.15 Temporary And Overhead Signal Installation

The Contractor may be requested to provide overhead or temporary signal installations as shown in the contract drawings and in accordance with OPSD 2540.010, 2545.01, 2242.020, and 2245.010, as applicable.

Newly installed overhead traffic signal system spans shall be tightened 30 days after signal activation to ensure proper span and mounting heights are maintained as per contract drawings. These works shall be performed at no additional cost to the Agency.

Overhead Traffic Signal Heads

The Contractor shall supply and install signal heads on span wires or mast arms in an overhead or temporary installation. All vehicle and pedestrian signal heads shall be as per Traffic Signal Heads section.

All signal heads shall be supplied with span wire hangers. Both the upper and lower signal head mount shall be reinforced with a steel plate in each section.

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The Contractor, as directed by the Agency, may be required to install signal heads with mast arms directly to wood poles, as per OPSS 2461 and OPSD 2501.020.

All signal heads that are not to be operational during designated construction stages shall be covered with "Traffic Jackets" complete with mounting hardware. Overhead traffic signal heads shall include up to 10m of coiled wire from the junction box to the signal head. The signal head shall be able to move an additional 5m along the span from the location indication of the drawings.

Back Guy Anchors

The Contractor shall supply and install back guys for wood poles and hydro poles, as indicated in the drawings, in accordance with OPSD 2540.010 and OPSD 2235.010. The Contractor shall supply and install back guy anchors as further described in the tender items.

Where it is impractical to install the normal back guy, a sidewalk strut type back guy shall be provided. All back guys shall be installed prior to the installation of suspension spans, cables, signal heads and luminaires.

Where the ground is softer and anchors cannot be placed properly, the Contractor shall pour concrete footing/posts using concrete formwork and set anchor within the concrete footing.

Steel Messenger Cable

The Contractor shall supply and install steel messenger cable and all associated mounting hardware, as indicated on the signal drawings and in accordance with OPSD 2540.010. OPSD 2540.010 is amended to note that all steel messenger cables installed shall be 9mm Grade 160.

The messenger cable is to be spanned between poles using thimble eyebolts that are to be bolted through wood poles or steel-banded spool insulators for steel poles as per the project specifications.

Wherever aerial cable crosses under high voltage hydro lines, the Contractor shall arrange with the appropriate local Hydro Authority for the neutral conductor to be raised to clear the top span by a minimum distance as per local Hydro Authority. If they are unable to achieve this separation, the Contractor shall arrange with the local Hydro Authority to protect the neutral with a flexible line insulator hose. The covers shall extend no less than the minimum distance as per local Hydro Authority on each side of the outmost high voltage conductor. The minimum distance as per local Hydro Authority working clearance from high voltage conductors shall be maintained. Cable spans greater than 60m which require support cable hangers as per OPSD 2540.010 shall be at no additional cost.

The Contractor shall arrange with the appropriate local Hydro Authority for the attachment of overhead traffic signal equipment on their existing hydro poles at the intersection, as required.

SECTION 3.0: UTILITIES, STREETLIGHTING, AND TRAFFIC SIGNALS**Traffic Signal Cable**

The Contractor shall supply and install overhead traffic signal cable, as indicated on the drawings and in accordance with OPSD 2540.01. Traffic signal cables shall be sun resistant.

The Contractor shall ensure that no portion of the overhead span installation to be lower than 5.8m over the travelled portion of the roadway. The Contractor shall record the clearance heights measured, and provide documentation to the Agency.

Power Feed Cables and Streetlighting

The Contractor shall supply and install overhead power feed cable for both the traffic controller and streetlights, as shown on the drawings and in accordance with OPSD 2540.010. The power feed cables shall be sun resistant.

Ground Cable

The Contractor shall supply and install overhead ground cable, grounding for the messenger cable and the overhead system, which shall conform to the appropriate local Hydro Authority requirements and in accordance with OPSD 2540.010. The ground wire shall be sun resistant.

Ground Rods/Ground Plate

The requirements for the installation of grounding equipment shall be in accordance with OPSS 609.

At wood poles near a ground rod, the Contractor shall install a ground wire from the upper span to the lower span and then to the ground rod inside a protective moulding stapled to the pole.

Wood Post/ Portable Stand for Pedestrian Pushbutton

The Contractor may be required to provide a wood post or stand, on which to install the pedestrian pushbuttons and signs.

Where indicated on the drawing, a pushbutton with corresponding sign shall be mounted on a 100mm x 100mm x 5m pressure treated direct buried wood post. Wood posts shall be direct buried to a minimum depth of 1.2m and backfilled with limestone screening, compacted as required. Sufficient cable shall be coiled to permit relocation, if required.

Where indicated on the drawing, a pushbutton with corresponding sign shall be mounted on a portable stand and must be constructed to withstand outdoor / inclement conditions in Ontario and weighted down to prevent tipping. Sufficient cable shall be coiled to permit relocation, if required.

A 13mm steel or plastic riser conduit shall be fastened to the wood post or moveable stand from the pushbutton to the top.

Under temporary traffic control conditions, the Contractor is responsible for maintaining the pedestrian posts/stands in their proper location and ensuring full operation during all stages of construction. Moveable pedestrian stands should be placed on level ground and pedestrian accessible location and may require

relocation during construction. All relocation expenses shall be borne by the Contractor.

Overhead Fire Pre-emption Installation

Contractor be required to supply and install GTT 721 detectors on overhead span wires, the Contractor shall supply and install 3/C #20 AWG, GTT SPEC 138 pre-emption cable from each fire pre-emption detector head location to the traffic controller, as shown on the drawings.

The Contractor shall supply and install Emergency Vehicle Pre-emption equipment as detailed within the tender items. The Contractor shall install the manufacturer recommended cable, terminators, connectors, control unit/card and connect all the equipment for a fully functioning pre-emption system regardless of the system type.

The Contractor shall make the equipment ready for the Agency's maintenance contractor for QA test. For new signal installs testing shall be completed before the signal activation date. The Contractor shall provide appropriate staff as required, should the Agency's maintenance contractor require support for testing.

Adequate spare cable will be left coiled at the detector location and in the signal cabinet for final connection. All necessary hardware/brackets to ensure safe and consistent operation shall be supplied by the Contractor.

3.4.16 Uninterruptible Power Supply (UPS)

The Contractor may be required to supply and install UPS, capable of being side-mounted or pad-mounted. The UPS shall house a minimum of four (4) batteries and bypass switches. The UPS enclosure must not interfere with the opening of the traffic cabinet door.

All four (4) batteries must meet their specifications immediately after the initial 24-hour top-off charge. Batteries requiring cycling to meet the AH rating specifications are not acceptable. The UPS shall provide a minimum of four (4) hours of full run-time operation at 500 watts, with an additional nine (9) hours of Red Flash operation at 125 watts.

The UPS shall also feature two (2) independently programmable timers, ranging from zero (0) to eight (8) hours, with two (2) time-of-day restrictions on each timer, providing dry contacts for red flash operation at user-definable times of day. The UPS and batteries shall be easily replaceable with all necessary hardware and shall not require any special tools for installation.

3.4.17 System Communications

The Contractor may be required to include connections to the Public Sector Network (PSN) fiber-optic system. A 50mm conduit shall be supplied and installed by the Contractor, as shown in the drawings, from the nearest PSN access point to the traffic controller location. The PSN facilities shall be installed in the traffic cabinet by other forces, with the Contractor assisting in the completion of any PSN works.

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The Contractor may be required to install or relocate wireless radio equipment, such as antennas, cables, and cabinet equipment, to ensure the system is fully operational.

Any existing communications shall be maintained during all stages of construction.

The Contractor may be required to store the equipment for the duration of the project, which shall not incur any additional costs.

3.4.18 Traffic Cabinet Concrete Base

Traffic cabinet bases shall be constructed in accordance with the Standards Drawings, as applicable. Final orientation shall be as per drawings or shall be determined in the field and approved by the Agency's designate as required.

In situations for an MTO specified cabinet concrete base, the Contractor shall be required to supply a cabinet skirt to raise the cabinet and shall provide a detailed drawing of the cabinet skirt from the manufacturer to the Agency.

The Contractor may be required to install a pole mounted controller during temporary stages and at locations where space is limited. The controller shall be installed as indicated on the drawings and in accordance with OPSD 2510.01. Ducts entering the traffic cabinet base shall be sealed with electrical duct seal putty.

3.4.19 Electrical Chambers

Electrical chambers shall be constructed according to OPSD 2112.010, 2112.020, 2112.040, respectively and additionally OPSD 2117.020, 2118.020, and 2123.030. The requirements for the installation of the concrete electrical chambers shall be in accordance with OPSS 602.

If installed within or adjacent to hard surface such as concrete or asphalt the electrical chamber shall be flush to grade as not to create a tripping hazard. Poured concrete shall be placed, vibrated, cured, protected, and finished conforming to OPSS.MUNI.904 and shall be formed as one monolithic structure. All concrete shall be 32 MPa.

All steel junction box/electrical chamber-lids shall be grounded and bonded to the ground wire network.

3.4.20 Concrete Base/footing For Poles Or Power Supply

All pole or power supply concrete bases shall be as per the Contract Drawings. Concrete shall be placed, vibrated, cured, protected, and finished conforming to OPSS.MUNI.904 and shall be formed as one monolithic structure. All concrete shall be 32 MPa.

3.4.21 Traffic Conduits

The Contractor shall supply and install conduits as per OPSS 603. All rigid and flexible ducts used shall be to:

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1. CSA Standard C.22.2 No. C211.2-06 for Rigid conduit; and
2. CSA Standard C.22.2 No. C227.1-06 for Flexible conduit.

At intersections where, underground conduits are to be installed for future traffic signals, as shown on the drawing, the Contractor shall supply and install a continuous #6 AWG (green) insulated ground wire. A minimum of 1.5m of ground cable shall be coiled in each electrical chamber. Where necessary, a split bolt connector shall be used or as per revised ESA standard requirements. The Contractor shall also supply and install No. 10 annealed fish wire or equal strength polyline through each duct going to a pole base/power supply base/electrical chamber/controller cabinet base.

The Contractor is advised that an existing conduit system may be present, as indicated on the drawings. All conduits shall be inspected, and the Contractor shall ensure they are free of obstructions or blockage. Any obstructions shall be cleaned prior to using the conduits. Where a blockage cannot be cleared, the Contractor shall report it to the Agency for authorization to proceed on repairs as directed.

3.4.22 Traffic Cable

Traffic signal cables used shall be #14 AWG colour coded and as per OPSS 2409, IMSA or an approved equal, according to the requirements of the ESA, prior to installing the cable. The cable jacket shall be polyethylene. It shall be the Contractor's responsibility to provide functional signal operation that is compatible with the timing and phasing of the controller unit provided for each location.

3.4.23 Power Feed And Streetlighting Wires

All power feed cables shall be installed from the source location to the traffic signal controller and/or intersection luminaires, as shown on the drawings.

3.4.24 Ground Wire

The Contractor shall supply and install electrical grounding equipment as per OPSS 609 (where applicable) and the Contract Drawings.

The Contractor shall supply and install 1-1/C #6 AWG solid RWU (Green) insulated copper ground wire in the underground duct system.

All connections shall be bonded to the leads between poles, electrical chambers, neutral of overhead streetlighting and ground rods or ground plates with compression sleeve connectors or as per revised ESA code.

3.4.25 Loop Detector Run Wires/pushbutton Cables

The Contractor shall supply and install 2/C #14 AWG ELV shielded detector cable runs from each vehicle detector splice point to the traffic controller. These cables shall be rated for 600V, have a polyethylene outer jacket, and have a drain wire.

All loop detector run cables shall be connected to the appropriate controller cabinet terminals as identified on the cabinet wiring diagram and in accordance with the Contract Drawing.

The Contractor shall also supply the same cables for audible pedestrian pushbuttons and regular pushbutton as directed.

3.4.26 Electrical Power Service Connections

The Contractor shall refer to the Contract Drawings for typical power service supply details. However, the Contractor shall comply with all applicable local Hydro Authority and ESA requirements. The Contractor shall be responsible for arranging all necessary inspections/connections and shall file required applications mandatory for connection to the power source.

The Contractor shall install in-pole breakers as per the municipality requirements. This work shall be carried out in coordination with and, if required, under the supervision of the local Hydro Authority.

The Contractor shall install the complete service facility with ground plates as soon as possible to permit hydro connection prior to the completion of the aboveground signal infrastructure. The Contractor shall arrange for ESA inspections and shall forward a copy to the Agency via email. The local Hydro Authority shall connect the power service facility to the power supply at a specified time once it receives the ESA approval.

For traffic signal intersections, the power supply shall be a 120V/240V split phase 100 amp rated for the main breaker. It shall include a one 30-amp circuit breaker labelled for streetlighting and one 40-amp breaker labelled for the traffic signal system. The power supply shall be a CSA approved weatherproof electrical enclosure.

Installation of the power service shall be completed within the first ten (10) working days of the project to allow Hydro Authority sufficient time to provide power prior to date of signal turn on.

3.4.27 Ground Rod/Plates

The Contractor shall supply and install electrical grounding equipment as per OPSS 609 (as applicable).

The Contractor shall supply and install #6 AWG type RWU (Green) insulated copper ground wire in the underground duct system. All connections shall be bonded to the leads from poles and ground rods or ground plates with compression sleeve connectors.

Ground plates shall be secured by means of exothermic weld connections with a compression connector to allow for #6 AWG (green) ground wire and shall be ESA approved.

Ground plates shall not be less than 6mm thick, 406mm in length and 254mm in width and shall be installed as per CEC Rule 10-700 and CEC Rule 10-702. Each corner boulevard electrical chamber shall have a ground plate and the power supply shall have a minimum of two ground plates.

The Contractor shall test all system and grounding components. The Contractor shall test the resistance to ground between the equipment enclosures and the grounding grid. Readings shall not exceed 25 ohms. These measurements shall

be performed when frost penetration does not exceed 150 mm. In soils of low conductivity, ground plates and ground wires shall be added as required.

3.4.28 Vehicle Detectors

The Contractor may be requested to install alternate means of detections, such as overhead detectors and wireless in-road sensors. It is the Contractor's responsibility to educate themselves on the installation and operation of these technologies to provide a fully operating system as per Agency requirements. In addition, the Contractor shall be familiarized on integrating the detection device to the controller unit. Where the Contractor lacks knowledge or experience about a particular device and requires supplier or manufacturer support, the Contractor shall contact and arrange for training and set up of the device in a timely manner that shall not affect the completion of the project. If necessary, the Contractor shall arrange with all equipment suppliers or manufacturers to provide training and education to ensure proper operation. Any additional expense incurred for such support shall not be considered and shall be borne by the Contractor.

Loops

Vehicle detector loops shall be installed in the road surface in accordance with OPSD 2520.01, OPSD 2520.02 at the locations specified on the drawings or as advised in the field by Town of Innisfil Traffic signal staff. Final placement is to be determined in the field in coordination with Agency staff.

Detector loops shall be in place prior to signal activation unless otherwise directed by the Agency.

A 25mm Electrical Non-Metallic Tubing for each individual loop lead wires shall be installed from the edge of roadway to the electrical chamber, as indicated on the drawings. Loop lead-in wires shall be spliced to run wires in the pole handhole. Where a lead-in splices is made in an electrical chamber, the Contractor shall use waterproof gel connectors.

The Contractor shall coordinate the placement of detector loops in the top course asphalt, such that they are installed prior to the pavement markings being placed. The crosswalk markings are not to be installed until all vehicle detection loops have been completed.

Overhead Detectors

The Agency will continue to test and review new emerging technologies to update the pre-approved overhead detectors. At the discretion of the Agency's traffic signals representative, new units may be installed on a case by case basis as approved by the Agency.

Depending on the type of vehicle detector shown on the drawing the Contractor shall be required to supply and install the proper cable to operate the vehicle detector. There shall be no splices in between cable runs unless specified by the manufacturer. The detector shall be installed in the locations indicated on the drawings unless otherwise directed by the Agency.

Should the Contractor be required to install overhead detector systems on temporary traffic signal installations, the detector unit(s) shall be installed on wood poles. Where installing on wood poles is not possible, the Contractor shall supply

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and install all hardware and equipment necessary to install the detector unit on overhead span wire. The requirements for the installation of an overhead vehicle detector shall be in accordance with OPSS 620.

Should the work involve multiple traffic stages, the Contractor is responsible for adjusting and recalibrating the detector units as directed by the Agency or Contract Administrator during staging traffic signal operation. Modification of detection zones may be due to traffic management plan changes and/or to maximize level of service.

The Contractor shall pre-program all detection zones as per design drawings prior to signal turn on unless otherwise directed by the Agency.

Wavetronix Smart Sensor

The unit model to supply and install shall be the Smart Sensor Matrix for the stop bar application. It shall be installed as per the manufacturer recommendations.

New Overhead Technology

New technologies shall include any detection system that has not been identified in this document. The noted technology shall be of similar install to the Wavetronix smart sensor, Iteris Next or Iteris Vantage, in that it shall be one detector appurtenance on a pole or mast arm, with lead-in/runner wires between the controller cabinet to the sensor. The Agency may supply the units, or the Contractor may be asked to purchase the detection unit, hardware, mounting hardware, cables, and control unit for a complete functioning installation.

3.4.29 Energizing Traffic Signals

The Agency or designate must be present when the Contractor energizes the traffic signals for full operations. The Contractor shall provide a minimum of 72 hours advance notice to the Agency when the signals are scheduled to be energized. The Agency reserves the right to cancel any traffic signal activations when the Agency has not been advised of within the 72-hour notice period. If extreme weather conditions present a safety concern, then the Agency and the Contractor can agree to re-schedule energizing the traffic signal.

The Contractor shall have a licensed electrician (experienced with energizing traffic signal installations) present when energizing a temporary or permanent traffic signal. When energizing the signals for acceptance, a Flash-out and a Conflict Monitor check must be completed.

Temporary and/or permanent traffic control signal installations must be energized after all vehicle/pedestrian detection has been installed, all central computer control hardware relocated, and all fire pre-emption hardware installed.

All traffic signal installations must be fully operational, furnished and complete which shall include but not limited to; pushbuttons, audible pedestrian pushbuttons, pre-emption equipment, detection equipment, pavement marking and signage on activation date.

3.4.30 Testing And Acceptance Of Work

Factory finished equipment shall be protected so that the surface will not be damaged during construction. All damaged work shall be removed and replaced at no additional cost to the Owner.

When all electrical work under the Contract has been completely tested and proven satisfactory, the protective covering of factory finished materials shall be removed and the equipment shall be thoroughly cleaned and kept clean so that the work is in good and proper working condition when acceptance is made. Luminaires and lamps shall be cleaned thoroughly prior to final inspection.

Tests on electrical wiring and material shall, unless otherwise specified, conform to the OESC, and shall include insulation value readings and resistance to ground readings. Testing shall only be performed by a certified electrician and shall be done in the presence of the Agency, local Hydro Authority and/or ESA Inspectors, as requested. The Contractor shall provide all necessary instruments, equipment and personnel required to satisfactorily carry out prescribed tests at their own expense.

The following tests shall be performed as directed by the Agency:

- All conduits and duct systems shall be proven free of stones, dirt, water, or other debris by pulling a test mandrel 6mm smaller in diameter than nominal conduit or duct size through each individual conduit or duct.
- All circuits shall be proven continuous and free of short circuits or ground faults.
- All circuits shall be proven free of unspecified grounds and the resistance to ground for all circuits shall be no less than 50 mega ohms.
- All circuits shall be proven to be operable. Each control or switching device shall be operated no less than 10 times and each circuit no less than eight (8) hours.
- The resistance to ground for the power service facility ground, the controller ground, and the intersection system ground shall be proven not to exceed 25 ohms. The Contractor shall perform the necessary tests and record the values on the form provided by the Agency.
- The Contractor shall measure the incoming voltage at the power service facility and shall record the value on the form provided by the Agency.

In addition to the above tests, the Contractor shall, where directed by the Agency, perform any tests called for where performance of the electrical system indicates a deficiency. The Agency may conduct tests on materials other than electrical materials as described elsewhere in the specifications for the contract.

Where any tests indicate faulty workmanship or unacceptable electrical measurements, the Contractor shall repair or replace the faulty equipment at their own expense and to the satisfaction of the Agency.

The Contractor or its duly appointed representative shall oversee all testing and shall assume full responsibility for any damage which may occur to the equipment installed because of such testing.

Prior to energizing the traffic control signals, the Contractor shall “Flash-out” all field circuits, perform a conflict monitor check as per the Project Conflict Monitor Check Sheet and log accordingly in the TSMR logbook.

3.4.31 Pavement Markings And Traffic Signs

Durable pavement markings in accordance with the Town of Innisfil Standards and OPSS.MUNI 710 shall be installed as per the Contract Drawings.

Where required, the Contractor shall supply and install signs to the pole with steel banding and stand-off brackets, in accordance with the Town of Innisfil Standards.

All signs supplied by the Contractor shall be according to OTM Book 5. The Contractor shall supply and install all signs and sign supports as shown on the contract drawings.

The Contractor shall be required to install an oversized street name sign onto a mast arm, in accordance with the Town of Innisfil Standard Drawings. Where the oversize street name signs are indicated to be installed on overhead span wire, the Contractor shall supply all appropriate hardware.

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4.1 GENERAL

The principles and design criteria in this section are intended to augment the guidelines, policies, and standards established in the latest version of the Ministry of Transportation (MTO) Drainage Management Manual, the MTO Highway Drainage Design Standards, the Ministry of the Environment, Conservation and Parks (MECP) Stormwater Management Planning and Design Manual, the Nottawasaga Valley Conservation Authority (NVCA) Development Review Guidelines, the Lake Simcoe Region Conservation Authority (LSRCA) Watershed Development Policies, the Lake Simcoe Protection Act, the LSRCA Technical Guidelines for Stormwater Management Submissions, LSRCA and Ontario Regulation 219/09 and MECP's Lake Simcoe Phosphorus Reduction Strategy.

Where the Town's Engineering Design Standards and Specifications Manual does not provide specific details, all designs should stay in conformity with the most current version of the above listed documents, including all Ministry of Transportation standards.

In the planning and design of stormwater management facilities, the designer is to have full regard for the riparian rights of all surrounding, upstream and downstream landowners. Consideration of the surrounding topography, land uses, and environment and integration of the facility into such elements is paramount. Opportunities for linking these facilities with trail systems should be maximized.

Electronic copies of all native, editable, design models, such as Visual OTTHYMO (.voprj), PCSWMM/SWMM5 (.inp/.pcp), HEC-RAS (.prj), HY8 (.hy8), etc. used to produce the engineering drawings and reports shall be included in all Site Plan/Subdivision submissions to the Town. When submitting your models for review, package all of these native files and any associated modeling files, PDFs of reports or plot outputs alone will not suffice.

4.2 LOW IMPACT DEVELOPMENT

The Town encourages the implementation of low impact development (LID) measures as defined by the Lake Simcoe Protection Plan (LSPP) and the United States Environmental Protection Agency (U.S. EPA, 2007) to minimize post development runoff volumes and maintain existing hydrological conditions within new developments. As such, the Town requires the stormwater management design of new and infill developments, as well as reconstruction and retrofit projects, to promote at-source control of post development runoff, thereby reducing the dependence on end-of-pipe controls where site conditions permit. However, due to the absence of definite Provincial and Conservation Authorities standards for the design of structural LID's, the implementation of these measures can be considered as a developing science. Local Conservation Authorities and the MECP are working towards the development of provincial standards, which upon their completion, will be incorporated into the Town's Engineering Design Standards and Specifications Manual. As a result, the Town will require that each construction project be assessed on a case by case basis.

To assess the applicability of incorporating structural LID as part of the stormwater management design, a comprehensive report prepared by a qualified engineer will be required for each project, which must include the following information:

- a) Describe existing site conditions, including significant environmental features as well as soil type, infiltration capacity, and depth to water table;
- b) Depending on the extent of the proposed project, prepare maps identifying the environmental features, soil conditions, and water table depth to show all aspects under consideration in the environmental design of the stormwater management system for the development;

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- c) Complete single event and continuous (if required) simulation rainfall/runoff event models to establish the baseline quality and quantity of stormwater runoff originating from the development area under existing conditions as a framework for evaluating combinations of structural LID components with conventional end-of-pipe controls;
- d) Prepare an assessment of the various combinations and sizing requirements of LID components and end-of pipe controls based on their suitability for achieving the stormwater management control targets under typical post development conditions accounting for snow accumulation and frozen ground conditions;
- e) Select a preferred alternative for achieving stormwater management control targets for consideration by the Town and the governing Conservation Authority prior to proceeding to detailed design; and

The assessment and recommendations can be included in the project SWM Report or be submitted as a separate document.

The implementation of any design that employs the use of Low Impact Development practices will be subject to Town and Conservation Authority Approval.

4.3 NUTRIENT MANAGEMENT STRATEGY AND WATER BALANCE

The Town, as an environmental leader, supports the reduction of phosphorous contributions from Greenfield development into the streams and lakes of the watershed within the Town. To achieve this goal, the Town encourages that effective measures be taken to mitigate and reduce phosphorous contributions from new developments wherever possible.

The Town also recognizes that reduced groundwater recharge because of new development can impact stream baseflows needed to sustain aquatic life and result in increased stream erosion.

As such, the Town will require that stormwater management design for new developments incorporate the most recent advances in phosphorus reduction and water balance technologies or strategies within the development proposal as per the most recent guidelines and standards as set out by the MECP and relevant Conservation Authority.

4.4 RAINFALL DATA

Stormwater management facilities should be designed based on the IDF tables developed by Environment Canada for Barrie WPCC based on rain gauge data for the period 1979 - 2003 including a 15% increase in rainfall intensity data to account for climate change. The adjusted Chicago distribution parameters for different return periods are provided below.

Barrie WPCC IDF Curve Parameters –Adjusted for Climate Change

Parameter	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
A	678.085	853.608	975.865	1146.275	1236.152	1426.408
B	4.699	4.699	4.699	4.922	4.699	5.273
C	0.781	0.766	0.760	0.757	0.751	0.759

Rainfall Intensity, I (mm/hr) = $A/(t+B)^C$, where t is time duration in minutes

Parameters based on rain gauge data for the period 1979 – 2003 for the Barrie WPCC Station #6110557

Based on a review of the literature, the IDF intensity values for Barrie WPCC Station were increased by 15% before calculating a, b, c values to account for climate change.

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Barrie WPC 2003 Rainfall Intensity (mm/hr) + 15 % to Account for Climate Change

Return Period	Duration (min)								
	5	10	15	30	60	120	360	720	1440
2 years	115.5	81.5	67.4	43.1	25.3	15.5	7	3.9	2.3
5 years	150	107.9	89.9	56.2	32.8	21.9	9.9	5.4	3.2
10 years	173	125.5	104.9	65.1	37.6	26.1	11.8	6.3	3.8
25 years	201.8	147.4	123.7	76	43.8	31.4	14.3	7.6	4.5
50 years	223.3	163.9	137.7	84.3	48.4	35.4	16	8.5	5.1
100 years	244.7	180.1	151.6	92.3	53	39.3	17.7	9.4	5.5

Barrie WPC 2003 Rainfall Depth (mm) + 15 % to Account for Climate Change

Return Period	Duration (min)								
	5	10	15	30	60	120	360	720	1440
2 years	9.7	13.6	16.8	21.5	25.3	31.1	42.3	46.7	55
5 years	12.5	17.9	22.4	28.2	32.8	43.8	59.5	64.3	76
10 years	14.4	20.9	26.2	32.5	37.6	52.2	70.8	76	89.9
25 years	16.8	24.6	30.9	38.1	43.8	62.9	85.2	90.7	107.5
50 years	18.6	27.3	34.4	42.1	48.4	70.7	95.9	101.7	120.6
100 years	20.4	30	37.8	46.2	53	78.5	106.5	112.5	133.6

4.5 STORMWATER MANAGEMENT SYSTEM - MINOR

Generally, storm drainage shall be accommodated by a system of curb and gutters as well as storm sewers, with the exception of rural roadways or estate residential subdivisions, where an open ditch system may be permitted if minimum design criteria can be realized.

Underground storm sewers within the public rights-of way are to be designed to convey a minimum of the 1:5-year storm without surcharge. However, when the major storm drainage system is inadequate, the Town may consider the approval of an underground storm sewer system designed to carry additional flows.

Underground storm sewers within site plans and private developments are to be designed to capture and convey a minimum of 1:100-year storm to the onsite storage facility.

4.5.1 Service Area

The system shall be designed to accommodate all on-site drainage areas as well as all external tributary areas to their maximum future development capacity in accordance with the Town's Official Plan.

4.5.2 Design Flows

The design flows used to size the storm sewer system or small developments (drainage area ≤ 50 ha) are to be calculated using the Rational Method, as follows:

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$$Q = \frac{(c)(i)(A)}{360}$$

where:	Q	=	design flow (m ³ /s)
	c	=	runoff coefficient (dimensionless)
	i	=	average rainfall intensity (mm/hr)
	A	=	drainage area (ha)

The average rainfall intensity is to be derived from the IDF curve from the Atmospheric Environment Service Branch of Environment Canada for the Barrie WPCC station 2003, adjusted for climate change, as follows:

$$I \text{ (mm/hr)} = A/(t+B)^C$$

where:	i	=	average rainfall intensity (mm/hr)
	A	=	coefficient for the 5-year return period
	t	=	time (minutes)
	B	=	exponent for the 5-year return period
	C	=	exponent for the 5-year return period

The time of concentration is to be calculated as the sum of the initial inlet and the travel time in the pipe, where the initial inlet time is to be ten (10) minutes for the five (5) year storm.

This shall apply where the upstream drainage area does not include large open space areas. Where peak flows from external areas enter a subdivision sewer system, the more critical case based on either the time of concentration including the external area or the time of concentration excluding the external area shall be used. Actual velocities of computed peak flows shall be used to estimate time of concentration.

A design evaluation of inlet times must be submitted to justify inlet times different from those specified above.

Runoff coefficients are given by components of surface treatment and by land use. The land use values are intended as a guide only and the designer is expected to develop an appropriate coefficient using an arithmetic composite calculation as shown below:

$$C = \frac{(A_1C_1) + (A_2C_2) + \dots}{A_t}$$

where:	C	=	composite runoff coefficient (dimensionless)
	A _{1,2...}	=	area corresponding to specific land use or soils type (ha)
	C _{1,2...}	=	runoff coefficient corresponding to A _{1,2...} (dimensionless)
	A _t	=	total drainage area (ha)

Source: adapted from the Ministry of Transportation Drainage Management Manual, 1997, Equation 8.10.

The higher of the arithmetic composite runoff coefficient or the minimum required runoff coefficient by land use, provided in the following table, shall be used to compute design flows.

TABLE 6 - Runoff Coefficients (Rational C) (5-yr to 10-yr) Based on Hydrologic Soil Group

Runoff Coefficient "C"			
Land Use	A-AB	B-BC	C-D
Cultivated Land, 0 - 5% grade	0.22	0.35	0.55
Cultivated Land, 5 - 10% grade	0.30	0.45	0.60
Cultivated Land, 10 - 30% grade	0.4	0.65	0.70
Pasture Land, 0 - 5% grade	0.1	0.28	0.40
Pasture Land, 5 - 10% grade	.015	0.35	0.45
Pasture Land, 10 - 30% grade	0.22	0.40	0.55
Woodlot or Cutover, 0 – 5% grade	0.08	0.25	0.35
Woodlot or Cutover, 5 - 10% grade	0.12	0.30	0.42
Woodlot or Cutover, 10 - 30% grade	0.18	0.35	0.52
Lakes and Wetlands	0.05	0.05	0.05
Impervious Area (i.e., buildings, roads, parking lots, etc.)	0.95	0.95	0.95
Gravel	0.40	0.50	0.60
Unimproved Areas	0.10	0.20	0.30
Lawn, < 2% grade	0.05	0.11	0.17
Lawn, 2 - 7% grade	0.10	0.16	0.22
Lawn, > 7% grade	0.15	0.25	0.35
Land Use	Recommended Minimum Coefficient		
Parks	Calculated		
Single Family Residential	Calculated		
Semi-Detached Residential	Calculated		
Townhouses, Maisonettes, Row Houses, Apartments, etc.	Calculated		
Institutional	Calculated		
Industrial and Central Business District	Calculated		
Commercial	Calculated		

Run-off Coefficients shall be determined from the types of land uses within the drainage area.

The run-off coefficient values provided above are recommended minimum values; however, the Developer's Engineer should determine the appropriate coefficient of imperviousness based on the actual uses. The maximum size of proposed units shall be considered when calculating the total imperviousness of the development.

Adapted from Design Chart 1.07, Ontario Ministry of Transportation, "MTO Drainage Management Manual," MTO. (1997)

Note: Gravel parking or storage areas for new development should be considered as paved areas as they may be paved in the future

Runoff coefficients (Rational C) for development such as single family, semi-detached, Duplex, Town housing, Commercial, Industrial, Institutional, Schools, Churches, and Park etc.

shall be calculated using a weighted average of the runoff coefficients for the relative areas using the coefficients outlined in the table.

On a project specific basis, a detailed calculation of the run-off coefficient may be requested by the Town.

For estimating flows from storms larger than the 5-year event, the runoff coefficients should be increased to account for the increase in runoff due to saturation of the soil.

The runoff coefficient shall be adjusted for return period events greater than the 10-yr storm as follows:

Runoff Coefficient Adjustment for 25-yr to 100-yr Storms

Return Period	Runoff Coefficient "C"
25 years	$C_{25} = 1.1 * C_5$
50 years	$C_{50} = 1.2 * C_5$
100 years	$C_{100} = 1.25 * C_5$

Adapted from Design Chart 1.07, Ontario Ministry of Transportation, "MTO Drainage Management Manual," MTO. (1997).

Note: When applying the runoff coefficient adjustment, the maximum c-value should not exceed 1.0.

Barrie WPCC IDF curves as outlined above

$$I \text{ (mm/hr)} = \frac{A}{(t+B)^C}$$

where:	i	=	average rainfall intensity (mm/hr)
	a	=	coefficient from IDF tables
	t	=	time (minutes)
	B	=	exponent from the IDF tables
	C	=	exponent from the IDF tables

4.5.3 Pipe Capacity

Manning's Formula is to be used in calculating the full flow capacity of the storm sewer.

The roughness coefficients to be used in the calculation are as follows:

Concrete pipe, $n = 0.013$

PVC and Smooth walled PE pipe, $n = 0.013$

Corrugated pipe (for culvert use only), $n = 0.024$

Storm sewers are to be designed such that individual pipes only reach a maximum of 80% of their total capacity. On an individual as-needed basis, the Town will review designs where pipes reach a greater percentage of their total capacity.

Storm sewer design sheets are to be provided and included on the drainage area plans. The design sheets shall demonstrate that the proposed pipe capacity and velocities are in

accordance with the Town's standards. All design sheets submitted for approval shall be sealed, signed, and dated by a professional engineer licensed to practice in the province of Ontario.

4.5.4 Velocities

The minimum allowable actual velocity in a storm sewer shall be as follows:

- a) The minimum flow velocity in the storm sewer shall be 0.75 m/s.
- b) Velocities in storm sewers shall not exceed 6 m/s.
- c) Additional protection against erosion, scouring, and pipe displacement must be provided by a Licensed Engineering Practitioner where flow velocities exceed 4.5 m/s.
- d) In certain circumstances, such as rehabilitation/replacement of an existing Sewer where deepening of the individual Sewer section will not be possible, design flow velocities of less than 0.75 m/s may be considered, provided that appropriate measures are taken to facilitate frequent flushing and maintenance needs and the Town accepts the increased maintenance requirements.

4.5.5 Minimum and Maximum Pipe Slopes

The minimum pipe slope shall be that which is required to meet the minimum velocity, but shall not be less than 0.3%.

The maximum pipe slope shall be that which is required to meet the required capacity and maximum velocity.

4.5.6 Minimum Pipe Sizes

The minimum pipe size is 300 mm for mainline storm sewers. Pipe sizes 450mm and larger shall be drawn to the outside diameter on the engineering drawings to confirm there are no conflicts with adjacent infrastructure. The minimum clearances as stated in Appendix C shall be provided.

4.5.7 Pipe Material & Pipe Class

For storm sewer pipe diameters up to and including 450 mm, PVC may be used, while reinforced concrete pipe is required for diameters greater than 450 mm. The bedding design must be compatible with the selected pipe type. Refer to Appendix B for the approved list of materials for storm sewers.

The pipe class shall be selected based on the bedding type, final burial depth, and anticipated surface loads. Label the pipe class for the sewers on the engineering drawings.

4.5.8 Minimum Depth of Cover

The minimum depth of cover to be provided shall be the greater of:

- a) 1.5 m below the centreline of road or finished ground surface elevation to the spring line of the sewer; or
- b) 1.2 m to the obvert of the sewer, provided that there are no conflicts with utility crossings; or
- c) That which is required to provide gravity foundation drain connections.

Where sufficient cover does not exist, the Town may consider shallower insulated sewers on an individual basis.

The maximum height of fill is not to exceed applicable OPSD (805.010 through 807.050) unless pipe strength design calculations are provided for approval by the Town.

4.5.9 Bedding and Backfill

All storm sewers are to be installed with bedding (well graded OPSS Granular 'A' or as recommended and approved by the Geotechnical Engineer and the Town) and backfill in accordance with OPSD 802.010 or 802.030 to 802.032 as applicable. Compaction is to be a minimum of 95% SPD or as indicated in the approved Geotechnical Report.

In soft or wet conditions, additional Geotechnical investigation may be necessary to determine the appropriate bedding and backfill measures.

4.5.10 Pipe Clearances

Minimum horizontal clearance between the outside wall of the adjacent sewer pipes (sanitary, or second storm) shall be 800mm. A minimum clearance of 500mm between the obvert of the sanitary sewer and invert of the storm sewer shall be provided if the sanitary connections are required to go under the storm sewer. Other minimum clearances shall be provided in accordance with MECP guidelines.

4.5.11 Sewer Layout

Storm sewers shall generally be located as per the typical road cross-sections.

Where storm sewers are located in easements, the easement width shall be a minimum of 9.0 m. However, the Town will review alternative easement widths on an individual basis in certain circumstances such as the utilization of a joint trench or installation of a sewer at a depth which is substantially greater than standard.

Where there is a rear yard catchbasin there is to be a 1.8 m easement on the lot with the rear catchbasin storm pipe and a 1.2 m easement on the adjacent, non-piped side of the property line.

4.5.12 Maintenance Holes

Maintenance holes shall be as per OPSD 701 and shall be placed at the beginning and end of each sewer line, at changes in pipe size and/or material, and at changes in grade and/or alignment. Curved (radius pipe) or properly deflected sewer lines may be permitted but written approval from the Town is required.

All maintenance holes shall be drawn to the outside diameter on the engineering drawings to confirm there are no conflicts with adjacent infrastructure. The minimum clearances as stated in Appendix C shall be provided.

During design phase, at the Town's discretion, maintenance hole waterproofing may be required.

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All maintenance holes sized up to and including 1200 mm diameter are to be pre-benched to spring-line by the supplier. All maintenance holes larger than 1200 mm diameter are to be benched to spring-line on-site after installation.

The maximum spacing between maintenance holes shall generally be according to the following:

Diameter	Maximum Spacing between Maintenance Holes
300 to 750 mm	120 m
825 to 1200 mm	150 m
1350 to 1800 mm	200 m
> 1800 mm	250m

Note: The pipe sizes listed in the table refer to circular pipes and are applicable to elliptical or box sections equivalent circular pipe diameters.

The maximum change in direction for pipes 825 mm and smaller is 90°. The maximum change in direction for pipes 900 mm diameter and larger is 45°.

A sufficient drop shall be provided across each maintenance hole to offset any hydraulic losses. The minimum drops across a maintenance hole shall be as follows:

Change in Direction	Minimum Drop
Straight run (0°)	0.03 m
1 - 45°	0.05 m
> 45°	0.08 m

All maintenance holes within an asphalt roadway shall include a self-adjustable autostable frame. Structures outside roadways or existing frame and grates in base asphalt which require adjustment for top lift asphalt may use lift rings (when approved by the Town). Otherwise, when adjusting the top elevation of maintenance holes, a minimum of one to a maximum of three adjustment units (Moduloc) shall be installed on the top of the structure. The maximum vertical adjustment of maintenance holes via Moduloc shall not exceed 300 mm. Any adjustment exceeding this amount shall consist of precast concrete riser sections.

Drop structures shall be provided when the difference in the inlet and outlet inverts is equal to or greater than 0.6m that cannot be eliminated by changing sewer grades. Drop structures shall be in accordance with OPSD 1003.010, OPSD 1003.020, OPSD 1003.030, OPSD 1003.031, OPSD 1003.032, and OPSD 1003.033.

Safety platforms shall be installed in accordance with OPSD 404.020 for all maintenance hole depths of 5.0 m or greater.

Obverts of inlet pipes shall not be lower than obverts of outlet pipes. Springline connection principle for the inlet and outlet pipes requires a written approval from the Town.

Where maintenance holes are located in areas to be flooded by the major storm design and surcharged sewer design is not used, maintenance hole covers shall be of the sealed variety.

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Where maintenance holes are located where the surcharged sewer design hydraulic grade line is higher than the rim elevation, maintenance hole covers shall be of the bolted variety. In all other areas, standard maintenance hole covers shall be used.

Except for special cases, the downstream pipe diameter shall always be greater than or equal to the upstream pipe diameter.

4.5.13 Catchbasins

Catchbasins shall be located upstream of pedestrian crossings and not within 1.0 m of any curb depressions. Preferably, catchbasins will be installed on projections of lot lines. Double catchbasins shall be located where flows are being received from more than one direction, such as at low points.

The maximum allowable spacing shall be in accordance with the following:

Pavement Width (m)	Maximum Spacing (m)	
	Slope \leq 4.5%	Slope $>$ 4.5%
8.5	90	60
12.0	70	50
14.0	60	40

Catchbasin capacities shall be determined in conjunction with the overall stormwater management system. On roadways, catchbasins shall have a minimum capacity to pass the runoff from the 5-year return frequency storm. Where the pipe system is required to convey flows in excess of the 5-year return frequency storm, sufficient catchbasin capacity shall be provided to permit the design flows to enter the sewer system. Inlet control devices may be used where the hydraulic grade line needs to be strictly controlled to prevent surcharging of the sewer line and to allow storm sewer house connections.

Catchbasins located within site plans and private developments shall be designed to capture and convey the 1:100 year storms. Inlet capacity calculations for a 100-year return frequency storm are to be provided. Inlet capacity calculations for catch basins shall assume a 50% reduction due to potential blockage.

Where catchbasins are used as inlet controls, spacing shall be determined by design and must be approved by the Town.

When adjusting the top elevation of catchbasins, a minimum of one to a maximum of three (3) adjustment units shall be installed on the top of the structure. The maximum vertical adjustment shall not exceed 300 mm. Any adjustment exceeding this amount shall consist of precast concrete riser sections.

Leads shall be minimum 250 mm at 0.7% (1.0% is required to convey 60L/s that single CB can capture) grade for single catchbasins and 300 mm at 0.7% (1.5% is required for flows captured by double, or increase pipe to 375 mm) grade for double catchbasins.

Leads shall connect to maintenance holes and shall have a minimum depth of cover of 1.2 m to the obvert.

All catchbasins shown on the engineering drawings shall indicate the OPSD standard, top of grate elevation, and invert.

