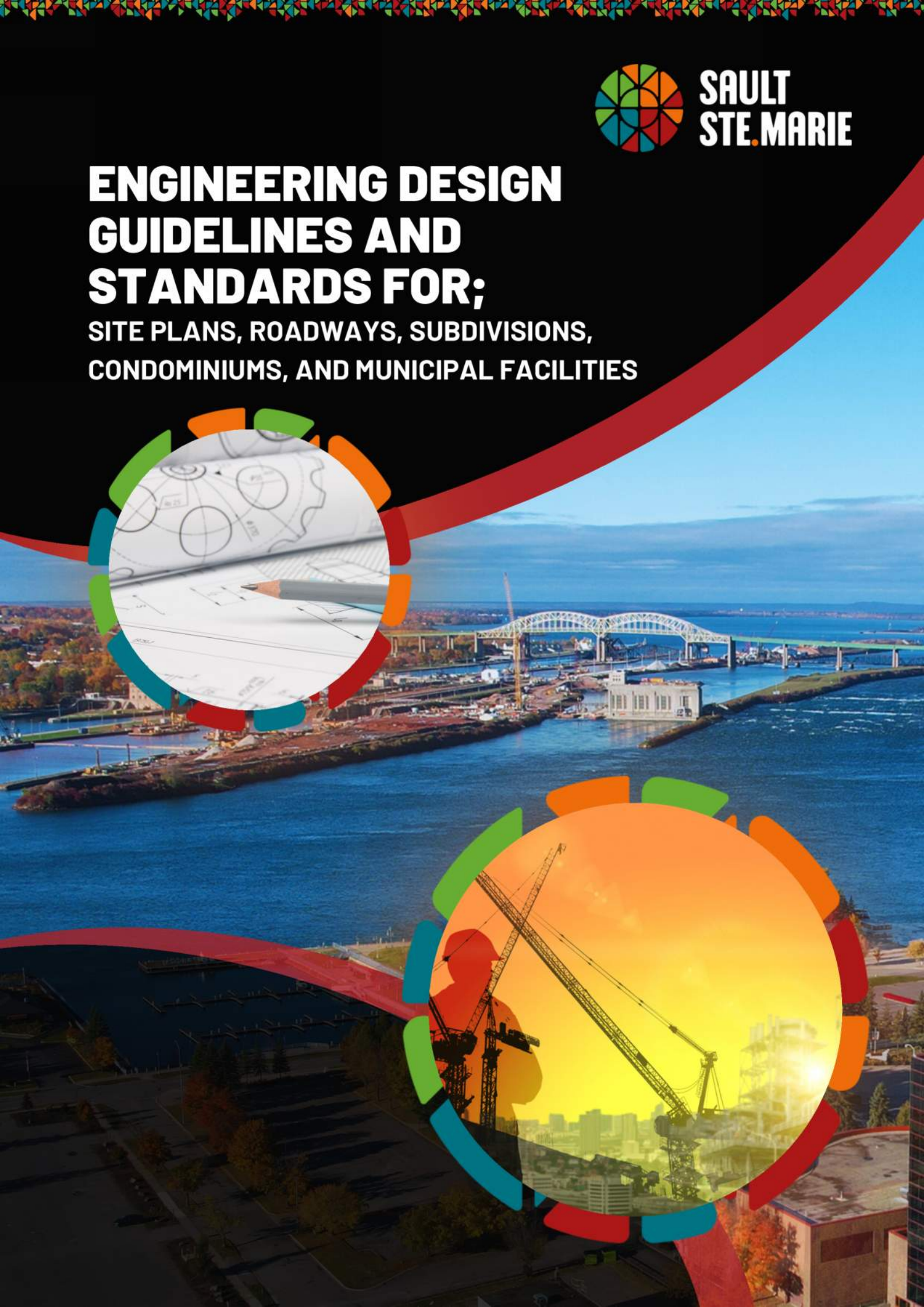
SAULT STE.MARIE

ENGINEERING DESIGN GUIDELINES AND STANDARDS FOR;

SITE PLANS, ROADWAYS, SUBDIVISIONS, CONDOMINIUMS, AND MUNICIPAL FACILITIES



CITY OF SAULT STE. MARIE ENGINEERING DESIGN GUIDELINES AND STANDARDS FOR MUNICIPAL ROADS, SUBVISIONS, AND FACILITIES

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1. INTRODUCTION

1.1 Purpose

The purpose of this document is to outline the Engineering Division's requirements for processing land development applications, as well as the standards for the design, construction, and acceptance of roads and municipal services associated with such developments. These requirements are intended to ensure that developers meet fair and reasonable obligations, safeguarding the interests of both future residents of the development and the broader community.

1.2 Process

The typical Subdivision Development planning and approval process can be found in the Plan of Subdivision/Condominium Application Process Appendix A, Process Flowcharts.

1.3 Submission Checklist

A checklist for typical application submission documents and requirements can be found in the Plan of Subdivision/Condominium Application Process Appendix B, Checklist for Studies/Plans/Reports.

1.3.1 Exemptions

Developers having three (3) lots or less on an existing opened and serviced road, may be exempted from some of the requirements and procedures outlined in this document. These exemptions will depend on the circumstances of the location and shall be at the discretion of the Engineering Division.

1.4 Design and Construction of Services

The services for the Development shall be designed for the actual site conditions which are encountered in the area to be serviced. The standards outlined in this document are minimum standards only. Site conditions and good engineering practice will dictate the work which shall be carried out. All sanitary sewer and stormwater facilities shall be designed in accordance with the latest edition of the Ministry of the Environment, Conservation and Parks guidelines for such facilities.

1.5 Policy Considerations

All developments shall meet all Provincial and Federal Acts, Regulations, and Policies.

1.6 General Conditions of Contract

Unless authorized otherwise by the Engineering Division all City contract documents shall include the Ontario Provincial Standards (OPS) General Conditions of Contract, November 2019. The General Conditions may be modified by OPS Supplemental General Conditions as prepared by the Engineering Division. The use of CCDC General Conditions may also be approved by the Engineering Division as modified by the City's Supplemental General Conditions for use with CCDC documents. The Supplemental General Conditions are available on request to the Engineering Division.

The above General Conditions of Contract shall be utilized for all municipal work that is tendered and contracted out either directly by the City or by a consultant on behalf of the City.

1.7 Construction of Services on City Lands

Private Contractors and Land Developers are not authorized to undertake construction work on any Municipality Owned Infrastructure without prior approval (municipal consent).

In order to proceed with any development proposal which will require either the construction of new municipal infrastructure or alteration of existing municipal infrastructure, authorization shall first be obtained from the Engineering Division. Prior to start of any work on municipally owned infrastructure, the proponent may be required to enter into an Agreement with the City, including the requirement to provide financial guarantees, and shall produce construction drawings in accordance with the standards contained in this document and other applicable municipal and provincial standards. The proponent must obtain all necessary municipal, provincial and federal approvals, make the necessary arrangements for resident inspection/certification/as-built record drawings for the completed works, and provide liability insurance coverage as required by the City of Sault Marie.

1.8 Approvals

1.8.1 Ministry of the Environment, Conservation and Parks – Sanitary and Storm Sewer Approvals

The Design Engineer shall prepare and submit to the Engineering Division as follows:

- The Ministry of the Environment application forms for approval of the sewer system(s),
- Functional Stormwater Management Report (outlined in **Section 8.1.1)**
- A Design Brief outlining the core details of the sewer system design (outlined in **Section 8.1.2**),
- Submission of three (3) sets of the plans,
- Sewer System Design Sheets and,
- Design calculations.

The City will carry out a full technical review of the application to ensure that the works are in accordance with published MECP guidelines and City Engineering Standards. At the conclusion of the review, the City would recommend to the Ministry's Approvals Branch that a Certificate of Approval be issued. The Ministry of the Environment's approval must be received before the City will allow construction to start. The Design Engineer should allow for a minimum two (2) months turn-around time for the technical review by the City and issuance of the approval certificate by the Ministry of the Environment.

1.8.2 Ministry of the Environment, Conservation and Parks – Water Service Approvals

The Design Engineer shall prepare and submit to the Engineering Division as follows:

- The Ministry of the Environment application forms for approval of the water service system(s),
- A design Brief outlining the core details of the water service system design (outlined in **Section 8.1.2**),
- Submission of three (3) sets of the plans,
- Design Calculations

2. SANITARY SYSTEM

2.1 General

In situations not covered by these guidelines the following documents must be referenced:

- Municipal Public Works and Engineering Services Design Manual
- Ministry of the Environment, Conservation, and Parks (MECP) Design Guidelines for Sewage Works (2016)
- Ontario Provincial Standard Drawings and Specifications, and
- American Water Works Association (AWWA)

2.2 Design

2.2.1 Hydraulics

Manning's Equation shall be used for the design of gravity sewers and open channels. The Mannings equation is as follows:

$$V = \frac{1}{n} \cdot R^{\frac{2}{3}} \cdot S_o^{\frac{1}{2}}$$

*Where, V = mean velocity [m/s], n = roughness coefficient [unitless] (see **Table 1**), R = hydraulic radius [m] =* $\frac{area\ of\ liquid}{wetted\ perimeter}$*, S_o = slope of energy line [m/m] (slope of invert for gravity flow)*

Using the continuity principle:

$$Q = A \cdot V$$

Therefore,

$$Q = \frac{1}{n} \cdot A \cdot R^{\frac{2}{3}} \cdot S_o^{1/2}$$

Where, Q = Flow [m^3/s], A = cross sectional area of liquid [m^2]

Manning's "n" roughness coefficients for common pipe surfaces are shown below in **Table 1.**

Table 1: Mannings Roughness Coefficients

Type of Pipe	Roughness Coefficient (n)
Smooth wall	0.013
Corrugated metal	0.025
Concrete or asbestos cement	0.013
PVC	0.013
Polyethylene	0.013

In designing a sanitary sewer system, the designer shall:

- Establish the boundaries of the specific area to be serviced
- Obtain mapping as required
- Break the area into smaller sub areas based on drainage (tributary areas)
- Determine the existing and proposed land use
- Decide on an ultimate population to be attached to each unit
- Determine the design flow for the population of each unit, and
- Determine a design allowance for infiltration.

After the proposed sewer routing is established and the necessary profiles obtained, the designer will proceed to calculate sewer pipe sizes and grade.

The downstream system must have sufficient capacity to accommodate the proposed development. During the pre-consultation meeting, the City will inform the developer of any downstream capacity issues and verify if a downstream capacity analysis is required.

Sewer flow rates are to be designed to standards established by the City of Sault Ste. Marie described herein. In situations not covered by the enclosed standards and specifications, the MECP Design Guidelines for Sewage Works shall be used.

No decrease in downstream pipe size shall be allowed unless otherwise approved by the City Engineer.

Digital sewer design sheets must be submitted as part of the Sanitary Sewer Design Brief in accordance with **Section 8.1.2.4.**

All sewers shall be designed and constructed so that surcharging above the pipe obvert from backwater conditions does not occur.

In the event the surcharging under backwater conditions is deemed minor in the opinion of the Engineering Division and mitigating measures are not required to eliminate such surcharging, the following conditions shall be complied with:

- The surcharging shall not extend into any lateral connection past the property line served by the sewer; and
- Hydraulic grade line calculations shall be provided, and a hydraulic grade line shall be shown on the engineering drawings to illustrate the loss of energy along the pipeline

The design flow for all sanitary sewers are determined as follows:

2.2.2 Design Flow

2.2.2.1 Peak Domestic Sewage Flow

The peak domestic sewage flow is calculated as:

$$Q_d = (P \cdot q \cdot M) / 86.4 + (I \cdot A)$$

*Where: Q_d(L/s) = Peak domestic sewage flow (including extraneous flow), P = Design Population in thousands, q(L/unit/d) = Average daily per capita domestic flow, M = Peaking Factor (as derived from the Harmon Formula), I(L/hectares/s) = Unit of peak extraneous flow (see **Table 3**), A = Area (hectares)*

Table 2: Population Design Guidelines

Land Use	Persons/ha
R1 - Single Family	40 - 55
R2 - Semi detached	90 - 120
R3 – Townhouses/Row housing	225 - 290
Low Rise Apartment	175
R5 – High Rise Apartment	375 - 405
Commercial	125
Light Industrial	40 - 125

2.2.2.2 Population Design Densities

Population design density is based on gross population per hectare and is to be determined from **Table 2 Section 2.2.2.1.** Values not determined from **Table 2** must be approved by the Director of Engineering. Industrial, commercial, and institutional design flows shall be considered on a case- by-case basis. The designer will provide the necessary calculations and rationale.

The design population is derived from the drainage area and the associated population density. The design should consider the maximum expected population over the design period.

2.2.2.3 Average Daily Flow

The average daily domestic flow (exclusive of extraneous flows) should be from 225 to 450 L/capita·d.

2.2.2.4 Maximum Flow

The maximum design flow is determined using Average Daily Flow and the Harmon Peaking Factor M:

$$M = 1 + \{14/(4+P^{0.5})\}$$

Where, M = the Harmon Peaking Factor, P = population (thousands)

2.2.2.5 Extraneous Flows

When designing sanitary sewer systems, an allowance must be made for the leakage of groundwater into the sewers, existing building connections, maintenance hole covers, etc.

Due to extremely high peak flows that can result from roof downspouts, they should not, under any circumstance, be connected directly or indirectly via foundation drains to sanitary sewers.

Extraneous flow in litres/second/hectare shall be determined from **Table 3** below.

Table 3: Infiltration Allowance (Extraneous Flows)

Pipe Description	L/ha/s
New Pipe	0.174
Existing (Older than 1980)	1.0
Existing (Newer than 1980)	0.24

2.2.2.6 Commercial and Institutional Flows

Sewage flows from commercial and institutional establishments vary greatly based on:

- The type of establishment
- The population using the facility.

Commercial and Institutional flows should be determined using historical records when available. Where no records are available, the unit values indicated in **Table 4** and **5** below should be used. For commercial and tourist commercial areas, a minimum allowance of 28m^3/ha·d average flow should be used in the absence of flow data. These values should be used only after consultation with the Director of Engineering.

Table 4: Typical Water-Use Values for Commercial Facilities

Facility	Unit	Flow [L/unit · d]
Airport	Passenger	10
Automobile Service Station	Vehicle Served	40
Bar Lounge	Customer	8

Boarding House	Resident	150
Hotel	Bed	225
Laundry (Self Service)	Machine	2000
Motel	Bed	150-200
Office	Employee	55
Restaurant (Conventional)	Meal	35
Rooming House	Resident	150
Department Store	Employee	40
Shopping Center	Parking Space	4
	Floor Area (m^2)	2.5-5.0
Theater (indoor)	Seat	10

Table 5: Typical Water-Use Values for Institutional Facilities

Facility	Unit	Flow [L/unit · d]
Hospital (Medical)	Bed	900-1800
Prison	Inmate	450
Rest Home	Resident	350
School	Student	70-140
School (boarding)	Student	280

When using the above unit demands, maximum day and peak rate factors must be applied.

Sewage flows for campgrounds will vary with the type of facility (i.e. showers, flush toilets, laundry facilities, etc.) and the ratio of these facilities to the number of campsites. A peaking factor of four (4) will generally be adequate; however, this factor should be applied to the average expected sewage flow at full occupancy.

For establishments in operation for only a portion of the day (i.e. schools, shopping plazas, day care centres, etc.) the sewage flows generated should be factored in accordingly.

2.2.2.7 Recreational Sewage Flows

Table 6 below lists the typical water use values for various recreational facilities.

Table 6: Typical Water-Use Values for Recreational Facilities

Facility	Unit	Flow [L/unit · d]
Bowling Alley	Alley	800
Cabin, Resort	Person	160
Cafeteria	Customer	6
Children's Camp (toilet and bath)	Person	160
Campground (developed)	Campsite	225-570
Travel Trailer Parks	Space	340 (without indiv. hookups)
	Space	800 (with indiv. hookups)
Mobile Home Parks	Space	1000
Cocktail Lounge	Seat	75
Coffee Shop	Customer	20
Country Club	Member Present	400
Dining Hall	Meal Served	30
Dormitory, bunkhouse	Person	150
Fairground	Visitor	4
Hotel, resort	Person	200
Laundromat	Machine	2000
Park (with toilets)	Person	30
Store, resort	Customer	10
Swimming Pool	Customer	40

Theater (drive in)	Car	15
Visitor Center	Visitor	20

2.2.2.8 Industrial Sewage Flows

Sewage flows from industrial areas vary greatly with the type of industry present, the provision of in-plant treatment, the presence of cooling water in the discharge, and the water demand for operating.

Typical sewage flow allowances for industrial areas are 35 m^3/hectare/day for light industry and 55 m^3/hectare/day for heavy industry. These are average flow rates; the peak sewage flow rates will typically vary with the size of the industrial area as shown in **Figure 1 Section 2.3.** By improving the monitoring of industries present in industrial areas a more suitable allowance can be made for peak industrial sewage flows. Industries which may discharge more than the accepted rate may be required to provide measures for flow equalization with off-peak discharge periods.

2.2.3 Sewer Mains

2.2.3.1 Design Sheets

The calculation of the sewage flows, and the determination of the sewer size, grade, and capacity is usually done using a Personal Computer and software such as SANSYS or SEWERCAD. An alternate method of generating and recording this data is via the use of a design sheet. Design Sheets shall be submitted as part of the design brief in accordance with **Section 8.1.2.4.** An example of a Sanitary Sewer Design Sheet can be seen in **Figure 2 Section 2.3.**

2.2.3.2 Velocity

The maximum and minimum flow velocities shall be in accordance with MECP Design Guidelines. All sewers shall be designed and constructed to give, when flowing full, a minimum velocity of 0.60 m/s using a Manning's n value of 0.013. In cases where the flow depth in the sewer, under peak flow, will not be 0.3 [d/D < 0.3] of the pipe diameter or greater, the actual flow velocity at peak flow should be calculated using a hydraulic elements chart and the slope increased to achieve adequate flushing velocities. In certain circumstances, such as where increased slopes would require deepening of multiple sections of the collection system or the addition of a pumping station, sewage velocities of less than 0.6 m/s may be considered provided the municipality accepts.

The velocities in sanitary sewers should not be more than 3.0 m/s, especially where high grit loads are expected. Higher velocities should be avoided unless special precautions are taken. Where velocities are greater than 4.6 m/s, special provisions should be made to protect against pipe displacement by impact or erosion. Sewers 1200mm or larger shall be constructed to give mean velocities, when flowing full, of not less than 0.9 m/s.

All sewers with slopes such that flow velocities will approach "critical velocity" shall be designed to reduce turbulence.

2.2.3.3 Grades

The minimum grade shall be 0.3% while the preferred minimum grade which should be provided whenever possible, is 0.5%. The first sewer length between manholes starting from a dead-end shall have at least a 1.0% grade. Grades of less than 0.3% shall be approved by the Director of Engineering prior to starting construction drawings. If a grade lower than 0.3% is approved, **Table 7** below provides the minimum slopes which should be provided for sewers 1050mm in diameter or less. The grade of any sewer shall not be lower than the value listed in **Table 7** below. In most cases, slopes greater than these values are desirable to control sewer gases and maintain self cleaning velocities.

Table 7: Recommended Minimum Slopes for Various Sewer Sizes (Manning's n = 0.013)

Nominal Sewer Size	Minimum Slope in m/100m
200mm (8in) (NPS-8)	0.4
250mm (10in) (NPS-10)	0.3
300mm (12in) (NPS-12)	0.22
350mm (14in) (NPS-14)	0.17
375mm (15in) (NPS-15)	0.15
400mm (16in) (NPS-16)	0.14
450mm (18in) (NPS-18)	0.12
525mm (21in) (NPS-21)	0.1
600mm (24in) (NPS-24)	0.08
675mm (27in) (NPS-27)	0.067
750mm (30in) (NPS-30)	0.058
825mm (33in) (NPS-33)	0.052
900mm (36in) (NPS-36)	0.046
975mm (39in) (NPS-39)	0.041
1050mm (42in) (NPS-42)	0.037

For pipes with a Mannings n-value other than 0.013, refer to **Table 8** below for other minimum sewer grades.

Table 8: Minimum Sewer Grades Flowing Full for Various Mannings n values

MINIMUM SEWER GRADES FLOWING FULL						
Size (mm)	Sanitary Sewer Mains Velocity 0.6 m/sec Minimum Grade - %					
	n=.010	n = .011	n = .013	n = .022	n = .024	n = .035
203	0.40	0.40	0.40	0.93	1.10	2.35
254	0.35	0.35	0.35	0.69	0.82	1.74
305	0.30	0.30	0.30	0.54	0.64	1.36
356	0.25	0.25	0.25	0.44	0.52	1.11
381	0.20	0.20	0.20	0.40	0.48	1.01
406	0.15	0.15	0.15	0.37	0.44	0.93
457	0.10	0.10	0.10	0.31	0.37	0.80
508	0.10	0.10	0.10	0.27	0.32	0.69
533	0.10	0.10	0.10	0.26	0.30	0.65
610	0.10	0.10	0.10	0.21	0.25	0.54
686	0.10	0.10	0.10	0.18	0.22	0.46
762	0.10	0.10	0.10	0.16	0.19	0.40
838	0.10	0.10	0.10	0.14	0.17	0.35
914	0.10	0.10	0.10	0.12	0.15	0.32
1067	0.10	0.10	0.10	0.10	0.12	0.26
1219	0.10	0.10	0.10	0.10	0.10	0.22
1372	0.10	0.10	0.10	0.10	0.10	0.18
1524	0.10	0.10	0.10	0.10	0.10	0.16
1676	0.10	0.10	0.10	0.10	0.10	0.14
1829	0.10	0.10	0.10	0.10	0.10	0.13
1981	0.10	0.10	0.10	0.10	0.10	0.11
2134	0.10	0.10	0.10	0.10	0.10	0.10

Maximum sewer grades to various Mannings n values are displayed below in **Table 9**. These values restrict the design to ensure the velocity remains less than 3.0m/s.

Table 9: Maximum Sewer Grades Flowing Full for Various Mannings n Values

MAXIMUM SEWER GRADES FLOWING FULL						
Size (mm)	Sanitary Sewer Mains Velocity 3.0 m/sec Minimum Grade - %					
	n=.010	n = .011	n = .013	n = .022	n = .024	n = .035
203	4.79	5.80	8.09	23.18	27.59	58.68
254	3.55	4.30	6.00	17.19	20.46	43.52
305	2.78	3.37	4.70	13.47	16.03	34.10
356	2.26	2.74	3.83	10.96	13.05	27.75
381	2.07	2.50	3.50	10.01	11.92	25.34
406	1.9	2.30	3.21	9.20	10.95	23.29
457	1.62	1.96	2.74	7.86	9.35	19.89
508	1.41	1.71	2.38	6.82	8.12	17.27
533	1.32	1.60	2.23	6.40	7.62	16.20
610	1.10	1.34	1.87	5.35	6.36	13.53
686	0.94	1.14	1.60	4.57	5.44	11.57
762	0.82	0.99	1.39	3.97	4.73	10.06
838	0.72	0.88	1.22	3.50	4.17	8.86
914	0.64	0.78	1.09	3.12	3.71	7.89
1067	0.52	0.63	0.89	2.54	3.02	6.42
1219	0.44	0.53	0.74	2.12	2.53	5.38
1372	0.37	0.45	0.63	1.81	2.16	4.59
1524	0.33	0.39	0.55	1.58	1.88	3.99
1676	0.29	0.35	0.49	1.39	1.65	3.52
1829	0.26	0.31	0.43	1.24	1.47	3.13
1981	0.23	0.28	0.39	1.11	1.32	2.81
2134	0.21	0.25	0.35	1.01	1.20	2.55

2.2.3.4 Steep Slope Protection

Sewers on 16 percent slopes or greater should be anchored securely with concrete anchors spaced as follows:

Not over 11m (36ft) center to center on grades 16 percent and up to 25 percent;

Not over 7.3m (24ft) center to center on grades 25 percent and up to 50 percent; and

Not over 4.9m (16ft) center to center on grades 50 percent and over.

2.2.3.5 Minimum Size

No gravity sewer conveying raw sewage within a municipal sanitary sewer system should be less than 200mm diameter (NPS-8).

2.2.3.6 Strength of Sanitary Sewer

Sewer pipes selected for any application should be able to withstand, with a margin of safety equal to 1.5, all the combinations of loading conditions to which it is likely to be exposed.

All pipes shall be clearly identified with the manufacturer's name and strength class or category.

Required pipe strength should be determined using the Marston and Spangler equations, or by nomograph method as published by the American Concrete Pipe Association for reinforced concrete pipe or the Uni-Bell PVC Pipe Association for PVC pipe.

Separate calculations for pipes of deeper bury may be required at the discretion of the Director of Engineering and Planning.

The strength class of each type of pipe required for the various depths of installation shall confirm with the manufacturer's recommendations.

The design and testing procedures used to calculate earth loading, superimposed loads, and supporting strength of the sewer pipe are covered in the pipe suppliers' catalogues or design manuals such as Water Pollution Control Federation or Design and Construction of Sanitary and Storm sewers.

Where poor ground conditions are expected, extra allowance should be made for the wider trenches that will result during excavation. Extra strength of pipe over that normally required shall be provided when the sewer is located in an easement.

2.2.3.7 Pipe Material

Sanitary sewers with a diameter of 250mm shall be PVC with an SDR of 35.

Sanitary sewers 300mm to 700mm in diameter shall be PVC with an SDR of 35 or Sanitite HP dual walled (CSA B182.13).

Sanitary sewers 750mm to 1500mm diameter shall be PVC with an SDR of 35 or Sanitite triple walled (CSA B182.13).

2.2.3.8 Depth of Cover

The preferred depth of cover for sanitary sewers is 3.05m to the pipe obvert. The minimum depth of cover on the sanitary sewer shall be 2.5m. This depth, in most instances, is adequate to prevent freezing of sewage. If it becomes necessary to provide an insufficient depth of cover as stated above, the minimum basement elevations shall be established and shown on the plan in accordance with **Section 8.1.2.4.**

Sewers should be sufficiently deep to receive sewage from basements and to prevent freezing and damage due to frost. To allow for gravity drainage from basements sewer inverts should normally be at least 0.9 to 1.5m below basement floor levels. In some cases, it may be more economical to pump into the sewer rather than deepen the sewer to accommodate a limited number of low-lying properties.

2.2.3.9 Sewer Location and Alignment

The Sanitary Sewer shall be located along the centerline of the right-of-way to allow buildings on both sides of the street to be services with approximately the same length of sewer.

In general, sewers equal to or less than 600 mm diameter (NPS-24) should be laid with straight alignment between manholes. Straight alignment should be checked by either using a laser beam or lamping.

Curvilinear alignment of sewers larger than 600 mm in diameter (NPS-24) may be considered on case-by-case basis provided compression joints are specified and American Society for Testing and Materials (ASTM) or specific pipe manufacturers' maximum allowable pipe joint deflection limits are not exceeded. Curvilinear sewers should be limited to simple curves which start and end at manholes. When curvilinear sewers are proposed, the recommended minimum slopes indicated in **Table 7** should be increased accordingly to provide a minimum velocity of 0.6 m/s (2.0 ft/s) when flowing full.

Other locations to suit existing conditions shall be approved by the Director of Engineering. Sanitary Sewers shall be located as shown on the standard drawings included in this manual and any variance from these

locations shall be authorized by the Director of Engineering.

2.2.3.10 Clearance Between Pipes

A minimum of 150 mm clearance is required between outside pipe barrels at all pipe crossings.

Sewers and watermains should maintain a minimum horizontal separation of 2.5m. Watermains should cross above sewers wherever possible. Whether the watermain is above or below the sewer a minimum vertical distance of 0.5m (1.6ft) between the outside of the watermain and the outside of the sewer should be provided to allow for proper bedding and structural support of the watermain and sewer pipes. Structural support should be provided to prevent excessive deflection of joints and settling.

The length of water pipe that crosses the sewer should be centered at the point of crossing so that the joints in the watermain will be equidistant and as far as possible from the sewer. This crossing should be as near to perpendicular as possible.

When it is not possible to obtain the horizontal and vertical separation as stipulated above, one of the following methods shall be specified:

The sewer should be designed and constructed equal to the water pipe and shall be pressure tested at 350 kPa (50 psi) to assure water tightness; and

Either the watermain or sewer line shall be encased in a watertight carrier pipe which extends 3m (10ft) on both sides of the crossing, measured perpendicular to the watermain.

2.2.3.11 Joints and Infiltration

All sewers shall have gasketed bell and spigot type joints.

The type of joints and the materials used should be included in the specifications. Sewer joints should be designed to minimize infiltration and to prevent the entrance of roots throughout the life of the system.

Leakage tests shall be specified as per **Section 10.4.1.**

The allowable infiltration/exfiltration for sewer pipe shall not exceed the vales listed in **Table 3** above in **Section 2.2.2.5.** Infiltration/exfiltration shall be measured in accordance with O.P.S.S. 410.

2.2.3.12 Pipe Bedding

The minimum bedding required for all sanitary sewers shall be Class "B" type and the type of bedding and class of pipe shall be noted on all plans. The excavation, backfilling, and installation procedures shall be in accordance with OPSS.PROV 401.

Pipe bedding shall be as detailed in OPSD Division 802. Bedding and cover shall conform to Granular “A” in accordance with OPSS.PROV 1010. For site specific bedding, embedment, and cover recommendations, the geotechnical report prepared for the project shall provide the class of bedding.

2.2.4 Sanitary Service Connections

2.2.4.1 Minimum Diameter

For gravity flow, a minimum 100mm diameter, or the pipe size needed to satisfy Part 7 of Division B of the building code (Ontario Regulation 350/06) made under the building Code Act, 1992, shall be provided to all residential buildings and 150mm diameter for all non-residential buildings. Double sanitary service laterals are not permitted unless authorized by the Director of Engineering. Larger building connections shall be

provided when additional capacity is required to accommodate larger buildings. Service connections greater than 150 mm diameter shall be designed as a sewer main.

2.2.4.2 Grade

Building sewers and service connections shall be laid at a minimum grade of 1% from the building line to the main sewer, however the recommended grade shall be 2%. The maximum grade shall be 8%. Common services will not be allowed.

2.2.4.3 Depth

The minimum cover for sanitary services at the structure will normally be of 1.8m from finished grade. Services of less than 1.8 m may be permitted on a case- by-case basis. In such cases frost protection must be equivalent to 1.8m of cover. Services with less than 1.0m of cover are not permitted.

Service risers from main sewers buried more than 4.0m (13ft) should be taken off at an angle not less than 45° from vertical, moved to the vertical by an appropriate elbow and the vertical section provided with a slide fitting. Alternatively, where the main sewer depth is greater than 4.0m, the use of a shallow “local” collector sewer could be considered with service connections made to the shallow sewer.