4.5.14 Groundwater & Foundation Drainage System

In order to minimize the flow rate from foundation drains, a minimum distance of 0.5 m shall be provided between the underside of the basement floor slab and the measured seasonal high groundwater table. Subdivision applications shall clearly include this difference of elevation at the time of the "Draft Plan Application" and shall be updated during the detailed design process. For subdivisions, fluctuating groundwater elevations shall be monitored for a period of not less than two (2) years prior to detailed design submission. Monitoring should continue through the design and construction phases. 12 months of continuous groundwater monitoring shall be conducted immediately prior to the date of the first detailed design submission.

For site plans, continuous monthly monitoring shall be conducted for a period of not less than one (1) year prior to detailed design submission.

The seasonal high groundwater elevations shall be indicated on the grading plan at the centroid of each building envelope/units along with the elevation of the bottom of the basement slab. The grading plan shall also provide the seasonally high groundwater contours for reference. The lots with basements shall be indicated on the plan.

Other methods of controlling foundation drain flow rate will be considered in consultation with Town staff.

A foundation drainage system is to be provided for each residential lot. The designer has three options to choose from:

1. A sump pump discharging to an underground storm sewer service connection as per TOISD 607
2. A gravity connection to the storm sewer, provided the 100-year hydraulic gradeline is minimum of 0.5 m below the finished basement floor elevation of the dwelling.
3. A sump pump or gravity connection to a third pipe (foundation drain) collection system that is separate from the storm sewer system, which discharges to a sufficient outlet, as per Section 4.5.3 or another approved location such as a valley or hillside.

4.5.15 Storm Service Connections

Single connections for residential lots shall be constructed in accordance with TOISD division 600 for each type of residential lot. Connections for commercial, institutional or multiple use will be considered on an individual basis.

The minimum depth of cover is 1.5 m and the minimum slope is 2.0%. Utility duct trench depths and other crossings must be considered in setting the depth of service connections.

Where a sump pump discharges to a storm service connection, a 25 mm air gap shall be provided at the building such that there is no direct connection between the building sump pump outlet and the storm service.

Where it can be shown to the satisfaction of the Town that groundwater conditions at footing level are unlikely to require more than two (2) sump basins and pumps for an entire townhouse block, storm service connections to the internal units in a townhouse block may be eliminated. However, storm service connections must be installed to the end units.

Single residential storm connections shall be 150 mm diameter with a 150 mm x 100 mm test fitting plugged and braced at the property line. Refer to TOISD 605.

Double "Y" residential storm connections shall have a 150 mm x 100mm x 100 mm boot jack fitting with a 100 mm diameter test fitting to each individual connection plugged and braced at the property line. Refer to TOISD 606.

For new developments, the service shall be extended 3.0 m beyond property line, with an additional test fitting, plug, brace, and marker.

Roof leaders shall not be connected to the storm sewer system. Roof leaders are to be discharged to the ground surface onto splash blocks or extended by a minimum of 450mm outwards, and flows shall be directed away from the building in such a way as to prevent ponding or seepage into the foundation weeping tile.

Where flat roofs are used, as in commercial or industrial sites, detention roof hoppers requiring smaller or fewer roof leaders may be used as part of the stormwater management design. No connections are to be installed directly to storm sewers.

4.5.16 Testing

The following testing requirements apply to all new storm sewers. Any sections of sewer or service connections which fail to meet the requirements shall be repaired or replaced at the direction of the Town.

An Inspection and Testing Plan shall be prepared and submitted to the Town at least two (2) weeks prior to the inspection or testing. The plan shall follow the requirements outlined in the most recent revision of the MECP Design Criteria for Sanitary Sewers, Storm Sewers and Forcemains for Alterations Authorized under an Environmental Compliance Approval.

4.5.15.1 Deflection Testing

All newly installed PVC and Polyethylene storm sewers shall be subjected to deflection testing in accordance with OPSS 410.

Deflection testing is not required for concrete storm sewers.

4.5.15.2 Infiltration/Exfiltration Testing

Infiltration/exfiltration testing of the storm sewer is not required.

4.5.15.3 CCTV Inspection

All newly installed storm sewers shall be subjected to a CCTV Inspection. Refer to Appendix D for the Town's CCTV Inspection Requirements.

4.5.15.4 Visual Inspection

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All maintenance holes shall be visually inspected by the Town for deficiencies. When requested by the Town, maintenance hole scans shall be provided by a qualified third-party sewer inspection firm. Scans must be completed using 100% digital panoramic scanning equipment. The digital files provided must include a distortion-free virtual pan and tilt to view the MH from any angle and at any depth. The Town must be able to view all pan, tilt, and unfolded views. If specific software is required it must be provided to the Town with the digital files.

4.5.17 Materials

Refer to Appendix B for a list of materials and specifications.

4.6 STORMWATER MANAGEMENT SYSTEM – MAJOR

Runoff rates in excess of the design capacity of the minor system shall be conveyed via roadways, swales, walkways, drainage easements, and in special circumstances the storm sewer system, to a sufficient outlet, reference 4.6.3. The combination of the overland flow system and the minor system shall be designed to prevent flooding of private property with maximum level of road flooding and surface detention as defined in the table below. These flows shall be conveyed within the public rights-of-way.

In the event of a blockage of the SWM system, A minimum of 0.15m shall be provided between the major flow spill elevations and the proposed units/building.

It shall also be demonstrated that overland flow conditions resulting from the 100-year/Hazel storm will not cause unacceptable flooding damage to private property with a maximum level of road flooding and surface detention as outlined in the table below.

TABLE 7 – Ponding: Maximum Allowable Flow Depths

LOCATION	STORM RETURN FREQUENCY (YEARS)		
	5	25	100/Hazel
Walkways	minor surface	as required	as required
Open Spaces	flow up to 25 mm on walkways	for overland flow outlets	for overland flow outlets
Local Roads (2 Lane)	No ponding	0.05m above crown	0.15m above crown
Collector (4 lane+), Local and Industrial Roads (extra wide lanes)	1.0 m wide in gutter or 0.10m deep at low point catchbasins	up to crown “contradictions” - discuss	0.10m above crown maximum depth of flooding of 0.3 m

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LOCATION	STORM RETURN FREQUENCY (YEARS)		
	5	25	100/Hazel
Arterial Roads (4 lane+)	1.0m wide in gutter or 0.1 m deep at low point catchbasins	1 lane clear	up to crown maximum depth of flooding of 0.30m Typically, 1 lane clear is required for 100yr
Private Property (House, Townhouse, etc.)	minor ponding in swales	no structural damage, ponding in yard areas below building openings - no basement flooding	up to 0.15m unless otherwise directed by the Town no structural damage from overland flow
Public Property	minor ponding in swales or ditches	no structural damage, ponding in flat areas, no erosion	no structural damage, ponding in flat areas, some erosion
Site Plan			up to 0.30m, maximum ponding depth of 0.20m preferred. (See Section 4.10.4)

In new subdivisions the limit of overland flow route floodlines for the 100 year/Hazel storm event shall not extend onto private property unless protected by a drainage easement. Development of the site must not increase flood levels upstream or downstream of the development.

For all classes of road, the product of depth of flow at the gutter (m) times the flow velocity (m/sec) shall not exceed 0.65 m²/sec.

Street grading must provide a continuous gradient to direct street flows to a safe outlet at low points. Outlets can be walkways or open sections of roadways leading to parks, open spaces or river valleys.

Pre-development peak flows shall be computed by an approved hydrologic model. Watershed definition and pre-development flows must be approved by the Town.

Preliminary estimates of post-development flow rates may be computed using the Rational Method.

For all systems and for the design of surcharged sewers and detention facilities, the latest version of the computer model OTTHYMO is recommended. Other hydrograph methods may be considered if it is demonstrated that the results are comparable to those from OTTHYMO. Post-development design flows may be determined using the Rational Method only where the design area is less than 40.0 ha and runoff control facilities are not considered.

4.6.1 Open Ditches

In rural areas, industrial areas, or estate residential subdivisions, open ditches may be permitted by the Town. Ditches shall be constructed a maximum of 0.5 m and a minimum of

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0.15 m below the sub-grade of the roadway. Where this cannot be achieved, a sub-drain may be provided under the invert of the ditch and day-lighted once the minimum depth can be attained.

The minimum ditch grade shall be 0.5% and the maximum 5%. In exceptional cases and where ditches are on easements off the Road Allowance, ditches with grades greater than 5% may be allowed by the Town, but these shall be suitably protected against erosion to the satisfaction of the Town. Where ditch grades exceed 5%, the Town may require that an urban cross-section be applied for that road segment.

The minimum ditch protection on all ditches shall be 300 mm of topsoil and staked sod on the side slopes and bottom of the ditch regardless of the ditch gradient.

4.6.2 Open Channels

Open channels are to be utilized in the following circumstances:

- a) For the Regional Storm where the upstream watershed area exceeds 1 square kilometre (100 ha);
- b) For a minimum 25-year return frequency storm with protection from erosion damage for larger storms if required by the Town;
- c) To maintain the natural storage characteristics of the watercourse;
- d) To maintain a natural appearance as far as possible; and
- e) To meet specific requirements of the Conservation Authority in each case.

4.6.3 Sufficient Outlet

All developments must demonstrate that the stormwater generated onsite is directed to a sufficient outlet.

A sufficient outlet typically constitutes a lake or permanently flowing watercourse. Sufficient outlet may also include public right-of-ways provided that written permission is obtained from the Town. In the case where the discharge is directed over private land, the developer must obtain a legal right of discharge registered on title for both properties. Copies of all written documentation such as a legal right of discharge registered on title and/or written permissions from the Town must accompany the design submission.

The designer shall provide calculations for the conveyance capacity of the downstream conveyance routes to demonstrate that upstream, downstream and adjacent landowners do not incur adverse impacts, including increased runoff volumes, and that the flow is conveyed in a safe manner.

4.7 STORMWATER MANAGEMENT FACILITIES

All stormwater management facilities are to be designed to ensure that post-development peak flows do not exceed pre-development levels for storm events up to and including the 1:100 year event applying the 4 hour Chicago storm and the 12 hour and 24 hour SCS Type 2 Storm. Where downstream flow constraints or flooding risks exist, additional quantity controls may be required at the discretion of the Town. Further, in accordance with the Lake Simcoe Protection Plan and Ontario Regulation 219/09, all new stormwater management facilities are required to provide an Enhanced level of water quality protection.

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The Town does not support the use of the Modified Curve Number method CN*. Curve numbers should be derived as outlined in the US Soil Conservation Service (1972) SCS curve number method. The Initial abstraction should be set as follows.

Initial abstraction/depression storage

Cover	Depth (mm)
Woods	10
Pasture/Meadow	8
Cultivated	7
Lawns	5
Wetland	12/16
Impervious areas	2

Ref: UNESCO, Manual on Drainage in Urbanized Areas, 1987.

Notes: The representative area method should be used to calculate the IA value for catchment areas.

The Town supports the design of stormwater management facilities using hydrologic computer programs including VISUAL OTTHYMO and SWMHYMO. Due to various industry standard software programs prior to submission the Town is to be contacted to confirm the current software packages which will be accepted in modeling submissions. If the submission does not use software that the Town has, the proponent could be directed to resubmit their analysis using the software in use at the Town.

All stormwater management facilities are to be designed in accordance with the preferred criteria listed in the most current MECP "Stormwater Management Planning and Design Manual" and the relevant requirements of the Nottawasaga Valley Conservation Authority (NVCA) and the Lake Simcoe Region Conservation Authority (LSRCA). The information provided below is intended to supplement the aforementioned manuals and requirements.

4.7.1 Stormwater Design Guidelines for Proposed Upstream Developments From Existing SWM Facilities

Where proposed development discharges into existing development and there is a downstream SWM facility designed to treat the existing and proposed development, the proposed development shall meet current engineering guidelines at the time of first detailed design submission for each phase and the following targets:

- a. All storms up to the 5-year storm event (4-hour Chicago, 12 & 24-hour SCS Type II) must be controlled to the outlet storm sewer capacity as previously designed and approved by the Town.
- b. All storms up to the 100-year storm event (4-hour Chicago and 12, 24-hour SCS Type II) must be controlled to the capacity of the major flow system as specified in the current engineering guidelines at the time of first detailed design submission of the current phase, using current IDF curves for the entire watershed.

4.7.2 Stormwater Quantity and Quality Controls

Current stormwater management practice advocates the consideration of Stormwater Management Practices (SWMP's) on a hierarchical basis, whereby more pro-active techniques are considered first. The SWMP's are grouped under the following headings in order of preferred application:

1. Lot Level Techniques and Source Controls
2. Transport or Conveyance Controls
3. End-of-Pipe Controls

The philosophy behind this hierarchy is that stormwater management techniques are usually more effective when applied at the source. Development can result in negative impacts to the hydrologic cycle elements of evaporation, infiltration, soil storage, and runoff as well as runoff water quality and erosion of local water courses and water bodies. Low Impact Development (LID) measures and Storm Water Management (SWM) measures can help reduce the impacts of development by increasing infiltration, evaporation, soil storage, water reuse, and reducing runoff, detrimental water quality impacts, and downstream erosion.

In Ontario, the Low Impact Development Stormwater Management Planning and Design Guide (Version 1, CVC/TRCA, 2010) is a comprehensive guideline that provides guidance on planning, site selection, design, construction, and operations and maintenance of LIDs. This guidance document, commonly referred to as the "LID Guide", must be used to select, design, and maintain LID practices

The Town of Innisfil supports the progressive implementation of a wide range of stormwater management techniques. This range is expected to increase and change over time, as long-term monitoring results indicating the level of success of various techniques become available. The Town also supports the integration of stormwater management facilities with passive recreational opportunities, where the intended function of either is not impaired.

LID functions may vary in time due to sedimental loading and shall not be used for quantity control or end-of-pipe quality control. LIDs may be used as part of a treatment train approach in addition to a quality control facilities

LID measures implemented within private lots will be the homeowner's responsibility to maintain. The Town will not assume ownership or maintenance of these proposed measures. The Town will assess the feasibility of LID measures on private lots on a case-by-case basis.

LID measures may be implemented within the ROW adjacent to private lots. The Town does not endorse LIDs being placed directly in front of private lots and in between driveways, as this presents operational and maintenance challenges.

The following table provides the current perspective of the Town of Innisfil regarding available stormwater management practices, as well as special supporting documentation which is required for implementation of each technique.

Proponents must contact the Town prior to submitting formal applications to discuss specific LID and SWM objectives for each project. In the absence of specific design criteria, proponents must utilize the following criteria for development projects:

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Stormwater Management Technique	Town of Innisfil Perspective	Supporting Documentation
Lot Level Techniques and Source Controls		
Green roofs	On a case-by-case basis	Requires Town acceptance
Bioretention	Encouraged for clean source areas	Requires Town acceptance on municipal lands
Roof leader discharge to surface	Encouraged	Uses an elbow which either directs towards a splash pad or utilizes a 450mm extension outwards from the structure
Soakaway, infiltration trench	Encouraged	On site 5 m from buildings, clean or pre-treated runoff
Rear lawn ponding	Discouraged in residential land use due to maintenance and impacts on use of rear yards, including West Nile Virus	But occurring in Dry Ponds and Wetlands and to some extent in Wet Ponds – same problem will occur with West Nile Virus.
Roof top storage	On a case-by-case basis	Requires Town acceptance
Parking lot storage	On a case-by-case basis	Requires Town acceptance
Permeable pavement	Encouraged	On private property
Rainwater harvesting	Encouraged	On private property
Vegetated filter strips	Encouraged	On private property
Enhanced grass swales	Encouraged	On private property or Requires Town acceptance
Dry swales	Encouraged	On private property or Requires Town acceptance
Conveyance Controls		
Perforated pipe systems under asphalt	Not currently endorsed on public lands	
Perforated pipe systems under boulevard	Encouraged	Requires Town acceptance
Pervious catchbasins	Not currently endorsed	
Grassed swales	Encouraged	On private property or Requires Town acceptance
Oversized pipes	Encouraged	On private property or Requires Town acceptance
End of Pipe Controls		
Wet ponds	Encouraged	SWM Report
Wetland ponds	Encouraged	SWM Report
Hybrid ponds	Encouraged	SWM Report
Dry ponds	Hybrid ponds	Drainage areas <5 ha or infiltration > 25mm
Oil/grit separators	Encouraged	Drainage areas <5 ha
Infiltration basin	On a case-by-case basis	Requires Town acceptance

Note: Several criteria are inter-related, for example retaining the first 5 mm of precipitation on-site not only produces water balance benefits, it also provides runoff water quantity reduction, water quality improvements, and downstream erosion benefits.

Application of in-ground LID measures has to be evaluated taking into consideration the groundwater levels observed in the project area.

4.7.3 Emergency Spillway

All stormwater management facilities shall be designed with an emergency spillway to allow drainage to safely exit the facility should the outfall structure fail to function, or should the storm event have a frequency lower than the 100-year storm. The emergency spillway shall be designed to convey the Regional Storm event post development routed peak flow with the invert of the spillway set, as a minimum, at the 100-year controlled water level (or Regional controlled water level for ponds where Regional control may be required). A freeboard of 0.30 meters shall be provided above the maximum routed Regional Storm water level to the top of the pond berm.

The emergency spillway shall incorporate erosion protection measures that are adequately designed to withstand the erosive velocity associated with the uncontrolled governing flow. The erosion protection shall be integrated with a natural vegetated surface treatment that is aesthetically pleasing.

Spillway side slopes shall not be steeper than 3:1 and shall be no steeper than 10% when incorporated into the access road. The spillway shall not be located directly above the outlet control structure and a minimum horizontal clearance of 3.0 m shall be provided.

4.7.4 Grading (Side Slopes)

Grading within stormwater management facilities shall be designed with the minimum slope requirements for the various components of the facility are as follows:

- Stormwater management facilities shall be designed with 4:1 above and below the safety shelf
- A safety shelf shall be provided with a slope of 7:1 extending 3m horizontally above and below the normal water level
- There must be a 3.0m flat buffer (2% to 5%) between the top bank of the facility and any existing or proposed private property where there is no maintenance road.
- 4:1 where the slope backs on to the rear yard lot line or an adjacent valley system
- 4:1 where the pond is adjacent to a municipal boundary
- 5:1 where the slope backs on to an adjacent road system
- 5:1 where the pond is being used as part of a trail system or passive recreation area

Retaining walls will not be permitted in the design of stormwater management facilities

4.7.5 Major System Overland Flow Routes

The major system overland flow route to the SWM facilities shall be designed to safely convey the Regulatory (i.e. the larger of the 100-yr storm and Hurricane Hazel or Timmins Storm) overland flow. Should the overland flow route to the SWM facility consist of the access road and path, then the flow depth shall not exceed 300 mm or a velocity of 0.65 m/s. Where feasible, the overland flow should not be directed into the forebay to avoid the re-suspension of settled sediments.

For subdivision walkways, the maximum drainage area shall be 2.0 ha.

4.7.6 Anti-seepage Collars

Anti-seepage collars shall be installed on all outlet pipes or as directed by a geotechnical engineer.

4.7.7 Existing Groundwater Elevation

Within the stormwater block, at least one borehole shall be located near the center of the block 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. Where soil conditions are very permeable and the groundwater elevation is below the permanent pool water level, lining of the permanent pool area with an impermeable material may be required to ensure permanent pool levels are maintained. A liner may 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.

Where the groundwater elevation is above the permanent pool water elevation, an investigation shall be undertaken to assess 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 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 Town.

The forebay should always be lined where the majority of the contaminants are contained. If an impermeable liner is required, the liner is to be constructed of impermeable clay or silt as per the geotechnical engineer's recommendation. The use of a manufactured bentonite geosynthetic liner is not supported. The installation of the liner must be supervised and certified by the geotechnical engineer.

4.7.8 Fire Use

In certain locations of the Town (e.g., remote development locations where access to fire hydrants is not available), and subject to review by the Town, it may be desirable to utilize the SWM pond as a source of water for fire use by incorporating a dry hydrant design. The design must meet the requirements of the Ontario Building Code for dry hydrants which is currently in accordance with FPA 1142, Water Supplies for Suburban and Rural Fire Fighting.

4.7.9 Sediment Forebay Bottom

A berm shall be constructed with a forebay spillway invert at the NWL with appropriate erosion protection to enable, as a minimum, the flow of the water quality event (25 mm event) without overtopping any other part of the forebay into the main cell of the facility. The minimum top width of the berm shall be 1.0 m and side slopes 3:1.

A dewatering sump shall be installed in the forebay to enable the drawdown of the permanent pool for maintenance and sediment removal. Where feasible, the forebay sump shall be connected to the pond outlet structure with a control valve to drain by gravity. Where draining by gravity is not feasible, a dewatering sump shall be included and drained by pump.

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The sediment forebay bottom is to be lined with 500 mm of 25 mm crushed stone or approved alternative to assist in the maintenance operations of the facility. A Geotechnical Engineer must certify that the forebay bottom design has sufficient bearing capacity to support maintenance equipment assuming the forebay has been drained.

4.7.10 Sediment Drying Areas

Sediment drying areas are to be incorporated into the design of wet end of pipe stormwater management facilities such that water from the sediment drains back into the sediment forebay with a slope of 2% to 4%. The sediment drying area shall be designed to:

- accommodate 30% of the forebay volume
- have a maximum sediment stockpile depth of 1m
- have a maximum sediment side slopes of 10:1
- located in areas that avoid high publicity
- is accessible from the maintenance access road
- is located above the five (5) year water level
- setback a minimum of 6 m from property line

4.7.11 Inlet Structures

Inlet structures shall be installed with the invert set to the NWL or higher. Suitable erosion control and energy dissipation treatment shall be provided at all inlets to the pond. The sizing of rip rap or river stone shall be based on appropriate erosive velocity calculations. Maintenance access roads shall be provided to all inlet structures.

Headwalls, barricades and safety grating shall be installed at all inlets as per OPSD 804.040, OPSD 804.030, OPSD 980.101 and OPSD 804.050. SWM pond inlet elevations are to be designed such that the one (1) in five (5) year storm design sewer capacity as per the storm sewer design sheet is maintained and not reduced due to tail water conditions.

4.7.12 Outlet Control Structures

Outlet control structures shall be designed with flow regulating devices to control the flow and pond drawdown time. The standards for end of pipe stormwater management pond outlets are as follows:

- a) The Town is requesting one control maintenance hole with a central wall designed with an orifice and/or notches to provide flow control and located at the top of the berm outside of the emergency spillway. It can be located on the maintenance road if the road is paved and the maintenance hole fitted with autostables
- b) If feasible, the intake pipe will be sized for the 100-year flow have sufficient cover to prevent freezing. For larger catchments to reduce the intake pipe size, a grated inlet can be used preferably above the 25-year water level
- c) Where the permanent pool elevation is greater than 1 m above the obvert of the intake pipe, a reverse slope pipe shall be used. The intake pipe must be anchored and stabilized and be fitted with a grate of sufficient size that a swimmer would not be pinned against it at high flow

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- d) Where the permanent pool elevation is less than 1 m above the obvert of the intake pipe, the outlet should be designed with a heavy duty galvanized CSP riser with pre-punched perforations with 1.5 times the 100 year flow capacity, a lockable non-hinged lid and large riprap placed against the riser to provide protection and filtering of stormwater. No hickenbottom or flow controls shall be in the riser.
- e) The low flow orifice on the center wall should be designed with an adjustable knife gate valve to control the flow and pond drawdown time and be accessible for adjustment through a standard maintenance hole cover without entering the maintenance hole. This would provide the Town with the ability to:
 - i. Adjust the low flow discharge to set the draw down rate (details provided in the Operations and Maintenance Manual)
 - ii. Open the valve fully to clear any clogging in the inlet pipe
 - iii. Shut the valve to control any spills from moving downstream

The outlet should also include a maintenance pipe with shut off valve for draining the SWMF if possible

The minimum design orifice size is 75 mm with filtered stormwater, or 100 mm. Outlet structures are to be designed in a safe and aesthetically pleasing manner with the majority of the structure contained within the berm. The use of orifice plates are not accepted by the Town for site plan developments.

Suitable erosion control and energy dissipation treatment shall be provided at the pond outfall where it discharges to the receiving body. The sizing of rip-rap or river stone at the outfall shall be based on appropriate erosive velocity calculations. Maintenance access roads shall be provided to all outlet structures.

When stormwater is discharged into an existing or proposed ditch, rip-rap must be installed from the outlet to halfway up the opposite side of the ditch to prevent erosion. In cases where the pond emergency spillway discharges into the ditch, the Town may require the applicant to install rip-rap to the top of the ditch, depending on the flow rate.

The outlet structure should be designed to operate under free-flowing conditions where feasible. The return period water surface elevations of the receiving body must be determined and verified to ensure the proper operation of the outlet structure. Where it is not feasible to operate the outlet structure under free-flowing conditions, appropriate submergence calculations must be completed to ensure that the outlet structure is sized correctly.

4.7.13 Fencing and Gates

Fencing shall be installed where the stormwater management facilities abut private lots, municipal boundaries, elementary schools and active recreation areas frequented by young children unless maximum slopes of 6:1 are provided. Town may request to install fencing in other conditions on project by project basis. Where required, fencing shall be installed as per Town of Innisfil Engineering Design Standards and Specifications Manual.

All stormwater management facilities are to be designed such that perimeter fencing is not required where it is adjacent to municipal right of ways. Gates with a locking system shall be provided on all maintenance road access points

4.7.14 Signage

Town Standard Sign, TOISD 818, shall be clearly visible and erected at the stormwater management facility's maintenance access road entrances, as approved by the Town. Town Standard signs shall be supplied and installed by the developer and designed in accordance with Town standards.

Warning signs shall be clearly visible and erected at all access points (maintenance access roads or pedestrian trail access points) to the stormwater management facility. Warning signs shall be supplied and installed by the developer and designed in accordance with Town of Innisfil Standard TOISD 818.

4.7.15 Geotechnical Review

As part of final design, the geotechnical engineer should review the detailed design of the stormwater management facilities as well as the procedures outlined in the operation and maintenance manual and provide written certification confirming that they meet current geotechnical standards and are suitable from a geotechnical perspective. Drawing for the SWM facilities should include any geotechnical design parameters required such as soil and compaction specifications for berm construction, sub-base for maintenance roads and erosion protection materials. The same requirements are required for temporary erosion and sediment control facilities.

4.7.16 Aesthetics and Landscaping

The stormwater management facilities shall be constructed with acceptable building materials (e.g. no gabions) to ensure that the pond is an aesthetically pleasing component of the community. Stormwater management facilities shall be integrated with parks and trails where feasible. Access to the SWM ponds by unauthorized vehicles should be restricted by the placement of armour stone and large trees around the perimeter where there is no fencing

4.7.17 West Nile Virus

Reasonable measures should be incorporated in the design of wet ponds and wetlands to minimize the proliferation of mosquitoes and the potential spread of the West Nile virus and to reduce the need to apply larvicide. Such measures, which focus on creating habitat less suitable for mosquito breeding and survival, include the following (adapted from TRCA Innovative Stormwater Management Workshop, Culex Environmental, May 2008):

- Encourage a plant-dominated state as opposed to an algae-dominated state – A plant dominated state (i.e., lots of submerged and floating-leaved aquatic plants) provides habitat for predators whereas algae dominated state is less favourable for predators and more favourable for mosquitoes with increased availability of nutrients and turbidity as a food source and warmer water. In addition, mosquito larvae tend to avoid submerged and floating-leaved plants
- Introduce predators – Along with a plant-dominated state introduce predators that feed on mosquito eggs and larvae, such as: grazing invertebrates (e.g., snails, Mayfly larvae, Chironomids), neustonic insects (e.g., water striders, water

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boatmen, whirligig beetles), benthic invertebrates (e.g., flatworms, leeches, Asellus, shrimps), three-spined sticklebacks, fathead minnows, dragonfly nymphs, water beetles, Alderfly larvae, and frogs and toads. In addition, bird and bat houses should be erected to encourage the nesting of bats and birds such as swallows and purple martins which rely on flying insects including mosquitoes as their primary food source

- Minimum water depths – Where possible, the minimum depth of water within the permanent pool should be 1.0 m or greater

4.7.18 Thermal Impacts

When discharging stormwater to a watercourse identified as a Cold Water Fishery, mitigation measures such as shoreline planting, shading with trees, bottom draw outlet pipes from deeper pools, or cooling trenches shall be implemented in SWM facilities to minimize thermal loading to the receiving watercourse. Bottom draw quality control pipes should have an inlet invert 500 mm above the bottom of the SWM facility to prevent sediment from entering the pipe. Cooling trenches should have a minimum length of 30 m.

4.7.19 Trails

Pedestrian circulation trails shall be incorporated into SWM facilities where public safety has been fully addressed in terms of access, side slopes and fencing requirements. The feasibility of connections to adjacent neighborhood parks, recreation areas and existing trail networks is to be explored as part of the initial SWM facility submission plans to the satisfaction of the Town. Wherever possible trails shall be co-located with maintenance access roads.

4.7.20 Operations and Maintenance Manual

A stand-alone operations and maintenance manual will be required as part of the design for the SWM facilities and stormwater infrastructure. The manual shall include inspection checklists, maintenance descriptions and projected frequency, as well as recommendations for facility and infrastructure cleanup. Refer to Chapter 6 in the MECP Stormwater Management Planning and Design Manual for further details and requirements.

4.8 FACILITIES PLANTING GUIDELINES

The following section outlines the specific design criteria and planting requirements which are to be followed within stormwater management (SWM) facilities and/or wetlands within the Town of Innisfil. These criteria are in addition to the minimum standards outlined within the MOE's Stormwater Management, Planning and Design Manual and planting standards for both the LSRCA and the NVCA.

Landscaped areas shall consist of native species only as per the *Native Plant Species in Ontario* (Riley, 1989) provided in the *NVCA Pond Planting Guidelines* (NVCA, April 2006) with the exception of those unacceptable/invasive species identified by the LSRCA and included in **Appendix J**. If a development is located within an area where an overall SWM planning study (*i.e. Environmental Impact Study, Ministry of the Environment Special Provisions*) is available, the design criteria and recommendations as specified in the appropriate study must also be followed where specific direction is given.

4.8.1 Landscaping

In cases where there are residential lot(s) adjacent to a stormwater management facility, a minimum 6 m wide landscaping buffer with a maximum slope of 4:1 will be required between the maintenance access route and the residential lot(s) to provide separation between the stormwater management facility and private property. This buffer can be included within the stormwater management block.

4.8.2 Planting Zones

SUBMERGENT (*Deep Water*) – Water depth 0.5 m to 2.0 m

- Planting is to consist of a combination of both floating and submergent species.
- Planting must include at least (3) three species each of robust, broadleaf and narrow leaf plant varieties

AQUATIC FRINGE (*Shallow Water*) – Water depth 0.0 m to 0.5 m

- Planting is to consist of a combination of both floating and submergent species.
- Planting must include at least (4) four species each of robust, broadleaf and narrow leaf plant varieties

SHORELINE FRINGE (*Extended Detention*) – 1.0 m (horizontal) from the permanent pool elevation

- Plantings zone appropriate wetland species must include perennial sedges, rushes and wild flowers in combination with shrubs and wetland seed mix
- The shoreline fringe is subject to fluctuations in water levels which will result in regular flooding and therefore plant selections must be flood tolerant

FLOOD FRINGE – 2.0 m (horizontal) from the limit of the shoreline fringe limit to the 100 year flood level

- Plantings must include a diverse variety of no less than five (5) flood tolerant species each of shrubs, deciduous trees and coniferous trees
- Trees and shrubs within the flood fringe will provide canopy structure to mitigate thermal effects on water temperature
- Herbaceous plant material may be provided by the use of an approved wet meadow seed mix which will be applied in combination with an annual rye nurse crop or suitable equivalent nurse crop
- UPLAND – includes all areas outside the flood fringe
- Plantings will include a minimum of seven (7) species each of drought tolerant shrubs, deciduous trees and coniferous trees
- Upland planting is intended to provide visual screening, aesthetic appeal, wind blockage and shading to mitigate thermal effects on water temperature
- Tree plantings to have no more than five (5) trees of the same species in a grouping

- Provide a minimum 1.5 m buffer between plantings and any structures such as maintenance roads and drying areas and fencing which abuts residentially zoned property
- Trees planted along fenced areas, bordering residential properties should be structurally sound, strong branched so to prevent falling branches into adjoining residential properties

4.8.3 Planting Guidelines

AQUATICS (Submergent and Aquatic Fringe)

- Spacing requirements for aquatics in plug form is five (5) units per m²
- Spacing requirements for aquatics in 100 cm potted form is four (4) units per m²
- Spacing requirements for aquatics in 150 cm potted form is three (3) units per m²
- Cattails (*Typha* spp.) will be planted as interim perimeter vegetation in sediment forebays to increase sediment trapping. The use of this material will not limit maintenance access and it is acceptable that this material will be removed during dredging operations
- Other aquatic species will not to be placed within the forebays as they would be less likely to re-colonize after dredging operations
- Plant material must be comprised of 100% native stock
- Protection from geese and other waterfowl may be required during initial aquatic plant installations
- Aquatic fringe plant installations should be installed one (1) full growing season after that of both the shoreline and flood fringe or at such time as a complete vegetative buffer is established around the pond perimeter as deterrence to geese

TERRESTRIAL (Shoreline Fringe, Flood Fringe and Upland)

- Do not utilize plant material which has been removed or harvested from natural wetlands or roadsides as they may contain invasive or non-native species
- Plant material must be comprised of 100% native stock from a reputable grower/supplier
- Plant shrubs in groupings of no less than 15 units [and no more than thirty (30) units] to promote both colonization and spreading
- Shrubs are to be no less than 60 cm height (container grown stock only)
- Deciduous trees within the flood fringe are to be no less than 50 mm caliper stock. Canopy to be structural sound with strong central leader, no co-dominant leaders will be accepted. Canopy to be healthy and balanced around main central trunk of tree with no rubbing branches nor damages/inclusions on bark. Bio-degradable support materials shall be as per Town standards or approved by project leader. Metal "T" bar and wire support will not be accepted

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- Deciduous trees within the upland may utilize a combination of caliper material and whip stock where caliper trees are planted based on a rate of one unit per 25 m². Whip stock is to be installed at a rate of 6.25 units per 25 m²
- Whips and any bare root stock to be planted prior to the third Friday of May in any given year
- Coniferous material will be no less than 2000 mm in height where height is measured from the top of the root ball to the first whorl (does not include the leader)
- Where applicable, shrubs, deciduous trees and coniferous trees are to be installed in accordance to current Town Standards
- Rodent protection will be installed around the base of all deciduous trees. It will be the installer's responsibility to remove rodent protection (2) two years prior to accepted/assumed. Biodegradable options will also be considered
- Weed abatement measures will be used around trunks of trees using mulch, coco fiber mats or Town approved substitute
- Bio-engineering (e.g. live staking) should be implemented on steep slopes in conjunction with other stabilization methods. Live staking will not be considered for use against density calculations for plant material

4.8.4 Calculation Table for Planting Density

Table 4.8 - Calculation Table for Planting Density

	A	B	C	D	E	F
ZONE	ZONE AREA	WATER'S EDGE	¹ QUANTITY OF AQUATIC SPECIES 35% Coverage	QUANTITY OF PLANT COVERAGE 50% Coverage	² NUMBER OF TREES REQUIRED	NUMBER OF SHRUBS REQUIRED
SUBMERGENT	n/a	B (lin. m)	$C = B * 0.35$	n/a	n/a	n/a
AQUATIC FRINGE	n/a	B (lin. m)	$C = B * 0.35$	n/a	n/a	n/a
SHORELINE FRINGE	A (m ²)	n/a	n/a	$D = A * 0.5$	n/a	F = D
FLOOD FRINGE	A (m ²)	n/a	n/a	$D = A * 0.5$	$E = (A/1000) * 25$	$F = D - (E * 15)$
UPLAND	A (m ²)	n/a	n/a	$D = A * 0.5$	$E = (A/1000) * 25$	$F = D - (E * 15)$

Note:

1. Quantities are based on plugs (5 units per sq/m)
2. Quantities are based on caliper stock (1 unit per 25 m²)

4.8.5 Topsoil

- Topsoil must meet the current Ontario Provincial Standard Specification No.570 (OPSS-570)
- Topsoil will be laboratory tested and the subsequent findings forwarded to Parks Planning and Development for approval prior to placement of topsoil
- Testing must demonstrate that topsoil has sufficient organic and nutrient content and is suitable for sustaining plant material which is to be placed into the pond and/or wetland
- Soil amendments required as a result of laboratory testing must be completed prior to or during the placement of topsoil in accordance with laboratory findings and amendment requirements
- For terrestrial habitats in the flood fringe, provide 0.35 m of topsoil
- For terrestrial habitats in the upland area, provide 0.20 m of topsoil
- For aquatic habitats, provide 0.45 m of topsoil for the first 1 m from the permanent pool elevation
- Stabilize topsoil after placement prior to the installation of woody plant material. In the event that erosion control blankets are utilized in combination to approved seed mixes for stabilization purposes, the netting and blanket material will be 100% bio-degradable. Photo-degradable plastic or plastic netting is not permitted for ground stabilization
- If topsoil stabilizations cannot be completed within one (1) construction year's growing season, the topsoil should not be placed until the following spring. In this event, sediment controls must be in place to prevent erosion of stockpiled materials

4.8.6 Seeding

- All seed mixes are to be placed in combination with an annual rye nurse crop or suitable equivalent nurse crop and will be applied at a rate of 12 kg per hectare
- All upland areas are to be seeded using a 'Simcoe County Native Seed Mix' or seed mixture indigenous to the area and applied at a rate of 20 kg per hectare
- Shoreline Fringe and Flood Fringe areas are to be seeded using an approved 'Wet Meadow' or seasonally flooded annual/perennial seed mix which are to be applied at a rate of 20 kg per hectare
- Seed application is to follow directly after topsoil placement in order to establish vegetative cover quickly for stabilization of topsoil. Seed application should be done at a time of year to ensure the best possible germination and mitigate seed loss
- Erosion control blankets are to be placed over top of seeded areas immediately after application where required
- Contractor will insure 100% coverage and establishment within the stormwater facility throughout the warranty period

4.8.7 Guarantee Period

- All aquatics, perennials, trees and shrubs are to be guaranteed for a period of not less than one year from the beginning of the maintenance period
- If aquatics, perennials, trees and/or shrubs are found dead, diseased, missing or are deemed to be unhealthy within the guarantee period the defective plants are to be replaced and re-guaranteed for an additional two (2) years

4.8.8 Monitoring and Maintenance

- Vegetation monitoring plans and schedules are required with all landscape plan submissions which will include monitoring of the performance and effectiveness of interim measures (e.g. nurse crops) and monitoring of plant health during droughts
- Monitoring reports for will be provided to the Town from the time of the initial plant installations until the end of the guarantee period. Inspections are to take place during September of each year and are to be provided to the Town no later than October 7th of each year
- Mulch saucers should be placed and maintained around the base of trees to retain water
- Watering activities should continue for the first two years after planting

4.8.9 Alternative Landscape Treatment for Low Impact Development

The Town of Innisfil supports a Low Impact Development approach to stormwater management. Given that this is an emerging and evolving technology, the Town will review landscape design requirements on a case-by-case basis.

4.9 FACILITIES MAINTENANCE AND INSPECTION PROTOCOL

4.9.1 Operations and Maintenance Manual

Prior to final Site Plan or Plan of Subdivision approvals at the detailed design stage, a stand-alone Operation and Maintenance Manual shall be prepared for all proposed SWM facilities that identifies on-going operation protocol including inspection and maintenance issues, inspection checklists, maintenance descriptions and projected frequency, as well as recommendations for facility cleanup. The Toronto and Region Conservation Authority (TRCA) document entitled "Inspection and Maintenance Guide for Stormwater Management Ponds and Constructed Wetlands", dated April 2018, can be used as a guide for development of the Operations and Maintenance Manual. The specific requirements that must be included in SWM facility Operation and Maintenance Manuals submitted to the Town shall include, as a minimum, the items outlined below:

4.9.1.1 Background Information

Introductory material describing the property location, including both municipal and legal descriptions, and the drainage area tributary to the facility.

4.9.1.2 Design Elements and General Description of Operation

- A general description describing the operation of the SWM facility and applicable water quality, erosion and quantity control criteria

- Indicate and describe the various design elements of the SWM facility (e.g. sediment forebay, permanent pool, extended detention and flood storage, drawdown time and how the facility operates under various storm events, inlet and outlet control structures including maintenance by-pass valve, drawdown valve and spill containment valve, if applicable)

4.9.1.3 Responsibility for Maintenance Activities

Provide details as to who is responsible for SWM facility maintenance before and following assumption by the Town.

4.9.1.4 Inspection and Maintenance Procedures

Prepare a list of key inspection items including but not limited to the following:

- Check inlet and outlet structures for accumulation of miscellaneous construction debris and other trash that may affect performance
- Check for unusually long extended detention drawdown time that could indicate a blockage in the outlet structure
- Check for sediment accumulation in the forebay and downstream of the facility
- Note evidence of seepage along the berms
- Check for vandalism including illegal access (e.g., gates) or encroachment around the perimeter of the facility
- Confirm that safety and security measures are in good working order
- Check for the presence of any unusual erosion around berms and inlet or outlet structures
- Complete visual inspection to confirm that vegetation is healthy
- Complete visual inspection to confirm no oil sheen present on water surface or the presence of other visible contaminants or odours
- Check drawdown valve and spill containment valve (if applicable) for proper operation

Provide recommended maintenance procedures for items including but not limited to the following: grass cutting around walking trails; weed control; upland and fringe plantings; shoreline fringe plantings; aquatic vegetation replanting; outlet adjustments; bathymetric survey to assess the need for sediment removal; trash removal; and winter maintenance.

4.9.1.5 Monitoring Program and Performance Evaluation

- Prepare a recommended plan for water quality monitoring that will accurately characterize the average water quality treatment provided by the SWM facility per the Lake Simcoe Protection Plan and demonstrate that it is in accordance with the MECP Certificate of Approval
- Include recommended procedure to verify the rating curve of the outlet control structure

- Provide a recommended plan to complete a SWM facility bathymetric survey to determine the quantity of sediment to be removed (if any)
- Include a list of key structures to confirm as-constructed elevations and dimensions (e.g., inlet, outlet control structure components including weirs and orifices) and proper installation (e.g., safety and security measures, vegetation, erosion protection)

4.9.1.6 Removal and Disposal of SWM Facility Sediments.

- Indicate the procedure required to dewater the permanent pool prior to sediment removal and how to divert storm flows away from the facility during maintenance operations
- Provide a sediment handling, removal and disposal plan including but not limited to the following: written notification to residents within 120 m of the SWM facility identifying maintenance works and duration; erosion and sediment control plan to prevent the release of TSS to the downstream receiver; treatment, sediment dewatering and drying techniques to be used; and the required chemical analyses to be completed in accordance with Ontario Regulation 558/00 prior to disposal

4.9.1.7 Estimated Annualized Operation and Maintenance Costs

Provide calculations of the estimated annualized operation and maintenance costs for the SWM facility. Costs should include but not be limited to the following: debris and litter removal; grass cutting and weed control (if applicable); maintenance of aquatic/shoreline fringe and upland/flood fringe vegetation; sediment testing; sediment removal and disposal; inlet/outlet structure repairs; side slope and access road repairs; and retaining wall repairs.