2.2.4.4 Clearances

Wherever possible, the construction practices outlined in **Section 2.2.3.10** Clearance Between Pipes should be applied to sanitary sewer and water connections.

Service laterals should be designed to provide a minimum of 300 mm clearance below the basement floor elevation of the structure being serviced.

2.2.4.5 Cleanouts

All sanitary services shall be equipped with a cleanout at property line.

2.2.4.6 Connections

Service connections to the main sewer should be made using factory made tees or wyes, strap-on-saddles or other approved saddles. Factory made tees or wyes should be used for all service connections where the diameter of the main pipe sewer is less than 450mm (NPS-18) or less than twice the diameter of the service connection.

Holes cut in the main sewer pipe must be done with an approved cutting devices and should be the minimum diameter required to fit the connection device. The pip shall not be subjected to impact by any means, mechanical or manual. These service connections must be plugged at the property line for required pressure tests. Plugs or caps should be braced sufficiently to withstand hydrostatic or air test pressure.

Building sewers and service connections connected to sewer mains larger than the service size may use a premanufactured tee connection rotated between 22 ½ degrees and 45 degrees to the horizontal. Service laterals shall be installed with no more than the equivalent of two 45-degree bends from the structure to the lot line. Where a 90-degree bend is required, a “long radius” bend shall be used.

Service connections may be connected directly to maintenance holes provided the installation is completed in accordance with all benching, drop structure, and maintenance hole requirements. Direct connections to the mains are encouraged instead of manholes.

Building sewers from adjacent properties shall not be connected to each other.

Unconnected sanitary and other drain services shall be brought to the property line, properly capped and clearly marked such that an installer will not cross-connect services. Capped services shall be appropriately marked to at least 1.0m above finished grade level.

Pumped service connections shall have pump chambers located on the exterior of the buildings and measures in place to alert the homeowners in the event of a pump malfunction.

Corrugated metal pipe couplings shall be five (5) corrugations wide and one (1) gauge lighter than that of the pipe. For outfall sewers on steep grades, the couplings shall be nine (9) corrugations wide, and the pipe shall be anchored with concrete blocks. All joints on sanitary laterals shall be of watertight design. Joints shall be rubber gasket such as “Ring Tite” or “Simplex” of approved manufacture.

Sanitary services shall not be connected to a storm main.

2.2.4.7 Connection Materials

Reference should be made to the Ontario Provincial Standard Specification for acceptable materials for services.

2.2.5 Foundation Drains

No foundation drains or building storm drains are permitted to be connected to the sanitary sewer system.

2.2.6 Sanitary Maintenance Holes

2.2.6.1 General

Precast maintenance hole sections shall comply with A.S.T.M. Specification C-478 with rubber gasket joints to A.S.T.M. Specification C-443.

All maintenance holes constructed shall be set to the temporary road grades and then raised when final roadway construction is carried out.

Where a change in pipe size occurs, the obverts of the upstream and downstream pipes through a manhole shall match unless the required drop in benching through the manhole results in the downstream pipe obvert being lower.

The OPSD’s provide details for maintenance holes up to certain maximum depths. The engineer shall analyze individually each application of the standards related to soil conditions, loading, and other pertinent factors, to determine structural suitability. In all cases where the standards are not applicable, maintenance holes shall be individually designed and detailed. When any dimension of a maintenance hole exceeds those indicated on the OPSD’s, the maintenance hole shall be individually designed and detailed.

For maintenance hole installation refer to OPSS 407.

A circular asphalt collar with a minimum 1.0m width and 50mm depth shall be installed around maintenance holes located in gravel areas.

Sampling maintenance holes shall be installed on a case-by-case basis at the request of the City Engineer.

2.2.6.2 Maintenance Hole Material

All maintenance holes shall conform to OPSD Division 700 standards and shall be constructed of precast concrete as detailed on the standard drawings. Manhole lift holes and grade adjustment rings should be sealed with non-shrinking mortar.

All maintenance holes shall be reinforced precast concrete and conform to CSA A257.4, unless otherwise approved to be cast in place.

Maintenance Hole Bases − Precast or cast-in-place bases may be used for maintenance holes up to 9 m deep. Maintenance holes greater than 9 m shall be designed by a Professional Engineer.

Concrete used in maintenance holes shall be air entrained in accordance with CAN/CSA A23.1.

2.2.6.3 Pipe Connections

A flexible joint should be provided on all pipes, within 0.3m of the outside wall of the manhole. Concrete bedding to solid ground mat be used as an alternate approach.

2.2.6.4 Water Tightness

Inlet and outlet pipes should be joined to the manhole with a gasketed flexible watertight connection that allows differential settlement of the pipe and manhole wall to take place.

Generally, maintenance holes should be installed in locations where flooding will not occur. In the event potential flooding could be experienced, watertight covers shall be used. Where significant sections of sewers are provided with watertight maintenance holes, extended vents may be required for the sewer system to prevent excessive sulphide generation.

All maintenance holes located on easements in parks, playgrounds, low areas, or in other locations as deemed necessary, shall be equipped with a locking watertight frame and grate.

2.2.6.5 Diameter

The minimum maintenance hole diameter shall be 1200mm (48in); larger diameters are preferable for large diameter sewers. A minimum access diameter of 610mm (24in) should be provided.

The maximum pipe sizes for precast concrete maintenance holes shall be based on manufacturers' standards.

The OPSD type and size of maintenance hole shall be specified on the profile and a detail of the benching is to be shown on the plan portion of the engineering drawing for cases when the benching differs from the OPSD standard.

2.2.6.6 Maintenance Hole Steps

Maintenance hole steps should be 400mm (16 in) aluminium or galvanized rungs and should be provided at a spacing of 300 to 400mm (12 to 16 in).

2.2.6.7 Safety Chains

Safety chains should be provided on the downstream side of manholes for sewers larger than 1200mm (NPS-48) in diameter.

2.2.6.8 Location and Spacing

Maintenance holes shall be provided at the end of each line, at all changes in alignment, grade, or size, and at all intersections (except curvilinear sewers).

Cleanouts may be used only for special conditions and shall not be substituted for manholes nor installed at the ends of laterals greater than 45m in length.

Maintenance holes shall be spaced at a maximum of 90m for pipe sizes up to 1200mm diameter, and a maximum of 110m for pipe sizes over 1200mm diameter.

2.2.6.9 Drop Connection

If a drop in a maintenance hole is 600 mm (24 in) or greater, a drop pipe shall be provided. Where the difference in elevation between the incoming sewer and manhole invert is less than 600mm (24 in) the invert should be filleted to prevent the deposition of solids. Details of such shall be included on the construction drawings and be acceptable to the Engineering Division. Whenever feasible, sewer systems shall be designed to avoid the use of drop structures.

Drop maintenance holes should be constructed with an outside drop connection. The entire outside drop connection shall be encased in concrete to prevent the unequal earth pressure that would results from the backfilling operation around the maintenance hole. If necessary, inside drop connections should be secured to the interior wall of the maintenance hole and provide access for cleaning.

Where future connections are likely to be made to a maintenance hole, a 1.25m length of pipe of proper size shall be installed in the maintenance hole and sealed with a standard plug.

2.2.6.10 Safety Platform

All maintenance holes exceeding 5.0m in depth must have a safety platform and shall not be more than 5.0m apart as per OPSD 404.020 and OPSD 404.021, OPSS 407 and OPSS 1351. Safety landings should be provided in accordance with Ontario Regulation 632/05 – Confined Spaces.

2.2.6.11 Hydraulic Losses

The obverts of all pipes flowing into maintenance holes shall never be below the obvert of the pipe flowing out of the maintenance hole. The extra fall through maintenance holes over the slope of the sewer shall be in accordance with **Table 10** below. This extra drop compensates for the energy loss resulting from the alignment change and ensures positive and continuous flow in and out of the manhole.

Table 10: Additional Maintenance Hole Drop

Alignment Change	Drop Required
Straight run	2% or 25mm (whichever is larger)
0 – 55 degrees	2% or 30mm (whichever is larger)
55 – 90 degrees	4% or 75mm (whichever is larger)
Junctions and Transitions	Physical Modelling Recommended

*Note: angles are taken from centerline of benching

Although the needed invert drops for the above hydraulic losses will be adequate for sewers with flows at the low end of the acceptable velocity range, the required drops should be specifically calculated for high velocity sewers.

2.2.6.12 Channel and Benching

All maintenance holes shall be benched as per OPSD 701.021. A bench should be provided on each side of any manhole channel when the pipe diameter is less than the manhole diameter. The bench should be sloped no less than 40mm/m (1/2 in per foot or 4%). No lateral sewer, service connection, or drop manhole pipe should discharge onto the surface of the bench. Refer to **Table 11** below for benching height requirement above outlet pipe invert.

Table 11: Benching Height above Outlet Pipe Invert (lowest benching shall govern)

Pipe Diameter	Benching Required
Up to 250 mm inclusive	0.5 pipe diameter
300 mm	175 mm

350 mm & 375 mm	0.5 pipe dia. + 50 mm*
400 mm to 600 mm inclusive	0.5 pipe dia. + 75 mm*
Greater than 700 mm	0.5 pipe dia. + 100 mm*

*Note: Channel benching above the 0.5 pipe diameter point shall be vertical

The flow channel through the maintenance hole should be made to closely conform in shape and size to those of the connecting sewers. The channel walls should be formed or shaped to the full height of the crown of the outlet sewer in such a manner to not obstruct maintenance, inspection, or flow in the sewers.

When curved flow channels are specified in manholes, including branch inlets, minimum slopes indicated in **Table 7 Section 2.2.3.3** should be increased to maintain acceptable velocities.

2.2.6.13 Frost and Corrosion Protection

Steel strapping shall be specified on all precast maintenance holes. Refer to OPSD 701.100.

Frost straps shall be provided to hold pre-cast manhole sections together. In areas where the freezing index is greater than 500 freezing degree days Celsius, pre-cast manholes/chambers should have three steel straps extending vertically from top to bottom and held by bolts in the top and bottom sections.

When the design freezing index equals or exceeds 1800 freezing degree days Celsius, an additional granular water draining layer at least 0.3m (12in) thick shall surround the manhole.

In the laying out of gravity sanitary sewers in areas where frost depth penetrations are great and/or other adverse conditions exist, the designer should consider alternate routing of the sewers (i.e., off the traveled/plowed portion of the road).

Where corrosive conditions due to septicity or other causes are anticipated, corrosion protection on the interior of the manholes should be provided.

2.3 Figures

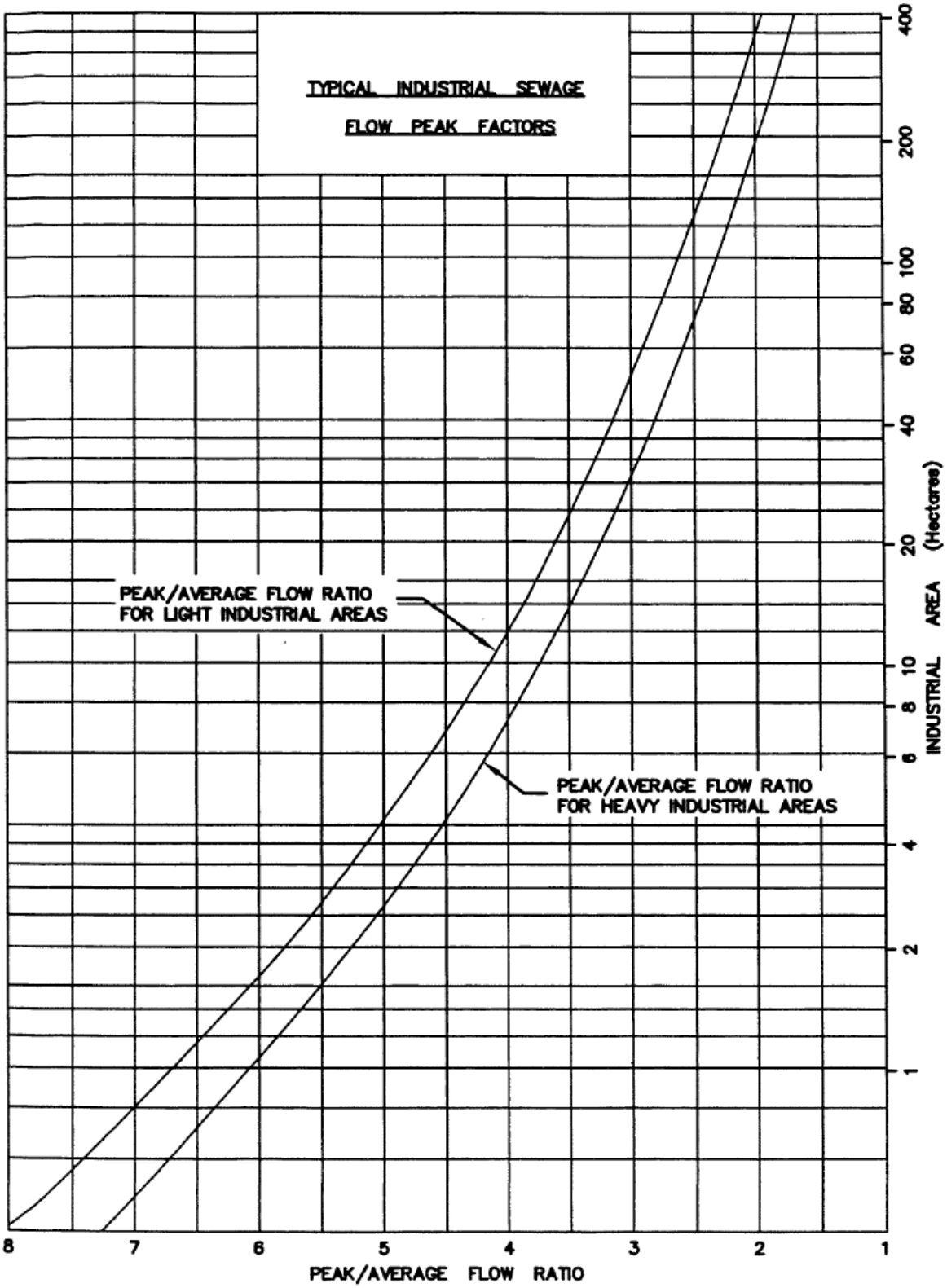


Figure 1: Typical Industrial Sewage Flow Peak Factors

Sanitary Sewer Design Sheet

q = average daily per capita flow (_L/cap.d)
I = unit of peak extraneous flow (_L/ha. s)
M = peaking factor
Q (p) = Peak population flow (L/s)
Q (I) = Peak extraneous flow (L/s)
Q (d) = Peak design flow

$$M = \frac{14}{4\sqrt{P}}$$

$$Q(p) = \frac{PqM}{86.4} \quad (L/s)$$

Q ((i)) = 1A (L/s; Q ((I)) = 1A (L/s) where A = area in hectares
Q (d) = Q(p) + Q Q (d) = Q(p) + Q (i) (L/s)

Location			Individual		Cumu		Peaking	Pop.	Peak	Peak	Length	Pipe	Type of	Capacity	Full Flow	Actual
Street	From	To	Pop	Area A Hectares	Pop	Area A (Hectares)	Factor M	Flow Q(I)	Extraneous Flow Q (i) (L/s)	Design Flow Q(d) (L/s)	(m)	Size mm	Pipe		velocity (m/s)	velocity Q (d)

Design		Project		Sheet	
Checked					
Date				of	

Figure 2: Sanitary Sewer Design Sheet

3. STORMWATER MANAGEMENT SYSTEM

3.1 General

For planning purposes, conceptual analysis of the storm sewer system (minor and major components of drainage) shall be undertaken in discussion with the City of Sault Ste Marie at the draft plan stage. The drainage and storm sewer system shall be designed to standards established by the City of Sault Ste. Marie described herein. In situations not covered by the enclosed standards and specifications, the following documents must be referenced:

- Municipal Works Design Manual
- Ministry of the Environment, Conservation, and Parks (MECP) Design Guidelines for Sewage Works (2023), and
- Latest revision of the MECP's Stormwater Management Planning and Design Manual (SWMP Manual)
- Ontario Provincial Standard Drawings and Specifications.

The design of the works shall follow the appropriate watershed, sub-watershed, and master drainage plans, as applicable.

In recognition of diverse development conditions, consideration will be given by the City to all innovative approaches and/or techniques that can be demonstrated to meet the required stormwater management objectives.

New development with a total site area greater than 2,500m^2 and less than 5ha, shall be required to implement a privately owned and maintained S.W.M facility for water quality control. All industrial, commercial, and institutional developments and redevelopments shall be required to implement a privately owned and maintained S.W.M. facility.

Infill and redevelopment sites with a total site area greater than 2,500m^2 and less than 5ha, shall be required to implement a privately owned and maintained oil/grit separator for water quality control.

3.2 Responsibilities

3.2.1 Approvals

City of Sault Ste. Marie approval is required on all storm sewer, drainage, and stormwater management systems. Additional approvals may be required but are not limited to the following list of agencies: MECP, MTO, MNRF, DFO, the Sault Ste. Marie Conservation Authority (SSMRCA), and Transport Canada. The proponent of the works shall ensure that all pertinent regulatory agencies are consulted during the design phase of the project.

3.2.2 Lot Grading

At the Building Permit Stage, prior to the issuance of a building permit, for lots developed under a Plan of Subdivision, Plan of Condominium, or Consent to Sever through the Committee of Adjustment, and for all developments subject to a Planning Division Agreement, lot specific grading plans showing the proposed lot grades and house location complete with setback dimensions to each lot line is required. This plan will show how the grading is in compliance with the overall Subdivision/Condominium/Lot grading plan. The lot grading plan shall be prepared and submitted in accordance with **Section 8.**

Natural drainage patterns and channels must be respected. Landowners must accommodate runoff from up gradient properties. Surface runoff water shall not be discharged onto adjacent lands in a concentrated amount, nor shall it exceed the pre-development flows.

All major swales and major system outlets are to be constructed and sodded by the Developer in conjunction with site servicing. While lot grading is generally the responsibility of the building permit applicant, common drainage facilities, as noted in the Subdivision Agreement, are the responsibility of the Developer.

3.3 Planning for Stormwater Management

Prior to initiating the design of drainage infrastructure, a consultation meeting with the Engineering and Planning Department is required to review the proposed stormwater management plans, assess the potential impact of these plans, understand the design approach (conventional or unconventional), and to review the approval process. The need for in-ground stormwater infrastructure and measures to control stormwater quality and quantity should be assessed considering both the incremental and total effects of changes in development on the drainage basin.

It is important that subdivision planning and the design of urban SWM practices are undertaken in an integrated process to ensure that an environmentally responsible planning process is implemented. The recommended strategy for stormwater management is to provide an approach to water management that is premised on controlling pollution at the source. The hierarchy of preferred SWM practices are:

- Stormwater lot level controls.
- Stormwater conveyance controls; and
- End of pipe Stormwater Management facilities.

Stormwater management shall be planned and designed in accordance with the Sault Ste Marie Stormwater Investigative Study, **Appendix K.**

3.4 Quantity Control

Controlling the quantity of stormwater implies reductions in the total volume and/or the rate of runoff. Control of the rate of runoff (peak stormwater flow) from areas of new development will be required. For all development, peak post-development flows should not exceed pre-development flows for all storm events up to and including the 100-year return period design storm and the Timmins Storm, at the discretion of the Director of Engineering.

Specific methods of stormwater quantity control are addressed in the following sections. Various methods of stormwater quantity control can also be found in the MECP's "Stormwater Management Planning and Design Manual" 2003.

For the purposes of quantity control, a hydrologic/hydraulic model is required to compare pre-development and post-development site runoff and stormwater management quantity control facilities. The rational method shall not be used as the sole method of analysis for designing these facilities. A list of acceptable analysis methods are provided in **Table 12** below.

Table 12: Stormwater Management Models - Acceptable Uses

Model/Method Type	Acceptable Usage
Rational Method	Instantaneous peak runoff <= 20 hectares. Not to be used for the design of storage retention facilities.
SCS Method	Peak flows and volume for rural areas, hydrologic impacts of urbanization, evaluate performance of storage facilities.
USEPA, SWMM, OTTSWMM Models	Design of stormwater systems for new developments especially areas > 20 hectares. Design of attenuation ponds. Assessment of hydraulic performance of drainage infrastructure under surcharge conditions.
HYMO, OTTHYMO	New development, storage calculations, and stream channel routing.
STORM	Checking stormwater system designs.
MIDUSS	Design of conveyance and detention facilities.

3.4.1 Flow Controls

Acceptable flow controls for storage areas (SWM ponds, parking lot storage, etc.) include culverts, weirs, orifices (pipes and plates), or any combination thereof.

Inlet control should not always be assumed on storage area outlet pipes.

Orifice plates are permitted provided the orifice plate is stainless steel, permanent, tamper-proof, and connects to a 300 mm minimum diameter outlet pipe.

The minimum orifice size shall be 75mm.

3.5 Quality Control

The City of Sault Ste. Marie expects developers to consider the “treatment train” approach when developing plans for stormwater management. The treatment train approach involves a series of structural and non-structural water quality management measures aimed at minimizing stormwater pollution wherever possible through appropriate reductions of pollutants at their source, during transit, and, if necessary, in receiving waters. Controlling stormwater pollution at its source includes controls on construction site runoff, better land use practices, reduced lot grading, the construction of litter traps, and on-site detention with rain barrels or infiltration trenches. Stormwater contaminants at the source can be minimized if a large percentage of the area being developed is kept vegetated or is re-vegetated quickly during and after construction.

Floatable pollutants such as oil, debris, and scum can be reduced with separator structures. Other methods of pollutant removal include sedimentation/settling, filtration, plant uptake, ion exchange, adsorption, and bacterial decomposition. Within these processes, there are generally three levels of treatment:

- Primary treatment including screening of gross pollutants, sedimentation of coarse particles;
- Secondary treatment including sedimentation of fine particulates, filtration; and,
- Tertiary treatment including enhanced sedimentation and filtration, biological uptake.

Pollutants in urban stormwater typically includes suspended solids (e.g., sand, silt); metals (e.g., copper, lead, and zinc); nutrients (e.g., nitrogen and phosphorous); bacteria and viruses; and organics (e.g.,

petroleum hydrocarbons and pesticides). The water quality parameters that are addressed in the City of Sault Ste. Marie Sewer Use By-law (By-law No. 2009-50) are provided in **Table 13** below. They are amended from time to time and they indicate the limits for Storm Sewer Discharge.

Table 13: Limits for Storm Sewer Discharges

Parameter	Limit (mg/L)	Parameter	Limit (mg/L)
Biochemical Oxygen Demand	15.0	1, 2-Dichloraobenzene	0.0056
Cyanide (Total)	0.02	1, 4-Dichlorobenzene	0.0068
Phenolics (4AAP)	0.008	Cis-1,2-Dichloroethylene	0.0056
Phosphorous (Total)	0.4	Trans-1, 3-Dichloropropylene	0.0056
Suspended Solids (Total)	15.0	Ethyl benzene	0.002
Oil & Grease – Mineral & Synthetic	15.0	Methylene chloride	0.0052
Aluminum (Total)	1.0	1, 1, 2, 2 - Tetrachloroethane	0.017
Ammonia	10.0	Tetrachloroethane	0.0044
Arsenic (Total)	0.02	Toluene	0.002
Barium (Total)	1.0	Trichloroethylene	0.0076
Cadmium (Total)	0.008	Xylenes (Total)	0.0044
Chlorine (Free)	0.1	Di-n-butyl phthalate	0.015
Chromium (Total)	0.08	Bis (2-ethylhexyl) phthalate	0.0088
Chromium (Hexavalent)	0.04	Nonylphenol	0.001
Copper (Total)	0.04	Nonylphenol ethoxylates	0.01
Lead (Total)	0.12	Aldrin/dieldrin	0.00008
Manganese (Total)	0.05	Chlordane	0.04
Mercury (Total)	0.0004	DDT	0.00004
Nickel (Total)	0.08	Hexachlorobenzene	0.00004
Selenium (Total)	0.02	Mirex	0.04
Silver (Total)	0.12	PCBs	0.0004
Tin (Total)	1.0	3, 3’ – Dichlorobenzidine	0.0008
Zinc (Total)	0.04	Hexachlorocyclohexane	0.04
Benzene	0.002	Pentachlorophenol	0.002
Chloroform	0.002	Total PAHs	0.002

3.5.1 Total Suspended Solids

Total Suspended Solids (TSS) has been selected by the city as a surrogate for the above water quality parameters as sediment is also a carrier of trace metals and toxicants associated with stormwater runoff.

The City of Sault Ste. Marie TSS removal requirements shall be defined on a case-by-case basis in consultation with both the city of Sault Ste Marie and the Sault Ste Marie Regional Conservation Authority (SSMRCA). The MOE provides “Level of Protection” for stormwater quality facilities as provided below:

Basic protection corresponds to the end-of-pipe storage volumes required for the long-term average removal of 60% of suspended solids.

Normal protection corresponds to the end-of-pipe storage volumes required for the long-term average removal of 70% of suspended solids.

Enhanced protection corresponds to the end-of-pipe storage volumes required for the long-term average removal of 80% of suspended solids.

The level of protection by geographic area within Sault Ste Marie are shown in the City of Sault Ste Marie Stormwater Investigative Study, Appendix K, Plan 1 – Stormwater Management Requirements.

Particle size distribution and settling velocities influence TSS removal efficiencies. Settling velocities are not linearly related to particle sizes. Particle size distribution varies depending on site use and storm events. **Table 14** below shows the typical stormwater particle size distribution and settling velocities. This table should be used when there is no data supporting particle size distribution and settling velocities.

Table 14: Typical Stormwater Particle Size Distribution and Settling Velocities

Particle Size Fraction [µm]	Percent By Mass [%]	Average Settling Velocities [m/s]
≤20µm	0-20	0.00000254
20µm ≤ x ≤ 40µm	20-30	0.00001300
40µm ≤ x ≤ 60µm	30-40	0.00002540
60µm ≤ x ≤ 130µm	40-60	0.00012700
130µm ≤ x ≤ 400µm	60-80	0.00059267
400µm ≤ x ≤ 4000µm	80-100	0.00550333

Developments that have less than 10% imperviousness should be exempt from stormwater management. This type of development would be typical of Estate Lot developments. In this type of development, the Engineer is to consider controls at any areas of concentrated runoff such as level spreaders or buffer strips.

3.6 Key Considerations

3.6.1 Upstream Effects

The process of planning for stormwater management should consider the entire upstream drainage area including basin characteristics (size, vegetation, land use planning and topography), runoff conditions (the rate and amount of runoff, and water quality), existing and future development and actual and proposed alterations to natural drainage patterns. Future development drainage areas characteristics should be consistent with zoning or the Official Plan land uses. Care should be taken not to assume an inlet time and time of flow for these undeveloped lands unless very short times of flow are assumed.

The design of drainage infrastructure within the City of Sault Ste. Marie should conform to this policy unless a separate Watershed Study has been completed and approved by the Director of Engineering.

3.6.2 Downstream Effects

The drainage facilities (both minor and major system components) for each new development shall be adequately sized to drain onsite runoff and convey estimated future runoff from upstream areas that have traditionally drained through a property. All drainage infrastructure shall be contained within the property boundaries of each development. Concentrated stormwater runoff leaving a development site must be discharged directly into an existing storm sewer (minor system) or into a well-defined, natural, or constructed channel (as part of the major system). The downstream stormwater drainage system shall have adequate capacity to convey the discharge from the proposed new stormwater drainage system. Designers shall confirm that the downstream capacities are not exceeded (see **Section 8**).

The potential for adverse downstream impact, such as flooding or erosion, because of an increased rate of discharge or increased runoff volume, shall be considered by the Engineer. New developments shall not result in an increase in peak flows. The extent of these impacts, if any, will be assessed by the Engineer. Depending upon the nature of any adverse impacts, the City of Sault Ste. Marie's Public Works and Engineering Division may require measures to prevent or alleviate such adverse impacts.

3.6.2.1 Discharges to Existing Drainage Infrastructure

New development shall not result in an increase in peak flows for all storm events up to and including the peak runoff from a storm event with a 100-year return period and the Timmins Storm. However, if a proposed development is expected to increase stormwater runoff to an existing drainage system, the existing system needs to be completely analyzed to ensure that the system will convey the additional flows without problems. Prior to making submission, the proponent must consult with the City and the SSMRCA to determine the specific technical analyses that will be required to support higher site release flows.

For each component of the stormwater drainage system (such as a storm sewer, open channel, watercourse, or culvert), the hydraulic capacity of that portion of the system needs to be determined and compared to the flow determined from the hydrologic calculations. To determine the capacity of open channels, ditches, and watercourses, the Manning equation may be used where grades are greater than 1%, considering the runoff from the major storm event at appropriate points. Where grades are less than 1%, it may be necessary to account for backwater effects using the energy equation and the direct-step or standard-step methodologies. The water surface elevation at the outlet of the ditch, watercourse, or channel should be determined. To calculate the hydraulic capacity of a culvert, both inlet control and outlet control must be checked.

The conveyance capacity of the minor storm sewer system should be checked for the 10-year return period storm. Analysis should account for pipe friction losses, junction and bend losses, and transition losses through maintenance holes, outlet tail water elevation, and capacity constraints of the downstream system. The hydraulic grade line (HGL), as determined by the standard-step method, the direct-step method, or acceptable energy equation principles, should be plotted on the profile drawing to ensure that the water surface profile is contained in the pipe, there is no back-up into service laterals or basements, and that no surcharging of the minor storm sewer system will occur during the 10-year return period design flow subject to the extent of downstream constraints.

3.6.2.2 Discharges to Stormwater Control Facilities

The design of a stormwater storage facility required as part of a new development shall be carried out using appropriate methods and sound engineering principles. To check the performance of a stormwater attenuation pond, a hydrograph shall be generated considering all design storms including the Regulatory (Regional) storm and the 1 – hour AES distribution for 2, 5, 10, 25, 50 and 100-year return periods applied to the watershed. Consideration should also be given to using the Chicago storm distribution (4-hour duration) for the 2, 5, 10, 25, 50 and 100-year return periods for fast draining urban sites. The design shall take into consideration various factors including, but not limited to, watercourse protection, erosion, and sediment control, impact on adjacent property, maintenance requirements, public safety, access, liability, and nuisance. Such storage facilities shall be designed to control the peak runoff conditions for the 100 year and regional storm.

Where new drainage infrastructure discharges to existing stormwater control facilities (such as attenuation ponds) it will be necessary to determine the inlet and outlet hydrographs of the stormwater control facilities. The use of simple instantaneous peak flow will not be adequate to analyze storage facilities. The inflow and outflow at this pond shall be calculated, taking into consideration the outlet structure design parameters. The maximum flood elevation shall be calculated as part of this work. Downstream capacities shall be checked to properly convey any control facilities' overflows.

3.6.2.3 Discharges to Adjacent Properties

No stormwater drainage is to flow onto, through, or over private property, other than by a natural watercourse, excavated ditch or swale, minor stormwater drainage system, with an agreement as necessary. Natural drainage may flow onto a neighbouring property if the cross-property boundary discharge existed in the pre-development condition. If the cross-property boundary discharge did not exist pre-development, directed drainage may not flow onto a neighbouring property without permission from the

receiving property owners. Proposed drainage is not to adversely impact natural drainage or impact neighbouring properties (i.e. natural drainage may not be "cut-off" and the construction of hydraulic controls may not cause off-property flooding). Runoff from a property may be directed to a natural watercourse, or to a municipal stormwater drainage system, with approval. The grading along the limits of a property shall be carefully controlled to avoid disturbance of adjacent properties or an increase in the discharge of stormwater to those properties. Temporary drainage of all blocks of land within multiple-parcel properties that are intended for future development should be considered. During the design of stormwater drainage systems, provision must be made to accommodate natural drainage from adjacent properties by means of an interceptor swale or other system component. Where a drainage channel to service one property is to be constructed on an adjacent property, written permission from the adjacent property owner(s) for such construction shall be required. A copy of the document which grants said approval shall be submitted to the Engineering and Planning Department and the SSMRCA.

3.6.2.4 Stormwater Drainage Blocks

For access to stormwater drainage systems, a municipal service block of adequate width shall be deeded to the City of Sault Ste. Marie when a need to accommodate future upstream drainage is identified to ensure proper functioning of the stormwater drainage system of a development. Generally, a municipal block will be required for stormwater conveyance from a development onto adjacent properties other than in a natural watercourse. Service blocks may be required for both the minor and major stormwater drainage systems. No development or placement of fences, barriers and the like shall be permitted on any block unless otherwise approved by the Director of Engineering.

The minimum width of a block for stormwater pipe shall allow safe access to excavate the minor system components in accordance with the requirements of the Occupational Health and Safety Act (OHSA) for the Province of Ontario, or 6.0m, whichever is greater. Depending upon the length and location of the block, the City may require a travel way to be provided within the block for access and maintenance purposes.

Drainage blocks for open channels shall be of sufficient width to contain the open channel, with the top of banks one meter or more within the Block. If the design flow for the open channel exceeds 1.0 m^3/s, the Block shall include a 4.0-m wide maintenance access road on one side of the channel. Turning room for vehicles operating on the service road should be provided at 250m intervals.

Where a development is traversed by a natural channel or stream, a drainage block conforming substantially to the limits of such a watercourse at flood stage may be required by the Director of Engineering. Generally, no development should encroach upon a watercourse so that its flow conveyance is reduced. A hydrotechnical study by a qualified professional engineer will be required prior to changes in dimensions or alignment of a stream and shall be reviewed by the City and the SSMRCA. It should be noted that buffers or other requirements may be required through the review processes of the City, SSMRCA, MNR or DFO.

The minimum municipally owned land area for an attenuation pond shall include the area of the pond for the required storage volume plus freeboard, the area required for associated facilities and maintenance access around the entire perimeter of the pond, and the storage of drainage material.

3.6.3 Fluvial Flooding

Fluvial flooding of low-lying areas at rivers and streams occurs due to upstream snow and ice melt. Fluvial flooding should be considered with respect to development and land use within the City of Sault Ste. Marie, and with respect to the design of stormwater systems.

Flood risk mapping and inundation mapping is available from the City of Sault Ste Marie and the SSMRCA for parts of Sault Ste. Marie and should be consulted and fully considered prior to any design.

Where development is proposed adjacent to a watercourse and where flood plain mapping is not available, suitable hydraulic calculations and/or modelling may be required at the discretion of the Director of Engineering.

3.6.4 Dedication for Water Courses

Where a subdivision or condominium is traversed by a watercourse, drainage way, channel or stream, a stormwater separation, right-of-way, or park dedication, whichever the Planning Division may deem the most appropriate, will be required, including a buffer corridor that conforms to the lines of such watercourses, should be also provided.

3.6.4.1 Vegetative Buffers

The purposes served for vegetative buffers include bank and shoreline stabilization; erosion prevention; filtration of nutrients, sediments, and other pollutants from storm flows; protection of stream beds and banks and mitigation of downstream flooding through moderation of peak flows both into and within the resource; regulation of in-stream temperatures; preservation of aquatic and terrestrial habitat; protection of scenic resources; and maintenance of property values.

- Protected stream buffers with a minimum width of fifteen (15) meters, as measured from the top of bank is required.
- Before any disturbance of ground vegetation or contour, or placement of any structure on the ground, a declaration, separation, or other instrument acceptable to the city must be implemented; and,
- The buffer should be indicated by either permanent, flush to the ground markers or permanent, post markers at the buffer's upland edge, with a design and text approved by the City.

The following activities are prohibited within a stream buffer:

- Creating impervious cover;
- Excavation or placing fill or debris;
- Altering vegetation, such as mowing, landscaping, and applying fertilizer except for as approved in writing by the City; and
- The removal of invasive species or trees for disease control or re-vegetation.

3.6.5 Wetland Inundation and Source Control

New development shall not increase the bounce (fluctuation) in water level or duration of inundation beyond the specified limits during storm events. These limits apply to 24-hour storms with return periods of 2-, 10-, and 100-years, and are enforced for any downstream wetland within 300 meters of the development site. **Table 15** below outlines the maximum allowable bounce and inundation periods based on the wetlands susceptibility classification, ensuring that stormwater impacts remain consistent with the existing natural conditions.

Table 15: Bounce Inundation Period Standards

Wetland Susceptibility Class	Permitted Storm Bounce	Inundation Period for 2-Yr Event	Inundation Period for 10-and 100 Yr-Event
Highly Susceptible	Existing	Existing	Existing
Moderately Susceptible	Existing plus 0.15m	Existing plus 1 day	Existing plus 7 days
Slightly susceptible	Existing plus 0.3m	Existing plus 2 days	Existing plus 14 days
Least susceptible	No limit	Existing plus 7 days	Existing plus 21 days

*Note: Wetland susceptibility classification is determined based on wetland type:

Highly susceptible wetland types include sedge meadows, bogs, coniferous bogs, open bogs, fens, coniferous swamps, lowland hardwood forests, and seasonally flooded basins.

Moderately susceptible wetland types include shrub-carrs, alder thickets, fresh (wet) meadows, and shallow & deep marshes.

Slightly susceptible wetland types include floodplain forests and fresh wet meadows, or shallow marshes dominated by invasive species.

Least susceptible wetland includes severely degraded wetlands. Examples of this condition include cultivated hydric soils, dredge/fill disposal sites and some gravel pits.

3.6.6 Wetland Impacts

The following shall apply where wetland designated areas may be disturbed as a result of development (in addition to any other requirements from other approval authorities such as the SSMRCA, MNRF, etc.):

- Applicants must adequately explain and justify each individual area of wetland alteration in terms of impact avoidance and minimization alternatives considered.

3.6.6.1 Wetland Replacement

Wetland Replacement must be located within the watershed and as close as possible to the site of impact. Qualifying City or Provincial impacts may be mitigated outside the watershed. However, the balance of replacement, required below, must be located within the watershed.

Full replacement of all wetland functions is required at the ratios directed by the SSMRCA.

3.6.6.2 Eligible Replacement Activities & Priorities

The following activities, listed in order of priority, are eligible for replacement credit. Applicants must first consider replacement of unavoidable impacts by restoring or, if wetland restoration opportunities are not reasonably available, creating replacement wetland areas having equal or greater function. Restoration and creation activities eligible for replacement credit include:

- Restoration of completely drained or filled wetland areas.
- Restoration of partially drained or filled wetland areas;
- Upland buffer areas (established or preserved).
- Vegetative restoration of farmed wetlands; and,
- Wetland creations.

If the above activities are not reasonably available to satisfy the entire replacement required, the following additional activities, where they protect or improve the functions of wetlands, should be considered for replacement:

- Protection of high-quality upland.
- Protection of landlocked basins.
- Protection and restoration of corridor connections; and,
- Those activities preserving wetland functions are eligible for 25% replacement credit on an area basis. Those activities restoring and preserving wetland functions are eligible for 50% replacement credit on an area basis.

3.6.7 Cold Water Streams

When a stormwater management facility discharges to a cold-water stream, either via a directly connected (i.e. storm sewer) system or within 30m via grassed or naturally vegetated conveyance path, the facility should be designed such that the discharge from the project will minimize any increase in the temperature of cold-water stream receiving waters resulting from the 2-year, 24-hour precipitation, SCS Type II event. Projects that discharge to cold water streams must minimize the impact using one or more of the following measures, in order of preference:

- Minimize new impervious surfaces.
- Minimize the discharge from connected impervious surfaces by discharging to vegetated areas, or grass swales, and through the use of other non-structural controls;
- Infiltration or other volume reduction practices to reduce runoff in excess of pre- settlement conditions (up to the two (2) year 24-hour precipitation, SCS Type I event);
- If ponding is used, the design must include an appropriate combination of measures such as shading, filtered bottom withdrawal, vegetated swale discharges or constructed wetland treatment cells that will limit temperature increases. The pond should be designed to draw down in 24-hours or less; and
- Other methods, as approved by the City, which will minimize any increase in the temperature of the cold-water stream.

3.6.8 Sault Ste. Marie Regional Conservation Authority Regulated Areas

Storm sewers, outfall structures and any required site grading located within the approximate area of the Sault Ste. Marie Regional Conservation Authority (SSMRCA) will require a permit from the SSMRCA under the Conservation Authorities Act, and O.Reg 176/06 Regulation of Development, Interference with Wetlands and Altercations to Shorelines and Watercourses. It is noted that the approximate regulated area will include: all watercourse and adjacent lands; all Provincially Significant Wetlands and 120-meter adjacent areas; fifteen (15) meters landward and two (2) kilometers lakeward from the 100-year Lake Superior flood level; ravines, valleys, steep slopes and talus slopes; hazardous lands including unstable soil and bedrock, and all land zoned Environment Protection.

3.7 Design Approach

3.7.1 Dual Drainage System

The Dual Drainage System consists of minor and major stormwater drainage systems. Minor stormwater drainage systems consist of underground pipes and associated structures designed to transport flows for low-intensity more frequent storm events. Major stormwater drainage systems provide an overland flow route which will be followed by the storm sewer water when the capacity of the minor system is exceeded (high-intensity, less frequent storm events). All areas of new development within the City of Sault Ste. Marie shall be designed using the Dual Drainage System (minor/major systems). The design of the dual stormwater drainage system shall be carried out to ensure that no proposed or existing structure shall be damaged by the runoff generated by a major storm event. This requires proper design of streets, curb and gutters, catch basins, pipes, open channels, grading of lots and road profiles, setting of elevations and openings to buildings, foundation drains, roof drains, or other “off-street’ connections. Design of the dual stormwater drainage system shall be based on the state of development anticipated to exist for both the area being developed (e.g. the limits of the development) and the upstream watershed areas, when all areas are completely developed in accordance with the land-use zoning in place at the time of design. Peak post-development flows are not to exceed the pre-development flows for all storms up to and including the major design storm event (the 100-year return period storm) and the Timmins Storm.

3.7.1.1 Minor System

The minor stormwater drainage system includes the underground pipe network, maintenance holes, outfalls, roof drains, lot drainage, and drain tiles. The minor system can contain public infrastructure (sewer piping and catch basins) and private infrastructure (drain tile and roof drains). The minor stormwater drainage system is designed to provide a basic level of service that ensures safe and convenient use of streets, lot areas, and other areas. In Sault Ste. Marie the minor system is to be designed to convey runoff produced by a 10-year return period storm event without surcharging. Surcharging of the minor system can be prevented by either increasing the capacity of minor system components, or (following approval of the Engineering and Planning Department) reducing the magnitude of the flow entering the minor system by directing more flow towards the major (overland) stormwater drainage system. Detailed requirements and specifications associated with the design and construction of the minor system are presented in **Section 3.10.**

3.7.1.2 Major System

The major stormwater drainage system conveys runoff that exceeds the conveyance capacity of the minor system. The overland flow of stormwater during major storm events (return period of 100 years and the Timmins Regional Storm) is preferable via public roadways, City blocks or trails. The major system must be designed to these storms. This helps protect structures and reduce property damage. Components of the major system typically include overland flow pathways (including drainage channels and floodwater diversion channels), streets, swales, stormwater detention and retention ponds, outfalls, and culverts. Drainage pathways for major events will always exist whether planned or not, but proper planning of a major system will reduce or eliminate unnecessary flooding and associated damages. The use of utility rights-of-way as part of the major system may be acceptable subject to the approval of the Director of Engineering and Planning and the utility owner. Detailed requirements and specifications associated with the design and construction of the major system are presented in **Section 3.11.**

3.8 Basis of Design

3.8.1 Hydraulics

Manning's Equation shall be used for the design of gravity sewers and open channels. The Mannings equation is as follows:

$$V = \frac{1}{n} \cdot R^{\frac{2}{3}} \cdot S_o^{\frac{1}{2}}$$

*Where, V = mean velocity [m/s], n = roughness coefficient [unitless] (see **Table 16**), R = hydraulic radius [m] =* $\frac{area\ of\ liquid}{wetted\ perimeter}$*, S_o = slope of energy line [m/m] (slope of invert for gravity flow)*

Using the continuity principle:

$$Q = A \cdot V$$

Therefore,

$$Q = \frac{1}{n} \cdot A \cdot R^{\frac{2}{3}} \cdot S_o^{1/2}$$

Where, Q = Flow [m^3/s], A = cross sectional area of liquid [m^2]

Manning's "n" roughness coefficients for common pipe surfaces are shown below in **Table 16.**

Table 16: Mannings Roughness Coefficients

Type of Pipe	Roughness Coefficient (n)
Smooth wall	0.013
Corrugated metal (Plain)	0.025
Concrete or asbestos cement	0.013
PVC	0.013
Polyethylene	0.013

In designing a storm sewer system, the designer shall:

- Establish the boundaries of the specific area to be serviced
- Obtain mapping as required
- Break the area into smaller sub areas based on drainage (tributary areas)
- Determine the existing and proposed land use
- Determine a design allowance for infiltration.

After the proposed sewer routing is established and the necessary profiles obtained, the designer will proceed to calculate sewer pipe sizes and grade.

The downstream system must have sufficient capacity to accommodate the proposed development. During the pre-consultation meeting, the City will inform the developer of any downstream capacity issues and verify if a downstream capacity analysis is required.

Sewer flow rates are to be designed to standards established by the City of Sault Ste. Marie described herein. In situations not covered by the enclosed standards and specifications, the MECP Design Guidelines for Sewage Works shall be used.

No decrease in downstream pipe size shall be allowed unless otherwise approved by the Director of Engineering.

Digital sewer design sheets must be submitted as part of the Functional Stormwater Management Plan in accordance with **Section 8.1.1.**

All sewers shall be designed and constructed so that surcharging above the pipe obvert from backwater conditions does not occur.

In the event the surcharging under backwater conditions is deemed minor in the opinion of the Director of Engineering and mitigating measures are not required to eliminate such surcharging, the following conditions shall be complied with:

- The surcharging shall not extend into any lateral connection past the property line served by the sewer; and
- Hydraulic grade line calculations shall be provided, and a hydraulic grade line shall be shown on the engineering drawings to illustrate the loss of energy along the pipeline.

3.8.2 Return Periods

Return period (or recurrence interval) is the average time between occurrences of an event with a given magnitude, e.g. a 10-year return period flood means that a flood with a similar or larger magnitude would occur once every ten years, given a long period and assuming hydro-climatic conditions do not change. The return period is based on past records, in the case of Sault Ste. Marie from 1962-2006. Probability is the inverse of return period; e.g. a 10-year storm event has a 10% chance of occurring in any year. The choice of a return period for the design of drainage infrastructure depends on what is considered to be an acceptable risk to property and public safety, and the desired level of service.

Design storm return periods for different systems and scenarios are provided **Table 17** below.

Table 17: Design of Systems Based on Storm Frequencies

System Type or Area Type	Frequency
SWM Control Facilities	100 yr and Timmins Storm
Minor System: Existing drainage infrastructure	10 yr
Major System	100 yr and Timmins Storm
Local Streets	10 yr
Trunk/ Collector	10 yr
Arterial Roads	10 yr
Commercial Area	10 yr
New Development	Minor = 10 yr Major = 100 yr
Re-development	Minor = 10 yr Major = Consult City of Sault Ste Marie Engineering Department
Infiltration trenches	10 yr

3.8.3 Meteorological Data and Rainfall Intensity

Design storms can be generated from Intensity Duration Frequency (IDF) Curves derived from the IDF Curve Lookup – Ministry of Transportation. Rainfall data is used in a variety of forms including Intensity-Duration-Frequency (IDF) Curves, synthetic design storms, historical design storms, and historical long-term rainfall records. Data selection depends upon the type of computational procedure to be used, the type of problem to be solved and the level of analysis required.

Advanced procedures for the design of stormwater drainage systems require the input of rainfall hyetographs, which specify rainfall intensities for successive time increments during a storm event. For this purpose, both synthetic and historical design storm hyetographs can be used.

For a discussion of rainfall intensity curves, reference should be made to the Manual of Practice on Urban Drainage and the Municipal Works Design Manual.

3.8.4 Synthetic and Regional Design Storms

Information regarding Synthetic and Regional Design Storms can be found in Appendix K, Section 5.2.3 and 5.2.4 of the Sault Ste Marie Stormwater Investigative Study Final Report.

3.8.5 State of Development

Design of the dual stormwater drainage system shall be based on the state of development anticipated to exist for both the area being developed (e.g. the limits of the development) and the upstream watershed areas, when all areas are completely developed in accordance with the land-use zoning in place at the time of design. Peak post-development flows are not to exceed the pre-development flows for all storms up to and including the major design storm event (the 100-year return period storm) and the Timmins Storm.

3.9 Runoff Methodology

There are numerous techniques and models available to the Engineer for use in the determination of stormwater runoff. Selection of an appropriate method must be based on an understanding of the principles

and assumptions underlying the method and of the problem under consideration. It is, therefore, essential that appropriate techniques and models be selected and used by qualified engineers.

The Engineering and Planning Department considers the RATIONAL METHOD as generally acceptable for the determination of instantaneous peak runoff for the design of stormwater management systems up to 20 hectares (0.2km^2) in area, for preliminary design of systems serving larger areas, and as a check on flows determined by other methods. This method should NOT be used to determine the size or hydraulic performance of storage or retention facilities (i.e. ponds, tanks, or other volume sensitive infrastructure).

The SCS METHODS as described in the United States Soil Conservation Service (US SCS) Technical Report No. 20 and No. 55 may be used to determine peak flow and volume for rural areas, to determine the hydrologic impacts of urbanization, and to evaluate the performance of storage facilities.

For the design of stormwater management facilities, a UNIT HYDROGRAPH program such as PCSWMM, the HYMO (Hydrologic Model) and the University of Ottawa Version OTTHYMO, the Storage-Treatment-Overflow-Runoff Model (STORM), the Microcomputer Interactive Design of Urban Stormwater Systems (MIDUSS), or other suitable techniques shall be used to calculate the flows. This allows for detailed modelling of catchments, and analysis of flow routing, storage, water quality, and LID implementation.

3.9.1 Time of Concentration (T_c) and Lag Time (T_l)

The Rational Method and the US SCS curve number-based simulation models require the estimation of the time of concentration (T_c), which is defined as the time required for surface runoff from the far end of a sewer shed to reach the sewer shed outlet, and the lag time (T_l), which is defined as the time between the peak rainfall and the peak runoff flow. For minor system drainage design, the time of concentration or lag time should include inlet time (time associated with overland flow) and travel time (time associated with flow through sewer pipes).

Inlet times can be established by adding the overland flow and gutter flow times for typical inlets. These flow times can be obtained from **Figures 3 and 4 in Section 3.14**, respectively. Other commonly used methods for the determination of inlet time (time associated with overland flow) can be found in Appendix K, Section 5.4.3 of the Sault Ste Marie Stormwater Investigative Study Final Report.

The estimated inlet time should not be less than five (5) minutes. For the Rational Method (described below) Sault Ste Marie typically uses an initial time of concentration of ten (10) minutes for single family residential developments using a design storm with a 10-year return period. This results in an initial rainfall intensity of approximately 102mm/hr.

3.9.2 Rational Method

3.9.2.1 Methodology

For the Rational Method, the peak rate of runoff is assumed to occur at a rainfall duration equal to the time of concentration T_c. The peak rate of runoff at each inlet in a storm sewer is determined using the Rational Method. The rate of runoff is determined using a total time of concentration T_c to that point in the system, which may include overland flow time to an upstream inlet and travel time from that inlet through the storm sewer system to a given point in that system. For the first length in a storm sewer, the time of concentration is equal the inlet time and is used to obtain the rainfall intensity from the rainfall intensity duration frequency (IDF) curve. This rainfall intensity is subsequently used in the rational formula to determine the run-off rate to be used in the design of the first length of storm sewer.

For the second and subsequent lengths of sewer, the rate of runoff is determined using the total time of concentration to that point in the system, which includes the time to flow to the upstream inlet and the associated travel time from that inlet through the storm sewer system to a given point in the system. After

the peak rate of runoff arriving at each inlet has been established, the storm drain conduits can be designed to carry this discharge.

Inlet times should ideally be calculated (see **Figures 3 and 4 in Section 3.14**), rather than relying upon arbitrary times. This calculation, however, must be based upon the overland flow route which will exist when the sewer has been developed to the drainage limit.

When using the "Rational Method" of calculating flows the following formula shall be used:

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

*Where Q (L/s) = Peak Flow, A(hectares) = Area, I(mm/hr) = Rainfall Intensity, R = Runoff Co-efficient (**Table 18**)*

3.9.2.2 Drainage Area

The designer must determine the drainage areas contributing to the storm sewer system.

The storm sewers shall be designed to drain all the watershed area, fringe areas not provided for in adjacent storm drainage areas and other areas which may become tributary as a result of re-grading. Information on the drainage areas to be included in the design may be obtained from the available topographical information and from the Engineering Division.

When plans for a storm sewer are submitted for approval, a print of the general plan of the subdivision marked to show the drainage areas and the storm sewer design sheets shall also be submitted. The storm sewer plans are to be submitted in accordance with **Section 8.**

The storm sewer must terminate at the subdivision boundary where outside drainage areas are considered in the design.

3.9.2.3 Runoff Coefficient

The run-off coefficient is a ratio of the amount of rainwater which will be carried away by the storm sewer to the total rainfall.

Typical runoff coefficients (“C” values/ “R” values) are provided in **Table 18** below**.** Where there are mixed land uses or where the impervious and pervious areas are known for a site, a weighted runoff coefficient should be calculated. If the desired land use is not provided in **Table 18** below, runoff coefficients for urban and rural areas may be used from Design Chart 1.07 of the MTO Drainage Management Manual. The designer shall use sound engineering principles to determine and justify the selected coefficient.

Table 18: Stormwater Runoff Coefficients

Land-use Type	Runoff Coefficient
Asphalt, concrete, roof areas	0.9
Granular Material	0.6
Grassed area, parklands	0.2
Commercial	0.7 – 0.8
Industrial	0.5 – 0.8
Single family housing (lot size >= 400 m^2)	0.3 – 0.4
Single family housing (lot size <= 400 m^2)	0.3 – 0.5
Semi-detached housing	0.4 – 0.7
Row housing, Town housing	0.6 – 0.8
Apartments	0.5 – 0.7
Institutional	0.5 – 0.7

Playgrounds	0.2 – 0.3
Area of building and parking lots	0.9
Remainder of Lot if Lawns	0.25
Railroad yard	0.2 – 0.35
Unimproved	0.1 – 0.3

These minimum values must be increased to accommodate the hydrologic effects of steeply sloped areas, longer duration events, and return periods greater than 10 years to account for antecedent precipitation. For urban areas, the values of the runoff coefficient may be increased for the high magnitude storms under urban conditions. For the 25, 50 and 100-year events, it is recommended to increase the coefficient by 10, 20 and 25% respectively up to a maximum value of 0.95. (MTO Drainage Management Manual Chapter 8, Page 19). The MTO further notes that no adjustments are recommended for rural drainage areas.

The engineer shall use proper engineering judgement when selecting an appropriate value from within the coefficient range.

3.9.3 US SCS Curve Number Method

The SCS Curve Numbers methods are described in the United States Soil Conservation Service (US SCS) Technical Report. This report categorizes soils into one of four Hydrologic Soil Groups (HSG) contingent upon its surface infiltration rate, and subsurface permeability. These numbers can be found in Appendix K, Section 5.4.2 of the Sault Ste Marie Stormwater Investigative Study Final Report.

3.10 Minor Drainage System Requirements

3.10.1 Storm Sewers

3.10.1.1 Hydrotechnical Considerations

The capacity of a proposed storm sewer system or an existing storm sewer system shall be checked by accounting for the head loss through the pipe system and through any junctions including maintenance holes and bends. As a preliminary check on the capacity of a piped storm system, the Manning's equation can be used. This will be particularly useful for preliminary sizing of pipes; however, a more detailed analysis of the system as a whole will be required.

This more detailed analysis will determine the hydraulic grade line (HGL) when the storm system is conveying the 10-year return period flows, and will take into account losses at maintenance holes, other junctions, transition maintenance holes, the head loss through the pipes, and any backwater conditions at the outlets of the minor drainage system.

Contingent upon the results of the HGL analysis, the Engineer shall revise as necessary the storm sewer design (e.g. diameter, slope, invert elevations, etc.).

The flow should be subcritical with no backwater adversely affecting upstream properties.

To help mitigate the potential that the minor drainage system is not surcharged to a degree that could result in flooding of property when the system is subjected to flows greater than its design capacity (i.e. major storm events), it is required that the Engineer check the individual and total inlet capacity for the entire system, at the discretion of the Director of Engineering and Planning.

This analysis may determine that during a major storm flows greater than a 10-year return period storm will enter the storm sewer system and, if there is evidence it will, then the Engineer will need to specify control measures (such as inlet control devices (ICDs) or limits on the surcharging of catch basin grates) in order

to limit the quantity of stormwater runoff entering the minor drainage system, at the discretion of the Director of Engineering and Planning.

3.10.1.2 Depth of Cover

Ideally, storm sewers shall be deep enough such that all service connections accommodating surface and foundation drainage from upstream lots can be drained to the storm sewer system by gravity.

The minimum depth of cover of storm sewers, measured from the design grade of the finished surface to the top of the pipe, is 1.5m. Where this minimum cover cannot be provided, an explanation of the reasons and pipe loading calculations shall be submitted with the proposed method of pipe protection (insulation thickness and details, or frost tapers) to the Director of Engineering.

The maximum depth of storm sewer, measured from the design grade of the finished surface to the top of the pipe, is 4.0m. Under special conditions, if justifiable reasons are given, the maximum depth of storm sewers may be increased with approval of the Director of Engineering.

3.10.1.3 Location

Wherever possible, all storm sewers and appurtenances shall be located within the street right-of-way or block of land owned by the City. Sewers shall be located 3.0m South or West of the centreline of the right-of-way. All storm drainage outfalls shall be located within land owned by the City.

Where Master Planning indicates a need to accommodate future upstream lands naturally tributary to the drainage area, a municipal block of land shall be provided from the edge of the street right-of-way to the upstream limit of the subdivision.

The storm sewer shall be located on the road allowance as shown on the standard drawings included in this manual or as otherwise authorized by the Director of Engineering.

3.10.1.4 Pipe Sizes

The minimum storm sewer pipe sizes shall be as provided in **Table 19** below**.** Storm sewer diameter must not decrease in the downstream direction.

Table 19: Minimum Storm Sewer Pipe Sizes

Type of Storm Sewer	Minimum Pipe Size
Storm Sewer Main	300 mm
Single Catch Basin Lead (road)	250 mm
Rear Yard Catch Basin Lead	300 mm
Double Catch Basin Lead	300 mm
Foundation and building drains	150 mm
Yard Catch Basin	150 mm
Building Connections	150 mm
Ditch Inlet Catch basin	300 mm
Radial Pipe	900 mm

3.10.1.5 Pipe Material

Storm sewers 300 to 700mm shall be PVC with an SDR of 35 or Ribbed polyvinyl chloride (P.V.C) pipe (CSA B182.4) or Sanitite HP dual walled (CSA B182.13) or reinforced concrete, Class 65-D.

Storm sewers 750 mm and over in diameter shall be reinforced concrete, Class 65-D or Ribbed polyvinyl chloride (P.V.C.) pipe (CSA B182.4) or Sanitite HP triple walled (CSA B182.13).

Pipe joints are to satisfy requirements with respect to leakage, durability, and performance throughout the life cycle of a storm sewer, which is generally considered to be 50 years or more. All pipe lines must meet leakage test requirements as set forth in the Ontario Provincial Standards, if required by the Director of Engineering and Planning.

3.10.1.6 Pipe Strength

Sewer pipes selected for any application should be able to withstand, with a margin of safety equal to 1.5, all the combinations of loading conditions to which it is likely to be exposed.

All pipes shall be clearly identified with the manufacturer's name and strength class or category.

Required pipe strength should be determined using the Marston and Spangler equations, or by nomograph method as published by the American Concrete Pipe Association for reinforced concrete pipe or the Uni-Bell PVC Pipe Association for PVC pipe.

Separate calculations for pipes of deeper bury may be required at the discretion of the Director of Engineering and Planning.

The strength class of each type of pipe required for the various depths of installation shall confirm with the manufacturer's recommendations.

The design and testing procedures used to calculate earth loading, superimposed loads, and supporting strength of the sewer pipe are covered in the pipe suppliers' catalogues or design manuals such as Water Pollution Control Federation or Design and Construction of Sanitary and Storm sewers.

Where poor ground conditions are expected, extra allowance should be made for the wider trenches that will result during excavation. Extra strength of pipe over that normally required shall be provided when the sewer is located in an easement.

3.10.1.7 Pipe Clearances

Minimum clearances between services shall be provided in accordance with MECP guidelines. See **Section 2.2.3.10**.

3.10.1.8 Design Grade and Velocity

All sewers shall be designed and constructed to give when flowing full, a minimum velocity of 0.60m/s (2 ft/s) and a maximum velocity of 6.0m/s (20 ft/s) unless otherwise authorized by the Director of Engineering.

The minimum pipe slope for permanent dead-end storm sewer mains is 0.5%. For other storm sewers lesser slopes are allowed if self-cleansing velocities under full flow conditions are maintained.

All sewers with slopes such that flow velocities will approach "critical velocity" shall be designed to reduce turbulence.