4.9.1.8 Primary Tables and Supporting Calculations

- SWM facility inspection checklist.
- Estimated annualized operation and maintenance costs and supporting calculations
- Sediment accumulation cleanout frequency calculations

4.9.1.9 Primary Figures and Drawings

- SWM facility location plan.
- Post-development drainage area plan tributary to the SWM facility.
- SWM facility stage-storage-discharge relationship and curve.
- General plan for the SWM facility and detailed drawings of key elements (e.g., inlet, outlet control structure, maintenance valve, spill containment valve).

4.10 POST-CONSTRUCTION REQUIREMENTS

4.10.1 Post-Construction Monitoring

At 95% build-out and after the facility has been cleaned-out, the Developer must request in writing, approval to begin the post-construction monitoring program for the Stormwater Management Pond that will eventually be assumed by the Town.

4.10.1.1 Monitoring Criteria

The purpose of the post-construction monitoring program is to ensure that the stormwater management facility, including end-of-pipe infiltration facilities, continues to satisfy the design criteria specified in the subwatershed study, SWM report, and MECP CLI ECA. It is also in place to identify any specific additional maintenance requirements and remedial works that may be necessary.

The Developer shall inspect, maintain, and monitor the stormwater management facilities as per the requirements of the SWM Report and the Town's CLI Environmental Compliance Approval (ECA). Monitoring of the stormwater management pond and reporting of the results shall be conducted in accordance with Sections 4.0 and 5.0 of Schedule E of the Town's CLI ECA.

Annual monitoring reports are to be submitted to the Town prior to January 31st of each calendar year for reporting to the MECP. At a minimum, the monitoring reports must include the requirements detailed in the Town's CLI ECA.

The post-construction monitoring program must be in place for a minimum of 5 years prior to Final Acceptance of the SWM facility.

Should the monitoring results show that the SWM facility is not functioning as outlined per the SWM Report and MECP ECA certificate, the Developer is responsible for remediating the SWM facility in order to meet the outlined objectives at the Developer's own expense.

4.10.2 Stormwater Management Pond Post – Cleanout (Final Acceptance)

Following removal of accumulated sediment, the developer's engineer shall provide a survey of the cleaned out SWM facility and provide As-Recorded SWM facility report and drawings which includes the following;

- A summary table with the design, pre, and post cleanout permanent pool volumes;
- A summary table with the design and as-recorded elevations of inlet headwall(s), outlet(s), weir(s), forebay berm inverts, emergency spillway inverts, and any other structures which are required for the facility to function as designed.
- As-recorded storage volume and discharge calculations of the entire SWM pond are to be quantified and certified by a Professional Engineer to verify conformance with the approved drawings and SWM report.
- Plan and sections of the pond which illustrate the maintenance access, hydraulic structures, and representative pond side slopes.

- The 100-year storm flow must be contained within the as-recorded pond.

Refer to Appendix G for additional as-recorded requirements for the SWM Facilities.

A geodetic monument shall be installed on the inlet headwall with the exact location and elevation included on the As-Recorded SWM Pond drawings set. The monument shall have horizontal and vertical controls in accordance with the Town's standards.

All required warning signage shall be installed with proof of installation provided to the Town via timestamped photographs.

The developer's engineer shall provide the Town with an Engineering Certification letter which confirms that all of the components of the SWM facility are in good condition and do not require repair, and have been installed in general conformance with the approved SWM Facility design and final approved drawings. The additional information should be included in a package to the Town:

- The approved SWM Facility Report;
- All approvals associated with the SWM facility and associated infrastructure (e.g. outfall headwalls to the natural environment) shall be provided to the Town. Approvals should include the Ministry of Environment, Conservation and Parks (MECP), Environmental Compliance Approval (ECA), formerly called Certificate of Approval (COA), LSRCA Ontario Regulation 179/06 (works within a regulated area); possibly Ministry of Natural Resources and Forestry; and/or Fisheries and Oceans Canada (DFO).

The developer shall provide the Town with a Landscape Certification letter which confirms that all of the plantings associated with the SWM facility are in good condition and do not require replacement, and are in general conformance with the approved landscape plans. The additional information should be included in a package to the Town:

- The final approved Landscape plans associated with the SWM facility;
- All approvals associated with the landscape plans.

The Town reserves the right to request modifications to the SWM pond if it is determined that the pond is not functioning as per the accepted design.

4.11 WATER QUALITY TREATMENT UNITS

4.11.1 Oil/Grit Separators (OGS)

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 encouraged by the Town to be used for spill control. Oil/grit separators are also appropriate for providing water quality control for redevelopment, or infill areas which typically have space limitations and where a stormwater management pond is not practical. Oil/grit separators should not be used as a substitute for an end of pipe SWM facility forebay. Standards as outlined by the LSCRA for OGS units will be applied.

Supporting calculations and anticipated maintenance requirements shall be provided to the Town along with certification of the design by a Professional Engineer. Additional documentation may be required on a case-by-case basis.

Design for an OGS shall use the OGS Review Sheet available at the Sustainable Technologies Wiki site using the analysis interval closed to the time of concentration and Barrie RG3 rainfall data. The target quality is 60% TSS removal.

4.11.2 Roof Top and Parking Lot Storage

The use of rooftop and parking lot storage for stormwater management has some challenges. The two issues would be the potential for flood damage to private property and the continual functioning of such devices if on-site controls are altered after construction (e.g. rooftop flow control inadvertently removed).

The use of roof top or parking area to provide peak flow control is generally not preferred, and shall be considered on a site specific basis by the Town through pre-consultation. On-site controls should generally be avoided on school sites and other sensitive institutional uses. Water quality and quantity controls in new development areas should be provided in Township-owned municipal blocks or easements.

4.11.3 Roof Top Storage

When used, flat roofs may be used to store runoff to reduce peak flow rates to storm sewer systems to mitigate the need for downstream storm sewer size increases. Per the SWMPD Manual (MOE, 2003), rooftop storage can typically store 50 mm to 80 mm of runoff subject to the roof loading design. Detention time is typically between twelve (12) to twenty-four (24) hours.

Supporting calculations and design drawings must be provided to indicate the following:

- The total number and location of proposed roof drains and emergency overflow weirs
- The type of control device proposed (i.e. product name and manufacturer). Tamper proof devices are preferred where feasible (provision of shop drawings required)
- Unless otherwise deemed appropriate by the Town and/or CA, a maximum flow rate of 42 L/s/ha of roof area
- Product specifications (i.e. design release rates for identified control devices)
- Emergency overflow weirs shall be provided at the maximum design water level elevation
- The maximum ponding depth, storage volume, and drawdown time for roof top storage during the 2-yr through 100-yr design storms
- Roof top control devices may require registration on title as part of the Site Plan Agreement and/or Subdivision Agreement)
- Certification from the structural and mechanical engineers that the roof structure and vertical drain pipes are designed to account for the roof top storage.

4.11.4 Parking Lot Storage

Since vehicles may be flooded, with water entering the passenger compartment at depths of less than 0.3 m, the use of parking lot storage represents a significant liability risk. Where other options for stormwater management practices exist, it is the preference of the Town that alternatives to parking lot storage be used. Should parking lot storage be supported, the following conditions must be met:

- Parking lot storage may require registration on title as part of the Site Plan Agreement and/or Subdivision Agreement) to ensure they are properly maintained and cannot be removed or altered during future site alterations without the provision of adequate alternative storage
- The site owner is responsible for all liability related to the proposed parking lot storage system, including all damages resulting from the designed operating conditions and any downstream damages resulting from removal, modification or lack of maintenance to on-site controls;
- Parking lot storage must be controlled by pipe size reductions within the storm sewer network and not through the use of orifice plate restrictors to a minimum size of 100 mm
- Surface ponding is only allowable during storm events greater than the 1:5-year design storm
- The maximum allowable ponding depth within the parking lot is to be limited to 0.3 m; however, maximum ponding depths of 0.2 m are preferred
- The 100-year ponding elevation and storage volume provided at each ponding location must be shown on the design drawings
- An emergency overflow system and overland flow route must be provided to allow all runoff exceeding the 100-year storage to be safely routed from the site to a suitable outlet (i.e. municipal R.O.W.) This flow route must be shown on an engineering plan

4.12 END-OF-PIPE CONTROLS

End-of-pipe control facilities shall provide the required quantity and quality control in accordance with the governing guidelines which are currently documented in the Ministry of the Environment's Stormwater Management Planning and Design Manual (MOE, 2003), unless otherwise specified below by the Town.

The planning and design of each pond shall also focus on opportunities to integrate the pond with the surrounding topography and land uses. Ponds are to be created as public amenity features and are to be safe, significantly visible and accessible to the general public. Opportunities for linkages through the use of trails to larger open space, floodplain areas or other SWM facilities are to be maximized.

4.12.1 Wet Pond with Extended Detention

Wet ponds are typically the preferred end-of-pipe control facility for drainage areas greater than 5 ha. Wet ponds shall be designed in accordance with the governing guidelines unless otherwise specified in the Town's guidelines.

4.12.2 Wetland with Extended Detention

A constructed wetland is an acceptable stand-alone end-of-pipe control facility. Constructed wetlands shall be designed in accordance with the governing guidelines unless otherwise specified in the Town's guidelines.

4.12.3 Hybrid Wet Pond / Wetland with Extended Detention

A wet pond / constructed wetland hybrid is an acceptable stand-alone end-of-pipe control facility. Hybrid wet ponds / constructed wetlands shall be designed in accordance with the governing guidelines unless otherwise specified in the Town's guidelines.

4.12.4 Dry Pond with Extended Detention

Dry ponds servicing development larger than 5 ha will not be permitted unless Low Impact Development has been designed to infiltrate the runoff from the 25mm storm event. Dry ponds for smaller development may be used as a part of a treatment train approach provided that an enhanced level of water quality treatment is achieved.

4.12.5 Infiltration Basin

In general, infiltration basins shall not be accepted as a stand-alone end-of-pipe facility, unless as part of a treatment train approach or as an additional feature. Infiltration basins shall not be permitted for drainage areas > 5 ha.

4.12.6 End of Pipe Water Depths

Maximum water depths for various end-of-pipe SWM facilities shall follow the recommendations in the latest version of the MECP Stormwater Management Planning and Design Manual, Preferred Criteria.

4.12.7 Maintenance Access

Maintenance access roads are required to all inlet and outlet structures, sediment forebays, sediment drying areas (if applicable), and emergency spillways associated with the stormwater management facility. Co-location of access roads with trails shall be implemented wherever possible. Where feasible, two access points shall be provided from the municipal road allowance such that the access road is looped to key hydraulic features. In situations where this is not practical, dead end access roads shall be designed with a hammerhead turning area consisting of a minimum hammerhead width of 17.0 m and a 12.0 m centerline turning radius, however this option is not ideal.

Where the access road enters the forebay below the NWL, the forebay ramp shall be constructed consistent with the lining of the bottom of the forebay or as recommended by a geotechnical engineer. Minimum width of 4.0 m and a maximum grade of 10% should be used. Ramp access should favour "green" solutions.

The access roads shall provide for all-weather ingress and egress with a minimum width of 4.0 m and a maximum grade of 3%. The maintenance access road shall consist of 50 mm HL4 with a minimum base of 300 mm of compacted Granular "A" (19mm CRLS) which extends 0.5 m on either side of the paved surface. The access road must have a 3m buffer to the adjacent private property. Curves on all access roads shall have a minimum centerline radius of 12.0 m. Maintenance access roads shall be set a minimum of 300 mm above the Regulatory pond water level. For industrial developments, the Town may consider an alternative pavement structure for the SWM Pond maintenance access route.

At locations where overland inlet flow routes or the emergency spillway cross the maintenance access, reinforcing measures shall be incorporated to strengthen the access route to carry truck loading and permit bike/stroller crossing.

4.12.8 Berming

Berms around wetlands and wet ponds shall be designed with a minimum top width of 3.0 m (where trails and access roads are not located) with a 3:1 maximum side slope on the outside. The core of the berms shall be constructed with engineered fill on the basis of the recommendations of a licensed geotechnical engineer. Topsoil is not permitted for berm construction except as a dressing to support vegetation on the top of the core.

For pond berms exceeding 2.0 m in height from the top of the berm to the toe of slope, the berm must be designed by a qualified professional engineer in accordance with the latest edition of the Ontario Dam Safety Guidelines (MNR).

4.13 EROSION AND SEDIMENT CONTROL

Sediment control measures have been required on construction sites for several decades, however, even on sites where recommended practices are applied, sediment continues to be discharged at concentrations above those required to protect aquatic life. It is important to consider that effective erosion and sediment control must move beyond the installation of devices such as silt fence and move towards an ongoing “process” within a project framework - from conception to construction.

A complete ESC plan includes the following:

1. Erosion and Sediment Control (ESC) Plans (report and drawings)
2. Spill Control and Response Plans
3. Inspection and Maintenance of ESC
4. Performance Monitoring and Reporting

This section presents the minimum criteria for the design of some commonly used erosion and sediment controls. For additional information and/or information on control options that have not been included in this section, please also refer to the latest revision of the Ministry of the Environment (MOE) *Stormwater Management Planning and Design Manual*, the Nottawasaga Valley Conservation Authority *Development Review Guidelines*, the Lake Simcoe Region Conservation Authority *Watershed Development Policies*, and the Greater Golden Horseshoe Area Conservation Authorities *Erosion and Sediment Control Guidelines for Urban Construction*.

Every control measure and all control plans must meet or exceed the specifications set out in these documents and must be designed to achieve adequate performance at all times. At final design submission, a stand-alone ESC report is required as outlined in the Greater Golden Horseshoe guidelines so that copies can be provided to all staff responsible to ESC on the construction site. The ESC report will include the following:

- a) Project Description
- b) Conditions of Existing Site
- c) Condition of Existing Receiving Water
- d) Adjacent Areas and Features
- e) Soils
- f) Critical Areas

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- g) Permanent Stabilization
- h) Design Details of ESC Measures
- i) Record Keeping Procedures
- j) Stockpile Details
- k) Emergency Contacts
- l) Stamped and Signed Report

A complete application submission requires ESC drawings that work with the ESC report to form a complete ESC Plan. The ESC Drawings should include the following:

- a) General Items
- b) Existing Contours
- c) Existing Vegetation
- d) Water Resources Locations (lakes, rivers etc.)
- e) Regional Storm Floodplain and CA Regulated Areas
- f) Critical Area
- g) Proposed Contours/Elevations
- h) Site Boundary Limits
- i) Existing and Proposed Drainage Systems
- j) Limits of Clearing and Grading
- k) Stockpiles and Berm Data
- l) ESC Measures Locations and Details
- m) Stormwater Management Systems
- n) Stormwater Discharge Locations
- o) Access Road
- p) Internal Haul Road
- q) Construction Phasing and Scheduling
- r) Inspection and Maintenance
- s) Signed and Stamped Drawings

The ESC controls should be designed using a phased approach whenever feasible to minimize the exposed area of the site at any given time. The ESC report should lay out the various phases of construction and any changes or additions to the ESC systems for each phase. Erosion prevention is the preferred mitigation measure for eliminating and/or reducing the potential for sedimentation. Topsoil stripping should be conducted in a logical sequence in order to minimize the areas where soil is exposed. Any areas that are scheduled to remain exposed for longer than thirty (30) days should be protected with vegetative cover. The method used to establish vegetative cover will vary depending on the soil type, site grading and time of year.

This section presents the minimum criteria for the design of some commonly used erosion and sediment controls. For additional information and/or information on control options that have not been included in this section, please also refer to the latest revision of the Ministry of the Environment and Climate Change (MOECC) *Stormwater Management Planning and Design Manual*, the Nottawasaga Valley Conservation Authority *Development Review Guidelines*, the Lake Simcoe Region Conservation Authority *Watershed Development Policies*, and the Greater Golden Horseshoe Area Conservation Authorities *Erosion and Sediment Control Guidelines for Urban Construction*.

Every control measure and all control plans must meet or exceed the specifications set out in this document and must be designed to achieve adequate performance at all times.

The controls should be designed using a phased approach whenever feasible to minimize the exposed area of the site at any given time. There must also be a contingency plan for repair, replacement and upgrading of control measures as required to achieve adequate performance at all times.

4.13.1 Runoff Control

The development of the control plan shall examine concentrated runoff from adjacent areas that will pass through the site and shall provide for the diversion of the runoff around disturbed areas. If this is not possible, the runoff shall be directed into armoured channels flanked by silt fencing with appropriate low point protection and shall outlet into a treatment facility prior to discharge.

For sites where sediment control ponds are not being proposed, sediment control fences and cut off swales/channels or equivalent control measures shall be placed along all down gradient boundaries of the site.

For sites adjacent to existing residential areas, a cut-off swale/channel shall be placed around the entire perimeter of the site to prevent drainage onto private lands. A 3.0 m wide buffer strip and/or sediment control fence shall be provided along the perimeter of the down gradient boundaries of the site.

4.13.2 Temporary Sediment Control Ponds

Temporary sediment control ponds are required for any project that has a construction area greater than 5.0 ha.

The location of the pond(s) shall intercept runoff from the entire disturbed area unless other controls are implemented, in conjunction with the pond, to ensure that adequate performance is achieved for the entire area.

In general, the pond shall consist of a:

- a) Permanent pool to contain accumulated sediment and post-storm waters;
- b) Water quality treatment volume that allows for settlement of suspended sediment from storms; and
- c) Forebay to quiet incoming flow if the construction project is anticipated to take place over more than one year.

The required active storage volume shall be designed with a minimum of 125 m³/hectare of contributing area.

The required permanent pool volume shall be designed with a minimum of 125 m³/hectare of contributing area.

The draw down time shall be a minimum of twenty-four (24) hours, or as required by the governing Conservation Authority.

The outlet works shall consist of a perforated riser system, with a minimum orifice diameter of 75 mm.

The forebay shall be designed with a minimum depth of 1 m, a maximum volume of 20% of the permanent pool, have a stable bottom to allow mechanical clean out, and incorporate sediment depth indicators.

The overall pond shall be designed with a minimum depth of 1.0 m, a maximum depth of 2.5 m, maximum side slopes of 4:1, and an emergency spillway sized to safely convey the 1:100 year storm event from the contributing area.

4.13.3 Silt Fences

Silt fence is to be installed on the perimeter and on the up-gradient side of sensitive areas, streams and rivers, and at the base of slopes. It should not be used in areas of high flows.

When silt fence is proposed, it shall be:

- a) Aligned with site contours;
- b) A minimum above grade height of 900 mm with a minimum of 300 mm of the fabric toed into the ground.
- c) Constructed of suitable woven UV stabilized fabric (with a weave density of 270R or greater) fastened with wire fasteners to 150 mm gauge wire fencing or acceptable equivalent.
- d) Supported by steel T bar fence posts with a separation distance of no more than 2.5 m.
- e) Accompanied by a vegetative buffer strip on the down gradient side.

4.13.4 Vegetative Buffer Strips

Vegetative Buffer Strips shall be provided between the site alteration area and every down gradient protected area. They shall be protected from up gradient erosion by silt fences and shall consist of established vegetation that is growing, whenever possible, on undisturbed soil. They are to be a minimum of 3.0 m wide between the perimeter of the property and a disturbed area and a minimum of 15.0 m wide between surface water and a disturbed area. Additional width may be required if the adjacent surface water is classified as a cold water source.

4.13.5 Non-Vegetative Buffer Strips

Non-Vegetative Buffer Strips shall be installed where there is not a minimum undisturbed area of established vegetation down gradient of the site alteration area. They shall be a minimum of 2.0 m wide between the perimeter of the property and a disturbed area and a minimum of 15.0 m wide between surface water and a disturbed area.

A second silt fence must be installed no closer than 1.0 m to the primary silt fence and there must be space provided for access to clean out trapped sediment and complete any repairs to the fence.

4.13.6 Channel Low Point Protection (Stone Silt Traps)

Channel Low Point Protection Devices shall be constructed in channels and ditches that will contain concentrated flows to reduce the velocity; thereby reducing erosion of the sides and invert. They shall be designed as follows:

- a) So that the crest of the downstream device is at the same elevation as the downstream base of the device further upstream;
- b) With 100 mm to 150 mm diameter rip rap, wrapped in geotextile fabric, from the invert of the channel or ditch to a maximum of 250 mm below the top of the channel or ditch;
- c) With a downstream slope not to exceed 4H:1V and an upstream slope not to exceed 1.5H:1V;
- d) With a 2.5 m long excavated sediment trap approximately 600 mm in depth at the upstream face.

4.13.7 Construction Access Mats

Construction Access Mats shall be installed at all exits from the site and shall be designed and maintained to remove most of the sediment accumulated on vehicle tires. They shall be designed as follows:

- a) 300 mm of 50 mm – 100 mm clear limestone placed on a geotextile fabric suitable for allowing ex-filtration of water and preventing the quarry stone from becoming contaminated with the substrate soil (Terrafix 270R or approved equal).
- b) To be a minimum of 6.0 m in width and extend a minimum of 30 m onto the site.
- c) To be flanked by silt fences and vegetative buffers from the property line to the
- d) t of any on-site roadways (refer to TOISD 505 for the detailed drawing).

4.13.8 Topsoil and Spoil Pile Management

Topsoil and spoil piles shall be designed such that they are not in low areas of a site where water may accumulate and they must be surrounded by one or more silt fences.

Any piles containing more than 100 m³ of material shall be a minimum of 15 m from a roadway or channel.

If topsoil or spoil piles are to be left in place for more than sixty (60) days, they shall be stabilized by mulching, vegetative cover, tarps or other equivalent means.

4.13.9 Drain Inlet and Catchbasin Protection

Protection of all potentially affected storm drain inlets and catchbasins shall be accounted for in the design.

Filter cloth protection may be used over the catchbasin inlet where ponding of water will not occur and where traffic will not affect the filter cloth. In all other cases, catchbasin inserts shall be used constructed of filter cloth with or without a metal support structure.

4.13.10 Site Dewatering/Discharge

Effluent from site dewatering operations must not discharge directly into receiving bodies of water or streams.

Water pumped from the site shall be treated by control devices such as a sediment control pond, grit chambers, sand filters, upflow chambers, swirl concentrators or other appropriate controls, and must not contain particles more than 40 microns in size, or more than 100 mg/L of suspended solids.

In instances where construction water is to be discharged into the natural environment or conveyed to a municipal storm or sanitary sewer system, a groundwater sample shall be obtained from the dewatering system prior to the initial discharge. This sample must be collected following the implementation of any pre-treatment processes.

The sample shall undergo laboratory analysis to determine the presence and concentration of metals, petroleum hydrocarbons (PHCs), volatile organic compounds (VOCs), and inorganic constituents.

Analytical results must demonstrate compliance with the applicable regulatory standards, including the Provincial Water Quality Objectives (PWQO) or the Town of Innisfil Sewer Use By-law 062-21, as appropriate

4.13.11 Other Erosion & Sediment Control Features

The Town will consider Erosion and Sediment Control measures not listed in the Town's Standard on a case-by-case basis.

4.14 SALT MANAGEMENT

Road salt application is necessary to provide safe conditions during the winter on roads, parking lots and sidewalks, however it is a major source of sodium and chloride ions in the environment. Many studies have shown that road salts have a negative impact on the receiving environment and urban infrastructure. Reducing the need for salt use through design of parking lots and road along with better application practices will help to minimize the impacts. Development must submit a salt management plan at the detailed design.

4.14.1 Salt Management Plan

The main objective of a SMP is to ensure environmental protection while maintaining safe roadway and parking lot to the public. A SMP is intended to set out a policy and procedural framework for ensuring that site owners continuously improve the management of road salt used in winter maintenance operations. A SMP for a development should consist of the following components:

- Establish effective operating procedures (e.g. snow storage/disposal, plow routes, minimum required equipment etc.)
- Identify ice control products
- Recommend/establish effective salt application rates
- Establish a benchmark to assist the site owners to assess/mitigate their onsite use of road salt and the impact to the natural environment

- Training program
- Record keeping protocol

The SMP for private sites should consist of a letter, report or technical memorandum that address the required content and a Site Plan drawing of appropriate scale. The site plan drawing must include:

- North arrow and scale
- Building footprint including all entrances and exits and locations of all downspouts
- All parking areas
- Sidewalks and all wheelchair access areas
- Vegetated areas
- Site entrances and exists
- Stormwater management collection system
- Snow pile storage areas
- Any winter maintenance material storage areas
- Any sensitive areas to salt
- Municipal maintained areas

4.14.2 Parking Lot Design

4.14.2.1 Snow Pile Storage Location

Snow piles on parking lot that are not designed with winter maintenance and salt management in mind can lead to significant application of additional road salt as well as cause further adverse impacts to the local environment. Melt water from snow piles must be collected as close to the piles as possible to limit the travel distance and potential for refreeze. Snow piles can be a significant source of road salts and other typical road runoff pollution source. Therefore, special attention must be given to the water quality treatment solution for snow pile runoff.

Listed below are multiple design recommendations that designers should take into consideration and incorporate where feasible and practical. It is acknowledged that the design is optimized by taking into consideration multiple constraints and not all suggestions can always be accommodated.

- Snow storage piles should be located along the downgradient edges of parking lots and positioned as far away from major pedestrian destinations as possible. If possible, the main snow pile should be placed at the lowest point of the parking lot.
- Parking lots should be graded such that meltwater runoff from snow storage piles is transported away from high traffic areas.
- It is suggested to plan for a snow pile storage volume range of 500 to 1,500m³ per hectare of parking lot (LSRCA, 2017). Snow pile area and height will vary greatly depending on the size of the snow removal area and the snow removal

equipment that is being used. For a maximum snow pile height of 3m (trucks with plow attachments), provide a snow storage area equivalent to 10% of the total area to be cleared on site. If specialized snow removal equipment is available, the snow pile heights will increase (safety permitting) and the required snow storage area will decrease.

- If groundwater recharge water quality is of major concern, then the snow storage locations can be designed using impervious surfaces to minimize infiltration (clay underlining of vegetated areas, asphalt pads, concrete pads etc.).
- Catch basins should be located directly downgradient and in the immediate vicinity of snow storage piles to minimize the parking lot area which is subject to meltwater runoff (this may require the construction of additional catch basins).
- Oil grit separators, vegetated filter strips and grassed swales (planted using salt tolerant vegetation) may be included downstream from snow disposal areas to attenuate runoff and reduce suspended solids, metals and petroleum hydrocarbon loads in parking lot runoff.
- Meltwater collected by catch basins downstream from snow storage piles should be routed through an oil grit separator to reduce meltwater contaminant loads, as snow storage piles typically contain high concentrations of oil, sediment and other contaminants.
- If dedicated snow storage areas are not feasible, portions of the parking lot that may have lower winter month parking requirements can be designated as snow storage locations and drainage infrastructure in this area can be designed to maximize the capture of meltwater.
- Snow storage piles should be staged in areas which receive large amounts of solar radiation to promote more efficient melting.
- Snow storage piles should be located in areas which are easily accessible for plows and other mechanical snow and ice removal machinery. This may involve having multiple snow storage piles.
- Snow storage areas should be clearly marked with signage to inform winter maintenance contractors where to pile snow which is important if there is contractor change over. Example sign text: "These parking stalls are designated as snow pile storage areas during the winter months". Also consider painting/marketing the snow storage areas on the pavement.
- The installation of mountable curbs (push points) can allow the contractor to push snow over the curb into designated snow storage area without the concern of causing damage to the curb.
- Snow storage shall not be located in any SWM facility, swale, or low impact development ("LID") feature.

4.14.2.2 Sidewalk Design and Pedestrian Flow

Careful consideration of location and layout of sidewalks/pedestrian walkways can eliminate over-salting of unused walkways. The design process should consider that

pedestrians typically follow the path of shortest distance and don't necessarily use the designed walkways. Occasionally, this leads to pedestrians walking along the vehicle routes and not the designed walkways, especially in large parking lots with walkways around the outer edge. By re-thinking the pedestrian walkways and designing them in a way that is more direct and user friendly, the reduction of walkway footprint on a typical parking lot can be achieved. This in turn leads to a reduction of salt application.

On sites where multiple pedestrian pathways are essential during warmer months, consideration should be given to temporary closure of the low traffic walkways during winter months to reduce the required winter maintenance. However, it is noted that priority should be given to the proper planning and placement of walkways during the initial planning process to avoid unnecessary walkways.

Listed below are multiple design recommendations that designers should take into consideration and incorporate where feasible and practical. It is acknowledged that the design is optimized by taking into consideration multiple constraints and not all suggestions can always be accommodated.

- Planners should verify that the number of sidewalks for the specific building/location is suitable for pedestrian traffic. Sidewalk layout should take into consideration pedestrian traffic flow to and from buildings, transportation corridors (such as bus stops), and connectivity to main pedestrian thoroughfares in addition to considerations for vehicular traffic. Pedestrian walkways should also be focused on family oriented locations: i.e. designated parking for families and elderly near the sidewalks.
- Vegetated islands can be used to help protect pedestrians from vehicular traffic. However, vegetated islands should be limited and strategically located so they do not create unnecessary obstacles for plows.
- Owners should look into the utilization of sidewalks and determine whether a sidewalk is primary or secondary. Consideration should only be given to the design of primary sidewalks. And where secondary sidewalks are required, consideration to temporary closing these during the winter months can lead to the reduction of salt application requirements.
- Partially covered walkways (i.e. overhang) can be eliminated and centralized fully covered walkways and main building entrances can be used where practical. Ensure that runoff from covered walkways is directed to appropriate stormwater management facilities, and not allowed to drain onto paved surfaces.
- Where possible, for major pedestrian thoroughfares, design the width to promote snow removal by conventional equipment and minimize manually shoveled areas (1.5 m minimum width).
- Snow storage locations for walkway clearing should be located to prevent melt water draining back over the walkway.

- Prevailing wind direction should be considered when selecting sidewalk location. When sidewalks are constructed on only one side of a roadway, consideration should be given to placing the sidewalk on either the north or west side.
- For mobility concerns, sidewalk plowing near transit stops should be a priority.
- The use of “rough” material that reduces slip risks without promoting heaving could prove beneficial. The use of darker materials can promote solar heating of walkways.
- By placing the building entrance near the road way, the length of sidewalk needed for primary pedestrian traffic walkways would decrease.
- Consider the use of heated walkways in front of the building. Heated entrances could limit the amount of salt applied.
- Where possible, pedestrian walkway design should consider plow routes.

4.14.2.3 Landscaping Features

Landscaping features such as vegetated swales or landscaped islands can lead to a reduced requirement of salt application by reducing the amount of paved surface. Vegetated swales, bio-retention or landscaped islands with curb cut inlets can be used to collect and retain melt water runoff, reducing melt water ponding and refreezing. The vegetation used in swales and landscaped islands should be salt tolerant and suited to each site's soil, climate and moisture conditions. Additionally, using deciduous trees in the planting plan will provide shade during the hot summer months and allow the sun to directly hit the parking lot during winter months to help melt snow and ice. Where feasible, evergreen trees and/or shrubs can be used as treed windbreaks along the site perimeter, considering the predominant wind direction and adequate setback to avoid accumulation of snow drifts

Although vegetation varies in its reaction to salt-affected soils, salt generally reduces the ability of the roots of the plant to take up water and nutrients by impeding uptake of moisture from soil with salt-laden water. This phenomenon essentially mimics drought conditions for the plant. If salt is sprayed onto plants from automobile traffic it can reduce cold hardiness in buds and new twigs, which may then become more susceptible to freezing, mortality or deformation. Road salt can also be directly toxic to plants; the dissolved sodium and chloride ions separate, and the chloride ions can reach toxic levels as they are absorbed into roots and then build up in the leaves.

Listed below are multiple design recommendations that designers should take into consideration and incorporate where feasible and practical. It is acknowledged that the design is optimized by taking into consideration multiple constraints and not all suggestions can always be accommodated.

- Parking lot layouts should be conducive to mechanical snow removal by snow plows. This may involve minimizing the number of tight turns and obstacles that

- snow plows encounter by allowing them to plow in straight lines as much as possible. Landscaped islands can be kept to the outside/ends of parking aisles.
- Curb cuts can be installed around the perimeter of the parking lot to promote drainage into landscaped areas.
 - All vegetation used in landscaping features should be non-invasive and tolerant to local climate and soil conditions. Preference should also be given to native plants where possible.
 - All vegetated landscaping features should be composed of salt tolerant vegetation, for vegetated islands, filter strips and swales. Due to the mobility of salt in soils, in source water protection areas vegetated filter strips and grassed swales should be constructed with an impermeable base material (i.e. clay). Bioretention features should be combined with other upstream salt reduction design features.
 - Bioswales should be installed in well-drained soils, or should include underdrain systems when installed in poorly drained soils (CVC and TRCA, 2010).
 - If trees are included in the landscaping areas, consideration should be given to deciduous trees with high canopies to maximize solar energy to melt snow/ice during winter months and promote cooling of parking lots in summer months and maintaining visibility.
 - During winter months, burlap can be used to protect trees and vegetation from damage.
 - Planting along the property boundary and the inclusion of various bio-retention features is encouraged, provided they don't promote snow drift accumulation directly adjacent to paved surfaces.
 - Using raised planters can also protect vegetation from being exposed to increases in salt.

Where feasible, evergreen trees and/or shrubs can be used as treed windbreaks along the site perimeter, considering the predominant wind direction and adequate setback to avoid accumulation of snow drifts. A list of salt tolerant plant species for parking lot design can be provided upon request.

4.14.2.4 Permeable Pavers

Permeable pavers can reduce the need for salt application in parking lots by improving drainage and preventing melt water from ponding and refreezing (Drake, J et al., 2012). Permeable pavers consist of interlocking pavers with a permeable joint material in the voids between the pavers to promote infiltration. A storage bed of crushed stone and/or sand beneath the pavers collects runoff and allows for infiltration. An underdrain system may also be installed if permeable pavers are constructed on poorly drained native soils or if infiltration is not desired.

Similar to permeable pavers, turf and grass block pavers (also known as concrete or plastic grid pavers) can provide a similar solution for pedestrian or low vehicular use areas. The open weave design (honeycomb design) allows for grass or moss to grow

through, preserving the look of a lawn while providing additional infiltration and structural support.

The installation of permeable pavement has been demonstrated to reduce salt application requirements for paved surfaces by up to 75% (University of New Hampshire Stormwater Center, 2007). Additionally, the highly porous joint and sub base materials, which surround and underlie permeable pavers, absorb and retain heat and further increases the efficiency of snow and ice melting from parking lot surfaces. Special consideration should also be given to the colour selection of the pavers/pavement. Dark coloured pavers will increase the absorption of solar radiation and lead to higher ice melting potential. For additional information on permeable pavers and turf and grass block pavers refer to CVC and TRCA, 2010.

4.14.2.5 Seasonally Closed Parking Areas

Shoppers naturally tend to choose parking spaces closest to the building. As a result, other than the peak shopping period around Christmas, there tends to be low use of the remote parts of large parking lots, including during the coldest parts of the winter (mid-January to end of February). Therefore, during the low customer periods there is the potential for closing some of the less used parking lot areas and not performing any winter maintenance in these locations. This can lead to a reduction of overall salt application, as the area requiring winter maintenance has been reduced. Additional benefit can be achieved in these remote parts of the parking lots by using permeable features for stormwater improvements.

4.15 DE-ICING CHEMICALS

Several de-icing products are available in either liquid or solid form. The most commonly employed de-icing chemicals are chloride-based salts, but acetate-based deicers have also been used on winter roads. Airport de-icing operations typically use acetates and glycols for their pavements and aircrafts due to the corrosive nature of chloride-based salts. A brief summary of the most common liquid and solid de-icing chemicals are provided below.

4.15.1 Sodium Chloride

Sodium chloride is a naturally occurring mineral and is the most commonly used de-icing chemical. Sodium chloride has a practical working temperature as low as -9.4°C and a eutectic temperature of -21°C at a mixture of 23.3% by weight in solution with water; however, it is generally considered ineffective below -17°C . Typical application rate of 113 to 142 kg per 2-lane km is used and costs approximately \$27-91 per tonne. Sodium chloride is generally readily available, easy to store, handle and distribute.

Sodium chloride is highly mobile and can have adverse effects on vegetation, soil, aquatic species, wildlife, and water quality. Sodium chloride is also known to cause corrosion and other damages to vehicles and infrastructure

4.15.2 Calcium Chloride (CaCl_2)

Calcium chloride in its natural state is a synthetic liquid brine solution but can be found as solid flakes. Calcium chloride is more effective as a de-icing chemical than sodium chloride and works at lower temperatures (practical working temperature -31.6°C and eutectic temperature of -51.1°C at a mixture of 29.8% by weight in solution with water). Recommended application rates are 28 to 55 kg per 2-lane kilometer and cost approximately \$110-270 per tonne.

Calcium chloride is known to have similar negative environmental impacts as sodium chloride, however, it is more corrosive to metal.

4.15.3 Potassium Chloride (KCl)

Potassium chloride is a common fertilizer and is less effective than sodium chloride and calcium chloride. It has a practical working temperature of -3.8°C and a eutectic temperature of -11.1°C at a mixture of 19.8% by weight in solution with water. Potassium chloride costs are similar to sodium chloride per tonne. Potassium chloride is slightly less toxic to vegetation and aquatic species but is slightly more corrosive to infrastructure than sodium chloride.

4.15.4 Magnesium Chloride (MgCl_2)

Magnesium chloride in its natural state is a synthetic liquid brine solution but can be found as solid flakes. It is only approximately 48% active. It has a practical working temperature of -15°C and a eutectic temperature of -33.6°C at a mixture of 21.6% by weight in solution with water. Magnesium chloride costs approximately \$90 per tonne and has similar effect on the environment and corrosion.

4.15.5 Calcium Magnesium Acetate (CMA)

Calcium Magnesium Acetate (CMA) is a synthetic powder but can also be found in liquid form. It has a practical working temperature of -6°C and a eutectic temperature of -27°C at a mixture of 32.5% by weight in solution with water. CMA does not work by melting snow and ice, rather it turns it into a slush. Therefore, CMA must be combined with plowing activities and applied prior to or near the onset of a winter storm event to function well in winter maintenance. CMA is a biodegradable substance and there is no evidence that it has an adverse impact on the environment. However, some studies have identified the potential for CMA to decrease dissolved oxygen as it decomposes. CMA is less corrosive to infrastructure than sodium chloride.

CMA is typically used in powder form and as such difficult to handle and store (as it is less dense than sodium chloride and requires approximately 60% more space). CMA has also been known to cause skin irritation. CMA is typically applied at approximately 70 to 113 kg per 2-lane kilometer and costs \$550-1,800 per tonne.

4.15.6 Potassium Acetate

Potassium acetate is typically found in liquid form but can be found in solid form. It is generally considered to perform better than CMA. It has a practical working temperature of -26°C and a freezing point of -60°C .

It is biodegradable and non-corrosive, but as it decomposes to potassium and acetate which exerts a slight Biological Oxygen Demand (BOD). Potassium Acetate must be kept in a clean sealed container or it can prematurely biodegrade. Potassium acetate costs approximately \$550-1,100 per tonne.

4.15.7 Urea Co (NH₂)

Urea is a common synthetic fertilizer comprised of ammonia and carbon dioxide, which is typically found in pellet or liquid form. Urea is less active than sodium chloride and calcium chloride. It has a practical working temperature of -3.8°C and a eutectic temperature of -11.6°C.

Urea can lead to eutrophic condition in water and as it degrades it converts to ammonia, which is toxic to aquatic life. Urea is less corrosive than chlorides.

Urea is typically applied at 113 to 142 kg per 2-lane km and costs approximately \$180 per tonne.

4.15.8 Sodium Formate (HCOONa)

Sodium formate is a waste by-product and found in solid form. It has a similar performance as sodium chloride, with respect to de-icing speed, temperature range and longevity, but it has a eutectic point of -18°C. Sodium formate has similar environmental impacts with regards to sodium ions (i.e. can damage soil structure and contributes to roadway vegetation burn). However, it is a non-corrosive material and costs approximately \$180-320 per tonne.

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5.1 GENERAL

In any project where sanitary sewers are required, the sewer system is to be designed to carry domestic, commercial, and industrial sewage for the area under consideration. Flow is to be by gravity and pumping. Low pressure sewer systems will only be considered where other alternatives are not possible and only with written approval from the Town.

If a pumping station concept is approved by the Town, it shall be designed in accordance with the current MECP guidelines and to the satisfaction of the Town and InnServices.

5.2 CONFIRMATION OF AVAILABLE CAPACITY

Prior to the commencement of any design, the developer and/or designer must contact the Town and confirm that there is adequate external trunk sewer, pumping station and treatment plant capacity to accommodate the proposed project.

5.3 SERVICE AREA

The system shall be designed to accommodate all on site drainage areas as well as all external tributary areas to their maximum future development capacity in accordance with the Town's Official Plan. Sanitary Drainage Plans identifying the internal and external drainage areas will be required.

5.4 DESIGN FLOWS

All sewers shall be sized for peak design flows, including an allowance for extraneous flow (Inflow & Infiltration) based on the following:

5.4.1 Residential Sewage Flows

The design population shall be derived using the proposed Plan of Subdivision and the following densities:

Single Detached and Semi-Detached Dwellings	3.36 ppu
Townhouses	2.70 ppu
Apartments	1.90 ppu

In the absence of detailed information, populations should be estimated based on drainage areas and proposed land uses identified in the Town's Official Plan or in the applicable Master Servicing Studies.

An average daily per capita flow of 250 L/cap/day (excluding extraneous flows) shall be used for average daily domestic flows in future sewered areas. For existing sewered areas, an average daily per capita flow of 275 L/cap/day (excluding extraneous flows) shall be used.

Peak domestic flows are to be calculated using the following formula:

$$Q(d) = \frac{P \times q \times M}{24 \times 60 \times 60} + \text{Extraneous Flow}(I\&I)$$

Where,

Q(d) = Peak domestic sanitary flow, including peak extraneous flows in L/s

P = Design population

q = Average daily per capita domestic flow in L/cap/ day

M = Harmon Peaking Factor (see Section 5.5)

Extraneous Flow (I&I) for Single Detached, Semi Detached, and Townhouse Dwellings =

400 L/cap/day x Design population (Lakeshore System – Future)
600 L/cap/day x Design population (Lakeshore System – Existing)
400 L/cap/day x Design population (Cookstown System – Future)
600 L/cap/day x Design population (Cookstown System – Existing)

Extraneous Flow (I&I) for Apartments and Mixed Use = 20,000 L/ha/ day

5.4.2 Institutional Sewage Flows

Historical water use data at the subject site or a similar site (covering at least 2 years) of the facility or other similar facilities can be used to calculate average institutional flows. Where historical water use data is not available, the unit values for institutional flows listed in the MECP Design Guidelines can be used. The designer shall use professional judgement to select appropriate flow rate within the range.

Average daily flow for elementary and secondary schools shall be calculated using 30 L/student/day. This rate does not include extraneous flows.

5.4.3 Commercial and Industrial Sewage Flows

Equivalent domestic flows for commercial and industrial areas are to be based on actual flow records for similar uses (covering at least 2 years) whenever possible. Where historical data is not available, the designer shall calculate flow rates based on a building floor area, or the lot area or the population basis and approved by InnServices prior to the start of the project.

Peaking factors shall be based on an individual assessment of each type of use or actual flow records whenever possible. In absence of such information, a peaking factor of two (2) may be used.

For more general applications, where the specific use is not known, an average design flow rate of 10 m³/ha/ day and peak flow rate (including extraneous flows) of 20 m³/ha/day shall be used.

5.5 RESIDENTIAL PEAKING FACTOR CALCULATION

Unless specifically defined in a standard flow rate, peak design flows shall be determined by applying a peaking factor to the average daily flows, based on the Harmon Formula, as follows:

$$M = 1 + \frac{14}{4+p^{0.5}}$$

Where,

M = Harmon Peaking Factor

p = Population (in thousands)

Maximum M = 4.0

Minimum M = 2.0

5.6 PIPE CAPACITY

The pipe capacity under full flow conditions is to be calculated using Manning's formula and a roughness coefficient of $n = 0.013$.

Sanitary sewers shall be upsized when flows exceed 85% of full flow under future peak flow conditions during inflow and infiltration.

Sanitary sewer design sheets will be used and included on the drainage area plans. The design sheets shall demonstrate that the proposed pipe capacity and velocities are in accordance with the Town's standards. All design sheets submitted for approval will be sealed, signed, and dated by a professional engineer licensed to practice in the province of Ontario

5.7 VELOCITIES

All gravity sanitary sewers shall be designed and constructed with slopes to provide at least 0.6 m/s of flow velocity, when flowing full to maintain solids in suspension.

The maximum allowable velocity shall be 3.0 m/s at peak flows.

5.8 PIPE SLOPES

The minimum pipe slope shall not be less than 0.5% or that which is required to meet the minimum velocity. Further reductions of the minimum slope must be approved by the Town and InnServices.

The first upstream leg of sanitary sewer shall have a slope of not less than 1.0%.

The maximum pipe slope shall be that which is required to meet the maximum velocity.

5.9 MINIMUM PIPE SIZE – SANITARY MAINS

The minimum pipe size of sanitary mains, including those constructed on private property (condominiums, etc.) shall be 200 mm in diameter.

5.10 DEPTH OF COVER – SANITARY MAINS

In areas servicing basements, a minimum depth of cover of 2.8 m below the centreline road elevation to the obvert of the sewer shall be provided or sufficient depth to connect basement floor drains by gravity using minimum pipe grade of 2% (use longest possible run).

In areas not servicing basements, minimum depth of cover for frost protection shall be 1.6 m below the centreline road elevation to the obvert of the sewer.

In special cases where sufficient cover does not exist, InnServices may consider shallower insulated sewers on an individual basis.

The maximum depth of cover is not to exceed applicable OPSD related to the pipe material unless pipe strength design calculations are provided for approval by the Town.

The maximum depth of sewers with direct lateral connections shall be 6.0 m below finished centreline to the obvert of the sewer. In cases where deeper sewers (>6.0m) are required (at the discretion of InnServices), these shall be considered as trunk sewers and no direct lateral connections will be permitted. Separate local sewers constructed above and adjacent to trunk sewers will be required for lateral connections.

5.11 BEDDING AND BACKFILL

Pipe embedment and backfill for flexible pipes shall be in accordance with OPSD 802.010 and 802.014. Pipe embedment for flexible shall be Granular 'A' in accordance with OPSS.MUNI 1010, unless otherwise approved by InnServices

Pipe bedding, cover and backfill for rigid pipes shall be in accordance with OPSD 802.030 to 802.032, inclusive. Pipe bedding for rigid pipes shall be Granular 'A' in accordance with OPSS.MUNI 1010, unless otherwise approved by InnServices. Pipe cover for rigid pipes shall be Granular 'A', or Granular 'B' (100% passing the 26.5 sieve), unless otherwise approved by InnServices.

Pipe bedding, cover Compaction is to be a minimum of 95% SPMDD and increased to 98% SPMDD within 1m of the road subgrade or as indicated in the approved Geotechnical Report. In soft or wet conditions, additional Geotechnical investigation and testing may be necessary to determine the appropriate bedding and backfill measures.

In areas where the invert of the pipe is below the groundwater table, clay or bentonite seals shall be installed at 50 m intervals as per OPSS 1205 and OPSD 802.095, and the Geotechnical Engineer's recommendation. Seals are to be 1.0 m thick measured along the pipe and are to replace the bedding and backfill.

Sanitary sewers installed lower than 0.5 m below the Seasonally High Groundwater Table (SHGWT) shall be designed to minimize infiltration.

The sewer pipes, pipe joints and connections shall be designed to withstand pressure in accordance with current MECP guidelines without leakage.

5.12 PIPE CLEARANCES

The minimum horizontal clearances shall be provided in accordance with MECP guidelines.

Whether the watermain crosses above or below the sewer, a minimum vertical distance of 0.5m between the outside edge of the watermain and the outside edge of the sewer must be provided. Generally, the watermain shall cross above sewers with sufficient vertical separation to allow for proper bedding and structural support of the watermain and sewer pipes.

When there is conflict with the elevation of the sewer and the watermain such that the watermain cannot pass over the sewer, then the watermain shall be designed such that it passes under the sewer subject to the following conditions:

- a) There shall be a minimum vertical separation of 0.5m between the bottom of the sewer pipe and the top of the watermain;
- b) The watermain shall be lowered below the sewer using vertical thrust blocks and restraining joints;
- c) The length of the watermain pipe shall be centered at the point of crossing so that the joints are equidistant and as far as possible from the sewer, and;
- d) The sewer shall be adequately supported to prevent joint deflection and settling.

A minimum vertical clearance of 0.3m shall be provided between the outside of pipe at the point of crossing for storm and sanitary sewers.

5.13 SEWER LAYOUT

Sanitary sewers shall generally be located as per the typical road cross-sections. Maintenance holes shall be located, whenever possible, with a minimum 1.0m clearance away from face of curb and/or any other service.

Where sanitary sewers are located in easements, the easement width shall be a minimum of 9.0m. However, the Town will review alternative easement widths on an individual basis in certain circumstances such as the utilization of a joint trench or installation of a sewer at a depth which is substantially greater than standard.

5.14 FORCEMAIN TRACER WIRE

Tracer wire shall be #12 AWG (0.0808" diameter" high strength copper clad steel conductor (HS-CCS), insulated with a 30 mm high density polyethylene (HDPE) insulation, rated for direct burial use at 30 volts.

Tracer wire shall be installed on forcemains for locate purposes. Tracer wire shall be brought to the surface every 300 meters using a test station. Each 300 m section of tracer wire is to be tested and confirmed acceptable prior to further pipe installation as per Contract or Agreement requirements.

Forcemains installed by trenchless technologies shall use extra-high strength copper-clad steel. A minimum of four (4) wires to be pulled during installation.

5.15 MAINTENANCE HOLES

5.15.1 General

Maintenance holes shall be as per OPSD 701. All maintenance holes shall be pre-benched up to obvert, to the satisfaction of InnServices and the Town. Sewer pipe connections to new maintenance holes shall have factory installed resilient connectors in the structure openings.

Safety platforms shall be installed in accordance with OPSD 404.020 for all maintenance hole depths of 5.0 m or greater.

5.15.2 Maintenance Hole Location and Spacing

Maintenance holes are to be placed at the beginning and end of each sewer line, at changes in pipe size and/or material, and at changes in grade and/or alignment.

A straight through maintenance hole with similar upstream and downstream sloped sewers shall be provided between new subdivisions and the existing municipal system for the purposes of flow monitoring.

The maximum spacing between maintenance holes shall be 120 m for all pipe sizes.

A maintenance hole will be required on the private property side for sanitary services to commercial, industrial, and institutional properties.

5.15.3 Maintenance Hole Waterproofing

A waterproofing membrane or petrolatum tape shall be applied externally around all joints of maintenance holes and chambers, including all Moduloc. Prior to installing membranes adhering surfaces shall be cleaned from debris/dirt and primed as per manufacturer's recommendation for priming. The membrane and primer shall be installed as per manufacturer's specifications and protected during backfill operations.

Where maintenance holes are located in areas to be flooded by the major storm design, low traffic areas or grassed areas, maintenance hole frame and covers shall be watertight. In all other areas, standard maintenance hole covers shall be used.

5.15.4 Maintenance Hole Frame and Cover

All maintenance holes within an asphalt roadway or maintenance access shall include a self-adjustable auto-stable frame. Structures outside roadways or existing frame and grates in base asphalt which require adjustment for top lift asphalt may use lift rings (when approved by the Town). Otherwise when adjusting the top elevation of maintenance holes, a minimum of one to a maximum of three precast adjustment units (Moduloc) shall be installed on the top of the structure. The maximum vertical adjustment of maintenance holes via Moduloc shall not exceed 300 mm. Any adjustment exceeding this amount shall consist of precast concrete riser sections.

5.15.5 Maintenance Hole New Development Bulkheads and Plugs

Sanitary sewers under construction shall be bulk headed and plugged to prevent infiltration or flushing water from entering the existing sewers, as per TOISD 612 . Generally, bulkheads and plugs are to remain in place until the first occupancy has been permitted. At the discretion of InnServices, bulkheads and plugs may be removed in advance of first occupancy to

accommodate testing of internal plumbing systems. Written approval from InnServices is required prior to the removal of bulkheads and plugs. Once the bulkheads and plugs have been removed, a flow meter will be installed, monitored and maintained by InnServices, at the Owner's expense, in the last downstream maintenance hole connecting to the existing sewer. Removal of flow meters is at the discretion of InnServices and must be coordinated accordingly.

5.15.6 Maintenance Hole Drops

A sufficient drop shall be provided across each maintenance hole to offset any hydraulic losses. The minimum drops across a maintenance hole shall be as follows:

Change in Direction	Minimum Drop
Straight run (0°)	0.025 m
1 - 45°	0.04 m
> 45°	0.06 m

The maximum change in direction permitted in a maintenance hole is 90°.

Drop structures shall be provided when the difference in the inlet and outlet inverts is equal to or greater than 610mm that cannot be eliminated by changing sewer grades. For new maintenance hole the internal drop structures are not permitted.

Obverts of inlet pipes shall not be lower than obverts of outlet pipes.

Except for special cases, the downstream pipe diameter shall always be greater than or equal to the upstream pipe diameter.

5.15.7 Maintenance Hole Frost Straps

Internal frost straps shall be provided on all sanitary maintenance holes, as per TOISD 611. Frost straps to extend to a depth of 3 m from finished grade. Internal frost straps shall be non-penetrating, anchored in the internal chamber wall as per pre-cast chamber manufacturer recommendations. To be factory cast inserts (pre-fabricated fastener sleeves).

5.16 FUTURE SANITARY CONNECTIONS

Where a sanitary sewer is to be stubbed, a sanitary maintenance hole will be required to limit infiltration into the existing system.

5.17 SANITARY SERVICE CONNECTIONS

Single connections for residential and industrial use shall be located in accordance with TOISD Division 600 for each type of residential lot.

All residential unit sanitary service connections shall be single type 125 mm diameter, with a 125 mm x 100 mm test fitting at property line. For new developments, the service shall be extended 3.0 m beyond property line, with an additional test fitting, plug, brace, and marker. Refer to TOISD 605. Connections for commercial, industrial and institutional will be considered on an individual basis but will generally be 150 mm diameter with a maintenance hole just beyond property line.

The minimum slope for all service connections shall be 2.0%.

Tees shall be installed at a 45° angle to the main, where possible, such that the invert of the tee is at the springline of the main.

Service connections shall be located at a minimum depth of cover of 2.6 m or sufficient depth for basement floor drains and frost cover. Service connections should cross under watermains.

Where the depth to the obvert of the sanitary main is deeper than 4.5 m from final road centreline elevation, the use of a sanitary riser is required. Controlled settlement joint fittings are to be used on all risers, conforming with the approved materials list.

Residential service connections are not permitted to connect directly to sanitary maintenance holes, unless approved by InnServices. Connections must occur on the sanitary main, a minimum of 1.0m away from the edge of the maintenance hole to ensure the structure of the main does not become compromised and result in issues with infiltration.

Sanitary service connections to new sewer mains shall be made with factory manufactured tees.

Sanitary service connections to existing sewer mains shall be made by coring and installing a gasket saddle tee.

Generally, if the sanitary service has a size greater than half the diameter of the mainline sewer, connection to a maintenance hole is required. New maintenance hole installations to existing mainline sewers are to be completed via doghouse maintenance hole structures. Consultation with InnServices is required for the design and construction of doghouse maintenance hole structures.

All floor drains are to be connected to the sanitary service connection. Foundation drains and roof water leaders are not to be connected to the sanitary system.

5.18 INSPECTION AND TESTING

The following inspection and testing requirements apply to all new sanitary sewers and maintenance holes. Any sections of sewer, maintenance hole or service connections which fail to meet the requirements shall be repaired or replaced at the direction of the Town and InnServices.

An Inspection and Testing Plan shall be prepared and submitted to InnServices at least two (2) weeks prior to the inspection or testing. Plan shall follow the requirements outlined in the most recent revision of the MECP Design Criteria for Sanitary Sewers, Storm Sewers and Forcemains for Alterations Authorized under an Environmental Compliance Approval.

5.18.1 Deflection Testing

All newly installed PVC sanitary sewers shall be subjected to deflection testing in accordance with OPSS 410.

5.18.2 Infiltration/Exfiltration Testing

All newly installed sanitary sewers shall be subjected to infiltration/exfiltration testing in accordance with OPSS 410. Groundwater levels must be considered when determining the appropriate testing method. The static water levels shall be measured and recorded by the Consultant Engineer.

Sanitary sewer infiltration testing is required when the groundwater level at the time of the testing is 600mm or more above the crown of the pipe for the entire length of the test section, per OPSS 410. Dewatering operations must be discontinued at least three days before conducting the test to allow the groundwater level to stabilize.

Sanitary sewer exfiltration testing is required when the groundwater level at the time of the testing is lower than 600mm above the crown of the pipe for the entire length of the test section or the highest point of the highest service connection included in the test section, per OPSS 410.

5.18.3 CCTV Inspection

All newly installed sanitary sewers shall be subjected to a CCTV Inspection. Refer to Appendix D for CCTV Inspection Requirements.

5.18.4 Visual Inspection – Maintenance Holes

All maintenance holes shall be visually inspected by the Town and InnServices for deficiencies. When requested by the Town, maintenance hole scans shall be provided by a qualified third-party sewer inspection firm. Scans must be completed using 100% digital panoramic scanning equipment. The digital files provided must include a distortion-free virtual pan and tilt to view the MH from any angle and at any depth. The Town must be able to view all pan, tilt, and unfolded views. If specific software is required, it must be provided to the Town with the digital files.

5.18.5 Testing – Maintenance Holes

Leakage testing is required on all new sanitary maintenance holes in high groundwater locations, at the discretion of InnServices. Testing methodology to be provided to InnServices for review and acceptance.

5.19 MATERIALS

Refer to Appendix B for a list of materials and specifications.

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SECTION 6.0: WATER SUPPLY AND DISTRIBUTION SYSTEM**6.1 GENERAL**

The water distribution system is to be designed as a network system to meet the water demand for each area or development under consideration. To ensure reliability, a looped system must be provided to the satisfaction of the Town and InnServices.

6.2 CONFIRMATION OF AVAILABLE CAPACITY

Prior to the commencement of any design, the developer and/or designer must contact the Town and InnServices and confirm that there is adequate system capacity to accommodate the proposed project.

6.3 SERVICE AREA

The system shall be designed to service all areas within the development to their maximum future capacity in accordance with the Town's Official Plan. Allowance shall be made for connection to appropriate watermains in adjacent developments or future growth areas. The exact location for these connections shall be approved by the Town.

6.4 DESIGN FLOWS

The estimated populations and development areas shall be by the Town's Official Plan.

The design population shall be derived using the proposed Plan of Subdivision and the following densities:

Single Detached and Semi-Detached Dwellings	3.36 ppu
Townhouses	2.70 ppu
Apartments	1.90 ppu

In the absence of detailed information, populations should be estimated based on proposed land uses identified in the Town's Official Plan or in the applicable Master Servicing Studies.

Watermains shall be designed to meet the greater of the maximum day demand plus fire flows or peak hour demand.

The average daily demand shall be:

Future Residential = 250 litres/capita/day

Existing Residential = 275 litres/capita/day

Commercial and Industrial – Site Specific Calculation (210m³/ha/day if specific use is unknown) (or site specific calculations)

Institutional = Historical water use data at the subject site or a similar site (covering at least 2 years) of the facility or other similar facilities can be used to calculate average institutional daily demand. Where historical water use data is not available, the unit values for institutional water demand listed in the MECP Design Guidelines can be used. The designer shall use professional judgement to select appropriate flow rate within the range.

Average daily demand for elementary and secondary schools shall be calculated using 30 L/student/day.

SECTION 6.0: WATER SUPPLY AND DISTRIBUTION SYSTEM

The maximum daily demand factor shall be determined from the current MECP design guidelines; however, a minimum of 1.8 is to be used.

Peak demands for land use other than residential shall be determined on an individual basis and approved by InnServices.

In general, the following minimum fire flow demands shall be used, unless the Fire Underwriters Survey (FUS) calculations require a higher fire flow:

Land Use	Required Fire Flow (L/s)
Residential – Single Family	100
Residential – Townhouse	135
Institutional – School	150
Institutional – Community (community services and facilities such as hospitals, churches or community recreational centres)	200
High Rise/Downtown/Mixed Use	200
Commercial – Small Businesses	125
Commercial	250
Industrial	325

The above noted requirements do not take into consideration any reductions that could reduce fire flow needs. Specific fire flow demand shall be calculated according to the latest published requirements of the Water Supply for Public Fire Protection (Fire Underwriters Survey (FUS)). Proposed fire flows (eg. For submitted site servicing plans) that are less than standard recommended would require approval by the Town of Innisfil and InnServices.

Where existing municipal infrastructure cannot meet the updated fire flow requirements, alternate methods should be reviewed to meet the level of service for fire protection required (e.g., sprinkler systems, fire rated materials, or additional on-site fire storage and pumping facilities). Fire flow requirements for new development in existing settlement areas should be reviewed on a case-by-case basis. Newly developed areas shall comply with the above fire flow requirements.

Fire flow requirements would also be subject to the fire protection requirements of the Ontario Building Code.

6.5 WATERMAIN SIZING

The Hazen-Williams formula shall be used for computing friction losses and subsequently sizing the watermains.

For new mains, the Hazen-Williams factors, “C”, shall be as follows:

C	=	100	for 150 mm diameter
C	=	110	for 200 mm and 250 mm diameter
C	=	120	for 300 mm diameter and greater

SECTION 6.0: WATER SUPPLY AND DISTRIBUTION SYSTEM

The minimum size of watermain shall be 150 mm diameter in residential developments, except beyond last hydrant on cul-de-sacs where the minimum diameter of watermain shall be 50mm. The minimum size of watermain shall be 200 mm diameter in industrial, commercial, and institutional developments.

For distribution systems that are not designed to provide fire protection, the minimum diameter of the watermain line shall be 75mm.

A hydraulic network analysis of the water distribution system shall be carried out by InnServices Modelling Engineer based upon the information received from the designer.

6.6 WATERMAIN PRESSURE

The minimum pressure during maximum daily demand (MDD) shall be 345 kPa (50 psi)
The minimum pressure during the peak hourly demand (PHD) shall be 275 kPa (40 psi).

The minimum pressure when the system is tested under fire flow conditions in conjunction with the maximum daily demand shall be 140 kPa (20 psi).

The maximum pressure under static load or during the minimum hourly demand shall be 550 kPa (80 psi).

6.7 OVERSIZING

Oversizing of watermain will be provided as required to provide for adjacent areas where service is expected to be extended, and to provide fire flow requirements including oversizing of hydrants, openings and leads as required.

6.8 WATERMAIN LAYOUT

Watermain shall generally be located as per the typical road cross-section.

When watermain are located within the boulevards, standard positions being on north and west side of the street. It is preferred to locate watermain on the opposite side of the road from the hydro distribution system. Refer to typical road cross-section for general guidance.

When watermain are located in easements, the easement width shall be 6.0 metres minimum. However, the Town will review alternative easement widths on an individual basis in certain circumstances such as the utilization of a joint trench or installation of a sewer at a depth which is substantially greater than standard.

6.9 MINIMUM DEPTH OF COVER

For urbanized roads a minimum depth of cover of the 1.7 m below finished ground surface or 1.9 m below road centreline, whichever is greater, is required.

Along open ditches, or unimproved roads, an increased cover may be requested by the Town to allow for future road improvements or lowering of road profile when urbanization occurs.

The maximum height of fill is not to exceed OPSD 808.010 unless pipe strength design calculations are provided for approval by the Town.

In zones where minimum cover cannot be provided design of pipe insulation must be submitted by the Engineer for approval by the Town.

The as-built elevations should be shown at every bend, tee, and every 20m on straight sections on the as-built plans.

6.10 PIPE CLEARANCE

Minimum clearances between other types of services (i.e. sanitary/storm) shall be provided in accordance with MECF guidelines.

Under normal conditions, watermains shall cross above sewers with a minimum of 0.5m vertical separation to allow for proper bedding and structural support of the watermain and sewer main.

When it is not possible for the watermain to cross above the sewer, the design shall refer to MECF guidelines and Section 6.13 below.

6.11 BEDDING AND BACKFILL

All watermain and appurtenances are to be installed with bedding and embedment (well-graded sand, which is free of stones, unless otherwise approved by InnServices) and backfill in accordance with OPSD 802.010 or 802.030 to 802.032, as applicable.

Compaction shall be to a minimum of 95% SPMDD and increased to 98% SPMDD within 1m of the road subgrade or as indicated in the approved Geotechnical Report.

In soft or wet conditions, additional Geotechnical investigation and testing may be necessary to determine the appropriate bedding and backfill measures.

All water services shall be embedded in well-graded sand, which is free of stones, 150mm above and below the service pipe, per TOISD 705.

6.12 RESTRAINING

All joints are to be mechanically restrained in fill areas, as per manufacturer's recommendations.

Concrete thrust blocking shall be installed at all tees, vertical and horizontal bends, hydrants, ends of watermain and connections 100 mm and larger, as per OPSD 1103.010 and OPSD 1103.020, in addition to restraining glands at mechanical joints.

All watermain and thrust restraints shall be designed to withstand the maximum operating pressure, plus the transient pressure to which it will be subjected. The value of transient pressure will not be less than the pressure surge that would be created by immediate stoppage of water column moving at 0.6m/s. The design pressure shall not be less than 150psi (1034kPa) in any case.

6.13 LOWERING OF WATERMAIN FOR CROSSINGS

If it is necessary to lower a watermain to avoid a conflict with other infrastructure, the designer shall refer to TOISD 727.

The maximum permissible vertical bend shall be 45° and the minimum length of the deflected watermain shall be 1.5 m.

Using 90° horizontal bends should be avoided where alternatives exist.

All fittings installed along watermains should not be located under any under service line, utility line, concrete curb or any other element restricting direct access to the pipe.

6.14 SUPPORTING OF WATERMAIN

Where crossing an existing watermain, if more than 0.9 m of the watermain will be exposed, the designer will be required to provide detailed drawings showing how the watermain will be supported during construction for approval by the Town.

6.15 TERMINATION OF WATERMAIN

Design proposal for the watermain system shall ensure that adequate water quality requirements are met. Water distribution systems should be designed without any dead-end pipes. Sizing of watermain in cul-de-sacs shall be done as described in Section 6.5 and engineering calculation for the size of looping pipe must be submitted for review.

Where dead-end watermain pipe is allowed, it must be terminated with a valve and hydrant, both in locations approved by InnServices. The use of blow-offs may be permitted at the discretion of InnServices.

6.16 FIRE HYDRANTS

Hydrants shall be installed in accordance with TOISD 703, complete with thrust blocks and mechanical restrainers. Driveway hydrants shall be installed in accordance with TOISD 725.

Hydrants shall be installed on all watermains with a maximum allowable spacing along the watermain of 120m in single family residential areas and 90m in industrial, commercial, institutional, townhouse and multi-residential areas land uses, or as required by the Town and InnServices.

Hydrants shall be located as per the typical road cross-section and generally on projections of lot lines, at the end of all cul-de-sacs, and at dead ends. Hydrant locations shall be at the discretion of the Town and InnServices. On rural cross-sections, hydrant access behind the ditch, complete with culvert, is to be provided. Refer to Appendix C for minimum clearances from other above grade features.

Hydrant flanges shall be set such that the final elevation is 100 mm maximum above finished grade. The as-constructed elevation of the top of flange should be labelled in the set of as-recorded drawings. Hydrant extensions are not allowed unless approval is given by InnServices.

In areas where the water table is known to be high, the Town and InnServices may request that the drain holes of the hydrant be internally plugged. Yellow stripe to be painted on hydrant if drain port is plugged as per TOISD 703.

Hydrants are to be fixed with anti-tampering devices at the discretion on the Town and InnServices

All hydrants are to be fixed with hydrant markers.

Paint specifications are subject to Town approval. Refer to Section 6.27.3 for testing and painting requirements.

Refer to Appendix B for a list of approved materials and specifications.

6.17 VALVES

The size of main line valves shall be equivalent to the size of the watermain.

SECTION 6.0: WATER SUPPLY AND DISTRIBUTION SYSTEM

Valves shall be located as required to meet spacing and intersection requirements, or as required by InnServices.

Generally, four (4) valves shall be placed at cross-intersections and three (3) valves at tee intersections, such that sections can be isolated without jeopardizing flow to other sections. Possibility to eliminate some of the valves will be confirmed during early stage of review of the engineering drawings.

Valves shall be spaced such that no more than forty (40) dwelling units are isolated at one time. In addition, the maximum permissible spacing between valves shall be 300 m for distribution/servicing watermains, and 400 m for trunk supply watermains.

All valves 450 mm diameter or greater shall be installed in a concrete valve chamber.

Air release valves on watermains up to and including 250mm diameter to follow TOISD 713 or to be direct bury installation, at significant high point locations where a fire hydrant is not located at the highpoint. For watermains 300mm or larger, air release valves to follow TOISD 713 or TOISD 715 and shall be provided at significant high points and, where possible, installed together with valves in valve chambers. Further, where possible, fire hydrants shall be located at all highpoints to minimize the negative impacts of trapped air.

Drain valves shall be provided at low points of all trunk watermains and, where possible, installed together with valves in valve chambers. Drain Chambers should be connected to a storm sewer maintenance hole, or to another technically feasible outlet point.

Where confirmed by the water modelling calculations, a pressure reducing valve shall be installed in an enclosure complete with an internal watermain bypass. Enclosures shall be sized appropriately to accommodate the pressure reducing valve, watermain bypass and all appurtenances to the satisfaction of InnServices. Detailed requirements will be confirmed by InnServices at the time of completion of the water modelling report.

A waterproofing membrane or petrolatum tape shall be applied externally around all joints of chambers and is to be overlapped halfway up the structure frame. The membrane shall be installed as per manufacturers specifications and protected during backfill operations.

Watermains crossing creeks, railways and provincial highways shall have a valve on each side of the crossing.

6.18 WATER SERVICES

Single 25 mm diameter water services with a curb stop at 0.3 m in front the property line is to be installed to each residential property.

Water services to commercial, industrial, institutional, and multiple use shall be sized for the specific land use and approved by the Town.

Single services for a residential lot shall be located in accordance with TOISD Division 600. The location of a water service for commercial, institutional, or industrial use will be considered on an individual basis.

SECTION 6.0: WATER SUPPLY AND DISTRIBUTION SYSTEM

Water services shall be located at a minimum depth of cover of 1.7 m with the curb stop being at least 1.0 m away from the future driveway. If a three (3) car garage is allowed by the zoning By-Law, and may be constructed on a lot, water services and curb stop should be installed with offset to accommodate such options. Any curb stop/water service must be relocated if found to be within the driveway or at unacceptable separation during the construction stage. If a curb stop cannot be relocated, InnServices Water Operations must be notified and contacted for an inspection before the driveway is paved to ensure a frost collar has been installed.

When the water service line is in conflict with any main service pipe (typically storm sewer main), the water service must be installed below the storm sewer with separation as required by MECP. Creation of high points along water service line is not allowed, with exception of a vertical goose neck, established near main stops for residential sized copper water services.

Where minimum pressure rates cannot be met, use of house-based water booster pump maybe allowed. Such system may be allowed as temporary solution after consultations with the Town.

6.19 WATER SAMPLING

Water sampling stations shall be provided where directed by the Town. In general, one (1) sampling station is required at a rate of one (1) per three-hundred (300) units. Sampling Station should be located within municipal ROW or in a corner area of municipal blocks (e.g. parks, parkettes). Locations in the intersection areas are not allowed.

6.20 FIRE DEPARTMENT CONNECTIONS

Fire department connections may be required for industrial, commercial, or institutional developments. Configuration of the fire and domestic water service connection is to be confirmed by the Town during pre-submission consultations.

6.21 FIRE SERVICE BACKFLOW PREVENTION

On private property, where a private fire service main is installed with private fire hydrant(s), a testable backflow prevention device shall be installed on the private fire service main to provide premise isolation to guard against possible cross-contamination of the municipal water system.

The selected backflow prevention device shall be determined by the Owners Consultant Engineering based on CSA B64.10 series standards, AWWA Canadian Cross-Connection Control Manual, Ontario Building Code and be in accordance with NFPA 24.

If determined by the Owners Consultant Engineer that a Reduced Pressure Principle (RP) backflow preventer is required, such backflow preventer shall be installed in an above ground enclosure and follow the requirements listed in Section 26 - Backflow Prevention.

If determined by the Owners Consultant Engineer that a Double Check Valve Assembly (DCVA) is acceptable, the DCVA shall be installed in an above ground enclosure or an underground chamber.

If installed in an underground chamber, the chamber housing the DCVA shall adhere to the following as a minimum:

- The chamber shall be located on private property, 0.3m minimum from property line.
- The chamber shall be located in a grassed area, not permitted in a driveway or laneway.

SECTION 6.0: WATER SUPPLY AND DISTRIBUTION SYSTEM

- To protect the valve and piping from freezing, the chamber shall have 50mm rigid insulation on the underside of top cap, on the interior walls to a minimum depth of 1.2m below grade and the access riser shall have a 50mm of removable rigid insulation.
- The chamber shall be designed to ensure a dry condition is maintained.
 - Gravity drain to storm system complete with check valve (preferred) or a permanently installed sump pump.
 - Precast concrete joints to have watertight gaskets, and to be externally wrapped with waterproofing membrane.
 - Internal frost straps shall be non-penetrating, anchored in the internal chamber wall as per pre-cast chamber manufacturer recommendations. To be factory cast inserts (pre-fabricated fastener sleeves).
- Clearances around the DCVA meet CSA B64.10 series standards.
- All test cocks on the DCVA device shall be plugged using a mean that is watertight.
- Chamber design shall be subject to the approval of InnServices and the Town.

The property Owner shall be fully responsible for private fire service main, enclosure or chamber, backflow preventer, hydrant(s) and all appurtenances, including but not limited to, all maintenance, inspection, testing, repair or replacement.

6.22 WATER METERS

A water meter is required for each water service. The water meter will be sized by InnServices using the peak instantaneous flow provided by the designer.

6.23 TRACER WIRE

Tracer wire shall be installed on all watermains, services, and hydrant laterals, except where such service is of copper material.

For open cut installations, tracer wire shall be #12 AWG (0.0808" in diameter) high strength copper clad steel conductor (HS-CCS), insulated with a 30 mm high density polyethylene (HDPE) insulation rated for direct burial use at 30 volts. Tracer wire shall not be wrapped around bolts or components along mainline and shall not be placed under any pipe or appurtenance. Tracer wire shall be laid flat and securely affixed with mastic tape to the top of the watermain at 5.0 m intervals.

For trenchless installations, tracer wire shall be extra-high strength copper-clad steel. A minimum of four (4) wires to be pulled during installation.

Breaks or cuts in the tracer wire are only permitted at the following prescribed locations:

- hydrant laterals,
- fireline water services,
- tees and crosses.

Tracer wire shall be looped at each hydrant such that the tracer wire is brought above ground in a 1" rigid PVC conduit placed at the back of the hydrant and looped back down the hydrant lead to the mainline. The looped wires are to be tightly taped together and left untouched in a hydrant Three Terminal Test Station, which is to be installed at the back of each hydrant and bolted at the flange.

Tracer wire shall not be brought up any mainline or secondary valves.

SECTION 6.0: WATER SUPPLY AND DISTRIBUTION SYSTEM

For PEX water services, tracer wire shall run between the shoulder set screw on the main stop to the shoulder set screw on the curb stop. Tracer wire for the PEX water service is not to connect to the watermain tracer wire. A grounding anode shall be installed at each main stop location by clamping the wire running from the anode to the main stop shoulder set screw. Profiling mastic and petrolatum tape to be applied at shoulder set screw locations as per TOISD 705-B.

In areas where more than one watermain exists on a single street, such as a transmission main and a distribution main, the tracer wire must be brought up at intervals of no greater than 350 m using a test station when no other connection points are available. Tracer wire running from the mainline to a connection post shall be in a 1" rigid PVC conduit. The test station shall be installed 1.0 to 1.2 meters above grade and shall be colour coded blue.

Refer to Appendix B for a list of approved materials and specifications.

6.24 CORROSION PROTECTION

All watermain fittings, valves and restrainers in chambers or direct bury shall have protective coatings applied. The protective coating shall be a petrolatum tape system consisting of a petrolatum primer paste, petrolatum molding mastic, and cold wrapped petrolatum tape applied in accordance with manufacturer guidelines.

In addition to the protective coating, sacrificial caps are to be provided on every bolt of all mechanical joints and restrainers. The bolt lengths shall be sufficient to accommodate the caps.

Sacrificial zinc anodes (5.4kg) shall be connected to copper water services, wire attached with ground clamp and installed in accordance with OPSS 442 and OPSD 1109.010 & 1109.011.

At their discretion, the Town or InnServices may also require a sacrificial zinc anode (10.8 kg) connected to hydrant boot, wire attached with thermite weld and installed in accordance with OPSS 442 and OPSD 1109.010 & 1109.011. Exposed weld to be protected in thick coat of mastic.

At their discretion, the Town or InnServices may also require other corrosion protection measures.

6.25 CAUTION TAPE

When the watermain or water service has been installed in non-standard locations, blue caution tape is to be installed, along its length, between 0.3 m and 0.5 m above the watermain or service.

6.26 BACKFLOW PREVENTION

Backflow prevention devices must be installed and maintained on all existing and/or proposed water services to industrial, commercial, institutional and multi-residential buildings to prevent the flow of contaminants into the municipal drinking water system in accordance with the Town of Innisfil Backflow Prevention By-Law.

Where a private water system is connected to the municipal water system, the municipal water system shall be protected through premise isolation of the private system by installation of a backflow prevention device in an aboveground enclosure or underground chamber. Additional consultation with InnServices is required for the use of an underground chamber to house a backflow preventer device and bulk water meter. Aboveground enclosures are to follow TOISD 726.

SECTION 6.0: WATER SUPPLY AND DISTRIBUTION SYSTEM

Backflow prevention devices must be installed downstream of the property's water meter, or in the case of a fire protection system, where the fire protection system enters the building.

Aboveground enclosures or underground chambers are to be located on private property, as close to the property line as possible, with adequate clearance around the enclosure for access during testing and maintenance.

Enclosures and chambers shall be sized to accommodate the selected backflow preventer and water meter as applicable and to the satisfaction of InnServices. Enclosures shall be prefabricated, insulated and heated to maintain temperatures above freezing and in accordance with ASSE 1060 Standards.

All backflow prevention devices, appurtenances and enclosures must be selected and maintained in accordance with the manufacturer's specifications, and the guidelines set out in the most recent version as well as AWWA, Canadian Cross Connection Control Manual, CSA Standards, Ontario Building Code and applicable Provincial Regulations.

6.27 TESTING AND DISINFECTION

The following testing requirements apply to all new sections of watermain. Any sections which fail to meet the requirements shall be repaired or replaced at the direction of the Town and InnServices. A temporary bypass connection is to be installed to permit testing of the system.

6.27.1 Watermain Commissioning

All watermains and service pipes 100mm diameter or greater are to follow InnServices Watermain Connection and Commissioning Standards Manual, which outlines the requirements for swabbing, flushing, hydrostatic pressure testing, disinfection, microbiological testing and final connection. Refer to Appendix H for InnServices Watermain Connection and Commissioning Standards Manual.

6.27.2 Continuity Testing

A continuity test for the tracer wire must be conducted by an independent third party. The Contractor has the option to perform the continuity test themselves, provided that a representative from the Town or InnServices is present to witness the procedure.

The test must be conducted using locating equipment that is approved by InnServices and operating with a maximum output of 50% and a frequency of 512Hz.

Continuity tests are to be conducted after the final connections between new and existing watermains have been completed, but before the certification and acceptance of the underground works, unless otherwise specified in the Contract Documents. An additional continuity test is required prior to the placement of the surface course asphalt, unless the surface course asphalt layer is completed within the same calendar year as the initial continuity test.

In the case of a continuity test failure, the Contractor is responsible for troubleshooting all faults, completing necessary repairs, and arranging a subsequent continuity test, all at no cost to the Owner.

6.27.3 Fire Hydrant Flow Testing

Hydrants are to be flow tested, by an organization approved by InnServices, to determine performance while maintaining a minimum residual system pressure of 140 kPa (20 psi), in

SECTION 6.0: WATER SUPPLY AND DISTRIBUTION SYSTEM

accordance with NFPA Standard 291. Tests shall follow InnServices Hydrant Flow Testing Protocol (Refer to Appendix I)

All hydrants are to be painted as follows:

- a) Body – Tremclad fire engine red
- b) Font Nozzle – Tremclad black
- c) Top and side nozzle caps – as per the results of the flow testing noted below

CLASS	CAPACITY	COLOUR
Class AA	> 5680 L/min (>95 L/sec)	Tremclad - Safety Light Blue
Class A	3785 L/min to 5675 L/min (63 L/sec to 95 L/sec)	Tremclad – John Deere Green
Class B	1900 L/min to 3780 L/min (32-63L/sec)	Tremclad - Safety Orange
Class C	< 1900 L/min (<32 L/sec)	Tremclad - Safety Red

Flow testing shall be coordinated with InnServices.

6.28 MATERIALS

Refer to Appendix B for a list of approved materials and specifications

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SECTION 8: PARKS AND LANDSCAPING**7.1 GENERAL**

The grading and drainage design, whether it is being prepared for an individual lot, small site, or entire development, should be completed with the following objectives:

- a) to provide positive drainage and maximize the use of land while minimizing maintenance requirements;
- b) to complement the land and suit the type of structure that is to be constructed;
- c) to accommodate runoff from adjacent lands and to ensure that the adjacent and downstream properties are not adversely affected;
- d) to minimize the perimeter disturbance and preserve existing trees, where required; and
- e) to minimize the use of rear lot catchbasins and retaining walls.

Where the overall grading of an area, such as a park or townhouse block, cannot be completed until after the area is fully developed, for example in the case of a phased development, the designer will be required to develop an interim grading and drainage design for that area, to the satisfaction of the Town.

7.2 GENERAL GRADING

For residential lots and blocks, it is preferable to have one consistent slope of between 2% - 5% for the entire rear yard area; however, where this is not possible, lots are to be provided with a rear yard amenity area in which a slope of between 2% - 5% is provided for a minimum of 5.0 m or 75% of the average rear yard length from the rear of the house, whichever is greater. Slopes from the end of the rear yard amenity area to the rear lot line shall not exceed 3:1. All exceptions must receive written approval from the Town.

All other areas shall have a minimum slope of 2% and a maximum slope of 3:1, if sufficient space is available.

Any lot with a 10% average grade may require a split-level dwelling and cross sections may be required.

7.3 SWALES

All swales are to be designed with a minimum slope equal to or exceeding 2.0% and a maximum slope of 5.0% with maximum side slopes of 3:1. If a slope equal to or exceeding 2.0% cannot be met due to grading constraints, a minimum of 1.5% can be considered if a perforated subdrain of 100mm in diameter covered in 19mm clear stone and wrapped in filter cloth is provided beneath the swale to reduce surface ponding. The subdrain must outlet to grade or a catchbasin.

All swales shall have a minimum depth of 0.15 m. Trapezoidal swales shall have a minimum bottom width of 0.30m. Drainage swales will require a Section 119 Restriction registered on title to prohibit the owners from restricting the drainage. The maximum depth for side yard and rear yard swales shall be 0.3 m and 0.4 m respectively.

The maximum contributing area to a side yard swale shall be 500 m². For rear yard swales, the maximum contributing area shall be 1,000 m² and the maximum length shall be 60 m. The flows from the contributing areas should be calculated and the capacity of the swale confirmed to ensure adequate conveyance.

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Swales shall not drain from one lot to another where the property lines are offset by more than 1.0 metre or drainage swale alignment deviates by more than 45 degrees. In these cases, catchbasins are required.

7.4 REAR YARD CATCHBASINS

Rear yard catchbasins are discouraged and will only be considered where necessary and where all structures are protected from flooding if the inlet is blocked or surcharged by a major storm event.

Where the rear yard catchbasin lead extends between houses, the rear yard catchbasin shall be placed on a 3.0 m wide easement. The easement shall extend 1.8 m onto the lot which includes the catchbasin storm piping and 1.2 m onto the adjacent lot. The catchbasin lateral shall be placed such that the centre is 0.5 m off the common lot line. The catchbasin shall be placed such that the centre is 1.5 m offset from the rear lot line.

Where the rear yard catchbasin lead extends across the rear yard of a corner lot, the rear yard catchbasin shall be placed on a 3.0 m wide easement with the catchbasin placed such that the centre is 1.5 m offset from the rear lot line.

Rear yard catchbasin leads are to be PVC. The minimum size of the connection shall be 300 mm in diameter. Minimum slope shall be 0.5%. No inlet control devices are to be used in locations where the rear lot catchbasin is connected to the road catchbasin or the maintenance hole.

Where the lead goes between the houses, catchbasin leads shall be concrete encased between the front building line and rear building line.

Maintenance holes on the mainline sewer shall be placed, where possible and applicable, at the intersection of rear lot catchbasin leads and the mainline to facilitate access to the rear lot catchbasin pipe. For locations where placement of maintenance hole at the inlet of rear yard catchbasin lead is not possible or feasible, such lead must be connected to road catchbasin which connects to a main line (without maintenance hole). The pipe connecting the road catchbasin with the main line must be of a diameter accommodating flows from the rear yard and the road surface.

Rear yard catchbasins shall not have sumps;

The proposed lowest adjacent opening elevation (i.e. basement window sill) shall always be above the maximum ponding level above the catchbasin, at which point there would be overland relief; Maximum ponding level above a rear lot catchbasin is 0.15m unless otherwise directed by the Town.

7.5 RETAINING WALLS

Retaining walls considered “Designated Structures” within the scope of the Ontario Building Code (OBC) will require a building permit from the Town of Innisfil’s Community Development Standards Branch. All other structures shall require engineering drawings stamped by a licensed professional engineer and shall conform to the following requirements:

For the purposes of this section, the height (h) of a retaining wall shall be measured from the finished ground level to the highest point of the wall and, if the height on one end of the wall is different from the height on the other end, the greater of the two shall apply.

- a) Retaining walls are to be constructed entirely on the upper lot so that the tiebacks, backfill, or wall system does not cross property boundaries of the lower graded lot.