3.10.1.9 Pipe Bedding

The minimum bedding required for all sanitary sewers shall be Class "B" type and the type of bedding and class of pipe shall be noted on all plans. The excavation, backfilling, and installation procedures shall be in accordance with OPSS.PROV 401.

Pipe bedding shall be as detailed in OPSD Division 802. Bedding and cover shall conform to Granular "A" in accordance with OPSS.PROV 1010. For site specific bedding, embedment, and cover recommendations, the geotechnical report prepared for the project shall provide the class of bedding.

3.10.1.10 Extraneous Flows

The allowable infiltration/exfiltration for sewer pipe shall not exceed the values listed in **Table 20** below. Infiltration/exfiltration shall be measured in accordance with OPSS 410.

Table 20: Infiltration Allowance

Pipe Description	L/ha/s
New Pipe	0.174
Existing (Older than 1980)	1.0
Existing (Newer than 1980)	0.24

3.10.1.11 Additional Considerations for Sanitary Sewers

The soil conditions such as rock or high groundwater can significantly affect the cost of the sewers and, in some instances, contribute to extraneous flow problems. It may be advisable in such circumstances to design and construct the system such that gravity drainage is only provided for the first floor and up. In assessing such an alternative, it is essential that the following factors be considered:

- The presence or absence of basements in the existing dwellings;
- The extent of “finishing” in an existing basement;
- The presence or absence of fixtures in the basement; and
- The need for a solids handling sewage pump in the basement, should the basement contain fixtures.

In the laying out of gravity sanitary sewers in areas where frost depth penetrations are great and/or other adverse conditions exist, the designer should consider alternate routing of the sewers (i.e., off the traveled/plowed portion of the road).

3.10.1.12 Storm Sewer Design Sheet

When designing storm sewers, it is best to use a standard detail design sheet, similar to the example in **Figure 5 in Section 3.14.**

Storm sewers, in areas where flooding will cause an unacceptable barrier to access or in low lying areas susceptible to flooding, shall be designed for a higher return period at the discretion of the Engineering Division.

Surcharging may be permitted subject to the peak flow from a 50-year storm not surcharging into any connected building foundation drainage system. Where there is potential for basement flooding and/or at the discretion of the Director of Engineering, hydraulic grade line calculations shall be provided, and a hydraulic grade line shall be shown on the engineering drawings in accordance with **Section 8.**

3.10.2 Storm Service Connections

3.10.2.1 Grade

The storm sewer service connection shall be laid at a minimum grade of 2.0% to 3.0m beyond the limit of the street right-of-way.

3.10.2.2 Minimum Diameter

The minimum storm sewer service connection size shall be 150mm.

3.10.2.3 Depth

Storm service connections should be constructed to a depth of 1.5m below finished grade.

3.10.2.4 Location

For single residential lots, one storm sewer service connection is to be supplied to each existing lot or potential future lot which could be created under the zoning in effect at the time of approval by the City. For semi-detached lots, one storm sewer service connection is required for each side of the lot.

Storm sewer service connections shall be installed in a common trench with sanitary sewer service connections wherever possible.

At the discretion of the Director of Engineering, storm sewer connections for commercial, industrial and institutional properties shall require a manhole located on the property line for maintenance access and inspection purposes.

At the discretion of the Director of Engineering, semi-detached units may be serviced by way of a single 150mm storm sewer service connection with a wye connection at property line and shall include a cleanout and backwater prevention valves on each property.

Storm sewer connections are required to all commercial lots, apartment building and residential lots. Houses are to be equipped with sump pumps for weeping tile water so that storm sewer laterals need not be installed below the basement floor elevation.

For paved areas (i.e. service stations, apartment complexes, schools, etc.), private side stormwater connection facilities will be allowed provided the owner has a catch basin system.

Individual separate connections from the building to the sewer main shall be provided to all portions of buildings which may be held in separate ownership.

3.10.2.5 Material

The pipe material colour shall be white for storm.

Storm service connection material shall be in accordance with OPSS.MUNI 410.

Where the mainline pipe material is pressure pipe, the service material must be of similar material. Provide service pipe material transition at the property line using Fernco couplings or approved equals.

Storm sewer service connections shall be PVC DR28.

Any change in vertical or horizontal alignment of storm sewer service connections shall be made with a “long sweep” bend, PVC DR28.

Storm sewer service connections to concrete pipes, with all saddles secured in place with an appropriate seal to render the connection watertight, shall be one of the following:

- Multi-fitting PVC service saddle with two, one-piece stainless-steel straps and a solid lip protruding into the main by no more than 10 mm.
- Canron polypropylene service saddle with two, one-piece stainless-steel straps and a solid lip protruding into the main by no more than 10 mm.
- Appropriately specified Fowler Inserta-Tee.

Storm sewer service connections to PVC pipe, with all saddles secured in place with an appropriate seal to render the connection watertight, shall be one of the following:

- Multi-fitting PVC service saddle with two, one-piece stainless-steel straps and a solid lip protruding into the main by no more than 10 mm.
- Appropriately specified Fowler Inserta-Tee.
- Gasketed one-piece PVC Tee.
- DFW/HPI flexible rubber service saddle.

3.10.2.6 Cleanouts and Backwater Valves

All service connections shall have cleanouts installed at the property line. Backwater prevention valves are required within the building/facility being serviced.

3.10.3 Maintenance Holes

3.10.3.1 Location

A maintenance hole must be hydraulically designed wherever two or more incoming laterals greater than 750 mm in diameter enter a maintenance hole. The design should be done by a professional engineer with experience in stormwater sewer design.

A maintenance hole must be provided on a storm sewer at:

- Any change in diameter, material, horizontal alignment, or vertical alignment;
- Pipe intersections; and
- The upper end of a sewer for maintenance purposes.

Detail plans of manholes with large pipes at intersections will be required to show layout of pipes and benching.

Maintenance holes at non-permanent storm sewer terminations shall have a sewer stub that shall extend beyond the limit of development sufficient to allow excavation to the Ontario OHSA.

Maintenance holes shall ideally be located 3.0m South or West of the centre line of the road and generally 3.0m upstream or downstream of sanitary maintenance holes if they are paired.

Transitions in direction of sewer pipes are to be accomplished by means of maintenance holes, except in the case of curved sewers. Modifications to maintenance hole spacing may be required where sewers are curved.

3.10.3.2 Spacing

Manholes shall be placed at a distance not greater than 90m for all sewers up to 750mm in diameter. For diameters larger than 750mm, storm maintenance holes shall be spaced at distances not greater than 110m. **Table 21** below provides recommended maintenance hole spacing.

Table 21: Storm Sewer Maintenance Hole Spacing

Storm Sewer Diameter (mm)	Maintenance Hole Maximum Spacing (m)
250 to 750	90
> 750	110

3.10.3.3 Minimum Diameter

The minimum size of precast concrete maintenance hole is 1200mm (48in). A minimum access diameter of 610mm (24in) shall be provided. The Engineer shall ensure that the internal diameter is adequate to accommodate all pipe and appurtenances in accordance with manufacturer's recommendations.

3.10.3.4 Allowance for Structure Losses

The obverts of all pipes flowing into maintenance holes shall never be below the obvert of the pipe flowing out of the maintenance hole The additional drop requirements to maintain allowances for hydraulic losses at maintenance holes are provided in **Table 22** below. Incoming pipes should not be at an angle greater than 90 degrees.

Table 22: Additional Fall in Manhole for Various Pipe Bends

Alignment Change	Drop Required
Straight run	2% or 25mm (whichever is larger)
0 – 55 degrees	2% or 30mm (whichever is larger)
55 – 90 degrees	4% or 75mm (whichever is larger)

Note: angles are taken with respect to centerline of benching

3.10.3.5 Safety Ladders and Platforms

All maintenance holes exceeding 5.0m in depth must have a safety platform and shall not be more than 5.0m apart as per OPSD 404.020 and OPSD 404.021, OPSS 407, OPSS 1351, and OPSS 1850. Safety landings should be provided in accordance with Ontario Regulation 632/05 – Confined Spaces.

Safety appurtenances (ladders and rungs) must be in accordance with OPSD 404 to OPSD 406, as amended. Refer to OPSS 1850 for frames, grates, covers, and gratings.

3.10.3.6 Channels and Benching

The flow channel straight through a manhole should be made to conform as closely as possible in shape and slope to those of the connecting sewers. The channel walls should be formed or shaped to the full height of the crown of the outlet sewer in such a manner to not obstruct maintenance, inspection or flow in the sewers.

A bench should be provided on each side of any manhole channel when the pipe diameter is less than the manhole diameter. The bench should be sloped no less than 40 mm/m (½ inch per foot or 4 percent). No lateral sewer, service connection, or drop manhole pipe should discharge onto the surface of the bench. Refer to **Table 23** below for the benching required for various pipe sizes.

Table 23: Benching Required for Various Pipe Diameters

Pipe Diameter	Benching Required
Up to 250 mm inclusive	0.5 pipe diameter
300 mm	175 mm
350 mm & 375 mm	0.5 pipe dia. + 50 mm*
400 mm to 600 mm inclusive	0.5 pipe dia. + 75 mm*
Greater than 700 mm	0.5 pipe dia. + 100 mm*

*Note: benching higher than the 0.5 pipe diameter point shall be vertical

3.10.3.7 Frost and Corrosion Protection

Steel strapping shall be specified on all precast maintenance holes. Refer to OPSD 701.100.

Frost straps shall be provided to hold pre-cast manhole sections together. In areas where the freezing index is greater than 500 freezing degree days Celsius, pre-cast manholes/chambers should have three (3) steel straps extending vertically from top to bottom and held by bolts in the top and bottom sections.

When the design freezing index equals or exceeds 1800 freezing degree days Celsius, an additional granular water draining layer at least 0.3m (12in) thick shall surround the manhole.

In the laying out of gravity sanitary sewers in areas where frost depth penetrations are great and/or other adverse conditions exist, the designer should consider alternate routing of the sewers (i.e., off the traveled/plowed portion of the road).

Where corrosive conditions due to septicity or other causes are anticipated, corrosion protection the interior of the manholes should be provided.

3.10.3.8 Access

Maintenance hole steps should be 400mm (16in) aluminium or galvanized rungs and should be provided at a spacing of 300 to 400mm (12 to 16in).

Safety chains should be provided on the downstream side of manholes for sewers larger than 1200mm (48 in) diameter.

3.10.3.9 Water Tightness

All maintenance holes located on easements in parks, playgrounds, low areas, or in other locations as deemed necessary, shall be equipped with a locking frame and grate. Catch basin inlet lids Type B per OPSD 407 are permitted on storm manholes.

Inlet and outlet pipes should be joined to the manhole with a gasketed flexible watertight connection that allows differential settlement of the pipe and manhole wall to take place.

3.10.3.10 Materials

All maintenance holes shall conform to OPSD Division 700 standards and shall be constructed of precast concrete as detailed on the standard drawings. Manhole lift holes and grade adjustment rings should be sealed with non-shrinking mortar.

All storm maintenance holes shall be reinforced precast concrete and conform to CSA A257.4 unless approved by the Engineering Division to be cast in place.

Maintenance Hole Bases − Precast or cast-in-place bases may be used for maintenance holes up to 9m deep. Maintenance holes greater than 9m shall be designed by a Professional Engineer.

Concrete used in maintenance holes shall be air entrained in accordance with CAN/CSA A23.1.

3.10.3.11 Drop Connection

A drop pipe should be provided for a sewer entering a manhole at an elevation of 610mm (24in) or more above the manhole invert. Where the difference in elevation between the incoming sewer and manhole invert is less than 600mm (24in) the invert should be filleted to prevent the deposition of solids. Details of such shall be included on the construction drawings and be acceptable to the Engineering Division. Whenever feasible, sewer systems shall be designed to avoid the use of drop structures.

Drop maintenance holes should be constructed with an outside drop connection. The entire outside drop connection shall be encased in concrete to prevent the unequal earth pressure that would results from the

backfilling operation around the maintenance hole. If necessary, inside drop connections should be secured to the interior wall of the maintenance hole and provide access for cleaning.

Where future connections are likely to be made to a maintenance hole, a 1.25m length of pipe of proper size shall be installed in the maintenance hole and sealed with a standard plug.

Drop maintenance holes shall be in accordance with OPSD 1003 series of drawings.

3.10.3.12 Additional Manhole Considerations

For maintenance hole benching and pipe opening alternatives refer to OPSD 701.021. Refer to OPSD Division 700 for additional Maintenance Hole specifications and procedures.

Other manhole design considerations include:

- Use of a plastic film around the outside of the manhole to prevent bonding of the soil to the structure and damage from frost heaving;
- Use of manhole insulation, generally 75mm (3in) of polystyrene or urethane; and
- An insulated manhole cover to further reduce heat loss.

Junction maintenance hole calculations shall be required at locations where incoming and outgoing pipe velocities differ by more than 0.6 m/s.

3.10.4 Catch Basins

3.10.4.1 Hydrotechnical considerations

Catch basin leads should be graded so that the top of pipe is below the subgrade elevation and such that the pipe grade is maximized for future lot drainage systems.

The inlet capacity of each catch basin should be sufficient to receive the calculated surface stormwater flow at that location from storm events with a maximum return period of 10 years.

To limit the surcharging of the minor drainage system during a 10-year storm event, the inlet capacity of each catch basin should be restricted to limit the maximum inflow into the catch basin.

Catch basin manholes are permitted.

3.10.4.2 Dimensions and Layout

All catch basin bodies shall be precast concrete meeting OPSS 1351 unless otherwise approved.

Catch basins shall be constructed at all low points in the road grade, upstream of pedestrian crossings, not within 1.0m of a curb depression, and at the beginnings of corner curves at intersections to catch the water before it flows around the corner.

3.10.4.3 Location

Catch basins shall be installed at mid-lot locations to avoid conflict with driveway entrances and shall not be installed at locations which coincide with fire hydrant locations.

Catch basin frames and grates shall conform to OPSD Division 400.

For crowned roadways, catch basins shall be provided on both sides of the roadway.

Catch basins shall be provided along the roadway as set out in **Table 24** below.

Table 24: Maximum Catch Basin Spacing

Road Gradient (%)	Road Width (m)	Maximum Spacing (m)
0.35 – 0.5%	8.5	45
0.35 – 0.5%	15	40
0.6 – 3.0%	8.5	90
0.6 – 3.0%	15	70
3.1 – 5.0%	8.5	75
3.1 – 5.0%	15	55
5.1 – 6.0%	8.5	60
5.1 – 6.0%	15	45

Rear yard catch basins shall have a birdcage grate to OPSD 400.120 and shall accept water from a swale of less than 90m in length.

Catch basins shall be installed at the curb of the street and shall be adequately spaced to prevent excessive water from flowing in the traveled lanes during storm events corresponding to the design of the minor system.

3.10.4.4 Curb Inlet Catch Basins

The spacing of curb inlet catch basins located within roads having grades greater than 1% must be approved by the Director of Engineering and Planning.

Curb inlet type catch basins are the preferred type and shall be used on all bus route roadways.

Road low points are to have curb inlet catch basins.

3.10.4.5 Double Catch Basin

In instances where the road grades are greater than 6%, double catch basins shall be used at 60m spacing. They may also be used where there is a sag in the vertical alignment of the roadway.

Twin inlet (double) catch basins shall be placed prior to intersections when the road grade beyond the platform exceeds 4.5%.

3.10.4.6 Ditch Intake Catch Basins

Ditch intake catch basins shall have sloping grates.

3.10.4.7 Yard Catch Basins

Yard catch basins shall have a maximum drainage area of 0.25 hectares.

3.10.4.8 Depth

For depths up to 1.8m (between ground level and invert) catch basins shall be 600mm x 600mm, square, precast concrete conforming to OPSD 705.010. For depths greater than 1.8m, 1200mm catch basin maintenance holes shall be used conforming to OPSD's 701.010, and 704.010. For other catch basin configurations refer to OPSD Division 700.

3.10.4.9 Sump

All structures with a catch basin shall have a 600mm sump to trap silt and gravel. Catch basins which do not have a sump shall not be connected directly into the storm sewer system.

3.10.4.10 Connections

Catch basin leads shall connect to maintenance holes where possible.

The connection into each manhole shall be made so that the flow from the catch basin does not oppose the flow in the sewer.

For catch basin lead sizes refer to **Table 19** in **Section 3.10.1.4**.

3.10.4.11 Catch Basin Retrofit Policy

To address drainage concerns of privately owned occupied lands which are not subject to a current land development proposal, the following criteria shall be used to determine the need for installation of a publicly funded and maintained catch basin:

- Areas involving more than one lot which have historically been subject to repeated flooding which for topographical reasons cannot be resolved by filling or regrading.
- Areas involving public lands including open space, lanes, road allowances which for topographical reasons cannot be drained on surface and are impacting surrounding private lands to the extent that the City will incur liability.

Catch basins will not be installed by the city to correct flooding involving only a single lot. Such situations will require the lot owner to privately install and maintain the necessary catch basin and associated piping.

Prior to the installation of any catch basin and piping the landowner shall obtain all necessary approvals for the design and construction of the works from the Director of Engineering.

All catch basins and associated piping constructed on privately owned lands shall be placed on an easement. The width of any easement shall be 4.0m unless approved otherwise by the Director of Engineering.

Due to limitations on depth of bury of catch basin piping and accessibility limitations of catch basins, such facilities are subject to periods of time when they are inoperative resulting in temporary flooding. The City will not accept liability for the consequences of such flooding.

The decision to install any publicly funded and maintained catch basin(s) and associated piping shall be subject to available funding and priority at the discretion of the Director of Engineering.

3.10.5 Storm Sewer Gratings

All inlets to piped stormwater drainage systems shall be via a catch basin or grated pipe, preferably with an inlet structure.

The inlets and outlets of piped stormwater management sections which are accessible to the public should be provided with protective devices. At minimum, at inlets and outlets of pipes 450mm or larger, gratings shall be provided. The grating bars shall be spaced 150mm (6in) apart. For large inlet structures, inclined grating may be necessary to prevent water pressure from trapping a person against the grading.

The design of the inlet shall take into consideration the effect of the grating on restriction of flow into the pipe.

Inlet grates shall be constructed of vertically oriented bars. Outlet grates shall be constructed of horizontally oriented bars.

3.10.6 Storm Sewer Inlets

All inlets to piped stormwater drainage systems shall be via a catch basin or grated pipe, preferably with an inlet structure.

Storm sewer inlets larger than 450mm shall require a grate (see **Section 3.10.5**).

The design of the inlet shall take into consideration the effect of the grating on restriction of flow into the pipe.

All frames and grates shall conform to OPSD 400 series of drawings.

3.10.7 Storm Sewer Outfalls

Where the storm sewer empties into a natural watercourse, a headwall with footings four (4) feet (1.2m) deep must be provided along with grouted rip rap. The flow from the storm sewer must blend with the flow from the natural watercourse.

Outfalls from piped stormwater drainage systems of 450mm in diameter and larger shall require a headwall and grate to prevent entry unless otherwise approved by the Director of Engineering (see **Section 3.10.5**). The headwall and grate shall be as per OPSD 804.

Inverts of outfall pipes should be installed above the normal winter ice level in the receiving stream wherever possible.

The maximum outfall discharge velocity permitted is 4.0m/s. Erosion control measures are to be incorporated in the design of outfalls to prevent the uncontrolled scour of the receiving channel (See **Section 3.12.2** for rip rap design requirements).

New outfalls should have stormwater management facilities at the end of pipe or placed prior to out letting.

3.10.7.1 Storm Sewer Outfalls into St. Mary's River or Other Receiving Watercourse

Storm sewers and outfall structures discharging into the St. Mary's River or other receiving watercourse shall be designed in consultation with the Sault Ste. Marie Region Conservation Authority (SSMRCA). The storm sewers shall be designed to accommodate backwater effects from normal seasonal/annual fluctuations in water levels of Lake Superior and/or the floodways as well as fluctuations resulting from storm events.

3.11 Major Drainage System Requirements

3.11.1 Hydrotechnical Considerations

The 100-year return period storm and the Regional Storm (Timmins Storm) is to be used as the basis for design for all major storm drainage system components. To accommodate any effects of climate change on urban drainage, the city will re-evaluate the IDF chart periodically to include recent precipitation and intensity data. The design will use the most up to date IDF.

The design of the major system shall include measures to limit the degree of surcharging of the minor system during a major storm event. These measures may include inlet control devices and flow relief to the major system at the discretion of the Commissioner of Engineering and Planning. The degree of minor

system surcharging during major storm events shall be controlled so as to prevent flooding of buildings connected to the minor system.

3.11.2 Open Channels

The capacity of open channels should be carefully considered during design. The most widely used formula for determining the hydraulic capacity of open channels is the Manning Equation:

$$V = (R^{2/3} \times S^{1/2}) / n$$

where: V = mean velocity of flow, m/s, R = the hydraulic radius, defined as the area of flow, A (m^2) divided by the wetted flow surface or wetted perimeter P_w(m), S = the slope of hydraulic grade line, m/m, and n = Manning roughness coefficient

In terms of discharge, Q, the above formula becomes:

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

For determination of the flow conveyance of natural streams within the City of Sault Ste. Marie, the minimum Manning's coefficient shall be 0.025 for minor natural streams, and 0.030 for major rivers and flood plains. Values of 'n' more than these minimum values may be chosen from published values in textbooks on open channel hydraulics considering changes in cross sectional area and shape, vegetation, the irregularity of the channel surface, obstructions and channel alignments. A composite 'n' based on the values of 'n' for the stream and its flood plains should be determined if a large portion of stormwater flow during the major design storm will occur on the flood plains.

Storm inlets, outlets and areas of concentrated flow shall have erosion protection. It is recommended that an analysis of receiving channel or downstream drainage course conditions be assessed to determine the potential effects of post-development flows, water levels, and flow velocities on erosion. An analysis of erosion potential should be completed downstream to a point where the runoff from the upstream drainage area controlled by the pond represents only 10% of the total drainage area or to a creek, strea, or river.

3.11.3 Grassed Swales

3.11.3.1 Hydrotechnical Considerations

Grassed swales should be designed as open channels using the Manning Equation, using a Manning's coefficient of 0.030 or greater.

The minimum swale grade shall be 1%, and in special cases 0.5% with approval of the Director of Engineering and Planning

The maximum length of a rear yard swale to a suitable outlet shall be 90 metres.

3.11.3.2 Dimensions and Layout

A minimum bottom width of 0.3m should be maintained.

A minimum depth of 0.2m should be maintained.

Side slopes should be no greater than 3 horizontal to 1 vertical but ideally should be less than 4 horizontal to 1 vertical.

3.11.3.3 Location

Grassed swales are typically used in more rural areas with rolling or relatively flat land or for rear yard drainage as part of the lot grading process. Grassed swales can be considered as an enhancement to stormwater curb and gutter system but are not permissible as replacements for curb and gutter systems in commercial and residential areas.

Grassed swales should be considered for use at sites where contamination from suspended solids is possible.

Since many stormwater contaminant particulates are filtered by grassed swales, they should be considered for use at sites where contamination from suspended solids might occur. Grassed swales are not considered effective in filtering contaminants such as organic nitrogen, phosphorus, and bacteria.

3.11.3.4 Construction and Maintenance

Grass should be local species or standard turf grass where a more manicured appearance is required.

The grass should be allowed to grow higher than 75mm so that suspended solids can be filtered effectively.

3.11.4 Streets

3.11.4.1 Roadway Drainage

Provision shall be made to remove runoff from streets into drainage channels, watercourses, and pipe systems at low points and at intervals that will assure that ponding of stormwater on streets does not occur for long durations.

The maximum depth of stormwater flow on any street measured at the lowest gutter line shall not exceed 0.2m, with a maximum flow velocity of 2m/s.

For storms greater than the design storm of the minor drainage system (i.e. a storm event with a return period in excess of 10 years), streets shall be designed to temporarily convey flow as part of the major drainage system. The flow conveyance capacity of a street shall be determined using the Manning Equation, with a Manning's resistance coefficient of 0.013 (asphalt surface), 0.015 (concrete surface) and 0.030 (sod surface).

For storms up to and including the 10-year return period storm, the Engineer must consider that, for all roads, a traveled way of adequate width is maintained to ensure the safe passage of all vehicles in both directions.

For residential streets and local collector streets, the Engineer must ensure that during storms up to and including the major design storm (the 100-year return period storm), the depth and spread of flow does not exceed the curb height and does not exceed the right-of way width (see **Section 3.11.4.2**).

For major collector streets and arterial streets (emergency access routes), the Engineer must ensure that during storms up to and including the major design storm (the 100-year return period storm), a traveled way of adequate width is maintained to ensure the safe passage of vehicles in both directions.

3.11.4.2 Curbs and Gutter

A curb should confine the surface water from the roadway to the gutter, which transports water to inlets into the minor drainage system or the major drainage system.

Curbs and gutters are usually installed along city streets. The gutter should be hydraulically efficient with a smooth surface texture and a minimum grade of 0.3%. Gutter flow can be determined using a modified version of the Manning Equation:

$$Q = (0.375 \times S_o^{0.5} \times d^{2.667}) / (n \times S_x)$$

Where, Q (m^3/s) = the gutter flow, S_o (m/m) = the longitudinal slope, d(m) = the depth of flow at the curb, n = Manning's resistance coefficient, and S_x (m/m) = cross slope over the pavement area.

In applying the equation, allowance should be made for changes in the gutter cross section if the slope of the gutter is depressed near the curb.

The depth and spread of flow during the major design storm (the 100-year return period storm) and the Timmins Storm shall be contained within the right-of-way if the curb acts as a barrier or discharged from the right-of-way through municipal land designed to convey the overland flow if the curb can and is designed to be overtopped.

For storms with a magnitude less than or equal to the 10-year return period storm, roadways should remain free of water, except for water accumulated between inlets. The maximum spread of water across a street as measured from the curb should not exceed 3.0m or one half of the width of the traffic lane closest to the curb, whichever is less. The calculation of maximum stormwater spread should be based on a road crown of 2.0%, in accordance with the City of Sault Ste. Marie general specifications for road and street design.

Inlets along streets should also be provided at:

- Sag points in the gutter grade, upstream of major street intersections and pedestrian crosswalks, and along median barriers,
- Upstream and downstream of bridges, and
- Upstream of the starting point of a horizontal curve where there are major changes in cross (transverse) and longitudinal slope.

3.11.4.3 Roadway Ditches

Roadway ditches shall be designed as an open channel with maximum fore slopes of 2 horizontal to 1 vertical, and maximum back slopes of 3 horizontal to 1 vertical.

Ditches shall be designed with adequate capacity to carry the expected flow from either the minor storm (10-year storm) or major storm (the 100-year return period storm and Timmins Storm) based upon the use of the ditch.

The minimum grade of a roadside ditch shall be 0.5% unless otherwise approved by the Director of Public Works and Engineering.

The maximum grade of a roadside ditch shall be 8% or a maximum of 2.0m/s velocity in an unlined ditch.

The depth below finished centreline grade shall be:

- Maximum: 2.0m
- Minimum: 1.0m
- Minimum: 0.2m below the road subgrade level measured at the ditch.

The Maximum Permissible Velocity Method or the Maximum Permissible Tractive Force Method, in accordance with the design methods provided in Section 5 of the MTO Drainage Management Manual (1995), shall be used to determine if erosion control measures, such as riprap and geotextile, are required.

The minimum ditch protection shall be nursery sod covering, at a minimum along the bottom of the ditch and 0.6m up each side slope, and 100mm of imported topsoil and hydroseed on the balance of the side slopes. Subject to steep ditch gradients, the level of sodding (staked) will be reviewed by the Director of Engineering.

3.11.5 Culverts

3.11.5.1 Hydrotechnical Considerations

Culverts are to be sized to convey instantaneous peak flows with a headwater depth (HW) to culvert diameter (D) ratio of 1.0 accounting for both inlet control and outlet control.

All culverts under roadways are to be equipped with an inlet and outlet headwall, or some other form of embankment stabilization and erosion control approved by the City.

Culverts located under driveways and roadways are to be designed to accommodate the 10-year return period storm, unless otherwise directed by the Engineering Division. Culverts located in major drainage courses or natural watercourses are to be designed to accommodate the major design storm (the 100-year return period storm), and the Timmins Storm unless otherwise directed by the Director of Engineering.

Driveway culverts on arterial roads and in other locations where flooding will result in unacceptable damage or barrier to access shall require edge of driveway surface protection (concrete headwalls, rip rap, asphalt). The method of edge protection applied shall be reviewed and approved by the Director of Engineering prior to construction. Headwalls on driveway culverts are to be in accordance with Public Works and Engineering Standards.

The maximum culvert outlet velocity shall be 4.0m/s.

A riprap splash pad and apron or a plunge pool must be designed to transition the culvert outlet velocity to the maximum permissible mean downstream channel velocity. For rip rap sizing and design requirements refer to **Section 3.12.2.**

Notwithstanding the above guidelines, culverts are not to initiate or aggravate flooding of private or public property.

HY 8 Modeling shall be used, and a report provided, showing hydraulic grade lines and energy grade lines in accordance with **Section 8.**

3.11.5.2 Minimum Culvert Size

The minimum culvert size shall be as provided in **Table 25** below.

Table 25: Minimum Culvert Size

Culvert Usage	Minimum Diameter (mm)
Driveways	400
Roadways/ Crossing	600
Drainage Course or Natural Watercourse	600

No downstream decrease in culvert size is permitted.

3.11.5.3 Cover and Backfill

Minimum cover for culverts under roadways is 500mm. Polyethylene culverts require a minimum 600mm cover. Exceptions will be allowed with approval of the Director of Engineering.

The maximum culvert depth shall be 1.5m. The minimum culvert depth shall be 1.2m.

Road cross culverts shall meet OPSD Division 800.

The culverts must not be backfilled with slag which corrodes the metal. It shall be backfilled with sand (max. stone size 25mm), with clay or sod at both ends to protect the sand from erosion.

Frost tapers shall be in accordance with OPSD 803.010, 803.030, and 803.031.

The side slope of the driveway shall not be steeper than 3:1 and the culvert shall extend a minimum of 0.5m beyond the toe of slope.

Marker posts may be required to indicate the locations of the ends of the culverts as determined by the Director of Engineering.

All culverts shall be installed with an anti seepage collar with the exception of residual/commercial driveway culverts not designed to convey storms with return periods in excess of 25 years. Anti seepage collars shall be installed on the upstream end of the culvert at the nearest point of full depth of cover at a minimum. It is preferred to install an anti seepage collar on both upstream and downstream ends of the culverts. Anti seepage collars may be constructed either by clay or poly sheeting.

3.11.5.4 Culvert Materials

For culvert design, material shall consist of the following:

- Less than 900 mm diameter – concrete, CSP - poly-coated CSP, aluminized CSP;
- 900 mm to 1800 mm – poly-coated CSP, aluminized CSP, and concrete;
- Greater than 1800 mm – concrete box culverts only

3.11.5.5 Culvert Inlet and Outlet Grates

Culverts longer than 25m and smaller than 1.2m in diameter shall be equipped with inlet and outlet grates.