SECTION 8: PARKS AND LANDSCAPING

- b) Retaining walls greater than 1.0 m in height are discouraged and will be reviewed by the Town only when the overall grading design warrants such grading differentials.
- c) If a retaining wall is required, a detailed drawing indicating the design, location, property line, height, tiebacks, etc. shall be submitted for approval. Construction details of retaining walls, including filter fabric and subdrain or alternative drainage, must be noted on both grading control and individual lot grading drawings and approved by the Town. Subject to detailed design and review at the building permit stage retaining walls may be either removed or added to the Lot Grading Plan.
- d) Retaining walls are not to be constructed of wood materials and must be stone with stackable connection blocks to provide an acceptable structural design.
- e) A minimum setback of 500 mm should be maintained from retaining wall tiebacks to the foundation of any structure. If the grading does not permit this setback, a Professional Engineer, licensed in the province of Ontario, shall provide a detailed design for Town consideration.
- f) All retaining walls with an exposed face height of 1.0 m or greater shall be designed and certified by a Professional Engineer, licensed in the province of Ontario specializing in structural engineering. The design must be accompanied by calculations clearly demonstrating that it is structurally satisfactory for the particular location and soil type.
- g) Any and all retaining walls shall have their construction certified by the Design Engineer prior to the release of grading securities and to commence the maintenance period.
- h) All retaining walls with an exposed face height of 1.0 m or greater shall incorporate a 1.5m high chain link fence or approved equivalent at the top. The structural stability of the retaining wall in use must be able to withstand any extra forces exerted by the fence as well as the earth loads.
- i) The detailed drawing shall include the following notes and illustrate:
 - i. Note 1: The walls have been designed in accordance with accepted engineering principles;
 - ii. Note 2: That the wall is suitable for the geotechnical condition of the site and for the loading type;
 - iii. Weeping tile must be directed to a positive outlet;
 - iv. A filter cloth envelope surrounding the compacted free draining granular material;
 - v. Sufficient top of wall and bottom of wall elevations;
 - vi. Type and material of wall;

- vii. A cross-section for the length, type, and location of any tiebacks;
 - viii. Surcharge load used and appropriate design calculation;
 - ix. A swale at the top of wall, if drainage directs to the wall.
- j) Retaining walls equal or higher than 1.0 m shall additionally include the following:
- i. Must be set back from the nearest property line or adjacent retaining wall a minimum distance of 0.6m;
 - ii. The Design Engineer shall be responsible for ensuring all set-back and zone of influence issues are resolved to the satisfaction of the Town;
 - iii. If adjacent to a public property access to a building, or private property to which the public is admitted, a building permit shall be required (refer to Article 1.1.2.2. (2) of the Ontario Building Code);
 - iv. Shall be designed inspected during construction and certified by a Structural Engineer and a Geotechnical Engineer. Certification is to be submitted to the Town prior to the release of any financial securities;
 - v. The location, type, and fastening of the 1.5m chain link fence, or approved equivalent, must meet the manufacturer's recommendations; and
 - vi. It is advised that Town Staff be contacted regarding the required retaining wall set-backs.
- k) Retaining walls that are maintained, repaired, and replaced by the Town shall require a minimum 2.0m easement for Town's access.

Shop drawings will be required for the retaining walls and appurtenances prior to construction. The retaining wall manufacturer and designer shall provide structural approval by a Professional Engineer licensed in Ontario to the satisfaction of the Town.

The safety fencing required for the retaining walls shall be designed with a top and bottom rail and be structurally designed by a Professional Engineer licensed in Ontario for placement on top of the retaining wall as per the retaining wall manufacturer's specifications. Material, post spacing, brace posts, and wire mesh shall be designed and approved by a structural engineer, to the satisfaction of the Town, to meet industry standards for strength and safety requirements applicable to the Development location.

The Town of Innisfil shall be notified forty-eight (48) hours prior to the construction of all retaining walls in order to arrange for an inspection.

7.6 DRIVEWAYS

The minimum slope on any driveway shall be 2%. For residential lots, this minimum shall be measured from the garage to the property line as well as on the driveway apron, which is the area within the

SECTION 8: PARKS AND LANDSCAPING

municipal road allowance. The preferred maximum slope for any driveway is 5%; however, an absolute maximum of 7% may be permitted where necessary.

7.7 PARKS AND OPEN SPACE

In parks or other open space areas, slopes of 2% shall be applied to provide a usable area for recreation purposes. Grading designs employing steeper slopes must be approved by the Town on a case by case basis.

Temporary topsoil stockpiles are not to be in open space or park areas.

7.8 PARKING LOTS

The desirable surface grade for an asphalt parking lot is 1.0%; the minimum grade shall be no less than 0.5% and no greater than 5.0%.

7.9 TOPSOIL AND SOD

The requirements in OPSS 802 & OPSS 803 shall apply except as amended herein;

7.9.1 Topsoil Materials

OPSS 802.05 - All topsoil shall be screened using 35mm (1 ½") size screen. This applies to all topsoil whether acquired from the jobsite or imported from offsite. The topsoil shall be a fertile, friable natural loam containing not less than 4% of organic matter for clay loams and not less than 2% for sandy loams. Topsoil shall have an acidity value ranging from PH 6.0 to 7.5, and capable of sustaining vigorous plant growth. It shall be free of any admixtures of subsoil, clay lumps and free of stones, roots and other extraneous matter. If this is not attainable from the topsoil on site, then either this topsoil shall not be used, or it shall be mixed with imported material to attain the above-mentioned specification.

7.9.2 Placing Topsoil

Subsection 802.07.03 – Topsoil shall be placed to a uniform depth of 150mm for local/collector residential areas, and 150mm on arterial roads and in commercial/industrial collector roads.

The topsoil shall be rolled with a 50kg roller for compaction. The finished topsoil surface shall be smooth and firm against footprints.

7.9.3 Stockpiling Topsoil

Subsection 802.07.01 is hereby amended by the addition of the following:

Topsoil shall be salvaged and stockpiled on-site at a location approved by the Contract Administrator. Stockpiled topsoil shall be stored in mounds not greater than 6.0m in height, with the side slopes graded no steeper than 2H:1V.

Topsoil stockpiles should be stabilized by covering with geotextile material to prevent soil erosion and contamination by weeds during storage. Where stockpiles are intended to store topsoil for periods longer than one-year, temporary ground cover vegetation composed of a non-invasive stabilizing ground cover (such as annual rye grass) will be requested.

The Contractor shall supply and install erosion and sediment control fencing as per TOISD 503 around all stockpiles. If deemed necessary by the Town, additional erosion and sediment control measures may be requested.

7.9.4 Sod

OPSS 803.05.01 is hereby amended by the following:

Sod shall be rolls of No. 1 premium grade nursery cultivated turf-grass sod, Kentucky Blue Grass/Fine Fescue.

7.9.5 Scheduling

Turf-grass sod shall be installed within 24 hours of delivery, and within 36 hours of harvest, unless otherwise authorized by the Town, and a suitable preservation method is approved prior to delivery.

Sod not installed within 36 hours of harvesting or within 24 hours of delivery may be rejected by the Town of Innisfil if there is any evidence of deterioration

7.9.6 Placement of Sod

OPSS 803.07.04 is hereby amended with the addition of the following:

Sod shall be placed in boulevards between the sidewalk and curbs, adjacent to concrete sidewalk abutting commercial or residential buildings, driveways and walkways, the bottom of swales and ditches, or as directed by the Contract Administrator.

Placement of sod shall include supply and placement of No. 1 premium grade nursery cultivated turf-grass sod, pegging, rolling, watering, and maintenance as necessary. Topsoil shall be included in the item for sod.

7.9.7 Staking Sod

OPSS 803.07.04 is hereby amended by the addition of following:

Sod shall be staked on slopes steeper than 2.5H:1V and in the bottom of all swales or ditches. Sod shall be laid at right angles to slopes or the flow of water. Sodding shall start at the bottom of the slope and shall be laid crosswise and staggered on the slope. Every row shall be pegged with wooden lath pegs, of sufficient length to ensure satisfactory anchorage of the sod, and at intervals of not more than 0.5m (1.5ft.). Pegs shall be driven flush with the sod.

Before pedestrian traffic is permitted on any staked turf, and after the turf is well rooted into the growing medium, pegs or stakes shall be removed or driven at least 5cm (2in.) below the sod surface.

7.9.8 Maintenance of Completed Sod

OPSS 803.07.05 is hereby amended by the following:

Sod shall be maintained for 60 Days following completion of placement. During this period, the placed sod shall be kept healthy, actively growing, and green in leaf colour. This requirement shall be suspended during the winter dormant period defined as November 1 to April 30 inclusive for Southern Ontario.

7.9.9 Performance Measure

OPSS 803.08.01 is hereby amended by the following:

At the end of the 60-Day maintenance period, the Contract Administrator shall make an inspection of all placed sod. The condition of the sod shall be as specified in the Maintenance of Completed Sodding subsection. The sod shall be in the same location as originally placed and shall not have moved, eroded, slipped, or sloughed. Sod shall show evidence of rooting into the underlying soil. The sod shall be of sufficient density that no surface soil is visible and there shall be no competitive growth, beyond that specified in the Sod subsection, emerging from the sod or from between the sod joints.

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8.1 TREE PRESERVATION

This section provides policies, general standards and guidelines for the protection of existing trees during construction and for the planting of new trees. The section outlines tree inventory, preservation and protection requirements to ensure existing vegetation is retained where required, and measures to ensure damage to existing vegetation is minimized.

8.1.1 Tree Inventory Requirements

The Tree Inventory drawing should be utilizing the most current available boundary survey as a base layer reference. For the entire property to be developed, the Proponent shall submit a Tree Inventory drawing for all trees greater than 100 mm diameter-at breast-height (dbh) on the subject property as well as for any trees on adjacent property whose canopies extend onto the property to be developed. For forests or other continually treed areas that are to be protected, the detailed inventory shall extend into the forest 15 m from the edge while the remainder of the forest shall be described on the basis of species present and range of sizes (dbh) for each species. For forests or other continually treed areas that are to be removed in their entirety, a general inventory shall be provided as described above. At the discretion of Town Staff, a sampling procedure may be used to prepare the inventory for well-treed lots. A sampling procedure may be used to estimate the tree inventory within a woodlot setting, with a minimum area of 200m² or 5% of the total lot area, whichever is greater. In all instances, any rare or endangered tree species of any size shall be identified and accurately located on the plans. The Town may require, at its discretion that significant trees must be individually inventoried and assessed, even when they occur within large stands. **It is advised that Town Staff be contacted regarding the required scope for tree inventory requirements.**

Inventoried trees shall be numbered, and these numbers must correspond to the arborist report and the Tree Protection Plan as outlined below.

8.1.2 Tree Protection Plan, Edge Management Plan & Report

An arborist report shall be prepared by an ISA Certified Arborist or Registered Professional Forester which details specific and accurate information about trees that may be impacted by the development initiative and identifies the nature of the work to be undertaken, and appropriate protection measures. For all trees that must be individually inventoried, as described above, the report is to include:

- Tree number;
- Species (Scientific and Common Name);
- Location (Onsite, Offsite, Boundary)
- Diameter at Breast Height; (cm)
- Canopy Diameter; (m)
- Assessment of Condition, including health, vigour, and structural integrity;
- Suitability for Retention; and
- Tree Protection Zone (TPZ) (radius in metres).

Additionally, the report should confirm the presence and location of any rare or endangered species and provide recommendations for protection. The arborist assessment should also inventory and assess any areas requiring a general inventory, as described above, and provide an assessment of the impacts of the proposed works and recommendations for retention or preservation. The report should include recommendations for tree protection

measures and all aspects of tree health including tree pruning, fertilization, mulching, irrigation and long-term monitoring and maintenance. Trees identified for removal for health or hazard reasons should first establish that the problem cannot be corrected by pruning or other treatments.

A Tree Protection Plan shall interpret the recommendations of the arborist report, designating trees to be removed, preserved, and compensated on the subject and adjacent property. It shall provide clear direction to the Contractor. The Tree Protection Plan and Tree Inventory may be combined, depending on the complexity of the project and at the discretion of the Town.

A Edge Management Plan may be required in instances where development or activities may impact the ecological integrity, stability, or functionality of a forest edge. A Edge Management Plan should include a canopy survey indicating either individual trees or tree groupings along the proposed forest edge, detailed assessments of existing vegetation, including the identification of native and invasive species, ecological functions, and potential risks such as erosion or encroachment. Recommendations for enhancement should include supplementary plantings of native species to improve biodiversity and ecological function along proposed forest edge. The plan should define buffer zones to protect the forest edge from adjacent development, and provide clear guidance for implementation, including contractor instructions and protective measures during construction. Monitoring and maintenance protocols, such as schedules for assessing plant health and invasive species control, as well as integration with related reports like Tree Protection Plans or Environmental Impact Studies, may also be required to ensure the forest edge's long-term stability and ecological value. Where required, quarterly inspections and reporting will be required from the consulting arborist on the status of the forest edge.

Any boundary tree identified for injury or removal will need signed consent from neighboring property owner(s). The town has no jurisdiction over boundary trees and, therefore, does not mediate a disagreement over boundary trees. When a Neighbour refuses to approve the removal of a boundary tree it becomes a civil dispute and falls under the legal provisions of the **Ontario Forestry Act 1990**.

8.1.3 Tree Preservation Measures

Lot grading should demonstrate best efforts to minimize perimeter disturbance and preserve existing trees. Through the site layout design the developer should attempt to incorporate design alternatives, such as adjustments to grade, which minimize the impact to vegetation. Grading Plans are the preferred base layer reference for Tree Preservation and Tree Compensation drawings.

Tree protection fencing is to conform to TOISD 905 and shall be erected at the minimum of 0.3m outside of the dripline prior to commencement of any clearing, grading or other construction activity. All supports and bracing used to secure the barrier should be located outside the Tree Protection Zone to minimize damage to roots.

In instances where a specimen tree is to be retained in proximity to a construction area, solid plywood hoarding mounted securely to steel or sturdy wooden posts. Posts should be installed no farther than 2.4m (8ft.) apart.

Tree protection shall not be removed until completion of all construction activity.

Where protection barrier is on slopes greater than 4%, provide a ditch on the elevated side of the fence, lined with filter fabric and backfill to prevent erosion.

Tree protection signage must be mounted on all sides of a Tree Protection Barrier. The sign should be a minimum of 40 cm x 60 cm and made of white gator board or equivalent material. The sign shall be in accordance with TOISD 906.

No grade change, storage of materials or equipment is permitted within this zone. Tree protection barrier must not be removed without the written authorization of Town of Innisfil.

8.1.4 Clearing and Grubbing

Existing site elements shall always be protected during clearing and grubbing operations.

Unusual or abnormal surface or subsurface conditions encountered on site during clearing and grubbing shall be documented and reported immediately to the consultant.

Cleared and grubbed materials shall be stockpiled separately from growing medium stockpiles.

Where noxious, undesirable weeds, or designated invasive species are found on site, grubbed materials shall be disposed of off-site as approved. These materials shall not be used as a constituent of, or as a growing medium.

Stumps and visible surface roots shall be removed except where removal might adversely affect the health or stability of a nearby tree or other preserved element that has been identified for retention.

In natural areas, stumps and roots are an essential part of the natural system, adding stability, nutrients, protection and habitat components to the site. Individual stumps and roots shall be assessed by the consultant to determine whether they should remain or be removed safely. Decisions should be documented in writing and included in the project documents.

Where stump removal is not recommended, the stump can be reduced by means of a mechanical stump grinder or retained as is, cut flush with the ground.

8.1.5 Trenching and Tunneling

No trenching is to occur within Tree Protection Zones. Excavations under the dripline of a tree should be executed with a trencher, vacuum truck, or other method approved by the Town. Roots encountered during trenching operations that are greater than 50 mm are to be pruned by a certified arborist.

Directional boring or micro-tunneling are permitted within a Tree Protection Zone provided that they are in accordance with the arborist report and meet the following standards:

- They occur at a minimum depth of 1.0 m;
- The bore or tunnel is a minimum of 1.0 m horizontally from the outside edge of the trunk of the tree; and

- The open excavation occurs outside the Tree Protection Zone.

All other Tree Protection Zone requirements (e.g. no storage of equipment or materials, no operation of equipment, etc.) shall continue to apply.

8.2 TREE COMPENSATION REQUIREMENTS

Tree compensation calculation methods will be at the discretion of the Town on a case-by-case basis. Town Staff will consider a combination of factors including but not limited to canopy area, lot size, tree density, cultural importance, and/or land designation. Where applicable, the ecological offsetting strategy shall conform to the LSRCA's Ecological Offsetting Policy for development within the Lake Simcoe watershed. The ecological offsetting strategy shall be prepared to the satisfaction of the Town in consultation with the LSRCA, and shall have regard for other offsetting programs and policies. It is advised that Town Staff be contacted regarding the required tree compensation rate requirements.

Where the LSRCA Ecological Offsetting Policy does not apply, the standard compensation rate for trees removed from a landscape setting are calculated using the chart below. The replacement value of a tree is determined by its caliper at breast height, corresponding replacement caliper range, and compensation rate. Trees that have been removed prior to being inventoried will be compensated at the discretion of the Town, to ensure the principle of 'no net loss of trees' is followed.

Removed Tree DBH	Compensation Ratio
100mm - 150mm	1 to 1
151mm - 350mm	2 to 1
351mm – 500mm	3 to 1
>501mm	4 to 1

All replacement trees should be provided at nursery stock standards unless smaller stock is deemed appropriate.

A tree health coefficient is applied to each tree prior to calculation of total compensation. The coefficient is multiplied to the replacement rate for that tree to determine a compensation rate relative to a healthy specimen. The total replacement rate is accumulated and rounded to the next whole number.

Health of Tree	Health Coefficient
Dead	0
Hazard or Infected	0.25
Poor	0.5
Fair	1.0
Good	1.25

Health of Tree	Definition
Dead	Tree is no longer alive. There is no active growth or foliage.
Hazard or Infected	The tree is severely compromised by structural damage, infection for infestation. It poses a risk to nearby structures or people and requires intervention or removal
Poor	The tree exhibits significant stress dieback or other signs of decline. Growth is stunted and the tree's lifespan or functionality is limited.
Fair	The tree is in average condition. The tree may show minor issues such as thinning foliage, small wounds or limited pest activity but overall the tree is functional
Good	The tree is healthy, vigorous, and free from significant pests, diseases, or structural issues. Growth and foliage are abundant, indicating optimal health and function.

If the minimum number of replacement trees cannot reasonably be met, as determined by Town Staff, tree compensation shall be in the form of shrubs at a compensation ratio of 5 shrubs to 1 tree.

If compensation cannot be provided, a cash in lieu agreement may be entered by the Developer. The rate for cash in lieu will be \$500 per replacement tree not planted on the site.

8.3 LANDSCAPE REQUIREMENTS

All landscape plans shall be prepared by an accredited professional Landscape Architect in good standing with the *Ontario Association of Landscape Architects* (OALA). The Landscape Architect shall coordinate and liaise with all other consulting professionals to ensure accurate representation of the site and the proposed development.

This section provides guidelines, policies of procedure and practice that are to be adopted by the proponent. Specific guidelines are included for plant materials, including nursery grown trees, topsoil, shrubs, groundcovers, sod and seed mixtures.

8.3.1 Topsoil & Seed Requirements

8.3.1.1 Topsoil

Topsoil shall conform to OPSS 802. Additional to the specifications, the subgrade is to be loosened to a depth of 100 mm immediately prior to topsoil application and the topsoil is to be placed no longer than seven (7) days prior to seeding or sodding. Topsoil depth requirements (after settlement or compaction to 85% SPD) are as follows:

Vegetation	Topsoil Depth Requirements
Boulevards	300 mm minimum continuous depth
Shrub Planting Beds	500 mm minimum continuous depth
Tree Planting Pits/Beds	500 mm minimum continuous depth
Sodded/Seeded Areas (non-boulevard)	200 mm minimum continuous depth

8.3.1.2 Topsoil Stockpiles

Topsoil stockpiles containing more than 100 m³ of material shall be located a minimum of 10.0 m away from any roadway, drainage channel or an occupied residential lot. Topsoil shall not be stockpiled on slopes steeper than 2H:1V and the stockpile height shall not exceed 6.0 m. Runoff from all topsoil stockpiles shall be controlled by a sediment control fence or other approved devices.

Perform weed control, when necessary, in accordance with relevant government chemical pesticide application legislation. Temporary seeding of topsoil with cover crops may be required by the Town to prevent weed growth.

Screen stockpiled topsoil, as necessary. Use a screener having a wire mesh screen size opening of minimum 10 mm and maximum 19 mm to remove stones, soil lumps, foreign material, debris, undesirable plants and roots. Stockpile topsoil shall be reasonably free of weed growth before placement on site.

Temporary topsoil stockpiles are not to be located in open space or park areas.

8.3.1.3 Seed Mixes

Refer to Appendix B for approved seed mix designs.

8.3.2 Plant Material Considerations

8.3.2.1 Stock

All plant material shall be nursery grown and conform to the Canadian Nursery Stock Standard [CNSS](Current edition).

The minimum size requirements for plant material are as follows:

Plant Material	Minimum Size
Deciduous trees	50 mm caliper, Wire Basket
Coniferous trees	200 cm tall, Wire Basket
Deciduous shrubs	50 cm tall, 3 gallon pot
Coniferous shrubs	50 cm wide, 3 gallon pot
Perennials and Ornamental Grasses	1 gallon pot

Caliper shall be measured at 15 cm above the soil line for trees with a caliper up to and including 100 mm. Trees greater than 100 mm caliper shall be measured 30 cm above the soil line. Soil line measurements shall be taken at or close to the root flare

Height shall be measured by the vertical distance between the collar or ground line and the top of the stem of the nursery stock, measured in its natural position.

Whips (bare-root stocks measuring 1.0 m to 1.5 m in height) may be planted in low-profile, rural areas, and stormwater management facilities, provided that they meet the

requirements of the applicable Conservation Authority Guidelines. Seedlings or whips may be used for naturalization or restoration areas.

8.3.2.2 Form Vigour of Trees

All trees shall be true to type, structurally sound with no evidence of dead branches, sun scald, frost cracks, abraded or broken bark, and be free of insect or disease infestation.

All trees shall have a full, well-developed symmetrical crown with one distinctive vertical leader, branches appropriately spaced, and a root system typical of the species. All parts shall be moist and show active green cambium when cut.

All trees must meet these specifications at the time of planting and final inspection by the Town's designate. Trees that are rejected will be replaced at the Proponent's expense.

8.3.2.3 Planting

All tree and shrub plantings shall be in accordance with the Town Standard Planting Details.

8.3.2.4 Pruning

The crown of the tree shall be pruned from the bottom up at the time of planting to remove all dead and damaged branches and to address any structural weaknesses, such as codominant branches, multiple branches arising from one point, included bark, etc. All pruning is to be performed by an International Society of Arboriculture Certified Arborist and is to conform to ANSI A300 Pruning Standards.

After pruning, the tree should have a symmetrical and full crown. Trees that do not meet these requirements will be rejected.

8.3.2.5 Staking

Tree stakes shall be heavy duty gauge T-bars, 50 mm x 50 mm x 1800 mm long.

Ties shall be 50 mm burlap strips or a proprietary flexible tie system which allow the tree a reasonable degree of movement to help build trunk taper. Plastic hoses and wire ties are not acceptable.

Ties are to be removed after one year.

8.3.2.6 Mulching

Mulch shall be shredded cedar bark, free of dyes and chemicals that inhibit plant growth.

8.3.2.7 Rodent Guards

Rodent guards shall be used on deciduous trees for all naturalization plantings, including storm water pond plantings. Rodent guards shall consist of white plastic spiral wrap wound around the base of trunk, up to a height of 60 cm or for seedlings, shall consist of 1200 mm long polypropylene tree shelters, twisted 50 mm into the ground. These guards must be installed after planting and inspection and then removed after two (2) years of growth (for spiral guard) or when seedlings grow taller than the tree shelter.

8.3.2.8 Deer Grazing Protection

In rural areas and stormwater management facilities, new plantings are to be protected with snow fencing in order to reduce incidents of deer grazing.

8.3.3 Acceptance and Warranty

All plant materials shall be maintained by the Proponent, from the time of planting until acceptance by the Town.

A maintenance regime shall consist of proper cultivation, weeding, watering and pruning to establish and maintain plant material in a healthy growing condition.

The Proponent shall arrange a time to have the plant material accepted following the guarantee period. At the time of inspection, all beds and tree pits shall be freshly cultivated, weeded and in a tidy condition, with all rubbish, leaves and dead plant debris removed.

8.4 DESIGN CONSIDERATIONS

In this section the requirements relative to acceptable tree species and related landscaping components with respect to specific applications are provided.

8.4.1 Acceptable Trees

Refer to Appendix B for a list of Acceptable Trees. Varieties and cultivars of the species listed will be reviewed pending specific site conditions and design applications.

In selecting trees for specific applications, consider the following factors:

- Assess conflicts with power lines, sidewalks and underground utilities;
- Select large trees where space is available to maximize planting effect;
- Encourage diversity of species to reduce susceptibility to disease;
- Utilize native species as much as possible;
- Consider long-term maintenance pruning requirements of trees;
- Select species with respect to soil microclimate requirements;
- Select species with respect to salt tolerance and specific moisture requirements.

8.4.2 Mixture and Proportion of Species

The planting of monocultures (dependence on one plant species) within the streetscape is detrimental to the maintenance of tree health, and increases a tree's overall susceptibility to pests and diseases.

As such, the Town encourages biodiversity in the streetscape, stormwater management, and restoration plantings by implementing the following measures:

- The random sequencing of tree species is encouraged within a planting scheme.
- The planting of any one individual species is limited to eight (8) consecutive trees in any given planting scheme, including both sides of a road allowance.
- To ensure diversity, the amount of one tree genus shall not exceed more than 20% of all plantings, and the amount of one tree species shall not exceed more than 10% of all plantings.
- The number of species required in a planting scheme shall be determined by the overall number of trees in the planting, as conforming to the following table.

TABLE 10
Number of Trees and Species in Planting

Number of Trees in Planting	Minimum Number of Species
1-8	1
9-15	2
16-30	3
31-40	4
41-50	5
51-100	6
101+	8

8.4.3 Tree Siting and Setback Requirements

Boulevard tree siting requirements are as follows:

- Boulevard trees are to be large crown trees, optimally planted at intervals ranging from 12.0 m to 15.0 m. Spacing requirements vary depending on the selected species. All species selections must be approved by Town staff.
- In single family detached residential developments as well as multi-unit developments, one (1) shade tree per lot is required. Where a tree cannot be accommodated on a lot, the tree may be planted on other public land within the development property, as directed by the Town. Should the tree not be accommodated on the development property, the Town will accept five-hundred dollars (\$500) cash in lieu for each tree not planted.
- Where overhead utilities or other constraints require the use of smaller trees, they may be used at the discretion of the Town, at a spacing of 6.0 m to 8.0 m on center.

When planting near utilities, the location and species of the plant material must be coordinated with engineering plans to ensure the non-obstruction of storm and sanitary sewers, water

SECTION 8.0: PARKS AND LANDSCAPING

service, hydro, telephone, gas lines and other services. All utilities must be demarcated by the Proponent prior to any excavation. Refer to Appendix C for minimum clearance requirements from other above grade features.

8.4.4 Landscape Strip Requirements – Residential Development

The following landscape treatments are guidelines for the location and use of plant material, fencing, berming on private lands adjacent the public road Right-of-Way. The planting density formulae establishes the desirable quantity of each type of plant material based on the proposed land use and the total site area. The following table outlines the landscape strip standards utilized by the Town for residential development adjacent to various road classifications and abutting land uses.

TABLE 11 - Landscape Strip Requirements

ABUTTING USE	MIN. LANDSCAPE STRIP WIDTH	LANDSCAPE TREATMENT GUIDELINES
Highway 400	12 m	<ul style="list-style-type: none"> Noise attenuation fencing Mixed Deciduous and Evergreen trees 2.0 m high berm with shrub massing Foundation planting
Arterial/Parkway /Major Collector	6 m	<ul style="list-style-type: none"> Entry feature/ornamental fencing Mixed Deciduous and Evergreen trees Berming and shrub beds Foundation planting
Minor Collector/Local	3 m	<ul style="list-style-type: none"> Entry feature/ornamental fencing Mixed Deciduous and Evergreen trees Berming and shrub beds Foundation planting
Schools	3 m	<ul style="list-style-type: none"> 1.8 m high chain link fence Mixed Deciduous and Evergreen trees Mixed shrub bed or hedging
Other Institutional	3 m	<ul style="list-style-type: none"> Mixed Deciduous and Evergreen trees Mixed shrub bed or hedging 1.8 m high solid fence (with 150 mm x 150 mm posts)
Residential	3 m	<ul style="list-style-type: none"> Mixed Deciduous and Evergreen trees Mixed shrub bed or hedging
Commercial	3 m	<ul style="list-style-type: none"> 1.8 m high solid fence (with 150 mm x 150 mm posts) Mixed Deciduous and Evergreen trees Mixed shrub bed or hedging
Industrial	3 m	<ul style="list-style-type: none"> 1.8 m high solid fence (with 150 mm x 150 mm posts) Mixed Deciduous and Evergreen trees Mixed shrub bed or hedging
Open Space/E.P.	3 m	<ul style="list-style-type: none"> 1.2 m high chain link fence Mixed Deciduous and Evergreen trees Mixed shrub bed or hedging

Planting Density Formula Guideline for Total Site Area Available for Planting

Total Site Area (m²) ÷ 200 = # of Deciduous Trees 50 mm caliper

Total Site Area (m²) ÷ 400 = # of Evergreen Trees 2.0 m in height

Total Site Area (m²) ÷ 50 = # of Deciduous Shrubs 0.6 m - 1.2 m in height

Total Site Area (m²) ÷ 100 = # of Evergreen Shrubs 0.45 m SPR/1.2 m in height

8.4.5 Park and Playground Requirements

8.4.5.1 Minimum Park Requirements for Residential Developments

Components of Parkland and other Open Space considerations are as follows:

- Contact Parks Project Manager for the typical park entrance sign details.
- Park display sign to be 1.8 m wide by 1.2 m high installed on two 0.75m aluminum or hot-dip galvanized steel poles. Park display sign to be as per the “RT07 Wayfinding Signage Standards and Specifications” page 7-1.1 (Drawing – Pd-1a Urban Pedestrian RTO 7 Map Directory). The sign text and image information will be provided by the Town for each park display sign.
- Park servicing: minimum 25 mm water service, 125 mm sanitary sewer service, 250 mm storm sewer service, and a hydro service are minimum requirements. The Town will provide minimum sizes specific to the project in early stage of designs.
- Park grading: minimum slopes of 2% graded to maintain proper drainage. Using slopes steeper than 4% is undesired.
- Park fencing: 1.8m high chain link fence.
- Must have street frontage
- Park turf: sodding is the minimum standard.
- Development construction: undeveloped, disturbed blocks shall be graded, seeded, and maintained by the Proponent until construction commences thereon.
- Park property shall not be used for storage of material or equipment during construction on development.

8.4.5.2 Development Adjacent to Park Property

Where development abuts a Park or Open Space, runoff from the development property shall not drain into the Park or Open Space. A rear lot catch basin may be required.

8.4.5.3 Park and Open Space Features

Required park and open space features include:

- Chain link fence (1.8 m) to Town standards where Park property is adjacent to private lots. No gates into parks, open spaces, or stormwater management facilities are permitted from private property. Park frontage on streets is not fenced.
- Site furniture, including benches and trash cans.

- Park walkways that are to be maintained in the winter must be 3 m width, asphalt surfaced. Otherwise, park walkway material is stone dust.
- Lighting of Park walkways in Neighbourhood Parks is generally not recommended.
- Lighting of sports facilities in Neighbourhood Parks is generally not recommended.
- Playgrounds must conform to the latest Canadian Standards Association (CSA) standards for play spaces and equipment.
- At least one (1) light standard must be provided at playgrounds for security.

8.4.5.4 Parking Supply Standards

Parking lots may be required for Neighbourhood Parks, if there is no adjacent parking.

Parking Supply Standards for Community or Town-wide parks:

- Sixteen (16) spaces per ball field, thirty-two (32) spaces if fields are lit.
- Sixteen (16) spaces per soccer field, thirty-two (32) spaces if fields are lit.
- Fifteen (15) spaces for general park users.
- Twelve (12) spaces (four (4) per court) per group of tennis courts.

8.4.5.5 Park Development Standards

All Parks and Open Space developed in the Town of Innisfil shall comply with the following standards:

Can/CSA Standard Z614 – Children’s Playspaces and Equipment (latest edition).

Accessibility for Ontarians with Disabilities Act (AODA), 2005, including all associated Regulations. Refer to *US Guide to ADA Guidelines for Accessible Play Areas for clarification and requirements of “accessible” play features.*

8.4.5.6 Playground Equipment Standards

The playground will be separated into distinct play area sections: a Junior play area for children eighteen (18) months to five (5) years old and a Senior play area for children five (5) years to twelve (12) years old.

It is acceptable to mix products from different manufacturers on a project site.

Specify steel posts, not aluminum for lower costs. Timber and wood components are not acceptable.

All playgrounds must have a minimum 1.5 m wide, hard surface pathway from the street or sidewalk to the play area for accessibility.

All playground equipment must be installed by a certified playground installer and must meet CSA standards.

8.4.5.7 Typical Playground Requirements

A typical program for a Neighbourhood Park must include at a minimum:

- Swings – two (2) seats for toddlers, four (4) belt seats, and one (1) accessible seat.
- Jr. creative structure: two to three (2-3) decks with minimum one (1) roof, transfer station & stairs, two (2) plastic slides – single and dual track, climber, tunnel or bridge between decks, three to four (3 - 4) activity panels, and talk tube or alternate.
- Sr. creative structure: three to six (3-6) decks with minimum one (1) roof, transfer station with stairs, accessibility ramp, two (2) plastic slides – straight and spiral both open, three (3) climbers, rock wall or similar activity, four to five (4-5) activity panels, and sliding pole.
- Spring/spinning toys: two (2) units varying types.

A typical program for a Community Park must include at a minimum:

- Swings – five (5) seats for toddlers, six (6) belt seats, and one (1) accessible seat.
- Jr. creative structure: two to three (2-3) decks with minimum one (1) roof, transfer station & stairs, two (2) plastic slides – single and dual track, climber, tunnel or bridge between decks, three to four (3-4) activity panels, and talk tube or alternate.
- Sr. creative structure: five to seven (5-7) decks with minimum one (1) roof, transfer station with stairs, accessibility ramp, two to three (2-3) plastic slides – straight and spiral both open, three to four (3-4) climbers, rock wall or similar activity, five to seven (5-7) activity panels, and sliding pole.
- Spring/spinning toys: three to four (3-4) units varying types.

8.4.5.8 Creative Play Structures

Only certified playground suppliers are permitted to supply and install play structures. Playground structures are subject to inspection by a registered playground inspector.

Decks:

- Steel with plastisol coating preferred or plastic wood is acceptable.
- Provide a transfer deck on structure to make it accessible.
- Provide minimum one (1) set of stairs.

Climbers:

- Chain net, cable net, and cargo net climbers shall have one piece coupling or nut and bolt couplings. Screw couplings are not acceptable.

Activity Panels:

- Do not place a poly panel at the end of a ramp.
- Use steel bars at ends of ramps.
- Vary steel bars, poly windows, activity panels to add interest to structure.
- Provide 40% of activity panels on ground level for wheelchair users.

Percussion musical panels are not permitted, except in low vandalized areas. All other activity panels will be considered but must be approved by the Town.

8.4.5.9 Play Areas

Perimeter:

Playground play area borders are to be cast-in-place concrete curbs.

Ensure minimum setbacks are provided from each piece of play equipment as per CSA standards.

Drainage:

Provide a subdrain system comprised of a minimum 100 mm (4") diameter corrugated poly drain pipe with filter sock embedded in a French drain of 300 mm wide x 400 mm deep 19 mm diameter clear stone set into the subgrade.

Slope subgrade to drain towards drain pipe at 1.0%.

Provide a non-woven geotextile filter fabric between the safety surface and French drain.

Provide a minimum three (3) legs of drain pipe to cover all sides and centre of play area.

Slope drain pipe a minimum 0.5% to drain towards a catch basin or discharge into a swale.

Ensure placement of drainage pipe does not interfere with play equipment footings.

In poorly drained areas: In addition to above, provide a drainage layer immediately beneath the safety surfacing comprised of 100 – 150 mm (4" - 6") 19mm diameter clear drain stone with a non-woven geotextile filter fabric.

Safety Surfacing:

Refer to Appendix B for a list of approved materials.

8.4.5.10 Play Equipment

Spring Toys:

Spring Toys must be removable by Parks Maintenance personnel.

Swing Standards:

All swing posts shall be embedded in footings (anchor footing to bedrock where depth of cover is not at least 1200 mm). All footings are to be a minimum 1.5m deep (Innisfil frost depth).

Top cross bar shall be min. 2440 mm (8'-0") above finished grade.

All swing chains shall be ¼" galvanized steel.

Refer to Appendix B for a list of approved materials.

Slide Standards:

Must be attached to creative play structures.

Poly slides are to be used except in highly vandalized areas, where stainless steel slides may be used.

8.4.5.11 Fencing

Commercial grade, galvanized steel, chain link fence or our black vinyl coated chain-link shall be the preferred option within residential developments, however, this should be confirmed by the Town.

Park, soccer and ballfield perimeter - #9 gauge [3.5 mm]

Baseball field backstops – 50 mm (2") square mesh, #6 gauge [5 mm]

Basketball/multi-purpose court – 3.0 m (10 ft.) high

8.5 STORMWATER MANAGEMENT FACILITIES

Refer to Section 4.0 for requirements regarding the stormwater management facilities.

8.6 INVASIVE SPECIES CONTROL PLAN

An Invasive Species Control Plan (ISCP) will be required when invasive plant species are present on the lands which, in the opinion of the Town, could cause adverse effects to human health, degrade ecosystems, or cause adverse economic impacts to the Town. Such species may include, but are not limited to, Giant Hogweed (*Heracleum mantegazzianum*), Invasive Phragmites (*Phragmites australis subsp. Australis*), Dog Strangling Vine (*Cynanchum rossicum*) and Poison Ivy (*Rhus radicans*).

Prior to implementation, the ISCP shall be accepted by the Town and any necessary permits and licenses shall be obtained from the Ministry of Natural Resources and Forestry (MNR), the MECP, and the Conservation Authority, as applicable.

The plan shall identify:

- Species to be controlled;
- Methods of control;
- Required permits / licenses / Letter of Opinion;
- Timing restrictions (e.g., for effectiveness and to reduce impacts to native plants and wildlife);
- Management frequency;
- Monitoring; and
- Reporting.

Pending approval of the ISCP and receipt of applicable permits, the control measures are to commence immediately and extend until the invasive species has been effectively controlled. Should the invasive species not be controlled at the time of municipal Assumption, the Town will determine an acceptable solution, at its discretion.

APPENDIX A: REVISION INFORMATION

LIST OF REVISIONS

The Town of Innisfil recognizes that revisions and updates to this document will be required from time to time. An up to date record of all revisions to this document is provided in the table below:

REV. NO.	DOC.	DATE	DETAILS OF REVISION
	Section 1		
	Manual	September 2025	Section 1.1 – The Town reserves the right to request additional requirements.
	Manual	September 2025	Section 1.1 – All infrastructure projects, including site plans, must conform to the TOI Standard.
	Manual	September 2025	Section 1.3.2 – Private well survey requirements.
	Manual	September 2025	Section 1.3.3 - Revision based on DLG comment: Updated details that are to be included in the SWM Report and updated reference guidelines.
	Manual	September 2025	Section 1.3.4 – The following revisions were made: <ul style="list-style-type: none"> • Electronic copies for traffic modeling are to be provided to the Town. • One site visit is to be conducted to assess traffic for the Traffic Brief • The use of Actual Peak Hour Factor • Swept path analysis requirement • Report stamped by engineer • 50 or more vehicle trips require a TIS Report • Traffic counts are to be conducted during peak hours/seasons • PHF of 0.90 to be employed for proposed or future conditions • LOS requirements • Parking & Circulation
	Manual	September 2025	New Section 1.4 – AutoCAD and drawing requirements.
	Manual	September 2025	New Section 1.5 – General requirements for applications.
	Manual	September 2025	New Section 1.6 – Subsurface utility investigations <ul style="list-style-type: none"> • Quality level surveys • Test pits
	Manual	September 2025	New Section 1.7 – Topographical Survey
	Manual	September 2025	New Section 1.8 – CLI ECA requirements.

APPENDIX A: REVISION INFORMATION

REV. NO.	DOC.	DATE	DETAILS OF REVISION
	Section 2		
	Manual	September 2025	Section 2.2 – Rural road requirements
	Manual	September 2025	Section 2.2.2 – Table 1 and 2 have been replaced by Table 1A and 1B for pavement structure requirements.
	Manual	September 2025	Section 2.2.3 – Table 3 revised to indicate maximum posted speed.
	Manual	September 2025	Section 2.2.6 – Reference to TAC manual was added.
	Manual	September 2025	Section 2.2.10 – Requirements for concrete deficiencies in curbs.
	Manual	September 2025	Section 2.2.11 – Sidewalk contraction joint requirements.
	Manual	September 2025	Section 2.2.11 – Requirements for concrete deficiencies in sidewalks.
	Manual	September 2025	Section 2.2.11 – Requirements for concrete deficiencies in sidewalks.
	Manual	September 2025	Section 2.2.14.4 – Entrance requirements regarding road classification.
	Manual	September 2025	Section 2.2.15 – Revision based on DLG comment: <ul style="list-style-type: none"> • Easements may be reduced on a case-by-case basis • Maximum drainage area that can be conveyed through a walkway • Alternative pavement design for industrial SWM pond maintenance access
	Manual	September 2025	Section 2.2.17 – Revision based on DLG comment: Revised noise fence requirements.
	Manual	September 2025	Section 2.2.18.3 – Durable pavement markings requirements.
	Manual	September 2025	Section 2.2.21.2 – Minimum 1.0% grade for parking areas.
	Manual	September 2025	Section 2.2.21.3 – Parking space reduction as per the Town's latest Zoning By-Law.
	Manual	September 2025	Section 2.3 – Contractor to notify Town 48 hours in advance prior to starting construction.
	Manual	September 2025	Section 2.5.2 – Warm Mix Asphalt added.
	Manual	September 2025	Section 2.5.2.3 – The following revisions were made:

APPENDIX A: REVISION INFORMATION

REV. NO.	DOC.	DATE	DETAILS OF REVISION
	Section 4		
	Manual	September 2025	Section 4.1 – All modeling files used in the design is to be provided to the Town as part of the submission package.
	Manual	September 2025	Section 4.2 – Revision based on DLG comment: Removed the monitoring program to assess the performance of the proposed design.
	Manual	September 2025	Section 4.5 – Underground storm sewers within site plans are to be designed to convey the 100-year storm.
	Manual	September 2025	Section 4.5.2 – Table 6 revisions to minimum runoff coefficients.
	Manual	September 2025	Section 4.5.2 – The maximum size of proposed units shall be considered when calculating the total imperviousness of the development.
	Manual	September 2025	Section 4.5.3 – Storm sewer design sheets to be provided.
	Manual	September 2025	Section 4.5.6 – Drafting requirement for pipe sizes 450mm and larger
	Manual	September 2025	New Section 4.5.7 – Details regarding the pipe materials for sewers
	Manual	September 2025	Section 4.5.12 – Drafting requirement for MHs
	Manual	September 2025	Section 4.5.12 – Frost straps removed for storm MHs
	Manual	September 2025	Section 4.5.12 – Revision based on DLG comment: OPSD reference added for drop structures
	Manual	September 2025	Section 4.5.13 – CBs within site plans are to be designed to convey the 100-year storm. Inlet capacity calculations are to be provided.
	Manual	September 2025	Section 4.5.13 – CB information to be provided on the drawing.
	Manual	September 2025	Section 4.5.14 – Groundwater monitoring requirements for site plans and subdivisions.
	Manual	September 2025	Section 4.5.14 – High groundwater elevations to be shown on grading plans.
	Manual	September 2025	Section 4.5.15 – Single storm connection sizes revised.
	Manual	September 2025	Section 4.5.16 – Inspection and testing plans to be prepared and submitted to the Town

APPENDIX A: REVISION INFORMATION

REV. NO.	DOC.	DATE	DETAILS OF REVISION
	Manual	September 2025	Section 4.6 – Maximum ponding depths for private properties and site plans were added to Table 7
	Manual	September 2025	Section 4.6 & 4.7 – The use of the Modified Rational Method has been removed.
	Manual	September 2025	Section 4.6.3 – Legal right of discharged to be registered on both properties.
	Manual	September 2025	Section 4.6.3 – Legal right of discharged to be registered on both properties.
	Manual	September 2025	Section 4.7 – Additional quantity controls may be required where downstream flow constraints or flooding exists.
	Manual	September 2025	Section 4.7 – The Town does not support the use of the Modified Curve Number method CN*. Curve numbers should be derived as outlined in the US Soil Conservation Service (1972) SCS curve number method.
	Manual	September 2025	Section 4.7 – A table with IA was added.
	Manual	September 2025	Section 4.7.1 - Stormwater Design Guidelines for Proposed Upstream Developments From Existing SWM Facilities
	Manual	September 2025	Section 4.7.2 - LID functions may vary in time due to sedimental loading and shall not be used for quantity control.
	Manual	September 2025	Section 4.7.2 – LID locations within ROW and private ownership of LIDs within private lots.
	Manual	September 2025	Section 4.7.5 – Maximum drainage area conveyed through walkways
	Manual	September 2025	Section 4.7.12 – Orifice plates are not permitted for site plans
	Manual	September 2025	Section 4.7.12 – Rip-rap installed on existing ditches that serve as an outlet for the development.
	Manual	September 2025	Section 4.7.20 – O&M manual must detail the maintenance for all SWM facilities and infrastructure
	Manual	September 2025	Section 4.9 – Revision based on DLG comment: Reformatted section.
	Manual	September 2025	New Section 4.10 – Revision based on DLG comment: Revised to align with the Town's CLI ECA
	Manual	September 2025	Section 4.10.2 – As-recorded storage volume and discharge calculations for SWM pond.