Under no circumstances shall a culvert be equipped with an outlet grate and no inlet grate.

Inlet grates shall be constructed of vertically oriented bars. Outlet grates shall be constructed of horizontally oriented bars.

Design and sizing of inlet and outlet grates must account for the restriction in flow created by the grate and blockage.

Placement of any grate shall be as per Ontario Provincial Standards (OPSS and OPSD).

3.11.5.6 Inlet and Outlet Headwalls

All culverts under roadways are to be equipped with an inlet and outlet headwall, or some other form of embankment stabilization and erosion control, approved by the City.

Headwalls on driveway culverts are to be in accordance with Public Works and Transportation Standards.

3.11.6 Foundation and Roof Drainage

The connection of roof drainage systems to a sanitary sewer system shall not be permitted as the hydraulic capacity of the sanitary sewers and downstream works is not adequate which increases the risk off surcharging.

Where lot sizes and surface conditions permit, it is preferable that roof drainage discharge directly onto the ground surface rather than connect directly to the storm sewer since this increases the possibility for surcharging. If approved by the Director of Engineering, foundation drains may be connected by gravity to the storm sewer, but the designer should then consider the following:

- The use of a higher return frequency in the design of the storm sewer;
- The construction of a deeper sewer with the depth of sewer being determined/checked hy the hydraulic grade line for surcharging conditions;
- Inlet controls or increased spacing of inlets to prevent water from gaining access to the sewers at a rate greater than the design storm.

Where a minor stormwater drainage system does not exist, other options are permitted as specified in the Ontario Building Code (OBC).

Roof drains from buildings with a roof area less than 250m^2 or from single family / semi-detached homes shall not be connected to storm drains but shall discharge onto splash pads at the ground surface a minimum of 600 mm from the foundation wall in a matter that will carry water away from the foundation wall.

Roof drains from buildings with a roof area equal to or larger than 250m^2 may be directly connected to a stormwater drainage system pending available system capacity (see above design considerations). To limit the surcharging of the minor drainage system during storm events with a return period of more than 10 years, the maximum discharge from roof drains should be restricted to the stormwater surface flow of a 10-year return period storm event.

Foundation drainage will normally be pumped or gravity fed to the minor stormwater drainage system to minimize the likelihood of basement flooding or foundation damage in accordance with the City Sewer Use By-Law as amended.

Foundation drains shall not be permitted to discharge to ground surface in such a way as to direct stormwater runoff to the street surface, curb, walkway, or adjacent private property.

Weeping tile and storm sump pumps shall not be connected to the sanitary sewer system. If a storm sewer service does not exist at the property line, the sump pump shall discharge to the ground surface. If pumped to the surface, runoff shall be contained onsite and prevented from draining across sidewalks.

3.12 Environmental Design Criteria

The environmental design criteria to be considered shall include water balance, water quality, in-stream erosion control/geomorphology, and water quantity.

3.12.1 Water Balance

The requirement for water balance calculations and groundwater recharge measures will be determined on a site-by-site basis in consultation with the Sault Ste Marie Engineering Department.

Water balance and groundwater requirements of other authorities having jurisdiction, specifically the Sault Ste. Marie Source Water Protection Committee, the Sault Ste. Marie Regional Conservation Authority, and

the Ministry of the Environment, Conservation, and Parks shall be confirmed, accounted for, and documented in a Functional Stormwater Management report in accordance with **Section 8.1.1.**

3.12.2 Rip Rap Requirements

Storm sewer and culvert outlets shall have riprap treatment in accordance with OPSD 810.010, Type B, with geotextile.

A rip rap splash pad and apron or a plunge pool must be designed to transition the outlet velocity to the maximum permissible mean downstream channel velocity. Rip rap should be sized in accordance with the following equation:

$$D_{mean} = 0.019 \times V^2$$

Where D_{mean} = equivalent spherical diameter of rip rap (m), V = culvert outlet velocity (m/s)

Rip Rap shall be made up of a graded mixture in such a way that 50% of the mixture by weight shall be larger than the D_{50} (median) size selected by the designer.

The largest size shall be 1.5 times the D_{50} size. The smallest size shall be approximately 100mm.

The minimum thickness of the rip rap layer shall be 1.5 times the maximum stone diameter but not less than 150mm.

For the design of riprap, **Table 26** below provides the diameter and weight relationships for angular shaped rock that shall be used. Assuming a rock density of 2400kg/m^3 (150lb/ft^3) and that the rock is cubic in shape, the dimension is approximately 10% less than the diameter specified. The stone distribution shall be as provided in **Table 27** below.

Table 26: Relationship Between Diameter and Weight for Angular Shaped Rocks

Diameter (mm)	Weight (kg)	Diameter (in)	Weight (lb)
50	0.25	2	0.5
100	2	4	4
150	7	6	15
200	16	8	35
250	34	10	75
300	50	12	110

Table 27: Riprap Stone Distribution

Size of Stone	Percent of Total Weight Smaller than the given size
3K	100
2K	80
K	50
0.1K	10

Note: K is the specified D_{50} weight.

Example: if a D_{50} rock = 200mm or 16kg is required, 10% of the rocks will weigh 1.6kg or less, 50% of the rocks should weigh 16kg or less, 80% of the rocks should weigh 32kg or less, and all the rocks should weigh less than 48kg.

Geotextile shall be placed under riprap in accordance with OPSS 511, shall conform to OPSS 1860, and shall be nonwoven, Class I, with a max filtration opening size (FOS) of 75-150µm.

3.12.3 Grouted Rip Rap

Where a storm sewer empties into a natural watercourse, a headwall with footings four feet deep must be provided along with grouted rip rap.

If the D_{mean} exceeds 300mm, the rip rap shall also be grouted.

3.12.4 Energy Dissipators

Only external energy dissipators permitted. Stilling basins are preferred.

Grout for stilling basins shall be minimum 10MPa with 5-8% entrained air.

3.12.5 Infiltration Trenches

This section is intended to provide general guidance on the use of infiltration trenches within the City of Sault Ste. Marie. Details regarding the design and use of infiltration trenches can be found in the MOE's "Stormwater Management Planning and Design Manual" (2003), and the City of Sault Ste Marie Storm Water Investigative Study, Appendix K.

3.12.5.1 Hydrotechnical Considerations

The design of an infiltration trench should be completed by a professional engineer with experience in stormwater management.

Infiltration trenches are used to improve quality of stormwater runoff by removing particulate and soluble pollutants.

Infiltration trenches and basins should reduce runoff volumes normally directed to the minor drainage system.

Infiltration trenches and basins should be designed to collect and temporarily store surface runoff and to promote subsequent infiltration, considering the volume of stormwater from a 10-year return period storm.

Infiltration basins should drain within 72 hours to maintain aerobic conditions (which favour bacteria that aid pollutant removal).

Infiltration trenches shall have a cleaning/excavation and disposal regimen established prior to implementation.

The use of infiltration galleries can be used for roof water providing soils parameters and distance from the building are properly engineered.

3.12.5.2 Location

Infiltration basins can be used as recharge devices for compact residential developments (less than 2 ha). Infiltration trenches differ from on-lot infiltration systems in that they are generally constructed to manage stormwater flow from a number of lots in a developed area, not a single property.

Infiltration trenches should only be used where the soil is porous and can absorb the required quantity of stormwater.

Potential contamination of groundwater should be considered when examining runoff quality directed to an infiltration trench or basin.

Infiltration trenches and basins are not recommended for use in commercial or industrial areas due to the potential for high contaminant loads or spills, resulting in groundwater contamination.

Infiltration trenches and basins should not be built under parking lots or other multiuse areas, within 2.0m (measured vertically) of bedrock, near a septic field, on fill material, where the underlying soils have a low percolation rate of less than 15mm/hour, or where runoff is likely to he highly polluted.

3.12.5.3 Construction and Maintenance

Only clear stone of appropriate diameter should be used in the construction of an infiltration trench.

Regular inspections and maintenance including the cleaning of inlets to prevent clogging is required to maintain proper operation, and to prevent the nuisances of insect infestations, odours, and soggy ground. A guide for maintenance procedures is available in the MOE's "Stormwater Management Planning and Design Manual" (2003) Chapter 6.0.

3.12.6 Buffer and Filter Strips

Buffer and filter strips are practical and low-cost measures that provide stormwater quality control. This section is intended to provide general guidance on the use of buffer and filter strips within the City of Sault Ste. Marie. Details regarding the design and use of buffer and filter strips can be found in the MOE's "Stormwater Management Planning and Design Manual" (2003).

Buffer and filter strips remove pollutants from overland runoff by means of filtration and infiltration due to dense vegetation.

Natural buffer strips should be maintained within 30m of the natural boundary of a wetland or the banks of a watercourse. Within the buffer strip, the land should not be disturbed, vegetation removed, soil removed, or materials deposited.

Filter strips are usually grass planted between a source area and a receiving watercourse to provide a degree of stormwater quality control. The filtering action of the vegetation, sediment deposition, and infiltration of pollutant-carrying water reduces pollution to watercourses from sediment, organic matter, and trace metals, but are not considered reliable for the removal of soluble pollutants. Filter strips are used primarily in residential areas around streams or ponds, where runoff does not tend to be heavily polluted.

Filter and buffer strips are used primarily in residential areas around streams or ponds, where runoff does not tend to be heavily polluted.

Filter and buffer strips should be considered ineffective for:

- Runoff velocities exceeding 0.75m/s
- Runoff that is not in the form of sheet flow
- Runoff volumes greater than that produced from a two (2)-hectare catchment during a 25-year return period, 24-hour duration storm.

The width of the filter strip should be determined considering topography, the characteristics of the upstream development, and the types of soil and vegetation at the site, with 10m considered the minimum practical width.

The maintenance of filter strips should be arranged during the design and construction of filter strips and as a critical component of stormwater quality control. Filter strips require periodic repair, such as re-seeding and the removal of dead vegetation.

3.12.7 Oil/ Grit Separators

Areas subject to the collection of contaminants or spills shall be fitted with adequate oil/grit separators or suitable alternative.

Oil/grit separators may generally be used for catchment areas of ≤ 2ha where alternative quality control facilities, such as BMP's, are not practical due to site specific conditions.

When completing sizing calculations for oil/grit separators, the following conditions must apply:

- TSS removal efficiency to the enhanced level of treatment is required, based on treating 90% of the annual runoff volume, as per the MECP guidelines.
- The owner is responsible for inspecting, maintaining, and repairing oil/grit separators located on private property. Operation and maintenance requirements for oil/grit separators are to be identified in the SWM report, in accordance with **Section 8**, for the property and shall be implemented by the owner to ensure the continued performance of the system is designed.
- The particle size distribution that shall be used is listed in **Table 14 in Section 3.5.1.**

Oil and grit separators are intended to remove sediment, debris, and hydrocarbons (oil and grease) from stormwater, and may consist of commercial in-ground structures, ponds, or other Best Management Practices (BMPs).

The oil and grit separators should be designed such that high flows from infrequent rainfall events do not result in the re-suspension of contaminants in the separator and the discharge of these contaminants into the receiving environment of the storm sewer system.

The design of oil and grit separators or the selection of commercially available oil and grit separators shall be done by a Professional Engineer with experience in stormwater management. The engineer should consider the specific site conditions, such as soil type, depth of water table, topography, the expected types and amounts of pollutants, and overall stormwater management for the catchment. The specifications for any oil and grit separator models proposed for a development must be signed and sealed by a Professional Engineer. The required submission of information for review and approval by the City must include design computations including estimated performance, supported with well-documented sizing (computer modeling) program and CADD details in accordance with **Section 8.**

The oil and grit separators make and model specified on the approved Stormwater Management Report cannot be substituted with an "equivalent" model later, without the approval of the Director of Engineering. Requests for substitution must be accompanied by certification of equivalency by the Professional Engineer who prepared the approved Stormwater Management Report with additional supporting documentation required for certification and approvals.

The OGS performance criteria must meet the quality control requirements specified in **Section 3.5**, and the associated TSS Removal Requirements from the City of Sault Ste Marie Stormwater Investigative Study, Appendix K, Plan 1 – Stormwater Management Requirements.

3.12.7.1 Location

OGS structures should be installed as a component of the minor drainage system. OGS, ponds, or other non-structural BMP's should generally be installed in the most downstream portion of the property to prevent the discharge of contaminated runoff into the minor stormwater system or receiving watercourses. The location of the OGS should allow access for maintenance activities at any time of the year, typically in a street setting.

3.12.7.2 Maintenance

OGS should be designed and constructed to ensure easy access for inspection and cleaning.

OGS should be cleaned of sediment, accumulated oils and grease, debris and other pollutants as needed to ensure the continued proper operation of the system. The maintenance protocol for the OGS shall be reviewed and given to the City of Sault Ste. Marie prior to installation in accordance with **Section 8.**

For private OGS an acceptable written maintenance protocol shall be supplied to the City as part of the Site Plan Control Agreement. Maintenance for private OGS shall be by the owner.

3.12.8 Instream Erosion Control/ Geomorphology

The requirement for in-stream erosion control/geomorphology control will be determined on a site-by-site basis at the discretion of the Director of Engineering.

In-stream erosion control/geomorphology control requirements of other authorities having jurisdiction, specifically the Sault Ste. Marie Regional Conservation Authority, shall be confirmed, accounted for, and documented in the Functional Stormwater Management report in accordance with **Section 8.**

Where it has been determined that in-stream erosion control/geomorphology control is required, an acceptable method of control shall be the 24-hour detention of the post-development runoff volume from a 25mm rainfall event.

3.12.8.1 Erosion and Sediment Control (ESC) Plan

An Erosion and Sediment Control Plan should be completed and submitted as part of all construction and development project approval and prior to site alteration activities and should address construction and post-construction conditions. Detailed requirements for an ESC Plan is provided in **Section 8.**

3.13 Onsite Storage

3.13.1 Stormwater Attenuation Ponds

The purpose of a stormwater attenuation pond is to restrict peak flows to pre-development conditions and reduce the potential of downstream flooding and erosion.

SWM ponds are to be incorporated adjacent to existing natural features and park facilities. The City will determine safety, aesthetic and additional maintenance criteria based on each specific development. Separate SWM pond and BMP planting plans are required for all new facilities and are to be approved by the Director of Engineering in a report in accordance with **Section 8.**

Stormwater management ponds shall be designed in accordance with the latest revision of the MECP's Stormwater Management Planning and Design Manual (SWMP Manual).

Stormwater ponds within a subdivision are to be on lands dedicated to the City of Sault Ste. Marie. Ponds are not considered parkland dedication but may be included within the landscaping area calculations.

SWM ponds on City of Sault Ste. Marie lands or on lands that the City will assume shall not have permanent full perimeter fencing, unless otherwise approved by the Director of Engineering. Safety issues for SWM ponds shall be addressed using other techniques, such as gentle side slopes, incorporating trash/safety racks into the pond outlet, community education, etc. With full perimeter fencing installed, reaching a person who requires assistance within the fencing would be impeded by the fence. In addition to safety concerns,

ponds that are surrounded by fences are generally not as well maintained as those that are in the open and more visible.

All SWM ponds shall have warning signs conspicuously located on all sides of the facility and/or where directed by the Director of Engineering. Warning signs shall contain the text:

"WARNING

POND NOT MONITORED FOR HAZARDOUS CONDITIONS

THIS STORMWATER MANAGEMENT POND IS SUBJECT TO FLUCTUATING WATER LEVELS, WATER QUALITY, AND THIN ICE

THE CITY ASSUMES NO RESPONSIBILITY FOR ITS UNINTENDED USE"

3.13.1.1 Hydrotechnical Considerations

The emergency spillway of the pond should be designed to accommodate overtopping beyond the typical design storms.

The stormwater management pond shall be designed to attenuate post-development peak flow rates to pre-development flow rates for all design storms 2 yr – 100 yr, and the Timmin's Storm.

The stormwater management pond should be designed to empty within 72 hours following the termination of stormwater inflow.

During the design process, the engineer is to generate hydrographs to assess the performance of the stormwater pond and shall include these in the Functional Stormwater Management report in accordance with **Section 8.**

3.13.1.2 Wet Ponds vs Dry Ponds

Dry ponds only contain water immediately following a storm event and have no permanent pool of water, while wet ponds always contain water. Therefore, the removal of stormwater contaminants in dry ponds is a function of the pond's drawdown time. Dry ponds operating in a batch mode are considered more effective than a dry pond operating in a continuous mode. Dry ponds typically have limited effectiveness with regards to quality control and should be used in tandem with other stormwater management measures such as oil and grit separators and low impact development measures.

The City of Sault Ste. Marie's Engineering and Planning Department prefers the use of dry ponds over wet ponds.

Wet ponds provide a breeding habitat for insects due to permanent standing water thereby increasing the spread of biting insect-borne diseases. Wet ponds also have a greater potential for increased water temperature that can be detrimental to aquatic life.

3.13.1.3 General Dimensions and Layout

Freeboard of 0.3m is required above the maximum water level. The freeboard is described as the vertical distance between the max water level and the top edge of the ponds embankment or containment structure.

To maximize the water quality benefits from a stormwater attenuation pond, the ratio of effective pond length to width should exceed 3 to 1, and the inlet should be located as far away from the outlet as possible.

Signage shall be installed by the City and the City shall collect costs from the developer for the signage.

At any point where an excavator is to enter the pond a “Turf stone” or similar material shall be utilized on the slopes.

Material excavated during construction of the pond shall be disposed of appropriately.

The pond bottom shall be re-established as designed once maintenance is completed.

3.13.1.4 Wet Ponds

The permanent pool shall have a maximum depth of 2.5m and a minimum depth of 1.0m.

The maximum depth for water quality or erosion control active storage/extended detention shall be 1.0m above the permanent pool (normal water) level.

The maximum total active storage depth, including extended detention and water quantity control shall be 2.0m above the permanent pool (normal water) level.

Side slopes shall be no steeper than 5:1 from the bottom of the pond to 3.0m (horizontal distance) upland of the permanent pool level. Above this, the side slopes shall be no steeper than 3:1.

3.13.1.5 Dry Ponds

The maximum active storage depth shall be 1.8m.

Side slopes shall be no steeper than 5:1 from the bottom of the pond to the greater of the water quality or erosion control active storage/extended detention depth. Above this, the side slopes shall be no steeper than 4:1.

The bottom of dry ponds shall be graded to drain all areas after operation. The minimum bottom slope is 0.5%. The recommended bottom slope is 2.0%. The maximum gradient shall be 5.0%.

3.13.1.6 Operation and Maintenance of Stormwater Management Ponds

Developers are required to maintain and monitor the operation of detention ponds, BMP’s, and all SWM facilities to ensure the facility meets the criteria outlined in the design brief and the current MOECC criteria prior to the city assuming the facility. Performance testing, such as TSS removal, infiltrations rates, etc., and satisfactory results, over a six-month period, or minimum two (2) storm events will be required prior to the City assuming responsibility for City owned facilities.

Stormwater management areas for industrial, commercial, and institutional development, subject to site plan approval, will be on lands retained by the owner. All costs associated with the construction and continuing maintenance of stormwater management facilities shall be borne by the owner.

3.13.1.7 Operation and Maintenance of Access Roadways for Stormwater Management Ponds

A maintenance roadway shall be provided for all SWM ponds.

The roadway shall provide access to all areas of the SWM pond in order that accumulated sediment from all areas of the pond bottom can be excavated with an excavator.

Where the roadway does not surround the entire SWM pond, a hammerhead turnaround area shall be provided, unless the access road is less than 60m in length.

The roadway shall have a minimum width of 4.0m, a maximum gradient of 10%, and a minimum cross fall of 1%. The road shall consist of 600mm of Granular B and 150mm of Granular A.

3.13.1.8 Landscaping and Community Trails

Where the Stormwater Management Pond can be integrated in or adjacent to active or passive recreation areas, it shall be suitably designed and landscaped to complement the overall park concept. The site shall be designed for ease of maintenance and with due regard for safety of the public.

A landscape plan of the stormwater management facilities shall be approved by the City prior to the registration of the Plan of Subdivision. All landscaping of areas shall be installed at the developer's cost, in accordance with the approved plan, during the first planting season after occupancy of the first unit. The developer shall maintain the planting for a period of one year from the completion of final planting. Landscape plans are to be prepared by a landscape architect or other qualified individual acceptable to the City and submitted in accordance with **Section 8.**

If a community trail has been identified and/or required by the City in the vicinity or adjacent to a stormwater management pond, they shall be implemented above the maximum extended detention level or 5-year storm level, whichever is greater, to prevent frequent flooding. Trails shall have a minimum width of 3.0m.

To enhance user comfort and safety, a 3.0m zone on each side of the community trail shall be designed in such a way that sight lines are preserved. If barriers are required, they must not interfere with visibility or create entrapment areas. In situations where a community trail is designed within the maximum peak flow depth zone, the 3.0m separation above the trail shall have a maximum slope of 3:1. Below the trail, the 3.0m separation shall have a maximum slope of 6:1. This zone shall be planted with low ground covers. Deciduous trees should be planted at a minimum distance of 1.5m from the edge of the trail. The planting of coniferous trees within this zone is not permitted.

Prior to the City accepting the stormwater management pond as shown on the approved landscape plan, the developer shall erect one or more information signs at any public access point(s) detailing the purpose of the pond, phone number for further information and any other relevant information, all at the cost of the developer in accordance with **Section 8.**

3.13.2 Rooftop Storage

Rooftop storage shall not be permitted unless otherwise approved by the Director of Engineering.

3.14 Figures

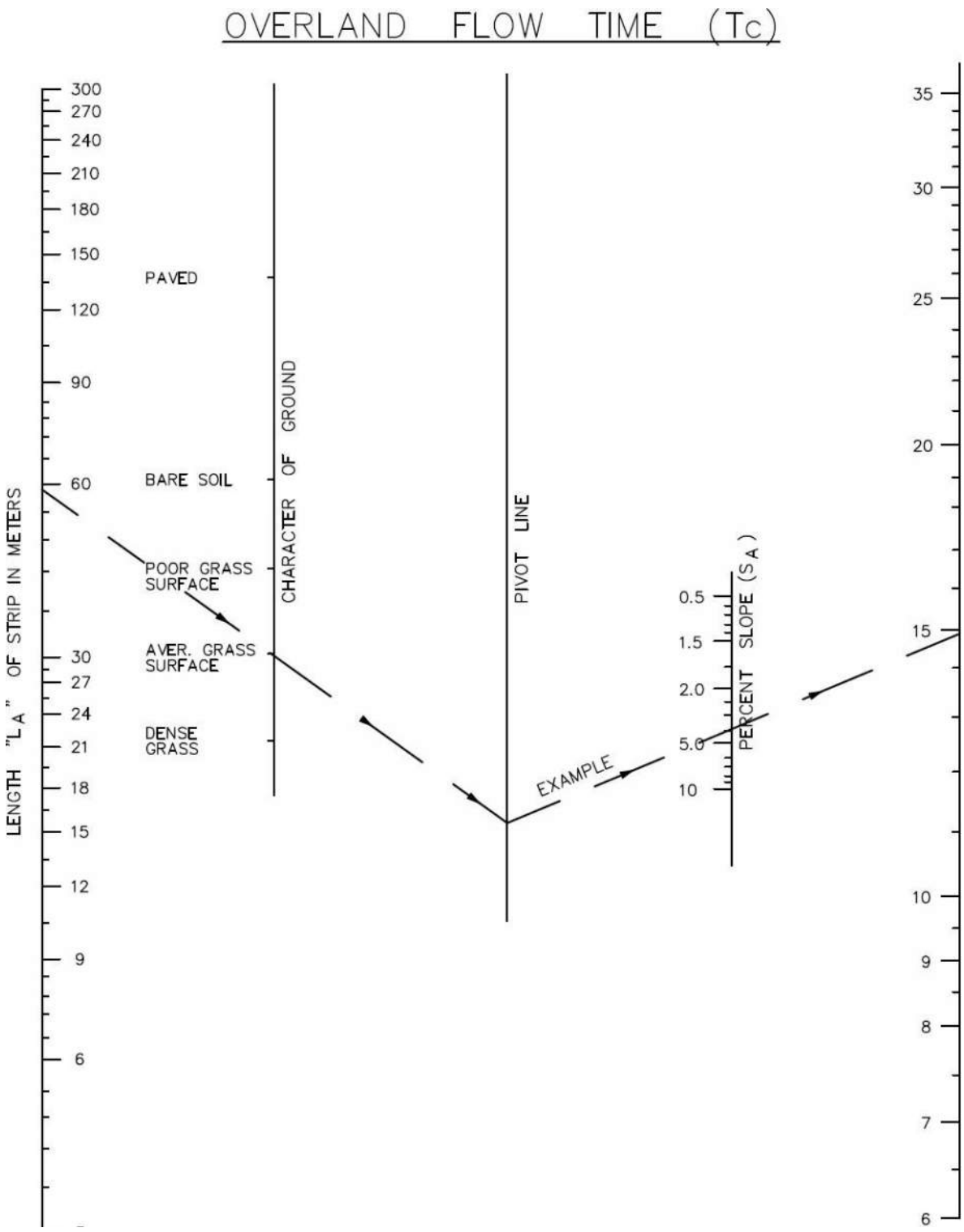


Figure 3: Overland Time of Flow

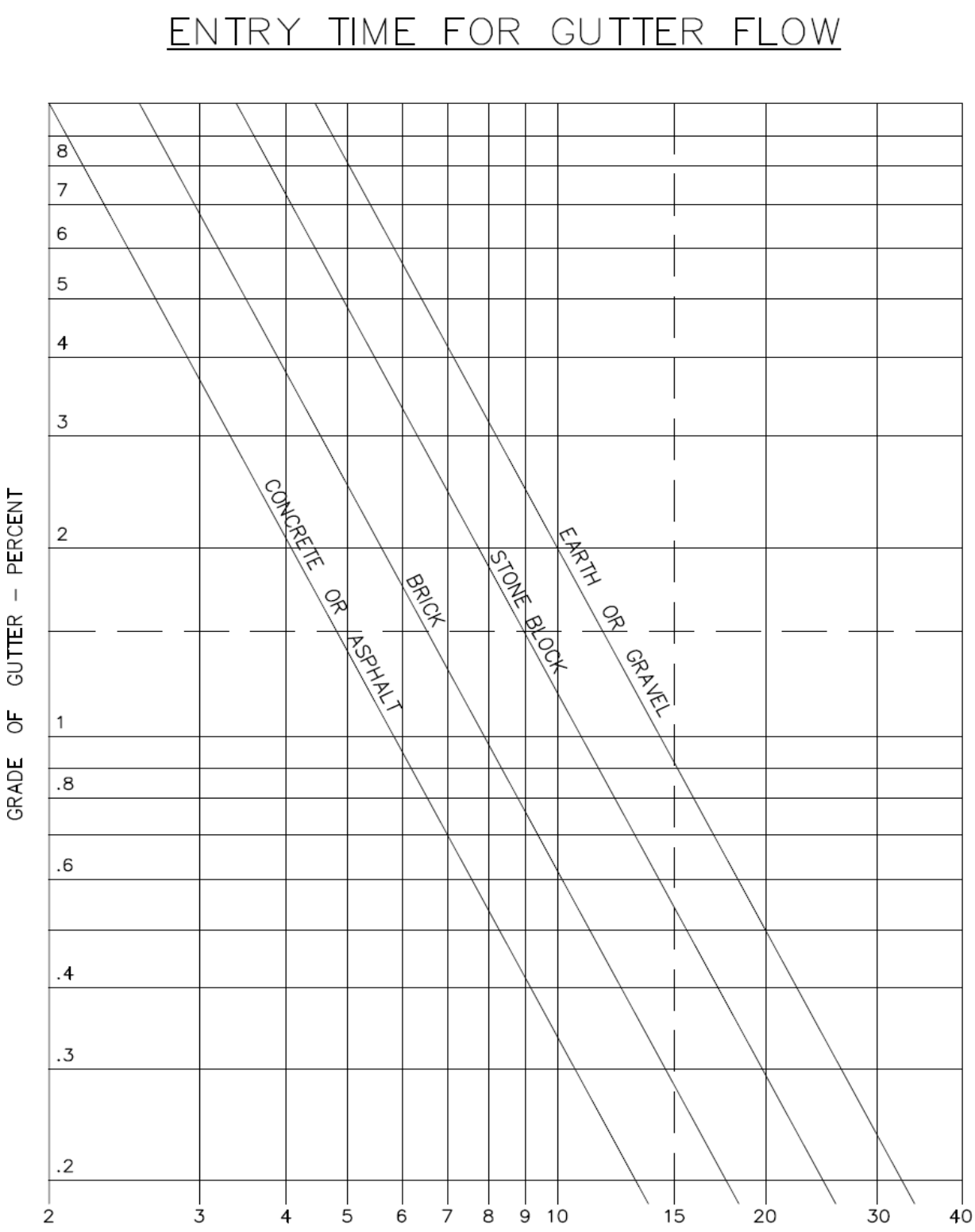
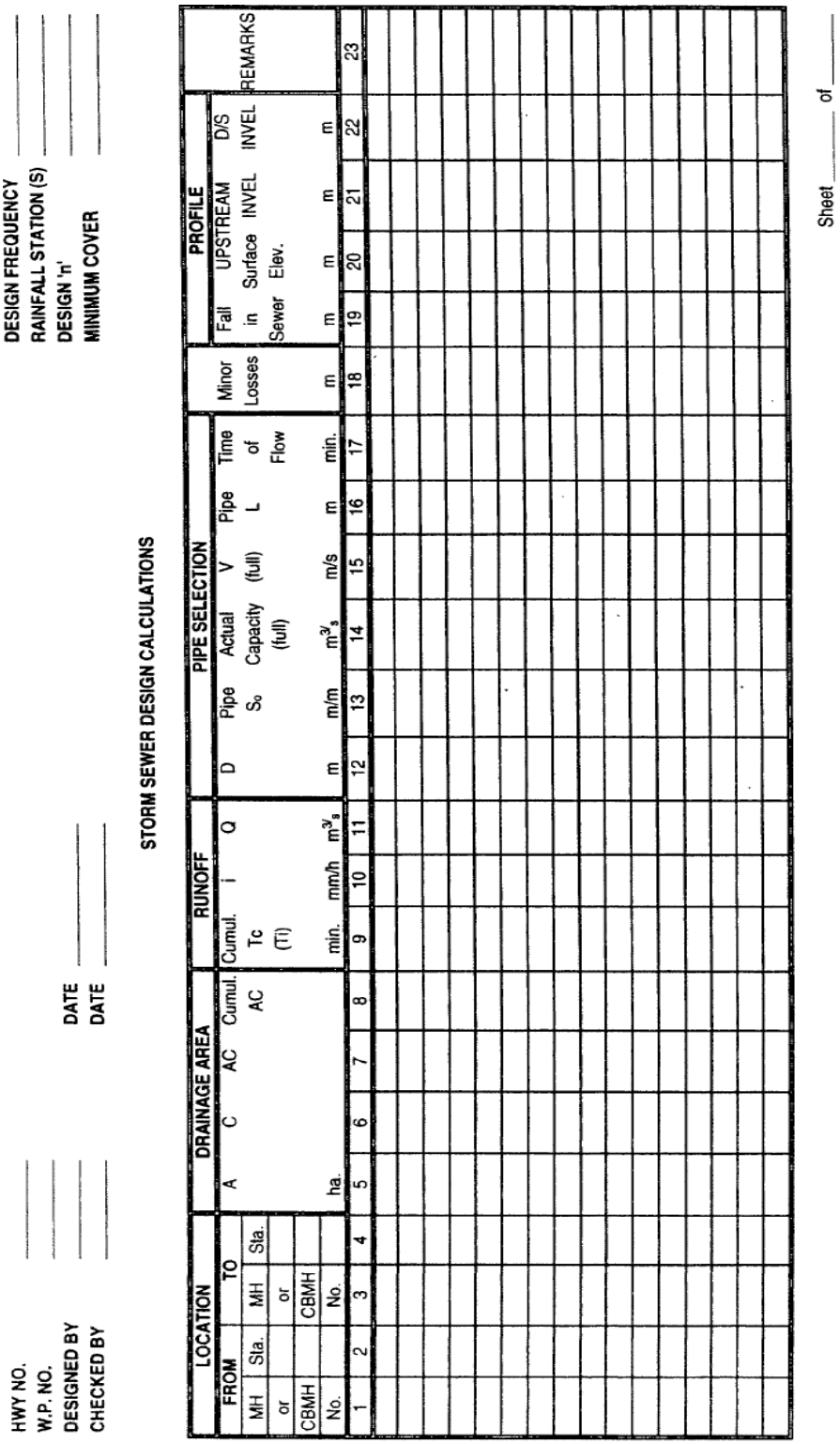


Figure 4: Entry Time for Gutter Flow



STORM SEWER DESIGN CALCULATIONS

HWY NO. _____ DATE _____ DESIGN FREQUENCY _____
W.P. NO. _____ RAINFALL STATION (S) _____
DESIGNED BY _____ DATE _____ DESIGN 'n' _____
CHECKED BY _____ DATE _____ MINIMUM COVER _____

LOCATION				DRAINAGE AREA				RUNOFF			PIPE SELECTION						PROFILE			
FROM		TO		A	C	AC	Cumul. AC	Cumul. Tc (Ti)	i	Q	D	Pipe S_o	Actual Capacity (full)	V (full)	Pipe L	Time of Flow	Minor Losses	Fall in Sewer	UPSTREAM Surface Elev.	INVEL	D/S INVEL	REMARKS
MH or CBMH	Sta.	MH or CBMH	Sta. No.	ha.				min.	mm/h	m^3/s	m	m/m	m^3/s	m/s	m	min.	m	m	m	m	m	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

Sheet _____ of _____

Figure 5: Storm Sewer Design Sheet

4. LOT GRADING

4.1 General

Lot grading and resulting drainage patterns shall not adversely affect either adjacent or downhill lands

Lot grading shall be implemented to facilitate ease of maintenance and maximize use of the land

All existing perimeter ground elevations of the subject property shall remain undisturbed unless approved otherwise.

All existing surface water runoff/ drainage run-off entering the subject property from adjacent lands shall be accommodated by the grading and drainage plan submitted for approval in accordance with **Section 8.**

Lot drainage shall be contained within the subject property and discharged into an existing municipal rear yard swale or storm sewer drainage system or directly into a natural watercourse in a manner acceptable to the City of Sault Ste Marie.

No alterations to existing boundary elevations of adjacent lands shall be undertaken unless written agreement with the adjacent property owner has been obtained and submitted in a format acceptable to the City of Sault Ste Marie. This shall be included in the design brief in accordance with **Section 8.**

If at the design plan submission stage, i.e. application for a building permit, it is known that surface water run-off from the owner/applicants' lot must flow across either adjacent and/or downstream properties, the owner/applicant must submit written confirmation of agreement to accept the surface water flow in perpetuity from the affected property owner. This shall be included in the design brief in accordance with **Section 8.**

Similarly, if during construction, altercations to the design plan(s) have to be made to drain water across either adjacent and/or downstream properties, letters of acceptance from the affected property owners must be received with the final as-built Lot Grading Plan. This shall be included in the design brief in accordance with **Section 8.**

4.2 Design Criteria

4.2.1 General Lot Grading

The grading plan detail requirements are provided in **Section 8.2.3.5.**

The location of the Geodetic Datum used as a reference point for elevations on the lot grading plan shall be shown on the lot grading plan in accordance with **Section 8.2.**

In areas of development adjacent to water courses the Engineer in consultation with the Sault Ste. Marie Region Conservation Authority shall determine the possible effects of hydrostatic ground water fluctuations during storm events on the building foundation and provide minimum footing elevations or other measures to mitigate such effects.

General lot grading requirements are as follows:

- The proposed finished elevations of the front lot corners shall be graded at 2% above the design back of curb at the street.
- The minimum front and rear lot gradient is 2%.

- The maximum front and rear lot gradient is 8%.
- Maximum rear or side yard swale slope shall be 3 parts horizontal to 1 part vertical (3:1 slope).
- Minimum side yard gradient is 2%.
- Maximum side yard gradient is 33% (3:1 side slope)
- Minimum height of top of foundation wall above finished grade is 150mm.
- Reduced lot grading can be implemented, subject to the approval of a geotechnical engineer, in areas that have more permeable soil types (a minimum infiltration rate of 15mm/hr is recommended). In these cases, the grading can be flattened to 0.5% to promote greater depression storage and natural infiltration, except within 2.0m to 4.0m of buildings where a 2% minimum grade away from the building should be maintained and soils should be well compacted in order to avoid foundation drainage problems.
- The maximum depth of ponding based on the major (100-year) storm event shall not exceed 300mm, before out letting through an overland flow route.
- Minimum easement widths for drainage or drainage infrastructure shall be 6.1m.

4.2.2 Rear Lot Grading

4.2.2.1 General

In Sault Ste. Marie, if properties drain front-to-back (away from the street), a designed swale or stormwater collection channel or natural watercourse must be present along the back of each property to drain the lots.

Where approved, rear yard drainage systems shall meet the following requirements:

- Rear yard drainage systems including piped systems with catch basins are required for any slope less than 2%.
- For slopes 1% to 2%, catch basin spacing shall be six (6) lots or 90m (whichever distance is smaller).
- For slopes 1% to 0.5%, catch basin spacing shall be four (4) lots or 60m (whichever distance is smaller).
- Slopes less than 0.5% are not permitted.
- Rear lot catch basins shall be in accordance with OPSD705-010 with bird cage catch basin grates as per OPSD 400.120. Catch basins in a yard shall have leads of 150mm diameter and shall have a maximum drainage area of 0.25ha.
- All rear lot drainage storm sewer systems draining to the road network storm sewer shall:
    - Be installed with typical pipe installation Granular A bedding and granular backfill.
    - Have a minimum depth of bury of 1.5m measured from finished grade to top of pipe, when possible. For depths less than 1.5m the pipe shall be appropriately installed to achieve an equivalent 1.5m bury.
    - Have a minimum diameter of 300mm.
    - Be PVC DR 35 or CSA approved high density corrugated exterior and smooth inside walled polyethylene BIG “O” Boss 2000 or equivalent as per OPSS 1840. Corrugated steel pipe is not permitted.
- Rear yard catch basin leads shall be located in public easements more or less straddling the common lot line.

The average slope of residential rear yard surfaces shall not exceed 8% and shall be measured by dividing the elevation difference by the distance using the following three measurements:

- Between the rear of the building and the rear lot line.
- Between the rear of the building and the centre line of the rear swale.
- From side lot line to side lot line over the full width of the lot.
- The measurement giving the steepest grade shall govern.

The grade difference in the rear yard shall be taken up using grading as follows:

- Generally, the slope of the rear yard shall be between 2% and 8% to maximize the useable area of the rear yard.
- Slopes shall be 1:3 maximum at the extremities of the property when matching surrounding lands.
- Retaining walls shall be used to reduce the grade differentials to an acceptable amount wherever the finished grade between two adjacent properties exceeds 400mm within 1.2m of the interior side lot line unless approved by the Director of Engineering or where erosion of soil may occur.
- Where retaining walls are proposed they shall be contained on the higher property.

Drainage flows which are carried around buildings shall be contained in defined swales located as far from the building as practical.

The type of building to be placed on the property shall be determined by the type of grading which is allowed by the topography of the land.

4.2.2.2 Rear Lot Swales

Grassed swales should be designed as open channels using the Manning Equation, using a Manning's coefficient of 0.030 or greater.

The minimum swale grade shall be 1% without subdrains.

Rear yard swales with gradient between 0.3 to 0.99% grade will be approved with a 150mm geotextile wrapped perforated subdrain within a 0.6m wide by 0.6m deep clear stone trench, the top of which may receive topsoil and grass.

The maximum length of a rear yard swale to a suitable outlet shall be 90m.

Grassed swales are not permissible as replacements for curb and gutter systems in commercial areas.

Swales should be of trapezoidal shape and have a minimum bottom width of 0.3m should be maintained.

Rear yard swale depths shall conform to the following requirements:

- A minimum depth of 150mm
- A maximum depth of 500mm
- A maximum seeded or sodded slope of 3 horizontal to 1 vertical (3h:1v)

All rear yard slopes shall be provided with vegetative cover consisting of either:

- Number 1 nursery sod and at least 75mm of topsoil, or
- Hydroseeding and at least 75mm of topsoil, or
- Alternative vegetative cover as approved by the City.

All rear yard swales may be placed on one side of the property line or split over property lines and shall be located on easements to be provided to the City.

As built rear yard swales are to be shown and described in the Functional Stormwater Management Design Brief in accordance with **Section 8.1.1.**

All subdrains must discharge to a positive outlet such as a creek, stream or natural drainage outlet. Alternatively, the rear yard swale may discharge into a storm sewer system complete with rear yard catch basin(s) and storm sewer systems. All rear yard catch basin(s) and storm sewer systems may be located either entirely on one property or split between adjoining properties. A minimum 3.0m wide easement centered over the catch basin(s) and/or storm sewer system must be provided by the city.

4.2.2.3 Rear Lot Swale Easements

Easements for rear yard swales and related rear yard catch basin and storm sewer systems, shall have a minimum width of 3.0m and be centered over the as built swale.

All easements must be sufficiently wide to accommodate/ permit necessary maintenance or future upkeep/ repairs of the swale and/ or infrastructure system.

4.2.3 Driveways

The minimum gradient of a driveway is 2%.

The maximum gradient is 10%.

It is desirable to install any hydrant, light standard or utility box at least 2.0m away from the driveway.

The gradient of the driveway shall be calculated from the back of the curb or edge of pavement to the front of the garage or level portion of the driveway. The future provision of a sidewalk on the City Road frontage must be taken into consideration when calculating the grade of the driveway.

4.2.4 Parking Lots

All new paved parking areas larger than 250m² in area and being drained to the municipal drainage system, require stormwater quantity and quality treatment. Drainage from parking areas should be directed to pervious surfaces and BMP facilities as much as possible to meet the quality control requirements. Catch basins, oil-grit separators, and other proprietary devices are acceptable methods of meeting quality control where site specific conditions do not allow for BMP facilities.

The maximum height of stormwater storage within parking lots shall be 250mm.

The minimum grade shall be 0.5%.

The maximum grade shall be 5%, not including drive isles or driveways.

4.2.5 Side Yard Drainage Swales

Side yard drainage swales will be centered on the property line of adjoining properties.

Side yard swale depths shall conform to the following requirements:

- A minimum depth of 150mm
- A maximum depth of 300mm
- A maximum seeded or sodded slope of 3 horizontal to 1 vertical (3h:1v)

The gradient of a swale will generally be in conformance with lot grading on the lot (i.e. front to back, or split yard).

On split yard drainage plans, the site yard drainage swale will generally end at the front of the building closest to the street. This will facilitate the runoff to drain onto the front lawns and be absorbed.

On exceptional cases, the swale will be permitted to extend to near the front property line and discharge into a front yard catch basin or catch basin inlet lead.

Under no circumstances will side yard drainage be permitted to drain directly onto any driveway and/or onto City property, including sidewalks, boulevards, and/or roadways.

Easements are not required on side yard swales.

4.2.6 Lot Grading Plans

The general Lot Grading Plan shall be part of the Stormwater Management Design Brief and contain the items listed in **Section 8.**

Severance and Building Permit Lot Grading Plans shall be developed in accordance with these Design Guidelines and/or other Design Standards acceptable to the City.

4.2.7 Unique Circumstances

It is anticipated that lot grading will be able to be completed using the guidelines contained herein for the majority of lots within the City. However, unique situations/locations may arise in specific scenarios. The Director of Engineering, or his or her designate, will consider proposed alternative designs/deviations from these guidelines that are prepared and submitted by design professionals using acceptable design criteria and ensuring that acceptable lot grading can be achieved.

5. WATER DISTRIBUTION SYSTEM

5.1 Design of Water Distribution Systems

5.1.1 General

Any private water distribution system, service, or appurtenance connected to a PUC Services (PUC) distribution system, or system to be assumed by the PUC must meet all PUC Services INC. (PUC) Standards, and MECP Watermain Design Criteria unless otherwise approved by the City of Sault Ste Marie Director of Engineering.

Water supply systems shall be designed to satisfy the greater of either of the following demands:

- Maximum day plus fire flow; or
- Peak rate (maximum hour demand)

5.1.2 Fire Flows

If inside the urban servicing boundary, fire protection shall be provided from the municipal system unless otherwise approved by the Director of Engineering.

Fire flows must meet the approval of the City of Sault Ste. Marie and the PUC's water distribution engineer. The designer shall determine the required fire flows using the latest edition of Water Supply for Public Fire Protection from the Fire Underwriters Survey or the Ontario Building Code as applicable. For Residential R1 and R2 subdivisions, a minimum flow rate of 75 L/s within all distribution watermains at a minimum pressure of 140 Kpa is required.

The available flow within the distribution system must be evaluated under the conditions of simultaneous maximum day domestic demand and fire flow demands. The distribution system pressure shall not be reduced to less than 140 kPa (20 psig). If the fire pumps are required, they must be supplied complete with standby power.

Residential peaking factors shall be in accordance with values listed in **Table 28** below.

Table 28: Residential Peaking Factors

PEAKING FACTORS			
Population	**Minimum rate factor (minimum hour)**	**Maximum day factor**	**Peak rate (peak hour)**
500-1000	0.40	2.75	4.13
1001-2000	0.45	2.50	3.75
2001-3000	0.45	2.25	3.38
3001-10000	0.50	2.00	3.00
10001-25000	0.60	1.90	2.85
25000-50000	0.65	1.80	2.70
50001-75000	0.65	1.75	2.62
75001-150000	0.70	1.65	2.48
Greater than 150000	0.80	1.50	2.25

5.1.3 Domestic Water Demands

Domestic demands shall be determined in accordance with MECP guidelines. The designer shall assume the highest density permitted by the Official Plan for areas to be served that lack a specific plan. For places where a plan has been authorized, use the number of units indicated in the plan.

For design purposes, existing reliable flow records for average, maximum day, and peak rates should be used whenever possible. Where reliable flow records for existing distribution systems suggest there is an excessive unaccounted for average daily demand (in excess of 15%), the existing consumption rates should not be used for the design of an extension, instead the average value of 270 to 450 L/capita·d shall be used, along with the population design guidelines listed in **Table 2** of **Section 2.2.2**.

5.1.4 Commercial, Institutional, and Recreational Water Demands

Demands should be determined in each case based on historical records or calculated based on specific data where available. Where no records are available, the values in **Tables 4, 5,** and **6** in **Section 2.2.2** shall be used. For other commercial and tourist-commercial areas, an allowance of 28 m^3/(ha·d) [3000 USgal/(acre·d)] average flow should be used in the absence of reliable flow data.

5.1.5 Water Age and Volume Turn Over

The water throughout the entire service system shall undergo a complete turnover once every three (3) days.

5.1.6 Design Life

Watermains shall be designed to a minimum 50-year service life.

5.1.7 Velocities

The maximum velocity within a watermain shall be 6.1m/s when subjected to fire flows and peak day demand flows. The maximum velocity within a hydrant lead shall be 8.0m/s at a flow rate of 150L/s. The distribution system should be designed to achieve velocities between 1.5 and 3.0m/s when subjected to fire flows and peak day demand.

5.1.8 Surge Pressures and Thrust Restraint

Thrust restraints shall be provided on all watermains. Thrust forces shall be calculated based on a water column instantaneously stopping from an initial velocity of 0.6m/s.

For watermains with a diameter of 300mm or less, mechanical restraints shall be used except with the approval of the Director of Engineering. For watermains greater than 350mm in diameter, every joint shall be restrained and shall be designed by a professional engineer.

5.1.9 Normal Pressures

It is the generally accepted practice within PUC Services INC. (PUC) to design water supply and distribution systems such that the normal operating pressure ranges between 50 psig and 70 psig. See **Table 29** below for a summary of normal operating pressures.

Table 29: Normal Pressures Under Various Operating Conditions

Item	The PUC Services INC. (PUC)
Maximum Pressure	100 psig
Maximum Pressure at minimum hour demand	70 psig
Minimum Pressure at maximum day demand	50 psig
Minimum Pressure at maximum hour demand	40 psig
Minimum Pressure at maximum day demand plus fire flow	20 psig
Fire Flow for R1 and R2 subdivisions	75 L/s

5.1.10 Maximum Pressure

The maximum pressure shall not exceed 700 kPa (100 psig) to avoid damage to household appliances and equipment. This usually occurs at minimum hour demands and reservoir full conditions, however pressure at higher demands should be checked when near pump stations.

When designing new systems where there are localized areas that must have pressures above this level, the homes affected should be provided with individual pressure-reducing valves on their services just before the water meter inside the house. If the area is substantial the system must be designed with a pressure-reducing station.

5.1.11 Minimum Pressure

For all new subdivisions, the minimum pressure under maximum day demands should not be below the MECP recommended normal operating pressure of 345 kPa (50 psig). If a subdivision has a small, isolated area, which will never be expanded to, which is below 345 kPa, it may be developed without a booster station if approved by the Water Distribution Engineer of PUC Services. However, the minimum pressure at maximum hour demands must never be below 275 kPa (40 psig). All subdivisions must meet both requirements.

If required, pressure boosting stations must be installed to boost the minimum pressure under all demands to greater than 345 kPa (50 psig). If the minimum pressure at maximum hour demands without the booster is greater than 172 kPa (25 psig) only one (1) booster pump complete with variable speed drive is required. If the pressure is lower than 172 kPa, two (2) 100% or three (3) 50% capacity booster pumps are required complete with one variable speed drive and standby power. If the subdivision is being built in stages, the booster station must be sized so that all pumps and standby power can be installed without external building modifications.

During the peak hour demands, the head losses in water mains shall not exceed 2.0m per 1000m.

5.1.12 Friction Factors

Values for the “C” co-efficient for new pipe shall be according to **Table 30** below.

Table 30: Hazen Williams C-Factors

Diameter	C-Factor
150mm	100
200 – 250mm	110
300 – 600mm	120
Over 600mm	130

5.1.13 Minimum Pipe Sizes

For distribution systems designed to provide fire protection, the minimum diameter of water mains shall be 150mm, except beyond the last hydrant on permanent cul-de-sacs where the minimum diameter of water mains may be 25mm, and they shall be looped.

For distribution systems that are not designed to provide fire protection, the minimum diameter of watermains shall be 75mm.

In all cases, water main diameters shall be such that a flushing velocity of 0.8m/s can be achieved for cleaning and flushing procedures.

5.1.14 Service Connections

Single connections shall be a minimum of 19mm in diameter. For lots where the distance from the main to the house is greater than 30m, consideration shall be given to installing larger services, i.e., 25mm. If operating characteristics indicate that the main pressure is 275-345 kPa (40-50 psig), consideration shall be given to 25mm services.

5.1.15 Oversizing of Watermains

Oversizing of watermains will be provided as required, to provide for adjacent areas where service is expected to be extended to un-serviced or undeveloped areas. The PUC Water/Distribution Engineer and Planning Department should be contacted for oversizing of water mains in proposed subdivisions.

5.1.16 Standard Sizes

The approved water sizes (mm) are as follows: 50, 100, 150, 200, 250, 300, 400, 500, 600. Any size not listed shall be approved by the Water/Wastewater Engineer.

5.1.17 Pipe Strength

The watermain material selected for a particular application shall be able to withstand, with a margin of safety, all the combinations of loading conditions to which it is likely to be exposed.

The minimum pressure Class/Series requirements for the most commonly used watermain materials shall be Class 50 for Ductile Iron, Class 150 for Asbestos Cement, Class 100 or Series 160 (i.e., DR or SDR 26) for PVC, and Series 80 (DR 18) for HDPE.

5.1.18 Materials

The materials used for the design of water distribution systems shall be in accordance with PUC Waterworks Special Provisions Section 441.05.01.

5.1.19 Safety Factors

The safety factors listed below are the minimum allowable design and safety factors according to the American Water Works Association (AWWA).

For Ductile Iron Pipe (DIP) and PVC (Polyvinyl Chloride) pipe a minimum safety factor of 2.0 shall be used. For Fiberglass Reinforced Plastic (FRP) pipe, a minimum safety factor of 1.8 shall be used. For High Density Polyethylene (HDPE) pipe a minimum safety factor is not discussed, however a design factor of 0.63 shall be utilized.

5.2 Construction of Water Distribution Systems

In addition to National Sanitation Foundation (NSF), American Society of Mechanical Engineers (ASME), ASTM International, CSA, and American Water Works Association (AWWA) standards referenced in OPSS 441, the following standards shall apply as referenced or amended herein and in the Contract Documents:

5.2.1 General

The work for the installation of watermains shall include all watermain pipes, bends, tees, fittings, thrust restraints, and the testing of the watermain system.

The interior of all pipes, fittings, and other accessories shall be always kept clean and free from undesirable material.

The work of installing watermains shall include installation of accessories including anodes, tracing wire, petrolatum tape systems and disinfecting and hydrostatic testing of the new waterworks systems.

5.2.2 Removals

Removals of waterworks shall be in accordance with PUC Waterworks Special Provisions Section 441.07.03 Removals.

5.2.3 Location

Typically, watermains shall be installed 3.0m North or East of centerline. In the case of roadway courts or looping roadways, the watermain shall be installed on the outside of curvature and avoid crossing the centerline.

5.2.4 Backfilling and Compacting

Backfilling material and compacting processes shall be in accordance with PUC Waterworks Special Provisions Section 441.07.13.

5.2.5 Installation of Pipes and Depth of Cover

Installation of pipes shall be in accordance with PUC Waterworks Special Provisions section 441.07.14.

Reasonable effort shall be made to ensure a consistent depth of bury below finished grade.

Mains shall be looped to avoid dead ends. Where dead end watermains cannot be avoided, they shall be designed with a means to provide adequate flushing (see **Section 5.2.16**).

Except for watermains which will be taken out of service and drained in winter, the minimum depth of cover over watermains and service connections shall be 2.2m. For PEX services the cover shall be 2.4m.

5.2.6 Thrust Blocks or Mechanical Restraints

Thrust Restraints shall be in accordance with PUC Waterworks Special Provisions Section 441.07.23.

In the case of non-restraining mechanical and/or slip on joints, restraint shall be provided by adequately sized thrust blocks positioned at all plugs, caps, tees, line valves, reducers, wyes, hydrants and bends deflecting 22 ½ degrees or more.

In designing thrust blocks and other restraint systems, transient pressures shall be added to the normal operating pressures when calculating the thrust forces. If velocity of flow is very high, dynamic thrust forces should also be calculated.

Hydrant leads shall be fully restrained in addition to a concrete thrust block located on the hydrant which is sized assuming no mechanical restraints are present.

5.2.7 Clearances

Clearances and Separation of Sewers and Watermains shall follow the MECP F-6-1 Procedures to govern separation of sewers and watermains. Watermains and sewage works located parallel to each other shall be constructed in separate trenches, maintaining a clear horizontal separation distance of at least 2.5m measured from the closest pipe edge.

If this horizontal separation cannot be maintained, the water main may be laid closer if the elevation of the crown of the sewer is at least 0.5m below the invert of the water main. Such separation shall be of in-situ material or compacted backfill and shall be approved by the Water Distribution Engineer.

If the above vertical separation cannot be maintained, the sewer main shall be constructed to water main standards of construction and pressure tested in accordance with OPSS 701, from maintenance hole to maintenance hole at 350 kPa with no leakage. This option shall not be used for crossings.

Under normal conditions, watermains shall cross above sewers with appropriate horizontal/vertical separation to allow for proper bedding and structural support of the watermain and sewer main. If water mains must cross below the sewer main, the watermain shall be protected by: providing a vertical separation of at least 0.5m between the invert of the sewer and the crown of the watermain, providing adequate structural support for the sewers to prevent excessive deflection of joints and settling, and the length of the water pipe shall be centered at the crossing so that the joints will be equidistant and as far as possible from the sewer.

When the adequate vertical separation cannot be achieved with crossings of watermain and sewer, either the water main or the sewer line shall be encased in a watertight carrier pipe which extends 3m (10ft) on both sides of the crossing, measured perpendicular to the watermain.

No watermain shall pass through or come in contact with any part of a sewer access/maintenance hole, septic tank, tile field, subsoil treatment system or other source of contamination.

5.2.8 Pipe Material

In order of precedence, materials shall be in accordance with sealed “for construction” drawings, Special Provisions, PUC Waterworks Pre-Approved Materials, and OPSS 441.

5.2.9 Cutting of Pipe

Cutting of Pipe shall be in accordance with PUC Waterworks Special Provisions Section 441.07.16.

5.2.10 Change in Line and Grade, Polyvinyl Chloride Pipe – PVC and PVCP

Changes in line or grade shall be made with factory fittings as approved within PUC Pre-Approved Materials. Pipe deflection is permitted provided the deflection does not exceed 85% of the maximum deflection amount stipulated by the manufacturer.

5.2.11 Installation of Valves and Fittings

Installation of valves and fittings shall be in accordance with PUC Waterworks Special Provisions Section 441.07.18.01.

Automatic air release or vacuum valves shall not be used in situations where flooding of the access hole or chamber may occur.

Chambers, pits, or access holes containing valves, blow-offs, meters or other such appurtenances to the distribution system, shall not be located in areas subject to flooding or in areas of high groundwater.

Chambers, pits and access holes shall not connect directly to any sanitary sewer but may be connected to storm sewers provided backflow prevention in accordance with PUC Standard Drawing WCS-9, and means of dichlorination is included.

Blow-offs and air release valves shall not be connected directly to any sewer.

Valves, valve boxes, and valve chambers shall be located at all intersections and future intersections.

Hydrant lead valves shall be installed on the 'tee' from the watermain.

If a new water main is constructed off an existing main, then a valve shall be placed on the new water main, and two new valves placed on the existing main, unless they are existing and in good working order.

Valves shall be located such that they align with the extension of the perpendicular property line through the intersection. The spacing between valves shall not exceed 230m.

5.2.12 Installation of Service Connections

The installation of service connections shall be in accordance with PUC Waterworks Special Provisions Section 441.07.20.

Minimum clearance between sewer and water services shall meet MECP Separation requirements of 2.5m horizontal separation or 0.5m vertical separation at crossings (see **Section 5.2.7**).

Individual lot service pipe materials and fittings shall be in accordance with PUC's Pre-Approved Material list. The owner is required to conduct environmental sampling in the location of proposed service laterals for petroleum hydrocarbons, should PEX service piping be proposed. Approval is subject to no hydrocarbons being identified. The sampling frequency shall be every ten (10) lots total or every fifteenth (15^{th}) lot on one side of the street, whichever is more. Sampling should be done at a depth of 1.8m.

5.2.13 Shutting Down or Charging Mains

Shutting down mains or charging main procedures shall be in accordance with PUC Waterworks Special Provisions Section 441.07.21.

5.2.14 Connections to Existing Watermains

Connections to existing watermains shall be in accordance with PUC Waterworks Special Provisions Section 441.07.22.

5.2.15 Hydrostatic Testing (General)

Hydrostatic testing shall be in accordance with PUC Waterworks Special Provisions Section 441.07.24.01, and PUC Standard Drawing WCS-4.

5.2.16 Flushing and Disinfecting Watermains

Flushing and disinfecting watermains shall be done in accordance with PUC Waterworks Special Provisions Section 441.07.25, and in accordance with PUC Standard Drawings WCS-3, WCS-10, and WCS-19.

Flushing hydrants or devices to the approval of the Water Distribution Engineer, shall be provided on watermains which are not capable of providing fire flow and for dead-end watermains.

Flushing devices shall be sized to provide flows which give a velocity of at least 0.8m/s in the watermain being flushed.

No flushing device shall be directly connected to any sewer and shall have an air gap to prevent cross contamination.

Flushing Stations shall be used as a temporary measure only.

5.2.17 Site Restoration

Site restoration procedures shall be in accordance with PUC Waterworks Special Provisions Section 441.07.26.

5.2.18 Management of Excess Material

The management of excess materials shall be according to PUC Waterworks Special Provisions Section 441.07.27.

5.3 Temporary Water Services

In addition to OPSS.MUNI 493, the following standards shall apply as referenced or amended herein and in the Contract Documents:

5.3.1 Submission Requirements

The submission requirements for temporary water services shall be according to PUC Waterworks Special Provisions Section 493.04.01, and in accordance with **Section 8.**

5.3.2 Materials

5.3.2.1 General

General materials for temporary watermains shall be in accordance with PUC Waterworks Special Provisions Section 493.05.01.

5.3.2.2 Temporary Potable Water Supply Services

Materials for temporary potable water supply services shall be in accordance with PUC Waterworks Special Provisions Section 493.05.02.

5.3.3 Construction

5.3.3.1 General

General construction practices shall be in accordance with PUC Waterworks Special Provisions Section 493.07.01.

5.3.3.2 Temporary Watermains

Temporary watermain construction shall be in accordance with PUC Waterworks Special Provisions Section 493.07.02.

5.3.3.3 Temporary Potable Water Supply Services

Temporary potable water supply services shall be constructed in accordance with PUC Waterworks Special Provisions Section 493.07.03.

5.3.3.4 Temporary Hydrants

The construction of temporary fire hydrants shall be in accordance with PUC Waterworks Special Provisions Section 493.07.04.