APPENDIX A: REVISION INFORMATION

REV. NO.	DOC.	DATE	DETAILS OF REVISION
	Section 5		
	Manual	September 2025	Section 5.2 – Text regarding capacity requirements
	Manual	September 2025	Section 5.4.1 – Flow requirements
	Manual	September 2025	Section 5.5 – Revised wording.
	Manual	September 2025	Section 5.6 – Sanitary sewer design sheet requirements
	Manual	September 2025	Section 5.10 – Revision based on DLG comments: Depth of cover requirements updated
	Manual	September 2025	Section 5.10 - No direct lateral connections to trunk sewer requirement added
	Manual	September 2025	Section 5.11 – Pipe joint and connection requirements for sewers installed below high groundwater table
	Manual	September 2025	Section 5.12 - Storm and sanitary crossing clearances added
	Manual	September 2025	Section 5.15.2 – Removal of curved or properly deflected sewers
	Manual	September 2025	Section 5.15.2 – Increased max spacing for MHs
	Manual	September 2025	Section 5.15.5 – Revision based on DLG comments: Plug removal timing revised
	Manual	September 2025	New Section 5.15.7 – Internal frost strap requirements
	Manual	September 2025	Section 5.17 – The use of sanitary risers for deep sanitary sewers
	Manual	September 2025	Section 5.17 – MH connection requirements based on sewer sizes
	Manual	September 2025	Section 5.18 – Testing and inspection plan requirements

APPENDIX A: REVISION INFORMATION

REV. NO.	DOC.	DATE	DETAILS OF REVISION
	Section 6		
	Manual	September 2025	Section 6.4 -Population per unit, average daily demand and fire flow requirements
	Manual	September 2025	Section 6.10 – Separation for watermains crossing sewers
	Manual	September 2025	Section 6.11 – Bedding requirements for water services
	Manual	September 2025	Section 6.12 – Additional worded regarding restraints at mechanical joints
	Manual	September 2025	Section 6.13 – Reference to new watermain crossing TOISD
	Manual	September 2025	Section 6.14 – Hydrant locations
	Manual	September 2025	Section 6.18 – Water services do not need to strictly be copper material
	Manual	September 2025	Section 6.21 – Testable backflow prevention device requirements a
	Manual	September 2025	Section 6.21 – Revision based on DLG comments: Underground chamber requirements for DCVA added
	Manual	September 2025	Section 6.23 - Tracer wire shall be extra-high strength copper-clad steel for trenchless installations
	Manual	September 2025	Section 6.23 - Tracer wire requirements for PEX water services
	Manual	September 2025	Section 6.24 – New requirements for corrosion protection
	Manual	September 2025	Section 6.26 – Backflow prevention By-Law referenced in standards
	Manual	September 2025	Section 6.27.1 – Watermain commissioning requirements revised. Commissioning requirements have been moved to Appendix I

APPENDIX A: REVISION INFORMATION

REV. NO.	DOC.	DATE	DETAILS OF REVISION
	Section 8		
	Manual	September 2025	Section 8.1.2 – Revised Tree Protection Plan & Report requirements.
	Manual	September 2025	Section 8.1.2 – Edge Management Plan requirements when developments impact ecological integrity, stability, or functionality of a forest edge
	Manual	September 2025	Section 8.1.2 – Any boundary tree identified for injury or removal requires signed consent from neighbouring property owner(s).
	Manual	September 2025	Section 8.1.3 – Signage requirements for where a specimen tree is to be retained.
	Manual	September 2025	New Section 8.1.4 – Clearing and grubbing requirements.
	Manual	September 2025	Section 8.2 – Health Coefficients revised.
	Manual	September 2025	Section 8.2 – New table for health of tree and associated definitions
	Manual	September 2025	Section 8.3.2.1 – Caliper and height measurement requirements added.
	Manual	September 2025	Section 8.4.4 – Planting Density formula revised.
	Manual	September 2025	Section 8.4.5.9 – Concrete sidewalk option removed.
	Manual	September 2025	Section 8.4.5.10 – Footing depth requirements for swings added.

APPENDIX A: REVISION INFORMATION

REV. NO.	DOC.	DATE	DETAILS OF REVISION
	Appendix		
	Appendix B1	September 2025	Section 4.2 – Lumec & Road Focus Family added to the manufacturer column
	Appendix B2	September 2025	Section 1.1 – Wavetronix added to the manufacturer column
	Appendix B3	September 2025	Section 1.0 – Combined sewer & catchbasin leads material list
	Appendix B3	September 2025	Section 2.0 & Section 3 – Fittings were added to the material list
	Appendix B3	September 2025	Various manufacturers and specifications were revised
	Appendix B4	September 2025	Revised the majority of sections
	Appendix B5	September 2025	Revised the majority of sections
	Appendix B8	September 2025	Recommended boulevard trees were updated
	Appendix C	September 2025	Title updated to include “horizontal”
	Appendix D	September 2025	The submission requirement for USB drives was revised to digital files
	Appendix D	September 2025	Section 2.15 – Clarification was added to when inspections are required.
	Appendix E	September 2025	Table 1 – Note added for recovered asphalt cement, the ash content must be less than 1%
	Appendix F	September 2025	Additional requirements included; <ul style="list-style-type: none"> • As-recorded drawing are to be stamped by a licensed engineer. • ESC drawings are to be excluded from the package • Grading and Drainage section added to the underground certificate • SWM Pond requirements revised • SWM Pond and Grading sections revised for the aboveground certificate
	Appendix H	September 2025	New Appendix created for Watermain Commissioning Manual
	Appendix I	September 2025	New Appendix created for Fire Hydrant Flow Test Protocol
	TOSID	September 2025	Refer to Appendix G and the individual TOISD for specific revisions

Any person may request a change or revision to this document by submitting a written request using the form provided on the following page to:

Town Engineer, Town of Innisfil
2101 Innisfil Beach Road
Innisfil, Ontario L9S 1A1
Phone: (705) 436-3710
Fax: (705) 436-7120

TOWN OF INNISFIL
ENGINEERING DESIGN STANDARDS AND SPECIFICATIONS
REVISION REQUEST FORM

Section A: Contact Information (To be filled in by the Requesting Party)

Contact Name:	
Organization:	
Telephone:	
Fax:	
Email:	

Section B: Requested Revisions (To be filled in by the Requesting Party)

Section of Document:	
Current Description:	
Suggested Revisions:	
Reasoning:	

Please check, if applicable:

- Additional Information/Documentation Attached Red Lined Detail Drawing Attached

Signature: _____ Date: _____

Section C: Revision Review (To be filled in by the Responding Party)

The Town of Innisfil has reviewed the requested revision to the Engineering Design Standards and Specifications and has decided to:

- Deny the Request Support the Request Request a Meeting to Discuss

Additional Details:

Reviewed By: _____ Date: _____

Approved By: _____ Date: _____
 (Town Engineer)

APPENDIX B: LISTS OF APPROVED MATERIALS

- B1 – Street Lighting**
- B2 – Traffic Signals**
- B3 – Storm Sewer System**
- B4 – Wastewater System**
- B5 – Water Distribution System**
- B6 – Parks and Landscaping**
- B7 – Fencing**
- B8 – Seed Mixes & Tree Species**

APPENDIX B: LISTS OF APPROVED MATERIALS

B1 – Street Lighting

APPENDIX B1
STREETLIGHTING MATERIAL LIST

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
1.0 LIGHTING				
1.1	Electrical Handholes	CSA	Precast concrete type complete with cover, 460mm Dia., as per OPSD 2112.02.	
1.2	Ducts	CSA C22.2, No.211.1 CSA C22.2, No.211.2 CSA Standard B137.1, Series 75 or ENT CSA C22.2, No.227.1	In boulevard, rigid PVC DB2 duct, 53mm Dia. Below roadways, rigid PVC Thickwall duct, 53mm Dia. Flexible duct (Polypipe) to be used for protection of cables entering the wiring aperture in the concrete poles.	
1.3	Cables	CSA C22.2 No.38	Power supply cables shall be 3-#2 AWG copper RWU90 (including ground wire), with cross-linked polyethylene insulation rated 600 volt. Street light cables shall be 1-2C#6	

MATERIAL		STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
			<p>AWG copper and #10 AWG copper GND, 60°C, NMWU; or 2-#6 AWG copper RW90 and #8AWG copper GND RW90</p> <p>Riser wires from pole handhole to luminaire shall be #12 AWG stranded copper type RWU90 insulation.</p> <p>Insulation colour for line conductors for 1-phase, 3-wire 240/120V system shall be “Red” and “Black” and for 1 phase, 2-wire 120V system shall be “Red”. Insulation colour of all neutral conductors shall be “White”.</p> <p>Cable connectors in pole handholes shall be compression connectors with insulating covers.</p>		
1.4	Fuses		Fuse holders in pole handholes shall be in-line break-away type rated 600V complete with 10 amp KTK fuse.		
1.5	Grounding	CSA C22.2 No.41	Ground rods shall be solid steel, 19mm Dia., 3.0m long, copper clad for full length.		

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.	
2.0 POLES					
2.1	Standard Roadway Lighting Poles	CSA A14-M1979	<p>Direct Buried, Class “B” spun concrete, tapered round with natural concrete smooth mold finish, complete with handhole cover plate, nameplate and ground lug.</p> <p>Arterial Roads – 12.2m (40Ft.) Collector Roads – 10.7m (35 ft.) or 12.2m Local Roads – 7.5m (25ft.) or 10.7m</p> <p>Base mounted galvanized octagonal steel poles as per OPSD-2415.010.</p> <p>Arterial Roads – 10.5m Collector Roads – 9.0m/10.5m Local Roads – 7.5m/9.0m</p>	StressCrete Sky Cast U.S.I.	
2.2	Poles for Walkways/Bikeways		<p>Base mounted contemporary pole with high tensible carbon steel shaft round (76mm) welded to top and bottom of anchor plate.</p> <p>Pole to be black semi-gloss powder coat finish complete with base cover assembled with</p>		

MATERIAL		STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
			<p>stainless steel hardware.</p> <p>Photobutton light control recessed near top of pole.</p>		
2.3	Poles for Commercial Sites		<p>Poles shall be metal type square or round to suit the luminaire style and shall be base mounted. Poles shall have durable powder coat finish, colour to match the luminaire.</p> <p>Poles in parking areas shall be restricted to 30 ft. (9.1m) in height. Poles may be reduced in height down to 12 ft. (3.65m) level for pedestrian pathway applications.</p> <p>Wherever feasible, poles shall be located off the edge of pavement, behind barrier curbs (islands).</p> <p>Concrete bases in parking areas shall be protected by bollards or shall be raised to minimum 900mm above grade and be 760mm diameter.</p>		

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
3.0 BRACKETS				
3.1	Standard Roadway Lighting Brackets	<p>Tapered elliptical aluminium brackets as per OPSD 2420.01. The length of the bracket depends on offset from pavement and pole height.</p> <p>Arterial Roads – 2.4m (10Ft.) preferred, 3.0m maximum Collector Roads – 1.8m (8 ft.) preferred Local Roads – 1.2m (6 ft.) preferred.</p>		
3.2	Walkways/Bikeways Brackets	Single or double brackets with bend aluminum tubing with decorative aluminum rod, welded assembly and cast aluminum adaptor.		
4.0 LUMINAIRES				
4.1	<p>Standard Roadway Luminaires: High Pressure Sodium</p> <p>NOTE – HPS fixtures were allowed in the past. Currently all luminaires are to be LED type. This section is kept for general information only. Designer to consult the Town at the project start-up to confirm all design parameters.</p>			

MATERIAL		STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
4.1.1	Arterial/Industrial Roads		<p>“Cobra Head” style, type II or III distribution pattern, medium cut-off, internally shielded with flat tempered glass lens and photocontrol receptacle.</p> <p>Lamp wattage to be long life 200W to 400W high pressure sodium.</p> <p>Luminaire housing to be die-cast aluminum with latch and standard grey polyester powder coat finish. Permanent type marking to be applied on underside of the luminaire housing for lamp wattage identification, (Yellow for HPS).</p> <p>Ballast to be C.W.I., 120 volt, 60Hz.</p>	<p>Cooper Lighting (OVF)</p> <p>AEL (series 315)</p> <p>GE (M-400A)</p>	
4.1.2	Local and Collector Roads		<p>“Cobra Head” style, type II or III distribution pattern, medium cut-off, internally shielded with flat tempered glass lens and photocontrol receptacle .</p> <p>Lamp wattage to be long life 70W</p>	<p>Cooper Lighting (OVH)</p> <p>AEL (Series 315)</p> <p>GE (M-250R2)</p>	

MATERIAL		STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
			<p>to 150W high pressure sodium.</p> <p>Luminaire housing to be die-cast aluminum, with latch and standard grey polyester powder coat finish. Permanent type marking to be applied on underside of the luminaire housing for lamp wattage identification, (Yellow for HPS).</p> <p>Ballast to be C.W.I., 120 volt, 60Hz.</p>		
4.1.3	Photocontroller		<p>Model TRS-1</p> <p>Photocontroller to have minimum surge protection of 40,000 amps and a minimum load rating of 1,000W/1,800 VA.</p> <p>Must have operating strength of 5,000 volts, and the photocell must be silicon sensor in glass and metal hermetic enclosure.</p> <p>Photocells shall be rated for a</p>	FP Outdoor Lighting Controls/Sunrise Technologies	

MATERIAL		STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
			minimum of 100,000 operational hours		
4.2	Standard Roadway Luminaires: LED – Cobra Head		<p>Luminaire – Cobra Head style, type 2 or 3 distribution pattern, rugged die cast aluminum housing with surge and brown-out protection, LED drivers and electronic transfer switch. Temperature control by robust heat sink ensuring a minimum of 80,000 hours L70 at 40C operating ambient.</p> <p>Operating range from – 40 to + 50C with light engines meeting the dust and moisture rating of IP-66. Luminaire design to meet CSA-C22.2 number 250 for 40C, wet location and to be ROHS compliant. Maximum total harmonic distortion to conform to ANSI C82.77: 2002.</p> <p>Solid state 120 volt 60 Hz electronic drivers with extended</p>	<p>CREE</p> <p>Cooper Lighting</p> <p>GE Lighting</p> <p>Leotek Green Cobra LED Family</p> <p>Lumec, Road Focus Family</p>	<p>XSP Series LED Street Luminaire</p> <p>XNV1/XNV2 LED Navion LED Verdeon LED</p> <p>GE Evolve LED</p> <p>G CJ, GCM, GCL, GC2</p>

MATERIAL		STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
			<p>Solid state 120 volt 60 Hz electronic drivers with extended life to 100,000 hours minimum. Temperature control by robust heat sink ensuring a minimum of 100,000 hours L70 at 40C operating ambient</p> <p>LED colour temperature 4000 K nominal.</p> <p>All luminaires to be provided with a Dimming Module Minimum 7 year limited warranty (10 year preferred) on LED light engine, LED drivers and all non-electrical components.</p>	<p>King LED</p> <p>Cyclone Lighting</p> <p>Lumec, LU40 Family</p>	<p>King Luminaire K601 Decorative LED</p> <p>Hudson Post Top HUD4T4-NL Sidemount HUDS4A-NL</p>
4.4	Park Walkway/Bikeway Luminaires:		50W pulse start metal halide.		
4.5	Commercial Site Luminaires: Metal halide		<p>In general shall be of the “Architectural Site Lighting” style, contributing a cohesive look to the overall site lighting system.</p> <p>The architectural outdoor luminaries may be shoe-box or round type with good optics and</p>		

MATERIAL		STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
			<p>full cut-off with optional house side shielding.</p> <p>Luminaires at lower mounting heights shall have a vandal proof lens. The luminaires shall be post top arm mounted suitable for 1A to 4C configurations and also be suitable for optional wall mount applications.</p> <p>Luminaire housings shall be die-cast type with durable powder coat finish colour to match site architectural features.</p> <p>Lamp wattage for parking lot and site roadway lighting shall be in the 150 to 400 watt range, subject to application. Lamp wattage for pedestrian scale pathway and building zone lighting may be reduced to 70 watt metal halide.</p>		
5.0 POWER SUPPLY DISCONNECT					
5.1	Pole Mounted Disconnects		Pole mounted power supply disconnects shall be outdoor weatherproof type 240/120 V rated	Square 'D' (CQO)	

MATERIAL		STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
			100 amps with 60 amp 2 pole main breaker suitable for service entrance.		
5.2	Pedestal Mounted Disconnects		<p>Pedestal mounted power supply disconnect shall be outdoor heavy gauge galvanized steel with lockable removable front cover complete with precast concrete base.</p> <p>Colour to be equipment green with powder coat finish.</p> <p>Interior power supply disconnect shall be 240/120 V rated 100 amps with 60 amp 2 pole main breaker suitable for service entrance. Branch breakers to be 30 amps 1 pole 120V.</p>	Pedestal Solutions Inc.	

APPENDIX B: LISTS OF APPROVED MATERIALS

B2 – Traffic Signals

APPENDIX B2

TRAFFIC SIGNALS MATERIAL LIST

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.	
1.0 TRAFFIC SIGNAL CONTROLLER					
1.1	Street Intersections	<p>NEMA Standards Publication No. TS2-2016, TS2-Type 2 design specifications and all revisions</p>	<p>8 phase, solid state, LCD display, microprocessor traffic based controller timer</p> <p>Programmable to start up in Phase 2 and 6 “Amber” and phase 4 and 8 “Red” intervals</p> <p>Capable of providing vehicle extensions of the actuated phases and capable of holding 4 different timing plans</p> <p>A “NEMA Plus” solid state 12 channel conflict monitor complete with LCD display and fault memory with RS-232 port and cable, EDI Model No. SSM-12LE.</p> <p>Include fully wired 12 position back panel set up to operate on the approximate number of vehicle and pedestrian phases</p> <p>Include wired 8 position detector rack</p>	<p>McCain</p> <p>Wavetronix</p>	<p>ATC eX2 TS2 Type 2</p>

APPENDIX B2: LISTS OF APPROVED MATERIALS

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
		<p>Cabinet power supply to provide regulated DC power, unregulated AC power and a line frequency reference for the detector racks, load switches and auxiliary equipment.</p> <p>All time clocks to have a minimum of 12 hour power reserve complete with LCD display and fault memory, with RS-232 port and cable, EDI Model No. SSM-12LE.</p> <p>Twelve (12) solid state load switches with PDC for vehicle and pedestrian indications only, EDI Model No. 200 or approved equivalent. Indication lights showing the condition of "Green (Walk)", "Yellow" or "Red (Don't Walk)" drive turned "ON" at the load switch shall be provided integral with the load switch.</p> <p>Provisions for future dial-in communication access (Bell Canada) and a 1200 baud FSK modem.</p> <p>Two (2) rack-mount pedestrian, 2-channel, DC Isolator cards, EDI Model 242, or approved equivalent.</p> <p>Four (4) Loop detector units (2 channel), EDI LM 222 series, or</p>		

APPENDIX B2: LISTS OF APPROVED MATERIALS

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
		<p>approved equivalent.</p> <p>Two (2) spare rack-mount slots wired for future emergency pre-emption cards.</p> <p>Police panel complete with a manual/auto switch, flash switch, and signal on/off switch.</p> <p>Thermostatically controlled 250W strip heater and fan which can be manually controlled.</p> <p>Four (4) Transfer Relays.</p> <p>NEMA solid state, 15A, 2-pole flasher, EDI Model #204 or approved equivalent.</p> <p>Radio interference filter.</p> <p>Two (2) internal circuit breakers for power feed:</p> <ul style="list-style-type: none"> • One 40 Amp for traffic signal system; and • One 15 Amp for cabinet accessories. <p>Duplex ground fault type convenience outlet.</p> <p>Lamp receptacle, complete with hand held lamp, bulb and switch.</p> <p>Switches inside the cabinet to simulate vehicle and pedestrian</p>		

APPENDIX B2: LISTS OF APPROVED MATERIALS

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
		<p>detector inputs directly to the controller.</p> <p>Switches for stop timing and flash toggle shall also be provided.</p> <p>Power surge protective device for filtering lightning and high voltage surges to ground, EDCO Model No. SHA-1210 or approved equivalent.</p> <p>Aluminium air vent cover, complete with dust filter.</p> <p>Two (2) Conflict Monitor check sheets verifying shop testing.</p> <p>Two (2) sets of equipment drawings, one (1) original bounded Manufacturer's operation manual with blank timing sheets, water-proof document bag, and two keys for the cabinet.</p> <p>The controller timer and cabinet shall be supplied completely wired and programmed to facilitate the mode of operation. Wiring drawings and connection instructions shall be included with the unit.</p> <p>Neoprene gasket installed between the base of a pad mounted cabinet and the concrete foundation.</p>		

APPENDIX B2: LISTS OF APPROVED MATERIALS

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
		<p>All external input wiring within the cabinet shall be Mylar tagged, labelled, grouped, and neatly tied in an organized fashion. There is not to be any loose or excessive wiring.</p> <p>Where the controller is for a pedestrian activated crosswalk the controller will be Trafficware Model 980 TS-2 Type 2 Traffic Controller and shall have vehicle pre-emption and time based co-ordination capability with an EDI NEMA 6 Channel CMU with Canadian Fast Flash capability. It shall include a minimum 4 position detector rack with 2-2 channel rack detectors. There shall also be a single card rack to support the addition of an Optical Pre-emption card. The controller cabinet shall be type "G" if pole mounted and type "M" if base mounted. The assembly shall include a 8 position back panel, 8 NEMA Load Switches, 1-NEMA Flasher, Internal lighting, GFI convenience outlet, internal test switches including auto/flash, stop time and interval advance. There</p>		

MATERIAL		STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
			shall be a police door on the front door of the cabinet and shall include auto/flash, manual/auto, and a police cord for manual control.		
2.0 CONTROLLER CABINET					
2.1	Pad Mounted		Aluminum door in door Type M-1 pad mount cabinet with base extension		
2.2	Pole Mounted		Type G		
3.0 CONCRETE POLE BASES					
3.1	For poles greater than 3.7 m		760 mm Dia. OPSD 2200.01 and with anchorage assemblies as per OPSD 2215.02 and 2215.03		
3.2	For poles 3.7 m and less		450 mm Dia as per OPSD 2200.04 An X is to be marked atop the concrete to show location of conduit entry A 20 mm sleeve to be provided in the concrete pole base for installation of ground wire		
4.0 TRAFFIC SIGNAL POLES					
4.1	Octagonal Steel Poles		Where a separate controller cabinet pole is required, the pole shall be 3.6		

APPENDIX B2: LISTS OF APPROVED MATERIALS

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
		<p>metre (Powco Steel #8312) hot dipped galvanized heavy duty octagonal, base mount pole, complete with handhole cover and top cap.</p> <p>Poles shall be 6.1 metre (Powco Steel #8620) hot dipped galvanized heavy duty octagonal, base mount poles, complete with handhole covers and top cap. The pole is to be situated such that the final mast arm position is perpendicular to the roadway and such that the hand hole is on the opposite side of the roadway.</p> <p>Combination Traffic Signal / Luminaire Pole</p> <p>Poles shall be 9.1 metre (Powco Steel #8535) hot dipped galvanized heavy duty octagonal, base mount pole, complete with handhole covers and top cap. The pole is to be situated such that the final mast arm position is perpendicular to the roadway and such that the handhole is on the opposite side of the roadway.</p> <p>On higher speed roads the use of yielding poles may need to be considered.</p>		

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
5.0 ELECTRICAL CHAMBERS				
		<p>Electrical chamber for the electrical systems shall be round precast concrete handwells, complete with cast iron frame and grate. The inside diameter of handwell shall be:</p> <ul style="list-style-type: none"> • 460mm ID for three (3) conduit inserts or less (OPSD 2112.02), and • • 675mm ID for four (4) conduit inserts (OPSD 2112.03). <p>Electrical chamber for vehicle loop detection connections only shall be 300mm ID round precast concrete complete with cast iron frame and grate (OPSD 2112.01).</p> <p>Each electrical chamber shall be separately grounded to a ground rod positioned 600mm from the outside of the structure. The ground wire shall be a #6 bare stranded and affixed to the frame using 70amp SLU solderless connector. System ground ties within the electrical chamber shall be made with split bolts or thermal weld "T" taps.</p>		

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
6.0 TRAFFIC SIGNAL ARMS				
		<p>Traffic single member arms shall be tapered spun aluminium, complete with mounting hardware and mounted so that traffic signal head clearances above the roadway are 5.2 metres. Approved manufacturers of traffic single member arms are:</p> <ul style="list-style-type: none"> • Sentinel Pole and Traffic Equipment Limited - TR Series; • Powerlite - SMA Series, <p>Or approved equal.</p>		
7.0 TRAFFIC SIGNAL HEADS				
		<p>Shall have polycarbonate “Special Highway” type signal heads with yellow door and housing, backboards, cowl visors, bird stops, plumbizer hanger system and steel reinforcing plates placed between the “Red” and “Amber” sections at locations indications on the Contract Drawings. Traffic signal heads shall have 300mm diameter “Red”, “Amber” and “Green” sections with LED lamp indications.</p>		

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
		<p>The traffic signal heads shall be installed on plumbizer signal hanger.</p> <p><u>SPECIAL TRAFFIC HEADS</u></p> <p>Shall have polycarbonate “Type 9”, “Type 9A”, “Type 10”, “Type 10A”, “Type 11” and “Type 11A” traffic signal heads with yellow door and housing, backboards, cowl visors, bird stops, plumbizer hanger system and steel reinforcing plates placed between the “Amber” and “Green” sections at locations indications on the Contract Drawings. The traffic signal head sections shall be fitted with LED lamp indications, unless otherwise noted on drawings.</p> <p>The traffic signal heads shall be installed on plumbizer signal hanger</p> <p><u>LIGHT EMITTING DIODE (LED) LAMP UNITS</u></p> <p>shall have LED lamp indications for the traffic and pedestrian signal heads. The LED lamp units shall be meet the requirements of the:</p> <ul style="list-style-type: none"> • ITE Specification for ITE Publication No. ST-017B-2001 - Equipment and Material Standards of the 		

APPENDIX B2: LISTS OF APPROVED MATERIALS

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
		<p>Institute of Transportation Engineers, and</p> <ul style="list-style-type: none"> • ITE Specification for ITE Publication – Traffic Control Signal Heads – Part 2: LED Pedestrian Traffic Signal Modules (March 2004). • ITE Specification for ITE Publication – Traffic Control Signal Heads – Part 3: LED Vehicle Arrow Traffic Signal Modules (March 2004). • ITE Specification for ITE Publication – Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED) Circular Signal Supplement (June 2005). <p>The following manufacturers of LED lamp units are approved for installation:</p> <ul style="list-style-type: none"> • Daylight – Distributed by Innovated Traffic Solutions Inc. • Leotek Electronic Corporation – Distributed by Electromega Ltd. • GELcore – Distributed by Tacel Limited. 		

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
8.0 PEDESTRIAN HEADS AND MOUNTING BRACKETS				
		Shall have single section pedestrian heads complete with mounting hardware and LED lamp unit, installed in accordance with OPSD 2505.01 and OPSD 2524.01, providing a clearance from the bottom of signal to ground level of 2.75 metres.		
9.0 PEDESTRIAN PUSH BUTTONS AND SIGNS				
		Push buttons shall be “Pelco” rectangular, yellow, freeze-proof, pedestrian push button assembly for pole mounting complete with stainless steel vandal proof screws, with diaphragm, at a mounting height of 1.1m. Anti-seize compound is to be applied to the face plate and mounting screws. It shall include Ra-12 (13 x 20cm) signs at all push buttons with an arrow indicating the direction of pedestrian crossing. EXTRA LOW VOLTAGE (ELV) CABLES FOR PEDESTRIAN PUSHBUTTONS Supply be four (4) conductor #18 AWG extra low voltage cable, in shielded core from the pedestrian		

APPENDIX B2: LISTS OF APPROVED MATERIALS

MATERIAL		STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
			<p>pushbuttons to the controller cabinet, including 3.0 metres of spare cable in each electrical chamber.</p> <p>The cable shall meet the requirements of OPSS Specification No. 2420 and shall be installed in accordance with OPSD 2528.01 and OPSD 2529.01. The cable shall be "3M Company", Catalogue No. Canoga CC 30003 or approved equal.</p> <p>All groups of ELV pedestrian pushbutton cables in the controller cabinet, are to be tagged and labelled indicating phase number and leg of intersection.</p>		
10.0 LOW VOLTAGE LUMINAIRE CABLE					
			<p>The luminaire wire shall be #12 TWU single conductor, stranded copper, low voltage cable, rated 600 volts. Low voltage wire shall meet the requirements of OPSS 604, or type RWU 90 - cross link meeting the requirements of CSA Standard C22.2, No. 38. The luminaire runner cable shall be #8 TWU-90.</p> <p>The luminaire wire shall be sized so as to satisfy voltage drop</p>		

APPENDIX B2: LISTS OF APPROVED MATERIALS

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
		<p>requirements of the electrical equipment and shall not exceed 5%.</p> <p>All wire apertures drilled in steel or aluminium poles / mast arms shall be deburred and painted with grey zinc rich paint. Rubber grommets will be installed after the paint is dry.</p> <p>All joints in the luminaire wire shall be made above ground in the pole handholes or junction boxes unless otherwise specified. All equipment is to be adequately grounded, using a brass ground fitting attached to the pole ground lug.</p> <p>The riser wires inside the poles and in the mast arms shall be included in this item and shall be connected to the external wiring circuit in the underground conduit by means of one single pole waterproof fuse holder "Bussman -Tron", Catalogue No. "HEB-AA" with rubber boots, or approved equal, with one 10 amp midget ferrule fuse, "Buss" type "KTK" or approved equal. A fuse holder shall be installed inside the pole handhole and shall be secured to the connector clip supplied in the pole.</p>		

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
		The luminaire wire shall be brought back and connected to the circuit breaker supplied and installed at the service pole.		
11.0 GROUND WIRE				
		All ground wire splices inside electrical chambers and in poles shall be connected using a split bolt. Ground wire connections to ground rods shall be made with Thermit Weld connections. System Ground - shall be continuous #6 AWG TWH green, stranded copper ground wire through the entire main conduit system. The system ground wire is to be connected to all steel poles and maintenance hole / handwell frames (using 70amp SLU solderless connectors), junction boxes on wood poles, and the ground rods for each maintenance hole / handwell. Pole Grounding - shall be continuous #6 AWG TWH green, stranded copper ground wire from the ground lug in the steel pole (using 70amp SLU solderless connectors) to the ground rod		

APPENDIX B2: LISTS OF APPROVED MATERIALS

MATERIAL		STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
			<p>located adjacent to the pole.</p> <p>Power Service Ground - A continuous #6 AWG bare, stranded copper ground wire will be installed from the service enclosure to the four (4) ground rods located 1000mm from pole, the second rod 3 metres from the first.</p> <p>A continuous #12 AWG TWH green, stranded copper ground wire shall be installed from the proposed luminaire fixture to the ground lug in the luminaire poles.</p> <p><u>GROUND RODS</u></p> <p>shall be 20mm x 3.0m copper clad ground rods where necessary to provide adequate system grounding. The ground rods driven into the ground shall be buried so that the top of the ground rods are 300mm below the finished grade.</p> <p>Grounds rods shall be driven on the exterior of electrical chambers.</p>		
12.0 UNDERGROUND CONDUIT					
			<p>Shall be Rigid PVC conduit or High Density Polyethylene Pipe (HDPE) ducts runs. Sections of conduit are</p>		

APPENDIX B2: LISTS OF APPROVED MATERIALS

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
		<p>to be joined together using solvent weld cement recommended by the conduit supplier. Depth shall be as per OPSD 2103.02 and installed below any existing subdrains.</p> <p>Open Cut Installation</p> <p>Rigid conduit systems installed by open cut, direct buried and subsurface installation shall be rigid polyvinyl chloride (PVC), unplasticized conduit conforming to CSA Standard C22.2 No. 211.0-03 and CSA Standard C22.2 No. 211.2-M1984 (R2003), except where otherwise indicated.</p> <p>Directional Boring</p> <p>Polyethylene duct installed by directional boring method shall be High Density Polyethylene Pipe (HDPE) in accordance with:</p> <ul style="list-style-type: none"> • United Laboratories, UL 651B – Standard Specification for Continuous Length HDPE Conduit • American Society for Testing and Materials International, ASTM F2160 – Standard Specification for Solid Wall High Density Polyethylene Conduit Based on Controlled 		

APPENDIX B2: LISTS OF APPROVED MATERIALS

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
		<p>Outside Diameter; and</p> <ul style="list-style-type: none"> National Electrical Manufacturers Association, NEMA TC 7-2005 – Smooth-Wall Coilable Electrical Polyethylene Conduit <p>All road crossing trenches are to be backfilled with unshrinkable material as per OPSS 603.07 and OPSD 2103.03.</p> <p>The conduit layout shall be as follows install 2-100mm (4 inch) conduits between electrical chambers in road crossings, a 75 mm (3 inch) Rigid PVC conduit for traffic signal cabling and a 50mm (2 inch) Rigid PVC conduit for lighting cabling, when necessary from electrical chambers to traffic poles, 2-100 mm Rigid PVC conduits between the controller cabinet and closest electrical chambers. A 25mm Rigid PVC conduit shall be used for loop lead-in wires between the edge of pavement and nearest electrical chamber.</p>		
13.0 LOOP DETECTORS				
		<p>Loops shall be sized and installed as</p>		

APPENDIX B2: LISTS OF APPROVED MATERIALS

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
		<p>shown on the Contract Drawings and as per OPSD 2520.01 and OPSD 2520.02.</p> <p>Loop wire size shall be #14 AWG stranded RWU90 type.</p> <p>Loop home-run cable from electrical chamber to the controller cabinet shall be 2 conductor, #14 AWG extra low voltage cable with shielded twisted pair conductors, a high density polyethylene insulation and ground wire. Approved cables are Belden #8719 or Detector Systems, #DSI 1602, or approved equal.</p> <p>All loop splices are to be soldered and sealed with waterproof "3M Scotchcast", "Raycam", "KCLICKIT II" kit, or approved equivalent.</p> <p>All single loops are to be wound 4 times. Quadrupole loops are to be wound 2-4-2.</p> <p>Saw slots should be 50mm to 75mm deep.</p> <p>Loops connected in the series are to be wound alternately in opposite rotation.</p> <p>Pieces of 150mm plastic foam backer rod are to be tightly packed within the sawcut slot every 2 metres</p>		

MATERIAL		STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
			<p>of the loop and lead-in sawcuts.</p> <p>Loop wire leads are to have a minimum of 5 twists per foot after leaving the loop saw slot.</p> <p>Loop sawcuts shall be fully sealed with hot applied tar or approved equivalent, and protected from traffic until completely dried.</p> <p>A loop inductance and leakage test is to be performed on the finished loop installation at the splice prior to being sealed. Loop inductance measurement shall be between 20 and 2,500 microhenries. Leakage resistance shall be equal to or greater than 100 megohms.</p>		
14.0 SIGNAL CABLE					
			<p>Shall be fourteen (14) gauge colour coded, traffic signal runner and riser cables to accommodate all equipment and installation operations specified in the Contract, including 3.0 metres of spare wire within each electrical chamber.</p> <p>The traffic signal cable shall meet the requirements of OPSS 2409.</p> <p>Traffic signal cable shall be installed</p>		

APPENDIX B2: LISTS OF APPROVED MATERIALS

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
		<p>in the underground conduit system in accordance with the Standard Drawings OPSD 2528.01 and OPSD 2529.03 (Note B omitted), except that the conductor cable be changed to:</p> <ul style="list-style-type: none"> • All riser cables for traffic signal heads shall be seven (7) conductor, #14 AWG. • All riser cables for pedestrian heads shall be five (5) conductor, #14 AWG. • All runner cables for traffic signal heads and pedestrian heads shall be twelve (12) conductor #14 AWG, and installed in accordance with OPSD 2529.03 except that Note B be omitted. Suggest OPSD 2925.11 <p>The traffic signal heads on all legs of the intersection shall be wired separately to allow the addition of advance green or split phases without additional wiring being required.</p> <p>The traffic signal cable for each pedestrian phase will be brought back to the controller separately to accommodate separate "Walk" and</p>		

APPENDIX B2: LISTS OF APPROVED MATERIALS

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
		<p>“Don't Walk” movements for each phase.</p> <p>Label all groups of traffic signal conductors in the controller cabinet indicating phase number, direction, and movement.</p> <p>All wire apertures drilled in steel or aluminum poles/ mast arms shall be deburred and painted with grey zinc rich paint. Rubber grommets will be installed after the paint is dry.</p>		
15.0 EQUIPMENT FOR POWER SUPPLY				
		<p>The power supply disconnect facility shall be installed to service the traffic signal control device and the related intersection lighting mounted on the traffic signal poles.</p> <p>Shall be a Square-D Model #CQ018M100RB load centre complete with circuit breakers at the supply location. The load centre shall include a 120/240V, 100A, 1Ø, 3 Wire assembly with:</p> <ul style="list-style-type: none"> • 1 - Main Circuit Breaker - 2 pole - 240V - 100A common trip circuit breaker, Square D, Catalogue # QO-2100 or approved equal. 		