5.3.3.5 Protection

Protection of temporary services shall be in accordance with PUC Waterworks Special Provisions Section 493.07.06.

5.3.3.6 Leakage Testing

Leakage testing for temporary water distribution services shall be performed in accordance with PUC Waterworks Special Provisions Section 493.07.07.

5.3.3.7 Flushing and Disinfecting Temporary Watermains and Services

The flushing and disinfecting of temporary watermains shall be done in accordance with PUC Waterworks Special Provisions Section 493.07.08, and in accordance with PUC Standard Drawing WCS-2.

5.3.3.8 Removal of Temporary Water Supply Services

The removal of temporary water systems shall be done in accordance with PUC Waterworks Special Provisions Section 493.07.09.

5.4 Fire Hydrants

5.4.1 General

Fire hydrants shall only be installed on watermains capable of supplying fire flow.

Fire hydrants shall be dry-barrel type and shall conform to the latest edition of AWWA Standard C502: Dry-Barrel Fire Hydrants.

Fire hydrants shall be provided with adequate thrust blocking to prevent movement caused by thrust forces (see PUC Standard Drawing WCS-21).

Fire hydrant leads shall be a minimum diameter of 150mm, as per PUC Standard Drawing WCS-21.

In areas where the water table will rise above the hydrant drain ports, the drain ports shall be plugged.

5.4.2 Installation of Hydrant Sets

The installation of hydrant sets shall be in accordance with PUC Waterworks Special Provisions Section 441.07.19, and PUC Standard Drawing WCS-21.

5.4.3 Removals

The removal of hydrants shall be in accordance with PUC Waterworks Special Provisions Section 441.07.03.

5.4.4 Hydrant Locations

Hydrants shall be located at a minimum of 1.5m away from the edge of existing driveways, walkways, ramps and house service connections, hydro poles, streetlights, transformers, and utility pedestals. At 60m from the end of all water mains in permanent cul-de-sacs. Hydrants shall be installed at every intersection 3.75m back from the corner formed by the intersecting streets.

All hydrants shall be located in an obstruction-free zone such that neither their visibility nor their accessibility is obstructed. More specifically, no object shall be permitted within a triangle bounded by a point 1.0m behind the hydrant and extending to the curb or roads edge at a 45° angle.

Hydrants to be installed on the same side of the street as the watermain.

Hydrants shall be installed 2.0m behind the back of the curb.

The elevation of the bottom hydrant flange shall be set 100 – 150mm above final grade, in accordance with PUC Standard Drawings WCS-21.

5.4.5 Spacing

The maximum spacing for hydrants shall be 120m for low-density residential (R1, R2) and 90m for higher-density residential, industrial, commercial, and institutional areas. Hydrant spacing shall be taken by drawing a circle of applicable spacing diameter centered on the hydrant.

5.4.6 Distribution and Marking

The overall distribution of hydrants within the design area shall be such that the center of lot frontage of every lot along the street is within the appropriate spacing. In rural areas, hydrant installation should only be done if there is a building within the hydrant's service area.

Marking the top of hydrants shall be color coded in accordance with NFPA 291 Standards latest edition.

Class AA – Rated capacity of 1500 GPM (5800 L/min) or greater; Light Blue

Class A – Rated capacity of 1000 – 1499 GPM (3785 – 5675 L/min); Green

Class B – Rated Capacity of 500 – 999 GPM (1900 – 3780 L/min); Orange

Class C – Rated Capacity of less than 500 GPM (1900 L/min); Red

5.5 Cathodic Protection of Water Distribution Piping

The following shall be used as the minimum standard for the design of cathodic protection systems for use in preventing external corrosion of metallic watermains, metallic fitting, hydrants, and service connections.

Use of materials and procedures other than those specified shall not be permitted unless they are proven to be equivalent or superior.

5.5.1 New Ductile Iron Watermains

All new ductile watermains shall be cathodically protected with sacrificial anodes designed for a minimum life of 20 years.

5.5.2 Zinc Anode Requirements

Where soil resistivities are less than 2000 ohm-cm packaged zinc anodes shall be used on all metallic fittings, hydrants and metallic service connections.

5.5.2.1 Piping

Packaged 10.9 Kg (24 lb.) zinc anodes shall be installed on all new ductile iron watermains. Anode spacing shall be determined according to pipe diameter in **Table 31** below.

Table 31: Zinc Anode Spacing (Soil Resistivity < 2000 ohm-cm)

Pipe Diameter (mm)	Anode Spacing (m)
100	12
150	8
200	6
250	5
300	4
400	3
600	2

5.5.2.2 Valves and Fittings

One (1) packaged 10.9 Kg (24 lb.) zinc anode shall be installed on each metallic fitting. Multiple fittings (up to 4 maximum) can be protected by a single anode if they are all located within 3.0m of each other. Valves and fittings that are manufactured with a coating that protects against corrosion do not require an anode.

5.5.2.3 Hydrants

At least one (1) packaged 10.9 Kg (24 lb.) zinc anode shall be installed on each hydrant lateral. Additional anodes shall be installed to maintain the anode spacing requirements in **Table 31 Section 5.5.2.1.**

5.5.2.4 Copper Services

One (1) packaged 10.9 Kg (24 lb.) zinc anode shall be installed on the first 6.0m of every water service. Copper water services longer than 6.0m in length shall receive one (1) additional anode for each 6.0m of additional length or fraction thereof. When replacing a watermain, one (1) packaged 10.9 Kg (24 lb.) zinc anode shall be installed on all exposed copper services.

5.5.3 Magnesium Requirements

Where soil resistivities are greater than 2000 ohm-cm packaged magnesium anodes shall be used on all metallic fittings, hydrants and metallic service connections.

5.5.3.1 Piping

Packaged 14.5 Kg (32 lb.) magnesium anodes shall be installed on all new ductile iron watermains. Anode spacing shall be determined according to pipe diameter listed in **Table 32** below.

Table 32: Magnesium Anode Spacing (Soil Resistivity > 2000 ohm-cm)

Pipe Diameter (mm)	Anode Spacing (m)
100	23
150	15
200	11
250	9
300	8
350	7
400	6
600	5

5.5.3.2 Valves and Fittings

One (1) packaged 14.5 Kg (32 lb.) magnesium anode shall be installed on each metallic fitting. Multiple fittings (up to four (4) maximum) can be protected by a single anode if they are all located within 3.0m of each other. Valves and fittings that are manufactured with a coating that protects against corrosion do not require an anode.

5.5.3.3 Hydrants

At least one (1) packaged 14.5 Kg (32 lb.) magnesium anode shall be installed on each hydrant. Additional anodes shall be installed to maintain anode spacing requirements in **Table 32 Section 5.5.3.1.**

5.5.3.4 Copper Services

One (1) packaged 14.5 Kg (32 lb.) magnesium anode shall be installed on the first 6.0m of every water service. Copper water services longer than 20m in length shall receive one (1) additional anode for each 6.0m of additional length or fraction thereof. When replacing a watermain, one (1) packaged 14.5 Kg (32 lb.) magnesium anode shall be installed on all exposed copper services.

5.5.4 Test Stations

Test stations shall be installed for the purpose of monitoring the effectiveness of cathodic protection.

Test station type may be either flush-mount or post-mount, as specified by the contract administrator. Typically, test stations shall be of the post-mount type in residential areas and flush-mount in downtown areas.

Test stations shall be located within 30m of each end of the watermain, and at maximum intervals of 300m along the watermain route, with no less than one test station per subdivision block.

Test stations shall be located along the hydrant line, at a distance of 2.0m from the hydrant.

Post-mount test stations shall be installed where they will not interfere with and/or be a hazard to pedestrian or vehicular traffic.

Test stations shall not be located in asphalt or driveways.

5.5.5 New PVC Watermains

All metallic structures associated with the new PVC watermains shall be cathodically protected using packaged zinc anodes.

5.5.5.1 Valves and Fittings

One (1) packaged 10.9 Kg zinc anode shall be installed on each metallic fitting. Multiple fittings (up to four (4) maximum) can be protected by a single anode if they are all located within 3.0m of each other. Valves and fittings that are manufactured with a coating that protects against corrosion do not require an anode.

5.5.5.2 Hydrants

At least one (1) packaged 10.9 Kg (24 lb.) zinc anode shall be installed on each hydrant lateral. Additional anodes shall be installed to maintain the anode spacing requirements in **Table 31 in Section 5.5.2.1.**

5.5.5.3 Copper services

One (1) prepackaged 10.9 Kg (24 lb.) zinc anode shall be installed on the first 6.0m of every water service.

Copper water services longer than 6.0m in length shall receive one (1) additional anode for each 6.0m of additional length or fraction thereof.

When replacing a watermain, one (1) packaged 10.9 Kg (24 lb.) zinc anode shall be installed on all exposed copper services.

5.5.6 Existing Watermains

Whenever an existing metallic structure associated with the watermain system is being serviced, repaired or replaced, cathodic protection must be employed.

5.5.6.1 Ductile and Grey Cast Iron Watermains

One (1) packaged 14.5 Kg magnesium anode shall be installed at any excavation on existing ductile and cast-iron piping systems, including repair/replacement sites of mains, services, valves, and hydrants, and at crossings with new pipes. Additional anodes shall be installed if the exposed section of pipe exceeds the anode spacing requirements specified in **Table 32 in Section 5.5.3.1.**

All exposed sections of metallic pipe and couplings must be bonded.

5.5.6.2 PVC Watermains

Packaged zinc anodes shall be installed at all excavations of previously unprotected metallic components of PVC watermains, according to the requirements of **Section 5.5.5.**

6. TRANSPORTATION SYSTEM

6.1 Road Classification

6.1.1 General

Roads are to be designed, commencing at the draft plan stage, to geometric standards established by the City of Sault Ste. Marie described herein. In situations not covered by the enclosed standards and specifications, the following documents must be referenced:

- Municipal Works Design Manual
- Geometric Design Guide for Canadian Roads (Transportation Association of Canada)
- Geometric Design Standards for Ontario Highways (MTO)
- Roadside Safety Manual (MTO)
- Ontario Provincial Standards and Drawings

6.1.2 Conceptual Review

Conceptual plans will be reviewed prior to draft plan approval, however the concept plan must include proper design criteria, including preliminary road alignments, horizontal curves, super elevation, etc. The more detailed the preliminary design the more accurate the comments.

6.1.3 Road Classification

The following are the six City of Sault Ste. Marie standard road classes:

- Urban Arterial
- Urban Collector
- Urban Local
- Rural Arterial
- Rural Collector
- Rural Local

The standard road cross section and utility locations are shown in Drawing number _. The City of Sault Ste. Marie's Official Plan/ Transportation Master Plan provides information detailing the location of both rural and urban areas.

6.1.3.1 Road Classification Description

Arterial Streets

Arterial streets are designed to facilitate the safe movement of large volumes of traffic at a moderate rate of speed over extended distances. A right of way width of up to 30.48m shall be protected for arterial streets. Access shall be restricted to other arterial streets, collector streets, and streets serving major commercial/industrial uses. Access from abutting uses0 shall be controlled and permitted only where approved by the Director of Engineering.

Collector Streets

Collector Streets are designed to facilitate the safe movement of traffic from residential, commercial, and industrial areas to or from the arterial street network. A right of way width of up to 24.38m shall be protected for collector streets. Limited access is permitted from abutting uses subject to the approval of the Director of Engineering.

Local Streets

Local Streets are designed to facilitate the safe movement of traffic within a residential area. A right of way width of up to 20.11m shall be protected for local streets. Individual access from abutting land uses is permitted. Local streets shall be designed to discourage through traffic, thus, preserving their usage as access to the abutting land uses and enhancing safety.

6.1.3.2 Determination of Road Classification

The Official Plan and the City of Sault Ste. Marie Transportation Master Plan must be referenced in addition to the traffic volumes when determining the proposed road classification.

Traffic Volumes forecasts at the Draft Plan Stage will be estimated based on ten (10) vehicle trips per dwelling unit plus expected through traffic from the existing road network. Trip generation for various land uses shall be determined using the Institute of Transportation Engineers Trip Generation Manual (current edition) or approved equal publication. Traffic distribution and volume forecast data should be described in conceptual plans. **Table 33** below shows examples for the six road classifications in Sault Ste Marie.

Table 33: Road Classification Examples for Sault Ste Marie

Road Classification	Road Sub Class	Examples
Urban Arterial	Major Arterial	Wellington Street, Great Northern Road, Second Line, Carmen's Way, Trunk Road
	Urban Boulevard	Bay Street, Queen Street, Wallace Terrace, MacDonald Ave
Urban Collector	N/A	Northern Ave, North Street, Goulais Ave, Sackville Road
Urban Local	Residential Street	Elizabeth St, Lake St, Prentice Ave
	Industrial Street	Industrial Park Crescent, Yates Ave
Rural Arterial	N/A	Second Line west of Leigh's Bay Road
Rural Collector	N/A	Fourth Line, Old Garden River Road, Allen's Side Road
Rural Local	N/A	Base Line, Old Goulais Bay Road

6.1.4 Class "B" Roads

Class "B" Roads may be constructed where permitted by the Subdivision Agreement. This type of road shall consist of a 6.7m width of HL4 asphalt, 50mm thick, with 1.2m paved shoulders on both sides. The road base under both the pavement and shoulders shall be as specified in **Section 6.2** below. The cross-section of the road and ditches is indicated on the standard City drawing for Class "B" Roads.

Testing cost of the asphalt mix is to be paid by the Subdivider or Contractor.

6.1.5 Specifications for Drivable Gravel Roads for New Subdivision

Road(s) in a land development project which is in the construction phase shall be constructed to a "drivable gravel standard" prior to the issuance of building permits for lots in the development. The following conditions shall be met to meet the drivable gravel road standard:

- The design engineer shall certify that the road is capable of carrying the anticipated loading of construction traffic at this partially completed stage.
- All clearing, brushing and excavation of the road allowance must be complete.
- Granular subbase material must be in place up to the designated elevation for top of granular subbase as indicated on the construction drawings.
- The granular subbase material road base shall be compacted to 96% proctor density and be graded to have sufficient crown to provide adequate drainage for the road.
- The road base granular shall be constructed to full design width of the proposed road and all dead-end roads shall have a turning basin of adequate size to accommodate emergency vehicles and Public Works maintenance equipment (12m centerline radius).
- All manholes, catch basins, valve boxes and other appurtenances shall be lowered to be flush with the gravel road surface. Manholes may be temporarily covered with steel plates in lieu of frames and covers if necessary to accommodate this requirement. The steel plates shall have steel legs or lugs attached to prevent being pushed off the manhole structure.
- The storm water collection system which is proposed for the completed road shall be complete to the extent that it is operational and can provide adequate drainage of the gravel road.
- The road shall be graded to provide adequate drainage into the storm water collection system.
- The developer of the land shall maintain the road in a driveable state at all times and shall take whatever action is necessary to ensure proper drainage of the road.
- The developer shall ensure that any or all underground utilities are properly covered and that all construction materials and construction debris are removed from the road allowance.
- The developer shall install temporary traffic control and street name signs at all intersections.

The developer shall carry out the above-noted requirements prior to the Engineering Division notifying the Chief Building Official that "sufficient work has been carried out by the developer so as to warrant this issuance of building permits for the lots in a development".

Following the issuance of building permits the developer will be responsible for snow plowing operations for the roads within the development on which building permits have been issued, including snow clearing around all hydrants, as well as any roads providing access to the said road, until such time that the base lift of asphalt has been placed. After the base lift of asphalt has been placed, the Public Works Division will snow plow these roads, with all plowing being completed on a "non-priority basis" until Acceptance has been granted by the City.

Any additional costs incurred by the Public Works Division due to non-compliance with the above-noted requirements will be chargeable to the developer of the land.

6.2 Roadway Design Criteria

6.2.1 Structural Design

6.2.1.1 Road Pavement Design and Geotechnical Report

A subsurface geotechnical engineering study shall be completed for all new roadway designs. The recommendation provided therein shall be used in the design of the roadway, meeting the requirements as stipulated herein as a minimum.

A road pavement design report prepared by a competent Geotechnical Investigative firm shall be required for new roads. The report should include an investigative report and recommendations based on soil tests conducted on the underlying strata and a pavement design in accordance with the Canadian Good Roads Association publication, "A Guide to the Structural Design of Flexible and Rigid Pavements in Canada."

Pavement designs must be capable of supporting the loads imposed by heavy truck traffic with only the base lift of asphalt in place (i.e. before the top lift is applied).

The design report must consider the effect of existing and future services located under the roadbed. The final geotechnical report must be submitted to the City of Sault Ste. Marie along with the first submission of drawings.

The submission of these reports shall be in accordance with **Section 8.**

6.2.1.2 Granular Subbase Course

The sub-base shall be free from organic or frost susceptible material.

The granular subbase should be applied in accordance with the pavement design/geotechnical report with the minimum values being as provided in **Table 34** below.

Table 34: Minimum Depth of Subbase Course

SOIL	DEPTH OF SUBBASE COURSE GRANULARS IBF No.3 NUTSLAG or BALLAST ROCK
Clay	600 mm
Silt	600 mm
Muskeg	Remove full depth of muskeg and replace with Granular "B"

6.2.1.3 Upper Base Course

The granular base course shall consist of a total depth of 150mm Granular "A". 75mm depth of Granular "A" is to be applied before preliminary acceptance and the remaining 75mm is to be applied prior to paving after contaminating materials have been removed and the road graded to proper cross-section and grade.

6.2.1.4 Asphalt

The mix design for all hot mix asphalt pavements shall be approved by the Director of Engineering prior to placing. The minimum thickness of hot mix is as follows;

Arterial Roads

50mm compacted depth Dense Friction Course (DFC) surface.

100mm compacted depth Hot Dense Bituminous Course (HDBC) base course.

Collector Roads

50mm compacted depth HL-3 surface.

100mm compacted depth HL-8 base course.

Local Roads

40mm compacted HL-3 surface.

50mm compacted HL-3 base course.

6.2.1.5 Tack Coat

A bitumen tack coat shall be applied to the top surface of the base course asphalt in accordance with OPSS.MUNI 310 prior to placement of the wear course asphalt.

Paved roadways with curb and gutter shall not be left indefinitely with only one (1) layer of asphalt without suitable arrangements made to eliminate standing water on the pavement. Any such arrangements to disperse the standing water shall be proposed to the Engineering Division for approval prior to any pavement being laid. In the event that suitable arrangements to disperse the standing water are not approved then the second layer of asphalt paving must be placed immediately. The responsibility for the repair of any damage to the finished roadway shall remain with the developer until final acceptance has been granted.

6.2.1.6 Roadway Minimum Performance Standards

All roadways shall be designed to satisfy the following minimum performance standards:

- Pavement, curbs, sewer manholes, catch basins shall not be subject to cumulative damage from movement due to frost action.
- The pavement shall not require resurfacing for at least fifteen (15) years.
- All pavements shall be warranted by the developer for a minimum period of two (2) years from the date of installation of the second lift. (This requirement is subject to the acceptance provisions for surface works contained in this document)

6.2.2 Geometric Design

6.2.2.1 Vertical and Horizontal Alignment

All road alignments shall be in accordance with geometric design standards (TAC or MTO) to produce safe traffic flow at the design speed. Designs should be based on a normal cross fall, however super elevation will be permitted depending upon road classification.

The minimum longitudinal grade of road centerline shall be 0.3%, however the minimum longitudinal grade of curb and gutter line shall be 0.5%. The standard roadway cross fall shall be 2%. Vertical curves are required where longitudinal grades change by more than 1.0%.

Road cross fall is to be adjusted at sag curves and detailed on the plans as necessary to maintain a minimum 0.5% grade along gutter line to catch basins. In the case of semi-urban sections, roadside ditch grades shall be designed at 1% minimum slope.

For accommodating major storms, the design profiles shall minimize the number of sag curves where possible. The limiting depth of flow on the roadway shall be 300mm and major overland flow routes are to be directed to coincide with public lands (parks, walkways, etc.).

In Cul de-sacs, a minimum grade of 0.5% should be provided around the longest curb and gutter.

The maximum grade shall be 7% on all streets unless otherwise approved by the Director of Engineering. To maintain a route for the major storm drainage system, sags in roadways between intersections are not acceptable, unless a suitable overland outlet is provided.

Where required around 3 degrees or greater curves on collector roads, the road shall be superelevated at the crown slope with the adverse crown slope removed. Transition from the normal crown to superelevation shall take place over the distance of 30.5m from both ends of the curve.

Table 35 below shows the geometric design features for various road classifications. For more design speeds and superelevation's refer to the Transportation Association of Canada (TAC) Geometric Design Guide (GDG) for Canadian Roads.

Table 35: Geometric Features for Road Classes

ROAD DESIGN, GEOMETRIC FEATURES							
		Urban			Rural		
		Local	Collector	Arterial	Local	Collector	Arterial
Design Speed (km/h)		60	70	80	80	80	90
Posted Speed (km/h)		50	50-60	60-70	50	60	80
Min. Super-elevated Horizontal Curve Radius (m)	**e = -0.02**	210	300	420	420	420	750
	e = 0.00	190	280	400	400	400	475
	e = 0.02	170	230	320	320	320	420
	e = 0.03	N.C.	220	300	N.C.	300	400
	e = 0.04	N.C.	200	280	N.C.	280	380
	e = 0.06	N.C.	190	240	N.C.	240	340
Min. Stopping Sight Distance (m)		130	130	180	130	130	260
Min. Crest "K" Value (m)		15	25	40	40	40	50
Min. Sag "K" Value (m) (with streetlights)		8	25	40	40	40	40
Grade (%)	**- min.**	0.3	0.3	0.3	0.3	0.3	0.3
	- max.	*7.0	7.0	7.0	7.0	7.0	7.0

*Note: e = Pavement super-elevation (tangent of the angle), k = The length of a section of curve measured horizontally over which there is a 1% change of gradient, N.C. = Normal Crown (i.e. superelevation not normally applied).
*Note: A maximum super elevation of 0.02 is recommended for urban local roads and a maximum of 0.06 for all other urban roads by the Transportation Association of Canada (TAC).

6.2.2.2 Integration of Design Features

The designer should observe the following guidelines when combining various components such as horizontal and vertical alignment:

- The use of minimum radius should be avoided wherever possible, since this represents the limiting condition.

- A sharp curve should not be introduced at the end of a long tangent;
- Sudden changes from long radius to short radius (i.e. compound curves) should be avoided;
- At the end of a long tangent section, a transition of gradually decreasing radius should be introduced to allow the driver to adjust his/her speed to the new condition. The additional length provides the opportunity for reducing speed safely.
- Sharp curves should not be introduced on high fills. In the absence of physical objects above the roadway, a driver may have difficulty in estimating the extent of the radius and fail to adjust to the conditions;
- Spirals should be used wherever possible rather than compounding circular curves;
- Abrupt reversal in alignment should be avoided. When reverse curves are too close it is difficult to super-elevate them adequately, resulting in hazardous and erratic operation. A reversal in alignment can be suitably designed by introducing back-to-back spirals of sufficient length between two circular curves.

Where it is necessary to change the widths of medians and shoulders, curvilinear tapers rather than tangents should be used to ensure smooth gradual tapers so as to appear to be a natural transition to the driver.

6.2.2.3 Cul-de-sacs/ Turning Basins

Permanent turning basins are to conform to the City of Sault Ste Marie standard turnaround detail drawing _.

A minimum grade of 0.5% is to be maintained along gutter line. Gutter line grades to be detailed on drawings.

Temporary turning basins, in accordance with the City of Sault Ste Marie standard drawings _, shall be provided at the limits of each phase where a temporary dead-end section of roadway would otherwise result. Where feasible, the temporary turning basin should be accommodated on lands beyond the phase boundary. If this is not feasible, the turning basin should be offset to one side of the roadway, so as to impact as few lots as possible.

When future phases of any subdivision are not constructed within a one-year time frame, all cul-de-sacs will be required to be paved with base course asphalt.

Easements are required for the purpose of constructing temporary turning basins outside of the public road system and shall be provided to the City of Sault Ste. Marie to be disposed of when no longer required. The easement shall be deeded to the City who will relinquish its interest in the lands at such time as the lands are no longer required.

Cul-de-Sacs Dimensions

- Bulb radius at back of curb - 14m
- Bulb radius at property line - 17.5m
- Bulb out returns - 20m.

6.2.2.4 Driveways

Access to the public street must comply with the City of Sault Ste. Marie By-Law 2020-070 and 77-200.

Driveway locations are required to be illustrated on the Engineering Plans for multi-residential lots.

All access driveways shall be located a minimum of 1.0m from utility poles, hydro transformers, catch basins, watermain valves, telephone maintenance holes and Bell and Cable T.V. junction boxes, and 2.0m away from hydrants.

Material Depths

- Minimum 250mm compacted depth of Granular B type I or II.
- Minimum 150 mm compacted depth Granular "A"
- 50mm compacted depth HL3.

6.2.2.5 Intersections

Intersection spacing shall be established on the basis of providing safe stopping, turning and crossing sight distances in accordance with the stipulated design speed.

An intersection angle of 90 degrees is preferred, but the minimum allowable angle shall be 70 degrees.

Gradients on through streets are to have a continuous profile. Maximum and minimum grades at an intersection are 8.0% and 0.5% respectively.

Gradients on all other streets must have 15m at a maximum of 2% prior to entering the intersection.

Intersections at Collector/Collector, Arterial/Arterial, and Collector/Arterial shall contain a 3.0m by 3.0m setback from the intersecting property lines to facilitate a day lighting triangle. A larger day lighting triangle may be requested by the Director of Engineering.

The edge of pavement intersection radii for the intersection of the various roadway classes shall be in accordance with **Table 36** below.

Table 36: Intersection Radii (From Street Class to Street Class)

From	To	Edge of Pavement Minimum Radii (m)
Rural Residential Semi-Urban Urban Residential	Local Collector	7.5
Collector	Any higher Class Road	12.0
Arterial	Any higher Class Road	15.0

6.2.2.6 Side Slopes in Cuts or Fills

Where the road is through cuts or on fills, the side slopes shall be 2.5 horizontal to 1 vertical. On fills the road shall have a normal cross-section for the full width of the road allowance. In cuts the side slopes shall not start closer than 0.61m from the outside edge of the sidewalk or back of curb if no side wall is present. All driveways are not to be more than 76mm above or below the crown of the road at the street line.

6.2.3 Access

6.2.3.1 Emergency Access

Phases shall not terminate in dead end streets, or in cul-de-sacs longer than 250m measured from the intersecting street line to the widening of the cul-de- sac right-of-way.

A temporary roadway longer than 250m is acceptable provided that a second temporary access is provided to either loop the street or limit the cul-de- sac length to 250m, or the linkage will be made through an adjoining phase in the next development.

6.2.3.2 Access to Arterial Roads

Parcels with greater than 100m of street line frontage on an arterial road shall be permitted one access to the arterial road for every full 100m of frontage.

Existing parcels of land with less than 100m of street line frontage, but with street lines only on an arterial road or abutting only arterial roads, shall be permitted one access.

6.2.3.3 Location of Access

Arterials

The location of all access to primary arterials shall be determined by the Director of Engineering, based on considerations of safety, protection of vehicular capacity of the arterial and sound engineering practice.

Access to the arterial roadway shall be located as requested by the applicant, except that where in the opinion of the Director of Engineering the access would unduly reduce safety or capacity of the arterial. The Director of Engineering will indicate an alternate location.

Locational Criteria

Locational criteria shall include the following:

- Where the speed limit is 80 km/h or more:
  - The minimum sight distance shall be as specified in **Table 35 in Section 6.2.2.1.**
  - Access shall not be within a daylighting triangle.
  - Access shall not be on a turning roadway at a channelized intersection.
  - Access shall not be on a grade of more than 4%.
- Where the speed limit is less than 80 km/h:
  - The minimum sight distance shall be as specified in **Table 35 in Section 6.2.2.1.**
  - Access shall not be within a daylighting triangle.
  - Access shall not be on a turning roadway at a channelized intersection.

Width of Access

The width of access for Light Industrial and Apartments shall be 7.2m.

The access width for Heavy Industrial and Commercial shall be 9.1m.

6.2.4 Road Closures

If the development construction requires an existing city road/street to be closed the Developer/Contractor must submit a “Road/Sidewalk Closure” application to the Engineering Division for approval prior to the closure. This requirement shall apply to the closure of a single lane of traffic, and/or a full road closure. Applications must be submitted twenty-one (21) days prior to the planned date of closure.

If a full road closure is required detour signage shall be mandatory. Road closures greater than 72 hours requires the approval of the council.

6.3 Curb and Gutter (Roadways)

6.3.1 Curb Radius

The minimum curb radius for the intersection of local streets shall be 7.6m. This minimum radius shall be increased as required when local streets intersect at angles other than 90° and when the intersection involves collector or arterial streets.

When intersections involve collector or arterial streets the intersection radii shall be determined by using the appropriate turning movement design templates for the type of vehicular traffic which could be reasonably expected to use the intersection.

The minimum curb radius for intersections involving collector roads shall be 9.14m.

The minimum curb radius for intersections involving arterial roads shall be 12.19m.

Curbs shall be flush with asphalt from 1.0m abutting a sidewalk.

6.3.2 Gutters

The gutter should be hydraulically efficient with a smooth service texture and a minimum grade of 0.5%.

6.3.3 Construction

The curb and gutter shall be constructed just prior to paving in accordance with OPSS 600.010 or 600.070. It shall be struck off and reinforced with 1-15M continuous rebar for the length of the curb cut at driveways and reinforced behind catch basins extruding 600mm on each side.

Where barrier curbs are specified, curb depressions shall be provided at driveways and sidewalk ramp locations.

Layout and construction of curbs and gutters shall be in accordance with OPSS 600.070 or OPSD 600.010.

6.4 Sidewalks

6.4.1 Intersections

At intersections, the sidewalks shall extend until they meet the curb of the intersecting street. The space between two intersecting sidewalks and the curb at the corners shall be filled in with concrete sidewalk construction. The sidewalk is to be dimensioned and reinforced. It shall be constructed on a 150mm base of Granular “A” Crushed Gravel, 300mm Granular “B” Type II or IBF No.3 Nut Slag or Crushed Ballast Rock and separated from the subgrade with a Class 1 non-woven geotextile.

The location of pedestrian crossings at intersections will be governed by pedestrian movements and the need to avoid conflicts with turning vehicles. Pedestrian crossing shall be designed per OPSD details and shall be AODA compliant (See **Section 6.4.8**).

Sidewalk ramps at signalized intersections shall include accessible pedestrian poles and tactile walking surface indicators as per OPSD 310.030 and **Section 6.4.8.**

Concrete sidewalk ramps at non-signalized intersections shall include tactile walking surface indicators as per OPSD 310.033 and **Section 6.4.8.**

6.4.2 Right-of-way

The location of sidewalks within the right-of-way will be determined in consultation with the City of Sault Ste. Marie giving due regard to the pedestrian traffic being generated and the Accessibility for Ontarians with Disabilities Act.