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
		<ul style="list-style-type: none"> • 4 - Lighting Circuit Breakers - 1 pole - 120/240 V - 30 A circuit breaker, Square D, Catalogue # QO-130 or approved equal. • 1 - Traffic Signal Circuit Breaker - 1 pole - 120/240 V - 60 A circuit breaker, Square D, Catalogue # QO-160 or approved equal. • Secondary Surge Suppressor, 650V Vac 2-pole secondary lightning arrester, Square D, Catalogue # QO2775SB or approved equal. <p>Or approved equivalent.</p> <ul style="list-style-type: none"> • There shall be sufficient length of 3-1/C #2 AWG (Black & White) copper stranded RWU (-40°C) wire coiled at the weather head for the connection to the secondary supply / transformer on the service pole. 		
<p>16.0 EMERGENCY PRE-EMPTION DETECTOR SYSTEM</p>				

APPENDIX B2: LISTS OF APPROVED MATERIALS

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
		Shall be two “3M Optical Pre-emption detector Model 721”, Two Channel, 2 Directions with “Discriminator Model 452” Actuator card including harness, wiring, hardware, and testing and install sufficient optical pre-emption detector cable manufactured by “3M Company (Model #138)” and connect each optical detector to the controller cabinet.		
17.0 LUMINAIRES				
		Luminaires shall be I.E.S. Type III-MSCO photometric curve, 250 Watt H.P.S. fixture housing, 250 Watt CWI ballast, for 120 Volt operation, complete with integral ballast, 250 Watt H.P.S. lamp, photo control receptacle, ground lug and photocell. The following luminaires are approved for installation: <ul style="list-style-type: none"> • American Electric - Catalogue # 125 25 S CT DT1 R3 DG, or • General Electric – Catalogue # M-400 25 S 1 P 1 2 R MS3 U 		

MATERIAL	STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
		<p><u>LUMINAIRE ELLIPTICAL BRACKETS</u></p> <p>Luminaire elliptical brackets shall be aluminum tapered elliptical mast arms, complete with mounting brackets and conform to OPSS 2420. Elliptical brackets shall be mounted in accordance with OPSD 2250.01. The following aluminum tapered elliptical brackets are approved for installation:</p> <ul style="list-style-type: none"> • 3.0 m Tapered Elliptical Bracket - Powerlite RE-10MA - 3mm Wall, 60mm x 100mm OD, <p>Or approved equal.</p>		

APPENDIX B: LISTS OF APPROVED MATERIALS

B3 – Storm Sewer System

APPENDIX B3**STORM SEWER SYSTEM MATERIAL LIST**

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
1.0 SEWER MAIN & CATCHBASIN LEADS				
PVC (300mm to 450mm)	CSA B182.2	- DR 35 - Rubber gasket in integral bell and spigot joints - Green in colour	IPEX Westlake Pipe & Fittings Diamond Plastics	As per individual manufacturer
Concrete	CSA A257.2	- Rubber gasket type joints certified to CSA A257.3	OCPA Plant Prequalification Member	
PVC Profile Pipe	CSA B182.4	- PVC Profile Pipe	IPEX	Ultra-Rib
Polypropylene Pipe	CSA B182.13	- Polypropylene Pipe	ADS	Sanitite HP Pipe
2.0 CONNECTION TEES & FITTINGS				
PVC Sewer Main	CSA B182.2	- DR 28 - Injection molded (100 mm dia. to 300 mm dia.) or factory-fabricated gasketed tee (375 mm dia. and larger)	IPEX Westlake Pipe & Fittings Galaxy Plastics Ltd.	As per individual manufacturer
Concrete Sewer Main	CSA A257.2,3	- Factory-fabricated tee	OCPA Plant Prequalification Member	
PVC Profile Pipe	CSA B182.4	- PVC Profile Fittings	Westlake Pipe & Fittings IPEX	As per individual manufacturer

APPENDIX B3: LISTS OF APPROVED MATERIALS

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
			Galaxy Plastics Ltd.	
Polypropylene Pipe	ASTM F2764	- Polypropylene Pipe Fittings	ADS Galaxy Plastics Ltd.	INSERTA TEE EZ Tee
3.0 SERVICE LATERALS & FITTINGS				
PVC Pipe	CSA B182.2	- DR 28 - Rubber gasket in integral bell and spigot joints - White or grey in colour	IPEX Westlake Pipe & Fittings Diamond Plastics Next Polymers	As per individual manufacturer
PVC Fittings	CSA B182.2	- Lateral PVC Fittings	Westlake Pipe & Fittings IPEX Galaxy Plastics Ltd.	As per individual manufacturer
4.0 TEST FITTINGS				
PVC	CSA B182.2	- Bootjack Fitting for double connections - Straight test fitting at property line	IPEX	As per individual manufacturer
Cast Iron	CSA B70	- Bootjack Fitting for double connections - Straight test fitting at property line	Crowle	As per individual manufacturer

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
		-		
5.0 SUB-DRAINS				
HDPE	OPSS 1840 BNQ 3624-115	- Perforated, with geo-textile sock filter		
6.0 MAINTENANCE HOLES				
Concrete	CSA A257.4	- Rubber gasket type joints certified to CSA A257.3	OCPA Plan Pre- Qualification Member	
7.0 FRAMES & GRATES – MAINTENANCE HOLES				
Cast Iron Ductile Iron	OPSS 1850	- Storm grate as per OPSD 401.010 (closed cover) with date and “STORM” cast into the cover - Adjustable/Autostable Frame -	EJ Canada Cedar Infrastructure Products	As per individual manufacturer
8.0 CATCHBASINS				
Concrete	CSA A257.4	- Use pre-cast concrete grade adjustment units with Moduloc tape between layers	OCPA Plant Pre- Qualification Member	

APPENDIX B3: LISTS OF APPROVED MATERIALS

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
	OPSS 1850	<ul style="list-style-type: none"> - Frame & grate as per OPSD-OPSD 400.100 - Rear yard catchbasin frame & grate as per OPSD-400.120 		
9.0 CULVERTS				
Concrete	CSA A257.2		OCPA Plant Prequalification Member	
CSP	CSA G401	<ul style="list-style-type: none"> - Galvanized - Wall thickness as recommended by manufacturer for H20 loading. - Minimum wall thickness 2.0 mm for road crossing, 1.6 mm for entrance. 		
HDPE (up to 600 mm)	CSA B182.6-02	<ul style="list-style-type: none"> - 320 kPa pipe stiffness - Smooth Interior Wall 	Armtec ADS Solenio	As per manufacturer
10.0 HEADWALL AND ENDWALL TREATMENTS (Only if Approved by the Town)				
Concrete			OCPA Plant Prequalification Member	As per individual manufacturer
11.0 ADJUSTMENT UNITS				
Concrete	CSA A257.4	<ul style="list-style-type: none"> - Pre-cast concrete grade adjustment units with Moduloc tape between layers 	OCPA Plant Pre-qualification Member	As per individual manufacturer

APPENDIX B3: LISTS OF APPROVED MATERIALS

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
Ductile HDPE		<ul style="list-style-type: none"> - Riser rings (only to be used when approved by the Town) - IPEX Lifesaver adjustment units 	Sigma IPEX	MH-640102 DI (38 mm) MH-640102 DI (51 mm) Lifesaver

APPENDIX B: LISTS OF APPROVED MATERIALS

B4 – Wastewater System

APPENDIX B4
WASTEWATER SYSTEM MATERIAL LIST

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
1.0 SEWER MAIN				
PVC (200mm to 525mm)	CSA B182.2	<ul style="list-style-type: none"> - DR35 - Colour: green - Rubber gasket in integral bell and spigot joints - "Kor-n-seal" gaskets on all pipes entering maintenance holes 	IPEX NAPCO Next Polymers Diamond Plastics	As per individual manufacturer
Reinforced Concrete Pipe (600mm and above)	CSA A257.2	<ul style="list-style-type: none"> - Minimum Class 65-D - Rubber gasket type joints certified to CSA A257.3 - Sulphate resistant cement 	CPCQA Certified Plant Member	As per individual manufacturer
2.0 CONNECTION TEES & FITTINGS				
PVC	CSA B182.2	<ul style="list-style-type: none"> - DR28 - Injection molded or factory-fabricated gasketed tees 	IPEX Westlake Pipe Galaxy Plastics Ltd.	As per individual manufacturer
Reinforced Concrete Pipe	CSA A257.2 CSA A257.3	<ul style="list-style-type: none"> - Factory fabricated tee for PVC lateral connection 	CPCQA Certified Plant Member	As per individual manufacturer
3.0 SERVICE LATERALS				

APPENDIX B4: LISTS OF APPROVED MATERIALS

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
PVC	CSA B182.2	<ul style="list-style-type: none"> - DR28 - Colour: green - Rubber gasket in integral bell and spigot joints 	IPEX Westlake PipeNext Polymers Diamond Plastics	As per individual manufacturer
4.0 VERTICAL RISERS				
PVC	CSA B182.2	<ul style="list-style-type: none"> - For use with sewer main depths in excess of 4.5 m 	Westlake Pipe	As per manufacturer (varies by size)
5.0 TEST FITTINGS				
PVC	CSA B182.2	<ul style="list-style-type: none"> - Straight test fitting at property line 	IPEX	As per individual manufacturer
Cast Iron	CSA B70	<ul style="list-style-type: none"> - Straight test fitting at property line 	Crowle	As per individual manufacturer
6.0 SERVICE SADDLES				
PVC	CSA B182.2	<ul style="list-style-type: none"> - For use as a new service connection to an existing municipal sewer only - SDR35 Gasket Hub x Gasket Saddle Tee c/w Stainless Steel Clamps and Short Skirt 	Westlake PipeGalaxy Plastics Ltd. IPEX	As per manufacturer (varies by size)
7.0 MAINTENANCE HOLES				

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
Concrete	CSA A257.4	<ul style="list-style-type: none"> - Rubber gasket type joints certified to CSA A257.3 - “Kor-n-seal” gaskets on all pipes entering maintenance holes - Factory cast inserts for internal non-penetrating frost straps - Precast factory-made benching up to obvert 	CPCQA Certified Plant Member	As per individual manufacturer
8.0 FRAMES & GRATES				
Cast Iron	OPSS 1850	<ul style="list-style-type: none"> - Grate as per OPSD 401.010 (closed cover) with date and “SANITARY” cast into the cover 	Bibby-Ste-Croix Star Pipe Canada	As per individual manufacturer
Ductile Iron	OPSS 1850	<ul style="list-style-type: none"> - Adjustable/Autostable Frame - C-50M-ONT - C-50M-ONT (Watertight Option) - SELFLEVEL – MC401010243 	Bibby-Ste-Croix EJ Canada	As per individual manufacturer
9.0 ADJUSTMENT UNITS				
Concrete	CSA A257.4	<ul style="list-style-type: none"> - Pre-cast concrete grade adjustment units with Moduloc tape between layers 	CPCQA Certified Plant Member	As per individual manufacturer

APPENDIX B4: LISTS OF APPROVED MATERIALS

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
Ductile Iron		- Riser rings (only to be used when approved by the Town)	Sigma	MH-640102 DI (38 mm) MH-640102 DI (51 mm)
10.0 FORCEMAIN				
PVC	CSA B137.3 AWWA C900 or, AWWA C905	- SDR26 (minimum) - Colour; White	IPEX Westlake Pipe	As per individual manufacturer
11.0 WATERTIGHT FRAME & GRATE				
Watertight Frame & Grate	ASTM D2240, ASTM D412, ASTM D573, ASTM D395, ASTM D746		Hamilton-Kent	The Life Span System
12.0 WATERPROOF MEMBRANE				
Waterproof Membrane/ Petrolatum Tape	ASTM D412, ASTM E96, ASTM E154		Blueskin R.W. Meadows Denso Petrolatum Tape	WP200 Mel-Roll as per manufacturer
13.0 SERVICE ABANDONMENT SLEEVE				
Service Abandonment Sleeve		Stainless Steel	Link-Pipe	As per manufacturer
14.0 FORCEMAIN TRACER WIRE				
Forcemain Tracer Wire (Open cut)		#12 AWG (0.0808" diameter" high strength copper clad steel conductor (HS-CCS), insulated with a 30 mm high density polyethylene (HDPE) insulation,	Electrical Suppliers Galaxy Plastics/Bren Technologies Canada Wire Copperhead	As per manufacturer

APPENDIX B4: LISTS OF APPROVED MATERIALS

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
		rated for direct burial use at 30 volts	Phillips Pirelli	
Forcemain Tracer Wire (Directional Drilling and Jack & Bore Installations)		<ul style="list-style-type: none"> - Extra High Strength - Colour coded green - Minimum 4 wires to be pulled 	Copperhead	845G-EHS 1045G-EHS 1245G-EHS
15.0 TRACER WIRE WATERPROOF CONNECTOR				
Tracer Wire Waterproof Connector	ASTM D1248, ASTM B910/B910M		Copperhead	Low-voltage Ace Connectors (SC-PB-01)
16.0 TRACER WIRE TEST STATION				
Tracer Wire Test Station		Colour Coded Green	Rhino	72" RhinoDome Test Station

APPENDIX B: LISTS OF APPROVED MATERIALS

B5 – Water Distribution System

APPENDIX B5

WATER DISTRIBUTION SYSTEM MATERIAL LIST

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
1.0 WATERMAIN				
PVC Pipe	AWWA C900 CSA B137.3	<ul style="list-style-type: none"> - DR18, Pressure Class 235 - Rubber gasket in integral bell and spigot joints - Colour coded "Blue" - 6 m pipe length - CI OD 	IPEX Westlake Pipe & Fittings Next Polymers Diamond Pipe National Pipe	As per individual manufacturer
Ductile Iron	AWWA C151/A21.51 AWWA C104/A21.4 AWWA C111	<ul style="list-style-type: none"> - Minimum Pressure Class 350 (100 mm to 300 mm diameter) - Cement Mortar Lined - Rubber gasket in integral bell and spigot joints - Polyethylene encasement - 6 m pipe length 	U.S. Pipe Canada Pipe Clow McWane	As per individual manufacturer
High Density Polyethylene (HDPE)	AWWA C906 CSA B137.1	<ul style="list-style-type: none"> - Minimum DR 11 - Thermal butt fusion joining of pipe - CI OD - Blue stripe 	Infra Pipe Solutions	As per individual manufacturer
Concrete	AWWA C301(L)	<ul style="list-style-type: none"> - Pre-stressed concrete lined cylinder pipe 	Decast Forterra	As per individual manufacturer

APPENDIX B5: LISTS OF APPROVED MATERIALS

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
Concrete	AWWA C301(E)	- Pre-stressed concrete lined embedded cylinder pipe	Decast Forterra	As per individual manufacturer
2.0 WATER SERVICES				
Copper	ASTM B88 NSF/ANSI 61	- Type 'K' - Heavy wall - Soft copper - Horizontal gooseneck	Great Lakes Copper Inc.	As per manufacturer
Cross-linked Polyethylene (PEX)	ASTM F876 AWWA C904 CSA B137.5 NSF/ANSI 61 NSF/ANSI 14	- Cross-linked Polyethylene (PEX)	IPEX Rehau	Blue904 MUNICIPEX
3.0 WATERMAIN FITTINGS				
Ductile Iron Compact Ductile Iron	AWWA C110/A21.10 AWWA C153/A21.53 AWWA C104/A21.4 AWWA C111/A21.11	- Minimum Pressure Class 350 - Cement Mortar Lined - Mechanical joint	Sigma Star Bibby St. Croix Tyler Union	As per manufacturer
4.0 WATERMAIN VALVES				
Gate Valves	AWWA C509 AWWA C515 AWWA C111/A21.11	- Non-rising stem and 50 mm square operating nut - Open counter clockwise - Resilient seat gate	Mueller Clow AVK Bibby	A2360 F-6100 Series 25/00 As per manufacturer

APPENDIX B5: LISTS OF APPROVED MATERIALS

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
		<ul style="list-style-type: none"> - Epoxy coating internal and external per AWWA C550 - Mechanical joints with restrainers - Bond breaker between concrete support and valve body - Stainless steel bolts 		
Pressure Reducing Valves	AWWA C530 NSF/ANSI 61	<ul style="list-style-type: none"> - Flanged - Epoxy coating internal and external as per AWWA C116/ A21.16 	Singer CLA-VAL	As per manufacturer As per manufacturer
Reduced Pressure Principle Back Flow Preventer	AWWA C511 CSA B64.4 NSF/ANSI 61		Watts	#909 Series
Air Release Valve	NSF/ANSI 61 AWWA C512		Apco CLA-VAL A.R.I.	As per manufacturer 34AR-332-3/4" As per manufacturer
5.0 FIRE HYDRANTS				
Fire Hydrant	AWWA C502	<ul style="list-style-type: none"> - 1.98 m barrel length - Post type dry barrel compression shutoff with ball valve closing with flow, opening counter clockwise 	Mueller Clow	Century (Canada Valve) M67B Brigadier

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
		<ul style="list-style-type: none"> - M.J elbow - 2 side outlets with 2.5" CSA standard hose nozzle threads - 1 - 4" Storz pumper nozzle outlet - Breakaway flange - Self draining 		
Hydrant Painting		<ul style="list-style-type: none"> - Hydrant colour shall be Fire Engine Red - Top and side nozzle caps shall be painted based on hydrant flows (front storz nozzle to remain black). 	Tremclad - Benjamin Moore (paint)	

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
Hydrant Marker		<ul style="list-style-type: none"> - 48” in height fluorescent yellow - Installed on side port 	Flexstake LHS Inc.	FH 800 Series Pretzel Marker
6.0 VALVE BOXES				
		- 150 mm cover	Bibby Sigma or approved equivalent	VB800 As per manufacturer
		- Guide Plate	Bibby Sigma or approved equivalent	VB875 VB4500
		- Extension 300 mm	Bibby Sigma or approved equivalent	VB700 VB4253,VB451 2
		- Extension 450 mm	Bibby Sigma or approved equivalent	VB705 VB4401, VB4518
		- Extension 600 mm	Bibby Sigma or approved equivalent	VB710 VB4400, VB4524
		- Adjustable valve box upper section	Bibby Sigma or approved equivalent	VB404-7393 As per manufacturer
7.0 VALVE STEM EXTENSIONS				
		- Required for additional depth over m	Bibby or approved equivalent	VB950

APPENDIX B5: LISTS OF APPROVED MATERIALS

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
		- 52 mm top operating c/w set screw		
8.0 RESTRAINT DEVICES				
MJ Restraining Gland for Ductile Iron Water Main	ASTM A536 AWW C111/A21.11	- Colour code black for ductile iron use	Uni-Flange/Ford Stargrip EBAA Iron	Series 1400 Series 3000 Series 1100
MJ Restraining Gland for PVC Water Main	- ASTM standard F1674-96 - ANSI/AWWA C111/A21.11		Uni-Flange/Ford Stargrip EBAA Iron Sigma Smith-Blair	Series 1300 Series 4000 Series 2000 ONE-LOK SLC Cam-Lock 120
Pipe Joint Restraint for PVC Water Main		- The split ring restraint design shall incorporate a series of non-directional machined serrations (not 'as cast') on the inside diameter to provide positive restraint, exact fit, 360 degree contact and support of the pipe wall. -	Uni-Flange/Ford Stargrip EBAA Iron Sigma	Series 1390 Stargrip 1100C Series 1500 PV-LOK
Joint Restraint System In-	- AWWA standard C900 - CSA standard B137.3 - NSF 61	- Integral Joint Restraint System	IPEX Westlake Pipe & Fittings	Terrabrute Cetra-Lok

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
line for PVC Water Main		- PVC DR18 Pressure Class 235 pipe		
9.0 CORROSION PROTECTION				
Sacrificial Caps	ASTM B418 – Type 2	- 99.9% high grade Zinc - Steel core - Coated with low resistant depolarizing material: 175 grams	Galaxy Plastics/Bren Technologies	SAP Cap
Zinc Anodes	ASTM B418 – Type 2	- 99.9 high grade Zinc - Supplied with a 3m #10 coper wire with THW insulation	Galaxy Plastics/Bren Technologies Interprovincial Corrosion Control	As per manufacturer
Protective Coatings	AWWA C217	- Petrolatum Tape System consisting of paste, mastic and tape - Applied as per manufacturer specifications	Denso North America Interprovincial Corrosion Control Petro Coating Systems	As per manufacturer
10.0 METALLIC CAUTION TAPE				
		- Mylar marking tape c/w metallic backing - Metallic Backing Tape “Caution Water Main” Blue and Silver	Galaxy Plastics/Bren Technologies	As per manufacturer
11.0 TRACER WIRE				

APPENDIX B5: LISTS OF APPROVED MATERIALS

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
Tracer Wire (Open Cut)		#12 AWG (0.0808" diameter" high strength copper clad steel conductor (HS-CCS), insulated with a 30 mm high density polyethylene (HDPE) insulation, rated for direct burial use at 30 volts	Electrical Suppliers Galaxy Plastics/Bren Technologies Canada Wire Copperhead Phillips Pirelli	As per individual manufacturer
Tracer Wire (Directional Drilling and Jack & Bore Installations)		<ul style="list-style-type: none"> - Extra High Strength - Colour coded blue - Minimum 4 wires to be pulled 	Copperhead	845G-EHS 1045G-EHS 1245G-EHS
Tracer Wire Waterproof Connector	ASTM D1248 ASTM B910/B910M	Connector in-line splice Max. Voltage 30V Solid brass lug	Copperhead King Innovation	SC-PB-01 Low-voltage Ace Connectors
Tracer Wire Test Station		Colour Coded Blue	Rhino	72" RhinoDome Test Station
Hydrant Three Terminal Test Station		Blue in Colour	Copperhead	Cobra T3 Hydrant Flange Package
Grounding Anode Rod		ANO-12 Andoe, Magnesium	Copperhead	Ground Rod 12 - AWG
12.0 TIE RODS (19mm)				
		- Stainless Steel		As per manufacturer
13.0 SERVICE BOXES				

APPENDIX B5: LISTS OF APPROVED MATERIALS

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
		<ul style="list-style-type: none"> - Steel boot only - Lids to be threaded to the steel pipe upper section. Set screw only permitted for repairs 	Mueller Clow Bibby Sigma	As per manufacturer
14.0 SERVICE BOX RODS				
		<ul style="list-style-type: none"> - 36" stainless steel - Stainless steel cotter pins 	Mueller Clow Bibby	As per manufacturer
15.0 SERVICE SADDLES				
PVC Water Main (19 mm to 50 mm)	NSF/ANSI 61	<ul style="list-style-type: none"> - Cast bronze service saddle - Double strap 	Robar Cambridge Brass	2706 Series 812
Ductile Iron Water Main (19 mm to 50 mm)	NSF/ANSI 61			
Tapping Sleeve – PVC and Ductile Iron Water Main	NSF/ANSI 61	<ul style="list-style-type: none"> - Stainless Steel, Type 663 	Smith-BlairRobar	Type 663 6606
16.0 SPACERS				
Casing End		<ul style="list-style-type: none"> - Seal-virgin SBR and Bands - T-304 stainless steel 	Cascade PSI	As per manufacturer As per manufacturer

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
Casing Spacers		- Fusion coated steel casing insulators	Cascade PSI	As per manufacturer As per manufacturer
17.0 MAIN STOPS				
19mm	AWWA C800 NSF/ANSI 61	Set screw for accepting tracer wire when connecting to Cross-linked Polyethylene (PEX) piping.	Mueller Cambridge Brass Ford	H25008 301-A3H3 19mm-FB1000-3-Q 17072 Compression
25mm	AWWA C800 NSF/ANSI 61	Set screw for accepting tracer wire when connecting to Cross-linked Polyethylene (PEX) piping.	McDonald Brass Mueller Cambridge Brass Ford	4701B-T H25008 301-A4H4 25mm-FB1000-4-Q 17072 Compression
38mm	AWWA C800 NSF/ANSI 61	Set screw for accepting tracer wire when connecting to Cross-linked Polyethylene (PEX) piping.	McDonald Brass Mueller Cambridge Brass Ford	4701B-T H25008 301-A6H6 38mm-FB1000-6-Q 17072 Compression
52mm	AWWA C800 NSF/ANSI 61	Set screw for accepting tracer wire when connecting to Cross-linked Polyethylene (PEX) piping.	McDonald Brass Mueller Cambridge Brass Ford	4701B-T H25008 301-A7H7

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
				52mm-FB1000-7-Q 17072 Compression
18.0 CURB STOPS				
19mm	AWWA C800 NSF/ANSI 61	<ul style="list-style-type: none"> - Non Self-draining - Set screw for accepting tracer wire on one nut (road side) when connecting to Cross-linked Polyethylene (PEX) piping. 	Mueller Cambridge Brass Ford	B-25209N 202-H3H3 B44-333
25mm	AWWA C800 NSF/ANSI 61	<ul style="list-style-type: none"> - Non Self-draining - Set screw for accepting tracer wire on one nut (road side) when connecting to Cross-linked Polyethylene (PEX) piping. 	Mueller Cambridge Brass Ford	B-25209N 202-H4H4 B44-444
38mm	AWWA C800 NSF/ANSI 61	<ul style="list-style-type: none"> - Non Self-draining - Set screw for accepting tracer wire on one nut (road side) when connecting to Cross-linked Polyethylene (PEX) piping. 	Mueller Cambridge Brass Ford	B-25209N 202-H6H6 B44-666
52mm	AWWA C800	<ul style="list-style-type: none"> - Non Self-draining 	Mueller	B-25209N

APPENDIX B5: LISTS OF APPROVED MATERIALS

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
	NSF/ANSI 61	- Set screw for accepting tracer wire on one nut (road side) when connecting to Cross-linked Polyethylene (PEX) piping.	Cambridge Brass Ford	202-H7H7 B44-777
19.0 COUPLINGS				
19mm	AWWA C800 NSF/ANSI 61		Mueller Cambridge Brass Ford McDonald Brass	H-15-403 118-H3H3 C44-33 4758T
25mm	AWWA C800 NSF/ANSI 61		Mueller Cambridge Brass Ford McDonald Brass	H-15-403 118-H4H4 C44-44 4758T
38mm	AWWA C800 NSF/ANSI 61		Mueller Cambridge Brass Ford McDonald Brass	H-15-403 118-H6H6 C44-66 4758T
52mm	AWWA C800 NSF/ANSI 61		Mueller Cambridge Brass Ford McDonald Brass	H-15-403 118-H7H7 C44-77 4758T
Asbestos to PVC Cast Iron to PVC	NSF/ANSI 61	- Hymax 2000 Coupling and Hymax 2100 Flanged Adapter - Omni Coupling System Cast Couplings	Krausz Industries Smith-Blair GF multi joint	As per individual manufacturer

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
HDPE to PVC	NSF/ANSI 61	-	GF multi joint or approved equivalent	As per individual manufacturer
20.0 SAMPLING STATION				
		1.7 m minimum depth of bury	Kupferle	Eclipse #88-SS
21.0 FRAMES & GRATES – VALVE CHAMBER MAINTENANCE HOLE				
Cast Iron	OPSS 1850	<ul style="list-style-type: none"> - Grate as per OPSD 401.010 (closed cover) with date cast into the cover - Adjustable/Autostable Frame - C-50M-ONT - MH62502-D - SELFLEVEL – MC401010243 	Bibby-Ste-Croix Star Pipe Canada, Inc.	As per individual manufacturer
Ductile Iron	OPSS 1850		Bibby-Ste-Croix Sigma EJ Canada	
22.0 ADJUSTMENT UNITS				
Concrete	CSA A257.4	<ul style="list-style-type: none"> - Pre-cast concrete grade adjustment units with Moduloc tape between layers - Riser rings (only to be used when approved by the Town) 	OCPA Plant Pre-qualification Member	As per individual manufacturer MH-640102 DI (38 mm) MH-640102 DI (51 mm)
Ductile			Sigma	
23.0 WATERPROOF MEMBRANE/PETROLATUM TAPE				
Waterproof Membrane/			Blueskin R.W. Meadows Denso Petrolatum Tape	WP200 Mel-Roll

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
Petrolatum Tape				as per manufacturer

APPENDIX B: LISTS OF APPROVED MATERIALS

B6 – Parks and Landscaping

APPENDIX B6

PARKS AND LANDSCAPING MATERIAL LIST

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
1.0 PLAYGROUND EQUIPMENT				
1.1 Swings	CAN/CSA Standards Z614 – Children’s Playspaces and Equipment (latest edition) Accessibility for Ontarians with Disabilities Act, 2005 and Ontarians with Disabilities Act, 2001	Neighbourhood Park: 2 seats for toddlers, 4 belt seats, and 1 accessible seat for children with disabilities Community Park: 5 seats for toddlers, 6 belt seats, and 1 accessible seat for children with disabilities - All styles approved, prefer rubber over wood. - All swing posts shall be embedded in footings (anchor footing to bedrock where depth of cover is not at least 1200mm) - Top cross bar shall be min. 2440mm above finished grade	Certified playground suppliers	

APPENDIX B6: LISTS OF APPROVED MATERIALS

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
		<ul style="list-style-type: none"> - Minimum 4 seats provided in one unit or two separate units - Minimum 2 belt seats, 1 toddler seat, 1 seat for a disabled child - All swing chains shall be 1/4" galvanized 		
<p>1.2 Junior Creative Structure</p>	<p>CAN/CSA Standards Z614 – Children’s Playspaces and Equipment (latest edition)</p> <p>Accessibility for Ontarians with Disabilities Act, 2005 and Ontarians with Disabilities Act, 2001</p>	<p><u>Neighbourhood Park:</u> 2-3 decks with min. 1 roof, transfer station & stairs, 2 plastic slides – single and dual track, climber, tunnel or bridge between decks, 3-4 activity panels, and talk tube or alternate</p> <p><u>Community Park:</u> 2-3 decks with min. 1 roof, transfer station & stairs, 2 plastic slides – single and dual track, climber, tunnel or bridge between decks, 3-4 activity panels, and talk tube or alternate</p>	<p>Certified playground suppliers</p>	

APPENDIX B6: LISTS OF APPROVED MATERIALS

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
<p>1.3 Senior Creative Structure</p>	<p>CAN/CSA Standards Z614 – Children’s Playspaces and Equipment (latest edition)</p> <p>Accessibility for Ontarians with Disabilities Act, 2005 and Ontarians with Disabilities Act, 2001</p>	<p><u>Neighbourhood Park:</u> 3-6 decks with min. 1 roof, transfer station with stairs, accessibility ramp, 2 plastic slides – straight and spiral both open, 3 climbers, rock wall or similar activity, 4-5 activity panels, and sliding pole</p> <p><u>Community Park:</u> 5-7 decks with min. 1 roof, transfer station with stairs, accessibility ramp, 2-3 plastic slides – straight and spiral both open, 3-4 climbers, rock wall or similar activity, 5-7 activity panels, and sliding pole</p>	<p>Certified playground suppliers</p>	
<p>Spring / Spinning Toy</p>		<p><u>Neighbourhood Park:</u> 2 units varying types</p> <p><u>Community Park:</u> 3 - 4 units varying types</p> <ul style="list-style-type: none"> - Spring toy see saws - Saddlemates, dino, fire chief car 	<p>Certified playground suppliers</p>	

APPENDIX B6: LISTS OF APPROVED MATERIALS

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
		<ul style="list-style-type: none"> - Spring rider, giant see saw, 4-way rock-a-bout - Selected spring products 		
Slide		<ul style="list-style-type: none"> - Attached to creative structures, no independent slides - High vandalized areas, specify stainless steel slide - All other areas specify poly slides - Open slides are required, slide tubes are not approved - Straight, wavy and spirals are acceptable 	Certified playground suppliers	
Decks		<ul style="list-style-type: none"> - Steel with plastisol coating preferred; plastic wood or Trex is acceptable - Provide minimum 1 set of stairs 	Certified playground suppliers	
Climbers		<ul style="list-style-type: none"> - Chain net, cable net, and cargo net climbers shall have one piece coupling or nut and bolt couplings. Screw 	Certified playground suppliers	

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
		couplings are not acceptable - Finish: zinc bath, polyester powder coat		
Activity Panels		- Steel bars at ends of ramps - Mix up steel bars, poly windows, activity panels - Provide 40% of activity panels on ground level for wheelchair users - Percussion musical panels permitted in low vandalized areas - (Tic tac toe, Mirror, Little Tikes 7 station panel, Poly windows, Steering wheel)	Certified playground suppliers	
Fibre		- engineered wood fibres minimum 300mm (12") deep	Certified playground suppliers	
Crushed granite sand	CSA Compliant			

MATERIAL	CERTIFICATION	SPECIFICATIONS	MANUFACTURER	CATALOGUE NO.
Rubber			Certified playground suppliers	

APPENDIX B: LISTS OF APPROVED MATERIALS

B7 – Fencing

APPENDIX B7
FENCING MATERIAL LIST

MATERIAL		STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
1.0 ACOUSTICAL FENCE					
1.1 Polyvinyl Chloride (PVC)					
	PVC	AASHTO "Guide Specifications for Structural Design of Sound Barriers"	<ul style="list-style-type: none"> - Silent Protector for absorptive applications. - Tuf-Barrier for reflective applications. 	Atlantic Industries Limited (AIL).	

MATERIAL		STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
2.0 CHAIN LINK FENCE					
2.1 Fabric and Wire					
Steel Wire hot dipped galvanized after weaving			<ul style="list-style-type: none"> - Minimum requirement for zinc coating – 0.5 kg/m² - 38 mm wire mesh - 3.4 mm (9 gauge) steel wire fabric 		
Steel Wire electro galvanized before weaving					
Black Vinyl Coated					
2.2 Post and Rails					
Galvanized Steel	ASTM Designation A 120		<ul style="list-style-type: none"> - Schedule 40 Pipe - Conforming to current specifications for black and hot dipped, zinc coated, welded and seamless pipe - Minimum requirement for zinc coating – 0.5 kg/m² 		
2.3 Fittings and Hardware					
Frames and Braces Cast Fittings Other Fittings	ASTM Specifications (A		Suitable Aluminum Alloy or Steel Ductile Iron		

MATERIAL		STANDARDS	FEATURES	MANUFACTURER	CATALOGUE No.
		152)	<ul style="list-style-type: none"> - Minimum requirement for zinc coating – 0.5 kg/m² for frames and braces - Minimum requirement for zinc coating – 0.6 kg/m² for cast and other fittings 		
3.0 WOOD PRIVACY FENCE					
	Construction grade cedar Approved brown pressure treated wood		<ul style="list-style-type: none"> - Zinc coated twisted steel nails #11 Gauge 		

APPENDIX B: LISTS OF APPROVED MATERIALS

B8 – Seed Mixes & Tree Species

APPENDIX B8

SEED MIX AND TREE SPECIES MATERIAL LIST

RECOMMENDED SEED MIXES

For undeveloped open space that is not adjacent to sensitive areas:

- 45% Creeping Red Fescue
- 30% Kentucky Blue Grass
- 25% Perennial Rye Grass

For stormwater management ponds and channels, refer to the Conservation Authority planting Guidelines or use:

Lowland

- 2% Awl Sedge (*Carex stipata*)
- 5% Bebbs Sedge (*Carex bebbi*)
- 1% Purple Stemmed Aster (*Aster puniceus*)
- 25% Fowl Bluegrass (*Poa palustris*)
- 40% Fox Sedge (*Carex vulpinoidea*)
- 5% Great Blue Lobelia (*Lobelia siphilitica*)
- 1% New England Aster (*Aster novae-angliae*)
- 1% Path Rush (*Juncus tenuis*)
- 7% Canada Goldenrod (*Solidago canadensis*)
- 10% Soft Rush (*Juncus effusus*)
- 1% Tall Manna Grass (*Glyceria grandis*)
- 1% Virginia Wild Rye (*Elymus virginicus*)
- 1% Wild Bergamot (*Monarda fistulosa*)

Upland

- 25% Canada Wild Rye (*Elymus canadensis*)
- 25% Indian Grass (*Sorghastrum nutans*)
- 20% Little Bluestem (*Schizachyrium scoparium*)
- 12% Black Eyed Susan (*Rudbeckia fulgida*)
- 10% Sand Dropseed (*Sporobolus cryptandrus*)
- 4% Canada Goldenrod (*Solidago Canadensis*)
- 2% New England Aster (*Aster novae-angliae*)
- 1% Heath Aster (*Aster ericoides*)
- 1% Wild Bergamot (*Monarda fistulosa*)

RECOMMENDED BOULEVARD TREES

<i>Family</i>	<i>Botanical Name</i>	<i>Common Name</i>
<i>Sapindaceae</i>	<i>Acer x freemanii cvs.</i>	Freeman Maple
<i>Sapindaceae</i>	<i>Acer rubrum</i>	Red Maple
<i>Sapindaceae</i>	<i>Acer saccharum</i>	Sugar Maple
<i>Sapindaceae</i>	<i>Aesculus glabra</i>	Ohio Buckeye
<i>Sapindaceae</i>	<i>Aesculus flava</i>	Yellow Buckeye
<i>Rosaceae</i>	<i>Amelanchier spp.*</i>	Serviceberry
<i>Cannabaceae</i>	<i>Celtis occidentalis</i>	Nothorn Hackberry
<i>Fabaceae</i>	<i>Gleditsia triacanthos var. inermis</i>	Thornless Honeylocust
<i>Ginkgoaceae</i>	<i>Ginkgo biloba</i>	Ginkgo
<i>Fabaceae</i>	<i>Gymnocladus dioicus</i>	Kentucky Coffeetree (male cultivar)
<i>Magnoliaceae</i>	<i>Liriodendron tulipifera</i>	Tulip Tree
<i>Rosaceae</i>	<i>Malus cvs.*</i>	Flowering Crabapple (non-fruiting, disease resistant)
<i>Nyssaceae</i>	<i>Nyssa sylvatica</i>	Black-Gum
<i>Platanaceae</i>	<i>Platanus acerfolia</i>	London Plane Tree
<i>Rosaceae</i>	<i>Prunus virginiana 'Schubert'*</i>	Schubert ChokeCherry
<i>Rosaceae</i>	<i>Pyrus calleryana</i>	Ornamental Pear (not Bradford cultivar)
<i>Fagaceae</i>	<i>Quercus alba</i>	White Oak
<i>Fagaceae</i>	<i>Quercus macrocarpa</i>	Bur Oak
<i>Fagaceae</i>	<i>Quercus muehlenbergii</i>	Chinquapin Oak
<i>Fagaceae</i>	<i>Quercus palustris</i>	Pin Oak
<i>Fagaceae</i>	<i>Quercus rubra</i>	Northern Red Oak
<i>Oleaceae</i>	<i>Syringa reticulata</i>	Japanese Tree Lilac
<i>Malvaceae</i>	<i>Tilia cordata</i>	Littleleaf Linden
<i>Malvaceae</i>	<i>Tilia americana 'Redmond'</i>	Linden, 'Redmond'
<i>Ulmaceae</i>	<i>Ulmus X 'Homestead'</i>	Homestead Elm
<i>Ulmaceae</i>	<i>Zelkova serrata</i>	Japanese Zelkova

* Small trees are to be used only in situations where space is constrained.

RECOMMENDED PARK TREES

The Town of Innisfil recommends the use of native trees in parks, when appropriate. The Town will review the proposed species on a case-by-case basis.

APPENDIX C: MINIMUM HORIZONTAL OFFSET MATRIX

APPENDIX C

TABLE OF MINIMUM HORIZONTAL CLEARANCES
(As measured in linear metres between the outside most edges of each feature/object)

		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.
		Water Service	Sanitary Service	Storm Service	Fire Hydrant	Watermain Valve	Boulevard Trees	Street Light (SL)	SL Power Pedestal	Hydro Transformer/Switch Gear	Bell/CATV Pedestal	Driveway	Community Mailbox	Stop Sign on Local Street	Stop Sign on Collector/Arterial	Hydro Service	Bell/CATV Service	Gas Service	Side Property Line
1.	Water Service	---	2.5	2.5	1.0	1.0	1.0	1.0	1.0	1.5	1.0	1.0	3.0	1.0	1.0	1.0	1.0	1.0	2.0
2.	Sanitary Service	2.5	---	0.5	1.0	1.0	1.0	1.0	1.0	1.5	1.0	N/A	3.0	1.0	1.0	0.5	0.5	1.0	2.0
3.	Storm Service	2.5	0.5	---	1.0	1.0	1.0	1.0	1.0	1.5	1.0	N/A	3.0	1.0	1.0	0.5	0.5	1.0	2.0
4.	Fire Hydrant	1.0	1.0	1.0	---	1.5	3.0	3.0	3.0	5.0/1.5*	3.0	3.0	3.0	3.0	3.0	1.0	1.0	1.0	N/A
5.	Watermain Valve	1.0	1.0	1.0	1.5	---	3.0	3.0	3.0	3.0	3.0	1.5	3.0	3.0	3.0	1.0	1.0	1.0	N/A
6.	Boulevard Trees	1.0	1.0	1.0	3.0	3.0	---	4.6	1.0	5.0/1.5*	1.0	1.5	3.0	20.0	60.0	1.0	1.0	1.0	N/A
7.	Street Lights (SL)	1.0	1.0	1.0	3.0	3.0	4.6	---	1.0	5.0/1.5*	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	N/A
8.	SL Power Pedestal	1.0	1.0	1.0	3.0	3.0	1.0	1.0	---	0.0	0.0	1.0	3.0	3.0	3.0	1.0	1.0	1.0	N/A
9.	Hydro Transformer/Switch Gear	1.5	1.5	1.5	5.0/1.5*	3.0	5.0/1.5*	5.0/1.5*	0.0	---	0.0	1.5	5.0/1.5*	N/A	N/A	N/A	N/A	N/A	N/A
10.	Bell/CATV Pedestal	1.0	1.0	1.0	3.0	3.0	1.0	1.0	0.0	0.0	---	1.0	3.0	3.0	3.0	1.0	1.0	1.0	N/A
11.	Driveway	1.0	N/A	N/A	3.0	1.5	1.5	1.0	1.0	1.5	1.0	---	3.0	N/A	N/A	N/A	N/A	N/A	1.2/0.6**

		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.
		Water Service	Sanitary Service	Storm Service	Fire Hydrant	Watermain Valve	Boulevard Trees	Street Light (SL)	SL Power Pedestal	Hydro Transformer/Switch Gear	Bell/CATV Pedestal	Driveway	Community Mailbox	Stop Sign on Local Street	Stop Sign on Collector/ Arterial	Hydro Service	Bell/CATV Service	Gas Service	Side Property Line
12.	Community Mailbox	3.0	3.0	3.0	3.0	3.0	3.0	1.0	3.0	5.0/1.5*	3.0	3.0	--	20.0	60.0	1.0	1.0	1.0	N/A
13.	Stop Sign on Local Street	1.0	1.0	1.0	3.0	3.0	20.0	1.0	3.0	N/A	3.0	N/A	30.0	--	N/A	1.0	1.0	1.0	N/A
14.	Stop Sign on Collector/ Arterial	1.0	1.0	1.0	3.0	3.0	60.0	1.0	3.0	N/A	3.0	N/A	N/A	N/A	---	1.0	1.0	1.0	N/A
15.	Hydro Service	1.0	0.5	0.5	1.0	1.0	1.0	1.0	1.0	N/A	1.0	N/A	1.0	1.0	1.0	---	0.5	0.5	0.5
16.	Bell/CATV Service	1.0	0.5	0.5	1.0	1.0	1.0	1.0	1.0	N/A	1.0	N/A	1.0	1.0	1.0	0.5	---	0.5	0.5
17.	Gas Service	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	N/A	1.0	N/A	1.0	1.0	1.0	0.5	0.5	---	0.5
18.	Side Property Line	2.0	2.0	2.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.2/0.6**	N/A	N/A	N/A	0.5	0.5	0.5	---

* 5.0m to hydro transformer/switch gear vault access door, 1.5m on other sides.

** Standard of 1.2m can be reduced to 0.6m where zoning allows 0.6m sideyard setback of the garage.

APPENDIX D: CCTV INSPECTION REQUIREMENTS

APPENDIX D

SEWER CAMERA INSPECTION REQUIREMENTS

This document outlines the Town's requirements for all Sewer Camera Inspection submissions. All data recorded must be validated according to the Water Research Centre (WRC) guidelines and the guidelines set out in this document. The Contractor must provide proof of PACP certification for each camera operator recording observations in the database.

1. Digital CCTV File & Reports

- 1.1 Pipes shall be cleaned and flushed immediately prior to CCTV inspection.
- 1.2 All silt, debris and other foreign substances are to be removed from the sewer prior to commencing video inspection. If any of these items are discovered during an inspection, the inspection will be erased and the lines are to be cleaned and re-videoed.
- 1.3 Storm and sanitary sewers are to be inspected separately and be submitted in separate digital folders with separate reports.
- 1.4 Each CCTV file is to be accompanied by a PDF report containing the observations made during inspection. The video is to be good quality and in focus. All CCTV files shall be provided to the Town in .mp4 format; other file types will not be accepted. Videos that are of poor quality or that cannot be played will be rejected by the Town.
- 1.5 The Engineer shall review the CCTV files and reports prior to submission to ensure completeness and accuracy, and to ensure videos meet Town Standards.
- 1.6 Should repairs be required, the Engineer is to provide repair methodology for Town's approval. Re-video is required after approval is granted and the repair is complete.
- 1.7 USB Flash Drive labels and covering page of the report are to include the name of the project, Town project number, digital folder/report identification number, street names if possible, and the name of the Contractor performing the inspection. The label is not to include the name or job number of the general contractor.
- 1.8 The videos shall have alpha-numeric data recorded on it before the inspection of any sewer section. The data will be recorded for 2030 seconds, during which time the camera is to be stationary and have the distance counter set to 0.0.

APPENDIX D: CCTV INSPECTION REQUIREMENTS

The information shall be in the format of the example shown below.

WEBSTER BOULEVARD	=	street being inspected
BENSON ST TO RANKIN WAY	=	streets bordering the street being inspected
1A TO 4A	=	which maintenance hole to maintenance hole section is being inspected (Town Numbering as per Engineering Drawings)
200 mm SAN	=	diameter of sewer (metric only) and sewer type
JUNE 01 2024	=	date of inspection
+000.0=		camera distance counter

- 1.9 The video shall have alpha-numeric data on it while the camera is travelling through the sewer. The information shall be in the format of the example shown below.

WEBSTER BOULEVARD	=	street being inspected
1A TO 4A	=	which maintenance hole to maintenance hole section is being Inspected
JUNE 01 2024	=	date of inspection
+004.9	=	camera distance counter

The alpha-numeric data will be displayed at all times in the bottom left corner of the screen. The background feature will be used when necessary to ensure the data is easily readable.

When the camera stops to view a pipe defect and/or a lateral, and the alphanumeric data is found to obstruct the defect, the camera will be moved a maximum of 0.1 meters forward or backward so the defect can properly be seen.

- 1.10 The entire length of the sewer, from starting to finishing maintenance hole wall, will be shown on tape whenever possible. The section of pipe between the start maintenance hole and the location where the distance counter is set shall be recorded on tape with the distance counter set at 0.0. If an observation is found before the distance counter is set, an estimated distance will be used.
- 1.11 All Sanitary Sewers within the roadway right-of-way and in any Town easements including all laterals are to be video inspected. Laterals shall be videoed from the main to 3.0m beyond the property line, unless otherwise approved by the Town.

APPENDIX D: CCTV INSPECTION REQUIREMENTS

1.12 All Storm Sewers within the roadway right-of-way/SWM blocks and in any Town easements including all catchbasin leads, rear lot catchbasin leads and any laterals are to be video inspected. Laterals shall be videoed from the main to 3.0m beyond the property line, unless otherwise approved by the Town.

2. INSPECTIONS

2.1 Sewers are normally to be inspected only when flow levels do not cover or splash up on the camera lens. An inspection showing high effluent levels will only be allowed when the camera is travelling through a sump.

2.2 Inspections will normally be done with the camera travelling with the flow direction.

2.3 Against-the-flow inspections can only be done under one of the following circumstances

- a) Effluent levels are minimal. Effluent does not cover or splash up on the camera lens,
- b) The inspection can't be done with the flow because the upstream maintenance hole
 - i) Is not found,
 - ii) Is inaccessible,
 - iii) Has a high effluent level,
 - iv) Has a high debris level, or
 - v) Has benching that will not allow camera entry.

2.4 If debris piles onto the camera lens and can't be shaken off, the inspection shall be terminated and restarted following sufficient cleaning/flushing of the line to remove debris.

2.5 A self-levelling camera is to be located at springline.

2.6 The pan and tilt feature is to be used on all connections and / or defects. Defects are to include but not limited to cracks, infiltration, questionable pipe joints, and scarring etc. When reviewing connections, the camera is to focus as far up the lateral as possible. Panning is to be stationary for 5 seconds. If the panning does not show the outer edge of the entire lateral, the camera is to be rotated to provide a complete view. Additional time is to be taken to investigate suspicious flows at laterals that are constant.

2.7 Lighting is to be of sufficient strength so that the field of view is clear (no shadows).

2.8 No inspection can be recorded when fog is on the camera lens.

2.9 No inspection can be recorded when fog in the sewer significantly affects the quality of the video image. The fan shall be used to attempt to clear the fog when necessary. If possible, sewers containing fog will be left until a time when the fog will no longer be present (i.e. warmer weather).

2.10 The camera distance counter is to measure distances from the centre of the lid of the start maintenance hole to the centre of the lid of the finish maintenance hole.

APPENDIX D: CCTV INSPECTION REQUIREMENTS

- 2.11 The distance measured by the camera between two maintenance holes (surveyed distance) is to be confirmed by using a measuring wheel between the same maintenance holes (surface distance).
- 2.12 All recorded completed inspections must have a surveyed and surface distance that does not differ by more than 1%. If it is confirmed that the surveyed distance has been recorded with an incorrect value, the inspection will be deleted and redone.
- 2.13 All street catch basin, rear yard catch basin, ditch inlet and leads are to be video inspected.
- 2.14 All storm and sanitary lateral videos are to be reviewed and approved by the Engineer and provided to the Town thirty (30) days prior to occupancy.
- 2.15 Inspections are required prior to the Underground Certificate / Substantial Completion Certificate and after the Aboveground Certificate but prior to the placement of surface course asphalt. For Capital projects, the inspections are required as outlined in the Contract Documents.

APPENDIX E: SPECIAL ASPHALT PROVISIONS

APPENDIX E

SPECIAL PROVISIONS – ASPHALT

REFERENCES

This specification refers to the following standards, specifications, and publications:

Ontario Provincial Standard Specifications (OPSS)

OPSS.MUNI 310 Hot Mix Asphalt

OPSS.MUNI 1101 Material Specification for Performance Graded Asphalt Cement

Ontario Ministry of Transportation Publications

LS-227 Determination of Ash Content

LS-299 Determining Asphalt Cement's Resistance to Ductile Failure Using Double Edge Notched Tension Test (DENT)

LS-308 Determination of Performance Grade of Physically Aged Asphalt Cement Using Extended Bending Beam Rheometer (BBR) Method

LS-319 Determining the Cross-Over Temperature of Asphalt Cement

LS-320 Determining the Low Temperature Critical Spread of Asphalt Cement

MERO Field Guide for the Acceptance of Hot Mix Asphalt and Bridge Deck Waterproofing

PH-CC-249 Recovered Asphalt Cement (RAC) Test Reporting Sheet

PH-CC-250 PGAC Test Reporting Sheet

ASTM International

D 3665-12 Standard Practice for Random Sampling of Construction Materials

D 7343-12 Standard Practice for Optimization, Sample Handling, Calibration, and Validation of X-Ray Fluorescence Spectrometry Methods for Elemental Analysis of Petroleum Products and Lubricants

American Association of State Highway and Transportation Officials (AASHTO)

M 320-10 Standard Specification for Performance Graded Asphalt Binder

M 332-14 Standard Specification for Performance Graded Asphalt Binder Using Multiple Stress Creep Recovery (MSCR) Test

R 29-14 Grading or Verifying the Performance Grade of an Asphalt Binder

T 40-02 Sampling Bituminous Materials

T 350-14 Standard Method of Test for Multiple Stress Creep Recovery (MSCR) Test of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)

Note: Always reference the latest version of the documents listed above.

DESIGN AND SUBMISSION REQUIREMENTS

PGAC Test Documentation

For each grade of PGAC specified in the Contract Documents, the Contractor shall supply the following items to the Town at least two (2) weeks prior to the use of each product:

- a) The PGAC supplier, facility type, and location that the product shall be supplied from.
- b) Applicable mixing and compaction temperatures for the product.
- c) Documentation of construction, storage and handling requirements, including the Safety Data Sheets (SDS), re-compaction temperature, mix discharge temperature, and recommended extraction procedures.
- d) When the asphalt cement contains any zinc oxide, iron carboxylates, or a combination, added as Hydrogen Sulfide (H₂S) scavengers, they must be declared.
- e) When the PGAC contains any polyphosphoric acid (PPA) and a liquid anti-stripping additive is incorporated into the PGAC at the PGAC supplier's depot, the documentation must include:
 - i. Information on how much anti-stripping additive was added to the PGAC.
 - ii. Documentation from the PGAC supplier stating that the PPA-modified PGAC, with the liquid anti-stripping additive added at the PGAC supplier's depot, shall meet all asphalt cement material requirements specified in the Contract Documents, including AASHTO M 320 for the PGAC grade specified.
- f) A letter from the PGAC supplier declaring that the PGAC does not contain any of the banned materials listed in the "Materials" section below.

PGAC Supply Documentation

For each grade of PGAC specified, the following items shall be supplied to the Town prior to the commencement of HMA production:

- a) All PGAC documentation from the PGAC supplier in the form of bill of lading and certificate of analysis, confirming the grade of PGAC. The bill of lading and certificate of analysis shall also be supplied for each subsequent delivery of PGAC that will be used for the HMA production.
- b) Documentation identifying the PGAC storage tank at the HMA plant that will be supplying the PGAC during production of HMA for the project. The Town shall be notified and provided updated documentation prior to changing the storage tank that is being used to supply PGAC for the HMA production at the HMA plant.

Materials

PGAC shall comply with the requirements of OPSS.MUNI 1101.

PGAC shall be according to AASHTO M 320 for the performance grades specified in the Contract Documents when tested using the methods designated in AASHTO R 29.

PGAC shall be homogeneous, free of water and any contamination, and shall not foam when heated to the temperatures specified by the manufacturer for the safe handling and use of the product. Silicone oils are allowed as anti-foaming agents at less than five parts per million. Zinc oxide and iron carboxylates may be used as hydrogen sulfide (H₂S) scavengers.

APPENDIX E: ASPHALT SPECIAL PROVISIONS

PGAC shall not contain more than 0.3% polyphosphoric acid (PPA) or 0.3% elemental sulfur (S) in addition to the typical sulfur that is naturally present in the asphalt cement, and these shall only be used as catalysts for the purpose of modification with epoxy (E)-type or styrene-butadiene (SB)-type polymer modifiers. PGAC shall not contain any orthophosphoric acid.

PGAC shall not be air blown or catalytically oxidized in any manner. PGAC shall not contain any air blown or catalytically oxidized residues.

The asphalt cement shall not contain any of the following additives added for PGAC modification: atactic polypropylene; carbon black; polyisobutylene; polyisoprene; natural rubber; alkaline bases; insoluble particulates or fibres; salts of iron, copper, manganese and/or cobalt; silicates; styrene-butadiene rubber (random copolymer latex); synthetic waxes (paraffin waxes, naphthenic waxes); synthetic and saturated oils (including but not limited to the following: vegetable oils or modified vegetable oils, paraffin oils, polyalphaolefins (PAO), lube oils, and re-refined lube oils, waste oils (including but not limited to the following: cracked residues, re-refined high vacuum distillate oils; tall oils, vacuum tower asphalt extenders, waste cooking oils, waste engine oils, and waste engine oil residues).

If modifiers or additives other than styrene-butadiene (e.g., SB diblock, SBS triblock, SBS radial, SBS high vinyl, SB tapered, etc.) or epoxy-type polymers (e.g. reactive elastomeric terpolymers) are used for the modification of neat asphalt cement, pre-approval from the Owner is required.

Organic bases may be contained in the PGAC provided they are used as anti-stripping or warm mix additives or both. If organic bases are present in anti-stripping and/or warm mix asphalt additives, they shall be declared at the time of mix submission.

PGAC grades shall meet the additional requirements shown in Table 1.

QUALITY ASSURANCE**Sampling**

Unless otherwise specified in the Contract Documents, the Town shall determine the frequency of sampling and testing based on Random Sampling Procedures. Lot and subplot sizes for each grade of PGAC shall be communicated with the Contractor during the Pre-Pave Meeting. The Town retains sole discretion to select lot and subplot sizes and the frequency of sampling.

Samples used for testing the original asphalt cement shall be obtained during the production of the asphalt mix from the storage tank which is directly feeding the production of the asphalt mix. All test samples shall be obtained by the Contractor in the presence of the Town according to AASHTO R 66, ASTM D 3665, and the asphalt plant's health and safety plan. The asphalt plant's health and safety plan and procedure for sampling shall be reviewed at the pre-pave meeting.

Sample Containers shall be supplied by the Contractor. QA and Referee samples shall be obtained at the same time and shall be a minimum of 2 litres each.

Quality Assurance Testing

APPENDIX E: ASPHALT SPECIAL PROVISIONS

When the QA and Referee samples arrive at the QA Laboratory, a representative from the QA Laboratory shall randomly select one sample for testing. The additional sample shall be retained for possible Referee Testing.

Test results shall be categorized as Acceptable or Rejectable based on performance grading requirements. "Borderline" results as per OPSS will be considered Rejectable and in most cases will require full removal and replacement of the HMA.

Test results shall be reported on MTO Form PH-CC-250 PGAC Test Reporting Sheet. Other forms are acceptable but must include the Complex Shear Modulus (G^*) and Phase Angles (δ) for all DSR test results. The Cross Over Temperature (LS-319) and Low Temperature Critical Spread (LS-320) shall also be reported for information purposes only. Testing of 40 hour PAV residue is not required unless specified in the Contract Documents.

Referee Testing

Referee testing may be invoked within 5 business days of the Contractor receiving QA test results. Referee testing shall be completed by a mutually agreed-upon, third-party laboratory. The same requirements for testing and reporting apply as stated above in Quality Assurance Testing.

Referee testing will be completed in the presence of the Town. The Contractor may observe the testing, however, there will be no cost to the Town stemming from the Contractor's observation. When referee testing shows that the PGAC is Rejectable, the HMA containing the Rejectable PGAC shall be fully removed and replaced from the work area.

Payment for referee testing and any associated construction or administrative costs shall be made in accordance with the Contract Documents.

Recovered Asphalt Cement (RAC)

Recovered Asphalt Cement (RAC) means the asphalt cement extracted from an asphalt mix.

Sampling for RAC shall be in accordance with typical sampling procedures for loose HMA samples. The frequency of RAC sampling shall be in accordance with the Town's PGAC sampling procedures. RAC samples shall be used in place of rolling thin film oven (RTFO) residue and only aged in a pressure aging vessel (PAV) as required for the requirements listed in this specification.

Extraction of asphalt cement samples shall be carried out in accordance with MTO LS-284 from loose HMA samples or sawcut samples from the finished pavement. Fines shall be removed using a high-speed centrifuge prior to recovery.

Extraction must be completed using reagent grade trichloroethylene or toluene. The extraction solvent used must be reported on the RAC test reporting sheet.

Test results shall be categorized as Acceptable or Rejectable based on performance grading requirements. The RAC must also meet the additional requirements of Table 1. "Borderline" results as per OPSS will be considered Rejectable and in most cases will require full removal and replacement of the HMA.

APPENDIX E: ASPHALT SPECIAL PROVISIONS

Test results shall be reported on MTO Form PH-CC-249 Recovered Asphalt Cement (RAC) Test Reporting Sheet. Other forms are acceptable but must include the Complex Shear Modulus (G^*) and Phase Angles (δ) for all DSR test results. The Cross Over Temperature (LS-319) and Low Temperature Critical Spread (LS-320) shall also be reported for information purposes only. Testing of 40 hour PAV residue is not required unless specified in the Contract Documents.

Table 1
Testing Requirements and Acceptance Criteria for PGAC Grades 58-34 and 64-34

PGAC Grade XX-YY	Property and Attributes (Unit)	Test Method	Results Reported Rounded to the Nearest	Acceptance Criteria	Rejectable
All PGAC Grades	Ash Content, % by mass of residue (%)	LS-227	0.1	≤ 0.6	> 0.6
	Low temperature limiting grade (LTLG) ($^{\circ}\text{C}$)	LS-308	0.1	$\leq (-YY + 1.5)$	$> (-YY + 1.5)$
	Grade Loss ($^{\circ}\text{C}$)	LS-308	0.1	≤ 6.0	> 6.0
	Non-recoverable creep compliance at 3.2 kPa ($J_{nr-3.2}$) (kPa^{-1})	Multiple Stress Creep and Recovery (MSCR) testing according to AASHTO TP 70 testing conducted at a temperature of 58 $^{\circ}\text{C}$	0.01	< 4.0	≥ 4.0
	Average percent recovery at 3.2 kPa ($R_{3.2}$) (%)		0.1	$>$ the lesser of $[(29.371)(J_{nr-3.2})^{-0.2633}]$ or 55	\leq the lesser of $[(29.371)(J_{nr-3.2})^{-0.2633} - 10]$ or 50
	Average critical crack tip opening displacement (δ_t) (mm)	LS-299	0.1	> 12.0	< 12.0
	Cross-Over Temperature ($T_{\delta 45}$), $^{\circ}\text{C}$	LS-319	0.1	For Information	
	Low Temperature Critical Spread (ΔTC), $^{\circ}\text{C}$	LS-320	0.1	For Information	

Note – For Recovered Asphalt Cement, the Ash Content must be $< 1\%$

APPENDIX F: AS-RECORDED REQUIREMENTS

Town of Innisfil As – Recorded Drawing Requirements

1.1. Introduction

The as-recorded drawings and documents shall reflect the actual as-constructed conditions and must be sealed by a professional engineer after verifying their accuracy. The engineering drawings accepted by the Town shall be used to produce the as-recorded drawings. The consultant who stamped and sealed the accepted engineering drawings shall be responsible for producing the as-recorded engineering drawings unless otherwise directed by the Town.

All as-recorded AutoCAD files provided to the Town shall be georeferenced as per the Town's standard.

Underground Certificate As-Recorded Drawing Submission Package

2.1. General Requirements

All As-Recorded drawing submissions to the Town must comply with all of the general requirements listed below:

- One (1) hard copy of As-Recorded drawings shall be submitted to the Town for review. All As-Recorded drawings for the development are to be provided, except the Erosion and Sediment Control drawings.
- Provide a copy of all reports accepted by the Town of Innisfil.
- Once the drawings have been reviewed, one (1) final hard copy, one (1) digital copy set, including the AutoCAD file, are to be provided to the Town;
- Removal of all verbiage related to “temporary” items (temporary road barricades, temporary fencing, etc.);
- Side profile elevations on the plan and profile are to match the as-recorded drawings submitted by the developer;
- Legend should indicate difference between “proposed” and “as-recorded”;
- The locations of maintenance holes/valves/hydrants, etc. which have been installed in significantly different locations from the original design will require updating on the plan and profile.

2.2. Cover Page

Cover page shall be labelled “As-Recorded” and shall refer to the Town file number and M-Plan number. The cover sheet shall have a list of all drawings submitted all drawings that are not included in the submission are to consist of a “strike through”.

2.3. Plan and Profile Drawings

Sanitary Sewer

- Pipe Class and material type of sanitary sewer to be confirmed and provided on the plan and profile drawings;
- Sanitary sewer lengths and slope percentages to be updated on the plan and profile drawings;
- Sanitary sewer inverts to be provided on the plan and profile drawings (strike through techniques are to be utilized as a comparison between proposed and constructed);
- Service Record sheets must be provided within the submission and must include the following information:
 - The registered plan number, lot number, municipal street address, service pipe size, service pipe length, and service pipe material type;
 - Invert elevations at the main line, property line, and three (3) metre extension;
 - Locations to be confirmed in relation to permanent structures and appurtenances (maintenance holes, gate valves, catch basins, etc.).
 - GPS coordinates of the lateral at property line and the main line connection;
 - Sanitary sewer bedding type to be provided on the as-recorded drawings in addition to the OPSD reference/class type;
 - Tie-ins to any existing sanitary sewer to be displayed on plan and profile drawings with pipe lengths, pipe locations, location of sleeves, and type of backfill;
 - Lateral extension to be drawn three (3) metres beyond property line on plan;
 - Maintenance hole sizing is to be confirmed and noted on the plan and profile drawings;
 - Legend to be provided for the “auto stable/selflevel” frame and cover and type to be confirmed as part of the plan and profile drawing set;
 - GPS coordinates for all street furniture (sanitary laterals, sanitary maintenance holes, etc.) to be provided for input into the Town’s GIS system;
 - Utilization of materials recommended by the geotechnical consultant during construction (example – geo-grid, filter fabric, stone wrapped in filter fabric, unshrinkable fill, etc.) should be noted on the drawings;
 - Anti-seepage collar elevations, locations, and type to be provided on profile drawings;
 - Plugs to be noted on the drawings. Any plugs that were removed during construction shall be updated on the drawings accordingly.

Storm Sewer

- Pipe Class and material type of storm sewer to be confirmed and provided on the plan and profile drawings;
- Storm sewer lengths and slope percentages to be updated on the plan and profile drawings;
- Storm sewer inverts to be provided on the plan and profile drawings (strike-through techniques are to be utilized as a comparison between proposed and constructed);

APPENDIX F: AS-RECORDED REQUIREMENTS

- Service Record sheets must be provided within the submission and must include the following information:
 - The registered plan number, lot number, municipal street address, service pipe size, service pipe length, and service pipe material type;
 - Invert elevations at the main line, property line, and three (3) metre extension;
 - Locations to be confirmed in relation to permanent structures and appurtenances (maintenance holes, gate valves, catch basins, etc.);
 - GPS coordinates of the lateral at property line and the main line connection;
- Storm sewer bedding type to be provided on the as-recorded drawings in addition to the OPSD reference/class type;
- Tie-ins to any existing storm sewer are to be displayed on plan and profile drawings with pipe lengths, pipe locations, location of sleeves, and type of backfill;
- Lateral extension to be drawn three (3) metres beyond property line on plan;
- Maintenance hole sizing is to be confirmed and noted on the profile drawings;
- Storm invert elevations for all rear lot catch basins to be provided at the mainline and at the rear lot catch basin;
- Storm invert elevations for all catch basin and double catch basin leads to be provided at the mainline and the structure;
- Utilization of materials recommended by the geotechnical consultant during construction (example – geo-grid, filter fabric, stone wrapped in filter fabric, unshrinkable fill, etc.) should be noted on the drawings;
- Anti-seepage collar elevations, locations, and type are to be provided on profile drawings;
- GPS coordinates for all street furniture (storm laterals, storm maintenance holes, catch basins, etc.) to be provided for input into the Town’s GIS system;
- Legend to be provided for the “auto stable/selflevel” frame and cover and type to be confirmed as part of the plan and profile drawing set;
- Bulkheads to be noted on drawings.
- Plugs to be noted on the drawings. Any plugs that were removed during construction shall be updated on the drawings accordingly.

Watermain and Appurtenances

- Pipe Class and material type of watermain pipe to be confirmed and provided on the plan and profile drawings;
- Watermain bedding type to be provided on the as-recorded drawings in addition to the OPSD reference/class type;
- Top of watermain elevations to be provided for all appurtenances (mainline valves, tees, crosses, etc.) and at a minimum of twenty (20) metre increments. Profile drawing to either be adjusted to show the contours of the watermain or markers placed on the profile drawings to confirm elevations and location;
- Service Record sheets must be provided within the submission and must include the following information:

APPENDIX F: AS-RECORDED REQUIREMENTS

- The registered plan number, lot number, municipal street address, service pipe size, service pipe length, and service pipe material type;
- Obvert elevations at the main line and property line;
- Locations to be confirmed in relation to permanent structures and appurtenances (maintenance holes, gate valves, catch basins, etc.);
- GPS coordinates of the service at property line and the main line connection;
- Water service connections 100mm diameter and greater must show the pipe size and obvert elevation at property line on the plan view;
- Horizontal distances to be confirmed in the field between bends/valves/tees should be recorded on the as-recorded drawings;
- Restraints on the watermain should be accurately noted on the profile drawings for any engineer fill areas or as recommended by the geotechnical engineer;
- Restraints utilized out of tees, bends, valves, etc. should be accurately noted on the as-recorded drawings;
- Legend to reflect the hydrant manufacturer and model;
- Hydrant flange elevations are to be provided on the plan and profile drawings;
- Utilization of materials recommended by the geotechnical consultant during construction (example – geo-grid, filter fabric, stone wrapped in filter fabric, unshrinkable fill, etc.) should be noted on the drawings;
- Insulated water services to be noted on the as-recorded drawings;
- Water sampling stations to be noted on the plan and profile drawings and the legend;
- Watermain “tie ins” to be noted on the as-recorded drawings including pipe lengths, pipe location, type and location of sleeves, and type of backfill that has been utilized;
- If watermain appurtenances were not installed please “strike through” the text and reconfigure the alignment;
- Top of watermain elevations for vertical bends to be provided with vertical distances to adjacent infrastructure;
- GPS coordinates for all street furniture (water service laterals, water boxes, hydrants hydrant secondary valves, mainline valves, valve chambers, etc.) to be provided for input to the Town’s GIS system;
- Note on legend required for any “non-draining” fire hydrants.

Roads

- Right of way must be shown and will include road width from EP to EP on drawings;
- Base asphalt elevations to be provided and updated on profile drawings and utilization of “strike through” technique as required;
- Road structure matrix to be provided on the drawings in order to provide information;
- Sub-excavated areas of the road are to be identified on the plan and profile drawings;
- Utilization of materials recommended by the geotechnical consultant during construction (example – geo-grid, filter fabric, stone wrapped in filter fabric, unshrinkable fill, etc.) should be noted on the drawings with accurate chain age;

APPENDIX F: AS-RECORDED REQUIREMENTS

- Culvert invert elevations, grade, type, length, and location to be provided;
- Utility crossing locations to be noted on the plan and profile drawings.

Grading

- Grading plans need to show significant alterations to the grading design or changes in runoff;
- The grading plans are to be updated to reflect the as-recorded base asphalt grades at 20m intervals
- The centreline base asphalt grade slope and length are to be reflected on the as-recorded drawings
- Pre-grade elevations of the lots, parks, blocks, etc., are to be shown on the drawing.
- The plan and profile drawings are to be revised to reflect the as-recorded conditions of the base asphalt grades at 20m intervals. The as-recorded information in the grading and profile drawings must be consistent.

Drainage Plans & Design Sheets

- Pipe information shown on the drainage plans is to be updated to reflect the as-recorded pipe information.
- Design sheets are to be updated to reflect the as-recorded pipe information to confirm pipe capacities and velocities.

SWM Pond Drawings

- GPS coordinates of all street furniture within the SWM pond are to be provided;
- As-recorded invert elevations for all of the SWM pond structures including but not limited to, orifice plate/pipe, inlet/out pipes, maintenance pipes, overflow, weir walls, etc. are to be gathered and “strike through” technique is to be utilized;
- As-recorded storage volume and discharge calculations of the entire SWM pond are to be quantified and certified by a Professional Engineer to verify conformance with the approved drawings and SWM report. The table shall be provided on the pond drawing and compare the design requirements to as-recorded calculations;
- As-recorded elevations for all of the pond contours to be provided including, but not limited to, the access road elevations (elevations prior to pavement commencement and base and top asphalt elevations), permanent pool, extended detention, top of berm, 100-year water level, spillway elevation, forebay bottom, main cell bottom, etc;
- Access road pavement makeup is to be documented on the plan and profile drawings;
- Clarification of any pond products (cable mats, turf stone, concrete liner in forebay, etc.) to be included on the plan and profile drawings
- Pond details and sections are to be revised accordingly.

“Final Acceptance” – As-Recorded Drawing Submission Package

3.1. General Requirements

- Cover page with all of the required drawings from the “List of Drawings” and “List of Reports” from the subdivision agreement (and any amendments) are to be provided;
- All as-recorded lot, block, and street names should be noted as per the Registered M-Plan
- Revision block within the title block of all drawings shall have an entry indicating that the drawing is “As-Recorded” with the date;
- Provide a letter from the developer’s engineer that all infrastructure meets Town standard “set back” requirements.
- Provide a copy of all reports accepted by the Town of Innisfil.
- Provide individual PDF files of the as-recorded drawings. The size of each PDF shall be approximately 2 MB or less.

3.2. Plan and Profiles

Sanitary Sewer

- Location of the sanitary lateral (at property line and main line connection) is to be reviewed by utilizing the GPS coordinates. The sanitary service lateral locations are to be revised based on the GPS coordinates. The depth to invert is to be confirmed and the lateral invert chart is to be updated. Alternatively, the lateral invert can be shown on each individual lot in a text box with a border;
- Top of grate elevations for the sanitary sewer maintenance holes to be gathered after top asphalt placement.

Storm Sewer

- Location of the storm lateral (at property line) is to be reviewed utilizing the GPS coordinates and depth to invert to be confirmed and the lateral invert chart is to be updated. Alternatively, the lateral invert can be shown on each individual lot in a text box with a border;
- Top of grate elevations are to be provided for the storm maintenance holes, all catch basins (including rear lots if applicable).

Watermain and Appurtenances

APPENDIX F: AS-RECORDED REQUIREMENTS

- Location of the water service lateral and waterbox (at property line and main line connection) is to be confirmed utilizing the GPS coordinates. The water service lateral and waterbox locations are to be revised based on the GPS coordinates;
- Locations of all mainline valves, hydrant valves, hydrants, valve chambers, air release chambers, etc. are to be confirmed and drawings are to be updated accordingly.

Composite Utility Plans

- Review all utility plans including electrical street lighting drawings for all above ground utilities, landscape features, driveways, sidewalks, mailboxes, utility boxes, street lights, hydro transformers, etc. to confirm locations and update drawings accordingly;
- GPS coordinates of all of the utility structures to be gathered and locations of proposed are to be confirmed and updated accordingly.

Roads

- GPS coordinates of the maintenance holes/catch basins to be gathered once the top asphalt has been placed;
- Top asphalt elevations are to be provided once works have been completed;
- Curb and gutter elevations to be provided and slopes to be compared with proposed on the plan and profile drawings

Landscaping

- Tree species and GPS coordinates to be provided;
- Record of planting dates to be provided (tracking device regarding planting history);
- Landscape/entry features to have a plant/tree inventory provided.

Grading

- Grading plans need to show significant alterations to the grading design or changes in runoff;
- The grading plans are to be updated to reflect the as-recorded centreline grades at 20m intervals
- The centreline road grade slope and length are to be revised to reflect the as-recorded conditions
- Spot elevations are to be revised based on the as-recorded conditions.
- The plan and profile drawings are to be revised to reflect the as-recorded conditions of the spot elevations, road grade slope and length, and centreline grades at 20m intervals. The as-recorded information in the grading and profile drawings must be consistent.
- Retaining Walls require clarification of type, length, height, and it should be noted if they were removed from the plan.

SWM Pond Drawings

- Pond survey along with the access road top asphalt and all street furniture, emergency spill way, and all other inlet/outlet structures and adjacent areas;
- As-recorded storage volume and discharge calculations of the entire SWM pond are to be quantified and certified by a Professional Engineer to verify conformance to approved drawings and SWM report. The table shall be provided on the pond drawing and compare the design requirements to as-recorded calculations;
- All of the trees within the SWM pond are to be identified by species along with GPS coordinates to be gathered as part of the tree inventory.
- Refer to section 4.9.11 Stormwater Management Pond Post-Cleanout of the Town Standards for additional requirements.

APPENDIX G: DETAIL DRAWINGS

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600	SANITARY AND STORM SEWERS
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APPENDIX H: WATERMAIN CONNECTION AND COMMISSIONING MANUAL

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DEFINITIONS

Commissioned watermain: in service for distribution of safe drinking water

Operator: MECP Certified InnServices Operator (Town of Innisfil's water operating authority)

Licensed Third Party: A Company that specializes in water distribution and has licensed Class one Distribution System Operators on staff.

REFERENCES

Ontario New Watermain Disinfection Procedure

American Waterworks Association (AWWA)

- AWWA Standard C651-14 - [Disinfecting Watermains]
- AWWA C655-09 - [Field De-chlorination]
- AWWA C605-13 - [Underground Installation of PVC and PVCO Pressure Pipe and Fittings]

Ontario Provincial Standard Specifications (OPSS)

Ontario Safe Drinking Water Act (SDWA)

Ontario Regulations

- O. Reg. 128/04 - [Certification of Drinking Water System Operators and Water Quality Analysts]
- O. Reg. 108/18 - [Fire Code]

NFPA Standard 291

1.0 General Information

- This procedure is required for addition, modification, replacement and extension of any watermain.
- This procedure is for all public and private watermain works.
- Service pipes with a diameter of 100mm or greater are to be considered watermains.
- The following procedure must also be followed for temporary watermains.
- Watermain commissioning is to be completed by a licensed third party.
- Scheduling is to be coordinated with InnServices Administrative Coordinator by email iuiwaterappt@innservices.co

1.1 Requirements

All procedures are to be followed in accordance to MECP and the latest AWWA Standard C651-14.

The MECP Procedure for Disinfection of Drinking Water in Ontario regulation shall take precedence if there are any discrepancies between MECP and the AWWA C651-14.

The watermain must meet design criteria set by the MECP.

Watermain live taps, commissioning and connections are to be witnessed by InnServices, and a senior staff member from the Owner's Consulting Engineer.

Mainline valves on a connected water distribution system may only be operated by an InnServices Operator. Valves on an unconnected system may be operated by a licenced third party.

If an Operator is required on site, the arrangements must be made with the Administrative Coordinator three (3) working days in advance.

Refer to Appendix B5 in the Town of Innisfil Engineering Design Standards and Specifications Manual for a list of approved materials. Materials not specified must be approved by InnServices prior to installation.

1.2 Watermain Commissioning Plan

A commissioning plan outlining the procedure that will take place along with specifications is to be **submitted to InnServices two (2) weeks prior** to the commissioning for review and approval.

The following should be included as part of the plan:

- Commissioning Procedure
- Specifications such as length of watermain to be commissioned, schedule of procedure, etc.;
- Outline steps to be taken if any testing has failed (ex. If turbidity of 1 NTU is not achieved within 10 minutes, the watermain will be re-swabbed);
- Outline all requirements that are to be met;
- Swabbing Procedure;
- Specify number of swabs to be launched, size, swab velocity, etc.;
- Hydrostatic Testing Procedure;
- Disinfection Proposal Plan (criteria, mapping, calculations);
- Include disinfectant to be used, initial concentration, details of continuous feed method, duration of exposure, etc.;
- Disinfectant used for the procedure must be NSF certified;
- Disinfection Site Map; and

- Procedure for Microbiological sampling with proposed sampling locations

1.3 Other Submissions

- Turbidity and Chlorine Residual Report
- MECP Form 1 to be submitted once final connection has been completed
- Backflow Certification

2.0 New Watermain – Physically Isolated From Existing Watermain

The following testing requirements apply to all new sections of watermain. Any sections which fail to meet the requirements shall be retested, repaired or replaced at the direction of InnServices.

2.1 Live Tap Procedure

Live Taps must be completed by a third party approved by InnServices

1. Watermain is safely exposed and cleaned.
2. Tapping saddle and mainstop/gate valve are installed on the watermain.
3. A five (5) minute pressure test on the saddle must be completed before the main is cut. Pressure must be held at 150 psi.
4. Tapping saddle, tapping machine, cutter and gate valve are to be disinfected.
5. Tapping machine is fastened onto the mainstop/gate valve and live tap begins.
6. Once live tap is completed, the watermain coupon must be given to the InnServices Operator on site and the mainstop/gate valve is to be closed.

Live taps are to be witnessed by an InnServices Operator and are to be scheduled 3 days in advance.

2.2 Installation of bypass and backflow preventer

- A temporary by-pass connection complete with a water meter is to be installed to permit testing of the system. Water meters up to 50 mm in size are available for rent by InnServices. Please contact the Administrative Coordinator for rental forms.
- A backflow preventer is required on all by-passes. It is the Owner's responsibility to hire a plumber for the installation and certification of a backflow preventer. Backflow preventers up to 50 mm in size are available to rent by InnServices.
- Manufacturer specifications and guidelines for installation must be followed.
- Removal of the backflow preventer shall not take place until the commissioning of the watermain has been completed.

2.3 Swabbing

- All watermains 600 mm diameter and less shall be swabbed. For diameters larger than 600mm, swabbing is to be discussed and approved by InnServices.
- All swabs are to be new and a minimum of 50 mm larger than the watermain diameter.
- Swabs are to be numbered in the order they are launched and collected thereafter.
- The watermain is to be loaded prior to swabbing.
- A turbidity reading must be taken within ten (10) minutes after the last swab has been launched and must be lower than 1.0 NTU. If a turbidity reading lower than 1.0 NTU is not achieved within ten (10) minutes the watermain must be re-swabbed.

2.4 Flushing and Turbidity Testing

- Flushing of the watermain (including all hydrant leads, services and sample point locations) is required to ensure removal of air pockets and particulates.
- **All hydrants must be flushed with high velocity.**
- Turbidity results must be obtained at each sample location and are to be documented in the Turbidity and Chlorine Residual Report.
- The flushing velocity is to be 3.0 ft/sec (0.91 m/s) or greater.

2.5 Hydrostatic Pressure Testing

Hydrostatic testing shall be performed, prior to disinfection of the watermain.

All main line and secondary valves must be open during testing except for valves being used to divide the system into sections for the purpose of testing.

Watermains must hold at **150 psi (1034 kPa)** for two (2) consecutive hours, with **no leaks** and **no additional water** added once pressurized and official pressure test has commenced.

Note: Only HDPE (High Density Polyethylene) watermains will have allowable leakage with respect to the manufacturer's recommendations.

If the watermain requires a repair, the swabbing and hydrostatic pressure testing procedures will be completed again.

2.5.1 Hydrostatic Pressure Testing of Fire Mains

Fire mains must hold at **200 psi (1379 kPa)** for two (2) consecutive hours, with **no leaks** and **no additional water** added once pressurized and official pressure test has commenced.

If the fire line requires a repair, the swabbing and hydrostatic pressure testing procedures will be completed again.

2.6 Disinfection/Chlorination

The system (including all hydrants) shall be disinfected using the continuous-feed method in accordance with AWWA C651-14.

- The chlorinated water is to remain in the watermain for a minimum contact time of twenty-four (24) hours.
- Initial chlorine concentration must be a minimum of 25 mg/L of free chlorine and a maximum of 125 mg/L.
- A chlorine residual is to be taken once the twenty-four (24) hour period has passed.
- The maximum allowable decrease in chlorine concentration after 24 hours is 40% of the initial concentration to a maximum decrease of 50 mg/L.
- The initial dosage and the concentration at the end of the twenty-four (24) hour contact time must be recorded in the Turbidity and Chlorine Residual Report for **all sample points and all hydrants** prior to flushing of the watermain.

2.6 De-chlorination

Following the required twenty-four (24) hour contact time, the system is to be flushed to remove super chlorinated water from of the watermain. The chlorinated water must be neutralized, prior to discharge, using an appropriate chemical such as sodium thiosulphate. Refer to the AWWA 651-14 for disposal of the treated water.

2.7 Chlorine Residual

Chlorine residuals are to be taken during initial chlorination, following the twenty-four (24) hour period and after de-chlorination at all sampling locations and recorded in the Turbidity and Chlorine Residual Report.

The chlorine residual after de-chlorination must be equal to the chlorine level of the water supply.

2.8 Microbiological Testing

Samples for bacteriological testing shall be collected by InnServices, a minimum of Sixteen (16) hours after flushing is completed, in accordance with AWWA C651.

Following the receipt of two consecutive sets of acceptable test results, InnServices will provide written notification that a final connection can be made to the existing distribution system.

For a test result to be deemed acceptable, the bacterial analysis of sampled water must indicate the following:

Total Coliform: 0 CFU/100ml

E.coli: 0 CFU/100ml

Background: <200 CFU/100ml

HPC: <200 CFU/mL

Should the results of the sampling be deemed unacceptable, additional swabbing, disinfection, flushing and sampling may be required at the discretion of InnServices.

A **minimum of sixteen (16) hours** after the de-chlorination of the main, **two (2) rounds of samples** are to be taken, **at least 15 minutes apart**, as stated in Section 5.1 of the AWWA C651. Each sampling point must remain open with water continuously flowing until both sets of samples have been collected. If a sample point gets shut off during sampling, the sampling process must start over and all samples previously collected will no longer be valid.

If water cannot be continuously flowing for the entire duration of testing for all sample points, the initial sample will be taken after de-chlorination and the second sample will be taken a minimum of 16 hours thereafter.

A set of samples is to be collected for every 370 meters and at the end of each branch and at the end of each line.

A set of samples is also to be collected at the water source.

Water samples are required every 61 meters wherever ground water has entered new watermain during construction.

All sampling is to be conducted by an InnServices Operator. Samples will be delivered to the lab for testing by InnServices.

2.9 Mandatory Submission

Prior to final connections, all documentation as part of new watermain commissioning shall be submitted to InnServices by email to uiwaterappt@innservices.co and the InnServices Project Manager involved with the watermain commissioning.

- Turbidity and Chlorine Residual Report
- Backflow Prevention Test Inspection Report
- Watermain Hydrostatic Pressure Test Results

2.10 Final Connection

The final connection shall not be made until all the required testing and disinfection has been completed and InnServices has provided written notification to proceed.

Final connection must be witnessed by an InnServices Operator and the Owner's Consulting Engineer.

If the connection requires a shut-down a resident notice including a map of the area affected by the shutdown is to be submitted at the time of scheduling. Once approved, the Owner's

Consulting Engineer is required to hand deliver the resident notices a minimum of forty-eight (48) hours before the works take place.

During the connection all piping is to be cleaned and disinfected thoroughly by use of 12% sodium hypochlorite or equivalent solution.

The excavated area must be dewatered at all times to ensure water does not enter the watermain.

In the case of contamination, the watermain commissioning procedure is to be repeated.

If the final connection is not made **within ten (10) days** of InnServices providing the sample approval, InnServices will take a residual chlorine reading. If the residual free chlorine has fallen below 0.05 mg/L InnServices will require additional flushing, chlorination, and sampling of the system prior to final connection.

2.10 Return to Service of Watermains Isolated from the Distribution System

As per the Ontario Watermain Disinfection Procedure, Section 1.7., where a section of watermain has been isolated from the distribution system and a concentration of 0.05mg/L of free chlorine residual in a chlorinated system was not maintained within the isolated section (e.g., valve connection to existing live watermain), the isolated section must be re-chlorinated and sampled prior to the system being livened.

An updated commissioning plan must be submitted which shall include a re-chlorination, dichlorination, flushing and sampling procedure.

APPENDIX I: HYDRANT FLOW TESTING PROTOCOL

InnServices – Hydrant Flow Testing Protocol

1. Preparation prior to Hydrant Flow Test:

- Hydrant flow testing shall be arranged through InnServices Water Operations by email (juwaterappt@innservices.co), a minimum of two (2) weeks in advance of the proposed hydrant flow testing date.
- Verify with InnServices the date and time of the test for approval and to confirm the system will be fully operational on that date.
 - Flow test should be conducted during peak hours in the morning to reflect the worst-case scenario.
- Confirm with InnServices by a sketch which hydrants are to be used for the Flow Hydrant(s) and the Residual Hydrant, and adjust locations at InnServices discretion based on available system information for each water system and modelling, if required.
- Provide confirmation to InnServices that the personnel who will be conducting the hydrant flow testing will be following NFPA 291 guidelines.
- Confirm with the Town of Innisfil any permits or approvals needed such as a Right-of-Way Activity Permit (ROP) and provide InnServices with an approved copy of the permit.
- Ensure testers have all required testing equipment, safety equipment and traffic control equipment.
- Ensure that hydrant flow test will not be performed below zero degrees Celsius.
- Testers to contact InnServices 48 hrs prior to testing to confirm that the system is still good for testing.

2. On-Site Preparation:

- Upon arrival, check in with InnServices to reconfirm the system is fully operational and that watermain mainline valves are all fully open.
- Confirm the hydrant locations, discharge location, treatment method of water flow and any impact to traffic and residents prior to start of testing.
- Confirm temperatures are acceptable for the testing to occur.
- Confirm that secondary valve is fully open and that hydrant is in good operating condition prior to beginning flow testing.
- Ensure traffic control measures are in place prior to testing.

APPENDIX I: HYDRANT FLOW TESTING PROTOCOL

- Ensure all safety measures are in place prior to testing.

3. Performing the Hydrant Flow Test

- Tester shall conduct hydrant flow testing in accordance with the guidelines set out in the current edition of NFPA 291.
- At the Residual Hydrant:
 - Check the secondary valve.
 - Install all testing equipment to hydrant.
 - Open the hydrant slowly and bleed out any air from hydrant barrel.
 - Verify that the hydrant is functioning properly and is fully open.
- At the Flow Hydrant:
 - Check the secondary valve.
 - Install all testing equipment to hydrant.
 - Install diffuser for discharge.
 - Add the de-chlorination tablets or other treatment method approved by InnServices.
 - Open the hydrant slowly and bleed out any air from hydrant barrel.
- Obtain and record the Static reading from the Residual Hydrant.
- Open one port from the Flow Hydrant and record the Pitot Pressure and record the start time of test.
- Monitor residual gauge to ensure system pressure does not drop below 20 psi (138 kpa).
- Record the residual reading from the Residual Hydrant.
- Open a second port from the Flow Hydrant and record the Pitot Pressure.
- Monitor residual gauge to ensure system pressure does not drop below 20 psi (138 kpa).
- Record the residual reading from the Residual Hydrant. Slowly shut down the Flow Hydrant.

4. Completion of Hydrant Flow Test

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- Restore the site to how it was found and ensure there has been no property damage.
- Be sure to drain / pump-out the hydrants, re-install Anti-Tamper-Device's (if required).
- Complete a **Fire Flow Test Report** and submit a PDF copy, signed by the tester, to InnServices via email. Review results to confirm the results obtained are reasonable based on available system information. The report shall include the following information at a minimum:
 - Test date and time;
 - Location description, including a Key Map that shows adjacent streets and hydrant info (residual & flow hydrant(s));
 - Name of InnServices Water Operator that was present;
 - Name of Company and name of tester that conducted the flow test;
 - Brief statement from tester confirming the test has been conducted in accordance with NFPA guidelines;
 - Table showing the following information:
 - Static pressure (psi), watermain size, test number, number of outlets, outlet inside diameter (in), discharge coefficient, residual pressure (psi), pitot pressure (psi), flow (US GPM). A minimum of two (2) sets of flow data are to be obtained during the test
 - Test readings plotted on a Pressure vs Flow Graph
 - Brief description of condition of hydrant, noting any minor defects (ie. Paint/rust issues, broken hydrant marker, slow leaking seals, etc.)