6.4.3 Access

Sidewalks are required to facilitate access to neighbourhood schools and at all Canada Post mailboxes.

Where it has been determined by the City that there is a need, sidewalk ramps and sidewalk stubs shall be constructed to link existing sidewalks to the curb. Any connecting sidewalks and ramps needed on the opposite side of the roadway to provide continuity for the pedestrian shall also be included.

6.4.4 Entrances

For commercial/industrial frontages, entrance locations shall be determined at the site plan approval stage. All sidewalks and walkways are to be continuous through driveway entrances and shall be in accordance with OPSD 310.050 and OPSD 350.010. Providing commercial sidewalks across each entrance will be evaluated by the City on a case-by-case basis.

Curbs lining entrances shall be depressed flush with the sidewalk 0.6m from its edge.

6.4.5 General Sidewalk Placements

Generally, sidewalks will be required in accordance with the criteria in **Table 37** below.

Table 37: Sidewalk Placement

Road Classification	Adjacent Land Use	Sidewalk Required
Residential	Low and Medium Density Residential, High Density Residential, All Other Land Uses	At the discretion of the Director of Engineering
Collector	All Land Uses	One side of street only
Arterial	All Land Uses	Both sides of Street

A sidewalk is not required on dead end roadways less than 150 meters in length unless through pedestrian access is required from the roadway to a park, roadway to roadway, etc. The 150 meters is measured from the intersecting street line to the nearest point of the cul-de-sac right-of-way.

6.4.6 Dimensions and Cross-section

The sidewalks shall be 1.5m wide with the edge located 0.61m from the property line. They shall slope down to the curb at 20mm/m (2%). They shall be constructed along one or both sides of the streets as required by the Subdivision Agreement. The running slope of sidewalks should not exceed 20:1 (5%) H:V unless unpractical due to the physical terrain.

6.4.6.1 Applicable Standards

OPSD 310.010 and OPSD 310.020 for sidewalk adjacent to curbs.

Residential entrances shall be in accordance with OPSD 351.010.

6.4.7 Sidewalk Closures

If the development construction requires an existing City sidewalk to be closed the following shall apply:

- If the sidewalk is located in a business district, or services a large volume of pedestrian traffic, the Developer/Contractor must submit a “Road/Sidewalk Closure” application to the Engineering Division for approval prior to the closure. Applications must be submitted fourteen (14) days prior to the planned date of closure.
- All closed sidewalks must be identified with a “Sidewalk Closed” sign placed at the nearest point of sidewalk intersection on either side of the closed area so that pedestrians can take an alternate route without having to back track.
- The portion of sidewalk that is intended to be closed must be barricaded so that pedestrians cannot unintentionally access it (e.g. at the excavation point, start of construction zone);
- Barricades must remain in place until the new sidewalk can be poured or until a temporary cold patch asphalt surface is installed. A temporary gravel sidewalk surface will not be permitted. The entire perimeter of the excavation must be barricaded, unless it is located inside a closed section of road.

6.4.8 Tactile Warning Plates

Tactile walking surface indicator panels shall comply with the Ontario Accessibility Act and shall conform to OPSD 310.039.

Tactile warning plates shall be placed in all locations specified by the AODA. Tactile plates shall be of cast iron material. Tactile warning plates shall be curved to match the back of curb radii of applicable.

6.5 Parking Lots

In the instance where the construction of parking lots falls under the jurisdiction of the Engineering Division as is the case in Site Plan Control Agreements, Condominium Agreements and Development Agreements, such parking lots shall be constructed to the following standards:

- See **Section 4.2.4** for parking lot grading requirements.
- All paved parking area and driveways shall have a minimum of 50mm thick HL3 or HL4 asphalt paving on 150mm thick granular "A" base over a suitable granular sub-base.
- Driveways and/or parking areas which are subject to heavy loads or high traffic volumes shall be designed and constructed for such traffic.
- The Engineering Division may require the design of proposed parking areas to be certified by a professional engineer.
- All driveways to parking lots shall be curbed to prevent vehicular encroachment onto adjacent public sidewalks and boulevards, see **Section 6.4.4.**
- All parking lot illumination shall meet the minimum requirements of I.E.S. (Illuminating Engineering Society) guidelines and shall be installed in accordance with PUC Standards.

6.6 Cycling Facilities

6.6.1 General

Bicycle movements shall generally be accommodated in the road right of way (ROW). Consideration shall be given for the inclusion of bicycle lanes, in addition to those which form part of the road system, in the

ROW for new arterial and collector roads, and the addition of facilities for bicycles on existing arterial and collector roads where it is feasible to do so.

Dedicated bike lanes may be required where an existing commuter route exists, or where an extension to the commuter route is being proposed by the Engineering and/or Planning Divisions. Bike lane widths and configurations shall be designed in accordance with the Transportation Association of Canada "Bikeway Traffic Control Guidelines for Canada" and shall accommodate all required vehicle lanes and parking along the commuter route. The design of cycling facilities shall conform to the Sault Ste Marie Cycling Master Plan Section 4.2, Design Parameters.

The operating envelope for a cyclist consists of the actual space occupied by a bicycle and cyclist, and the manoeuvring allowance to accommodate natural side to side movement. This brings the total operating space to 1.2m wide, and 2.5m tall. The corresponding minimum bike lane widths are listed below in **Section 6.6.2.**

6.6.2 Bike Lane Width

Minimum Bike Lane Width with on road parking, higher speed, or higher volume roads shall be: 1.8m.

Minimum Bike Lane Width with no parking shall be 1.5m.

Minimum Bike Lane Width for two-way bicycle traffic: 2.2 – 2.5m

6.6.3 On Road

The following guidelines shall be followed in the design of on road cycling facilities, with the supplementary addition of the guidelines listed in the City of Sault Ste Marie Cycling Master Plan Section 4.2.

6.6.3.1 Gradient

On steeper grades, additional width is recommended to allow cyclists extra maneuvering space to make corrections to their trajectory when descending downhill at higher speeds, or to accommodate how cyclists may weave from side to side to maintain balance when ascending uphill at lower speeds. **Table 38** below provides a guideline on extra cycling facility widths that may be required. In locations where adding extra width may not be possible, a selection of a parallel route may be considered, or a combination of edge lines, motor vehicle passing signs, and share the road signs should be considered.

Table 38: Extra Cycling Facility Width Required on Grades

	Length [m]		
Grade [%]	25-75	75-150	150+
3-6	-	20cm	30cm
6-9	20cm	30cm	40cm
9+	30cm	40cm	50cm

6.6.3.2 Design Speed

New or improved City roads will be designed to the roadway standards herein, which exceeds the minimum design parameters related to speed for cycling facilities. On-road cycling networks utilize existing roadways and are generally constructed to a design speed of 70 to 100 km/h for motorized vehicles (20 km/h over the posted speed limit). For these roads, sight distances and curvatures should, in most cases, exceed the minimum bicycle route design parameters. In addition, in most cases, a cyclist's eye height will be above that of the driver in a typical automobile. Therefore, the cyclist will be able to observe hazards at a greater distance than a motorist. Some existing roads may not. In these cases, additional signing and/or pavement

marking to caution motorists and cyclists should be considered when implementing or updating cycling facilities.

6.6.3.3 Stopping Sight Distance

On road cycling facilities should be on roads that provide for adequate sight lines to accommodate minimum stopping distances required for motor vehicles. Minimum stopping sight distance is the least visible distance required by a driver to bring the vehicle to a stop before reaching the object in the vehicles path. **Table 39** below sets out MTO's minimum motor vehicle stopping sight distances based on speed.

Table 39: Minimum Motor Vehicle Stopping Sight Distance on Wet Pavement

Speed		**Perception and Brake Reaction**		**Coefficient of Friction on wet pavement**	**Braking distance on level pavement**	**S-min stopping sight distance**	
Design	Assumed Conditions	Time	Distance			Calculated	Rounded
Km/h	Km/h	s	m	f	m	m	m
40	40	2.5	28	0.380	17	45	45
50	50	2.5	35	0.358	27	62	65
60	60	2.5	42	0.337	42	84	85
70	70	2.5	49	0.323	60	109	110
80	79	2.5	55	0.312	79	134	135
90	87	2.5	60	0.304	98	158	160
100	95	2.5	66	0.296	120	186	185
110	102	2.5	71	0.290	141	212	215

6.6.3.4 Horizontal Alignment

With respect to horizontal alignments, the design of on road cycling facilities are typically governed by the controls and design considerations for accommodating motor vehicles. It is expected that the existing horizontal alignment of roadways should be adequate, or even exceed the minimum requirements for cyclists, assuming the roadways were designed based on MTO's Geometric Design Standards for Ontario Highways, TAC's Geometric Design Guide for Canadian Roads, and these design guidelines. Where this condition does not occur, appropriate signing should be considered (see **Section 6.6.3.6** below) or the road on which the cycling facility will be installed on in the future, shall be reconstructed to current standards.

6.6.3.5 Vertical Alignment

Generally, all vertical alignment standards with respect to roadway design are based on accommodating motor vehicles, which exceed the requirements for bicycles, assuming the roadways were designed based on MTO's Geometric Design Standards for Ontario Highways, TAC's Geometric Design Guide for Canadian Roads, and these design guidelines.

On older roads where sight lines are also an issue because of the horizontal or vertical curvature of the road, additional cautionary signs (see **Section 6.6.3.6** below) may be warranted to restrict manoeuvres by motorists passing cyclists. Reducing the posted speed limit may be another alternative when a particular road segment experiences high motor vehicle volumes (AADT - Annual Average Daily Traffic) and/or commercial vehicle traffic.

6.6.3.6 Signage

When grade lines exceed 8% or sufficient facility width is not available, a combination of edge lines, Motor Vehicle Passing Prohibition signs, and Share the Road sign should be considered. When a no passing zone is specified, the termination of this zone should also be specified by use of a Motor Vehicle Passing Prohibited sign with the supplementary Ends tab sign. On roads where sight lines are also an issue because

of the horizontal or vertical curvature of the road, additional cautionary signs may be warranted to restrict passing manoeuvres.

6.6.4 Off Road

The following guidelines shall be followed in the design of off-road cycling facilities, with the supplementary addition of the guidelines listed in the City of Sault Ste Marie Cycling Master Plan Section 4.2.

6.6.4.1 Gradient

In the design of off-road bicycle routes, there are two major considerations when designing grades:

i) the effort to climb,
ii) and conditions required for a safe descent.

For a cyclist riding a bike without multiple gears (some mountain bikes have upwards of 24 different gears for power and speed variation), it is almost impossible to climb a 50m long 10% grade. Bicycles equipped with multiple gears allow almost every cyclist to climb a 50m 15% grade. However, grades greater than 5% should normally be avoided, and long uphill grades should ideally not exceed 3%. Where possible, on long steep grades it is desirable to introduce relatively flat rest areas approximately every 100m.

6.6.4.2 Design Speed

To ensure that the off-road cycling network is safe for all users, a minimum design speed of 40km/h should be assumed for off-road trails. On descents with steeper grades (exceeding 4%), the design speed should be increased to 60km/h and additional path width should be provided to accommodate the cyclists increased speed.

6.6.4.3 Stopping Sight Distance

Minimum stopping sight distance for both on, and off-road cyclists is the distance required to bring a bicycle to a full controlled stop upon spotting an obstacle. It is a function of the cyclist's perception and reaction time prior to braking, the initial speed of the bicycle, the coefficient of friction between the tires and the bicycle route surface, and the braking capacity of the bicycle. The stopping distance can be calculated using the following formula:

$$S = 0.694V + V2 / 255 (f + G/100)$$

Where: S = stopping distance [m], V = speed [km/h], f = coefficient of friction, G = Grade [%] (upgrade +, downgrade)

Table 40 below illustrates minimum stopping distances for a range of speeds and grades for bicycles. It is based on 2.5 seconds of perception-reaction time and a coefficient of friction (f) of 0.25 that accounts for paved surfaces during wet weather. This coefficient should be reduced by 50% for unpaved surfaces.

Table 40: Minimum Stopping Sight Distance for Cyclists

Grade [%]	Design Speed [km/h]								
	10	15	20	25	30	35	40	45	50
	Minimum Stopping Distance [m]								
+12	8	13	18	-	-	-	-	-	-
+10	8	13	18	24	-	-	-	-	-
+8	8	13	19	25	32	-	-	-	-
+6	8	13	19	25	32	40	-	-	-
+4	8	13	19	26	33	41	49	-	-
+2	8	14	20	26	34	42	51	61	-

0	9	14	20	27	35	44	53	63	74
-2	9	14	21	28	36	45	55	66	77
-4	9	15	21	29	38	47	58	69	81
-6	9	15	22	30	39	50	61	73	86
-8	9	16	23	32	42	53	65	68	92
-10	10	16	24	34	44	56	70	84	100
-12	10	17	26	36	48	61	76	92	110

6.6.4.4 Horizontal Alignment

The minimum radius of a curve on an off-road cycling facility depends on the bicycle speed, superelevation, and coefficient of friction between the bicycle tires and the cycling facility surface. The following formula should be used to determine the minimum radius of horizontal curves:

$$R = V^2/(127 * (e + f))$$

Where: R = radius [m], V = speed of bicycle [km/h], e = super elevation [m/m], f = coefficient of lateral friction

For most applications, the coefficient of lateral friction varies from 0.3 at 25 km/h to 0.22 at 50 km/h, and for unpaved surfaces the coefficient is reduced to 50% of the paved surfaces volume. **Table 41** below provides the coefficient of lateral friction and minimum radius for a range of design speeds and super-elevation rates.

Table 41: Minimum Radii for Paved Trails

Design Cycle Speed [km/h]	Coefficient of lateral friction	Minimum Radius [m] where e=0.02 m/m	Minimum Radius [m] where e=0.05 m/m
25	0.30	15	14
30	0.28	24	21
35	0.27	33	30
40	0.25	47	42
45	0.23	64	57
50	0.22	82	73

When horizontal curves are sharp (i.e. have a very small radius), cycling facility widening should be considered to compensate for the tendency of cyclists to track toward the inside of the curve. **Table 42** below shows the recommended widening of the riding surface on curves.

Table 42: Recommended Widening of Paved Trails

Curvature (m)	Extra width Required (grade = 0 to 3%)
24 to 32	250 mm
16 to 24	500 mm
8 to 16	750 mm
0 to 8	1000 mm

6.6.4.5 Vertical Alignment

The minimum length of crest vertical curves for off-road cycling facilities depends on the minimum stopping sight distance for the design speed of the facility. **Table 43** below shows vertical curve lengths for different design conditions for paved surfaces under wet conditions. Stopping sight distances for unpaved surfaces should be adjusted accordingly to satisfy reduced lateral friction conditions equal to 50% of those for paved surfaces.

As highlighted in **Table 43**, for values above the line, stopping sight distances are greater than the curve length, and L=2S-274/A, where S = minimum stopping sight distance from **Table 40**, and A = algebraic

difference in grades in %. Below the line, stopping sight distances are less than the curve length and $L=AS^2/274$.

Table 43: Crest Vertical Curve Lengths

	Minimum Curve Length [m]								
Change of Grade [%]	10	15	20	25	30	35	40	45	50
2	-	-	-	-	-	-	-	-	11
5	-	-	-	-	15	32	51	71	100
10	-	-	13	27	44	69	102	145	199
15	-	10	22	40	67	104	153	-	-
20	3	14	30	54	-	-	-	-	-
25	6	18	37	-	-	-	-	-	-

The criterion for bicycles on sag curves is comfort, which is expressed in terms of a vertical maximum radial acceleration of 0.3 m/s^2. However, it is important to consider non-illuminated cycling facilities, which might be used by cyclists after dark, by providing them with longer vertical curves. **Table 44** below provides minimum sag curvature values (K, metres) values corresponding to different design speeds based on the equation $K=V^2/390$.

Table 44: Sag Vertical Curve Lengths

Design Speed [km/h]	25	30	35	40	45	50
Minimum Sag Curvature (K), [m]	1.5	2.5	3	4	5	6

6.6.5 Cross Slope

Cross slope is necessary to provide positive drainage of the cycling facility surface. A cycling facility may have a crown or continuous cross slope. It is preferable to use a balanced cross slope on two-way paths for drainage purposes, and to direct cyclists to the right side of the cycling facility. Typical cross slopes depend on the surface type. **Table 45** below provides guidelines on typical cross slopes.

Table 45: Typical Cross Slopes

Surface	Range of Cross Slope
Concrete	1.5% to 2%
Asphalt	2% to 4%
Gravel, Crushed Stone, Earth	2% to 4%

6.6.6 Other Guidelines

For all other cycling facility design parameters including Network Facility Types (i.e. Bike Lanes, Multi Use Pathways, Shared Roadway Facilities, etc.) and Network Design Features (i.e. Intersection Treatments, Bike Lanes Between Two Motor Vehicle Lanes, Bridge Biking Lanes, etc.), refer to the City of Sault Ste Marie Cycling Master Plan Section 4.

6.7 Traffic Generation

Table 46 below shows a summary of the average weekday vehicle trips for different dwelling types.

Table 46: Average Vehicle Trips per Week for Various Dwelling Types

Type of Dwelling Unit	Weekday Average (Trips)
Single Family Detached Unit	10
General Apartment	7
Low-Rise Apartment	6
High-Rise Apartment	5
Condominium	6
Mobile Home	6

6.8 Community Mailboxes

Pedestrian approaches to community mailboxes shall be incorporated into the design of the works to accommodate the mailboxes provided by Canada Post.

At each permanent mailbox location, a concrete pad shall be provided with a concrete walk connecting to both the existing road and sidewalk system. The pad and approaches shall be poured in conjunction with the sidewalk system and shall follow the sidewalk width and thickness dimensions.

A mountable curb in accordance with AODA requirements, including tactile warning plates (see **Section 6.4.8**) for pedestrian access shall be provided.

The community mailbox location will be determined in consultation with Canada Post.

6.9 Landscaping

6.9.1 Boulevard Landscaping

The boulevard shall be that area lying between the shoulder of the road or the concrete curb and the property limits of the adjacent private property not occupied by a sidewalk.

Where detailed on the City's typical road section or directed by the Director of Engineering, boulevards shall be finished with 100 mm of topsoil and nursery sod and shall be watered for 30 days. The requirements for hydro-seeding or sodding of other public areas will be determined by the City Engineer.

Where indicated on the City's typical road section or directed by the Director of Engineering, boulevards shall be finished with surface asphalt paving with a minimum 150mm granular base material.

The boulevard slope shall be a minimum of 2% and a maximum of 10% within the public right of way. The boulevards shall have a uniform rising grade from the finished roadway to the property limits of minimum 2% where feasible. Deviation from this may be permitted depending on the existing contours in the area. The boulevards shall be sodded as outlined in **Section 6.9.2.**

6.9.1.1 Exceptions

Where the distance between the edges of the sidewalk and the curbing is less than one (1) metre, the area may receive an asphalt surface, subject to the approval of the Director of Engineering.

6.9.2 Sodding and Seeding

All areas between the back of the curb and sidewalk shall be sodded (or from back of curb to property line). All lands outside of the roadway to be assumed by the City shall be sodded with the exception of stormwater management facilities and areas shown on the approved landscaping plan.

Prior to the placing of topsoil and sod, the total area shall be fine graded to a uniform surface 100mm minimum grade below controlling grade factors such as curbs, road shoulders, manholes, etc., to allow for the placing of a minimum of 75mm of topsoil and the minimum depth of sod shall be as per OPSD 571. All sub-grades shall be loosened to a depth of 150mm prior to leveling (especially where heavy equipment has been in operation) allowing a bonding of top and sub-soil, for adequate root expansion.

Landscaping shall be free of roots, stones or other foreign debris. Soils infested with seeds or roots of noxious weeds will not be acceptable.

All sod shall be taken from loamy soil, free from weeds, in a healthy growing condition without sign of decay and containing sufficient moisture to maintain vitality during transportation and placing.

Sod shall be laid lengthwise across the face of slopes or parallel to curbs with ends close together. Joints in adjacent rows shall be staggered. Joints and broken sod shall be rolled or tamped to a uniform surface. Sod shall be harvested, delivered and installed within a period of thirty-six (36) hours and shall not be laid in a frozen condition nor laid on frozen soil.

The entire work shall be done in a thorough manner, achieving upon completion a quality natural turf approximately even with the top of the curb (where applicable).

The developer shall be responsible for the care and maintenance of sodded areas for a period of one (1) year from the date of initial acceptance. During this period any defects caused by slope failure, soil compaction or failure of the sod to grow will be repaired, removed and replaced with fresh live sod.

Seeding can only be used in the Right of Way when authorized by the Director of Engineering

All areas of the road allowance not covered with asphalt or concrete shall be prepared with a minimum of 100 mm of compacted topsoil and sodded in accordance with OPSD 571.

6.9.3 Easements

To accommodate the ongoing maintenance of services which are constructed, easements will be required for those services which are outside of normal service corridors. All easements which are provided to the City of Sault Ste. Marie shall be of sufficient width for excavation of the services in conformity with current Occupational Health and Safety Regulations without the need for excavation aids such as trench boxes or sheet piling.

In determining the width of easements required to provide maintenance access to a particular service, the depth of the service and anticipated soil type shall be considered. The minimum easement required shall be wide enough to allow excavation with side slopes of 1:2 or flatter, but no less than 6m. Additional width may be required if a separate maintenance access road is required to access the service, such as along trunk drainage ditches.

6.9.4 Trees

Tree and other landscaping features shall be shown on a landscaping plan to the approval of the City of Sault Ste Marie Parks Division.

One tree shall be planted on each single detached lot and semi-detached lot. The City of Sault Ste Marie Parks division shall be consulted when selecting tree species for planting.

6.10 Transit Facilities

All transit facilities shall be constructed in accordance with the Facility Accessibility Design Standards for the City of Sault Ste. Marie.

The layout and construction of bus bays shall be in accordance with OPSD 501.010. Bus bays shall be located as directed by the Director of Engineering.

6.11 Sign and Traffic Control

All traffic control devices are to conform to the Ontario Traffic Manual and shall meet the requirements of the Highway Traffic Act.

At each intersection, an approved double unit street name blade sign indicating the name of each intersecting street shall be erected. The sign shall be mounted on a galvanized metal post 3.7m long embedded 1.2m in the ground and shall be painted according to a colour scheme approved by the City.

The Developer shall provide all traffic and street signs as required. Signs shall be located in accordance with the Ontario Traffic Manual and shall have diamond grade sheeting.

All traffic and street name signs are to be erected prior to completion of the base course asphalt.

Warning signs with the text “ROAD NOT ASSUMED – USE AT YOUR OWN RISK” are to be placed at each entrance to the development at such time as the base course asphalt is applied. The sign shall be sized such that it is legible from the roadway, however it shall not exceed 3.0m^2 in size.

6.11.1 Local Intersections (2 lanes)

Signs are to be high intensity grade reflectorized sheeting (3M or equivalent) mounted on 150 mm extruded aluminum blanks (blue - anodized). Lettering shall be 100mm (125mm) series “B” Helvetica” (white – upper case).

6.11.2 Major Signalized Intersections

In accordance with Ontario Traffic Manual Book 8, Low-Speed Roadway Identification Signs mounted on the primary traffic signal arm are required at all major signalized intersections. Where the crossing roadway is different to the left and right, the front of the Low-Speed Roadway Identification Sign shall display the name of the road to the right and the back shall display the name of the road to the left and both shall include turn-off arrows.

6.12 Construction

All construction shall be in accordance with the City’s Construction Specifications as well as the Ontario Provincial Standard Specifications and Drawings.

6.13 House Numbering

A 911 numbering plan for subdivisions shall be submitted to the City for approval. The City will provide the Developer with the numbering format upon request.

6.14 Guide Rails and Barricades

Guide rails and barricades shall be installed in accordance with the Transportation Association of Canada (TAC), Geometric Design Guide for Canadian Roads.

6.15 Walkways, Ramps, and Stairs

6.15.1 Walkways and Ramps

Walkways shall be that area lying between the limits of adjacent private properties designated for pedestrian access between streets to parkland, commercial or institutional sites.

The minimum width of the ROW for a walkway shall be 3m, however greater widths may be required to facilitate vehicular access and/or the placement of underground utilities.

Walkways shall have an asphalt surface of minimum 50mm thick.

The Granular 'A' base shall be a minimum 150mm thick.

The Granular 'B' subbase shall be a minimum 300mm thick.

The width of the granular base and the granular sub-base shall be 0.3m wider than the asphalt surface.

All walkways shall be fenced on both sides with a minimum 1.5m high chain link fence along the length of the walkway, with the exception of the portion of the fence that is located within the front yard set-back, which shall be 1.219m in height. The terminal posts shall be installed at the intersecting property line or in a location approved by the City. The chain link fence for all walkways, complete with top rail, shall be installed in accordance with OPSD 972.130. All fence posts and rails are to be galvanized.

Walkways shall be sodded as outlined in **Section 6.9.2**, between the sidewalk and the fence.

The running slope of walkways should not exceed 20:1 H:V (5%) unless unpractical due to the physical terrain. Walkways that have a running slope greater than 20:1 H:V (5%) and elevate the person above the surrounding terrain shall be considered a ramp. The maximum allowable running slope for a ramp shall be 7.5%. The maximum cross slope of a ramp surface shall be 50:1 H:V (2%). Ramp designs shall include all required landings, handrails, and edge protection as defined by the applicable design code.

Adequate lighting will be required to ensure that the walkway is sufficiently illuminated for pedestrian safety purposes.

6.15.2 Stairs

Stairs shall have uniform riser heights (rise) and uniform tread depths (run). The stair riser height shall not be more than 175mm and not less than 125mm. The stair run depth shall not be more than 355mm and not less than 280mm. Handrails shall be installed on both sides of all stairs at a uniform height ranging between 865mm and 965mm above the stair nosing. The materials used for construction shall be approved by the Director of Engineering and be appropriate to the landscaping plan.

7. STREET LIGHTING AND POWER

7.1 Roadway Lighting

Roadway Lighting to be in accordance with OPSS 604 Construction Specification for Installation of Cable, OPSS 615 Construction Specification for Erection of Poles and OPSS 617 Construction Specification for Installation Roadway Luminaires. Any guidelines and standards not covered herein, refer to the Transportation Association of Canada (TAC) Guide for the Design of Roadway Lighting. In addition to these standard specifications, the following shall apply:

All roadway lighting installations should be in accordance with OESC 22.1.

7.1.1 General

This standard is intended to address the lighting of local and collector streets only.

- Illumination of streets of a higher classification will be dealt with on a case-by-case basis.
- A professional engineer shall design street lighting systems.
- Lighting may be required for pedestrian walkways and paths constructed as part of a development. The requirements for such lighting will be considered on a case-by-case basis.
- Developers shall consult with PUC Services Inc. (PUC) about current detailed specifications for all aspects of street lighting hardware.

7.1.2 Qualifications and Approval

All electrical construction shall be done by a certified Electrical Contractor capable of working in accordance with the standards and specifications of PUC Services Inc., Electrical Safety Authority, EUSA, OPSS.MUNI Divion 6 (Electrical), and any other appropriate governing bodies. The Contractor shall apply to these offices for the latest copies of these standards and specifications before commencing any work. All electrical construction shall be inspected by the Electrical Safety Association. The City of Sault Ste Marie Engineering Division shall receive copies of all inspection certificates before acceptance of any work.

All workers and agents employed by the Contractor and working on PUC Services Inc. poles shall be qualified certified electrical power linemen or apprentices-in-training under the on-site, direct supervision of qualified certified power linemen. Comply with specifications for working on Sault Ste. Marie poles.

Any contracting firms shall be members in good standing of the Electrical Utility Safety Association (EUSA).

7.1.3 Streetlight Poles

Poles to be installed shall be in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.8.1.

Light Standards shall have a maximum spacing of 45m with a standard placed at every intersection. Streetlight poles shall be placed on the same side as sidewalks. Where no sidewalk is proposed streetlights shall be placed on the opposite side of the roadway as the watermain. A standard shall be placed at all corners for collector intersections or greater.

Where warranted, the developer's consultant shall determine the correct lighting levels as per Transportation Association of Canada (TAC) guidelines.

A support bracket shall be fastened onto the pole using a 16mm galvanized bolt complete with nut and washer and a 12mm galvanized lag bolt. The center of the base plate shall be approximately 300mm from the top of the pole.

7.1.4 Luminaires

LED luminaries will be used at the direction of PUC Services Supplementary Specifications Electrical Works Section 1.8.2.

The street light intensity shall be as per **Table 47** below.

Table 47: Required Street Light Intensity

Classification Criteria	Rural Local	Urban Local	Urban Collector
Maintained Intensity in the foot-candles at the surface	0.2	0.5	0.9

Street light intensity shall be installed as per **Table 48** and **49** below. The illumination is based on pedestrian activity on the various road types. The Pedestrian Activity Classification shall be specified by the Director of Engineering.

Table 48: Roadway Luminance Levels

Road	Pedestrian Activity	Average Luminance	Uniformity Ratio E_{avg}/E_{min}	Uniformity Ratio E_{max}/E_{min}	Veiling Luminance E_{max}/E_{avg}
Arterial	High	≥1.2	≤3.0	≤5.0	≤0.3
	Medium	≥0.9	≤3.0	≤5.0	≤0.3
	Low	≥0.6	≤3.0	≤6.0	≤0.3
Collector	High	≥0.8	≤4.0	≤5.0	≤0.4
	Medium	≥0.6	≤4.0	≤6.0	≤0.4
	Low	≥0.4	≤4.0	≤8.0	≤0.4
Residential	High	≥0.6	≤6.0	≤10.0	≤0.4
	Medium	≥0.5	≤6.0	≤10.0	≤0.4
	Low	≥0.3	≤6.0	≤10.0	≤0.4

Table 49: Intersection Lighting Standards

Intersection Classification	Average Maintained Illumination at Pavement by Pedestrian Conflict (lux)			Veiling Luminance E_{max}/E_{avg}
	High	Medium	Low	
Arterial/Arterial	34.0	26.0	18.0	3.0
Arterial/Collector	29.0	22.0	15.0	3.0
Arterial/Local	26.0	20.0	13.0	3.0
Collector/Collector	24.0	18.0	12.0	4.0
Collector/Local	21.0	16.0	10.0	4.0
Local/Local	18.0	14.0	8.0	6.0

7.1.5 Transition Lighting

Transition lighting refers to the gradual adjustment of roadways lighting levels when a driver moves from a brightly lit area to a darker one (i.e. from urban areas to rural roads). **Table 50** below shows the minimum transition distances for various design speeds.

Table 50: Minimum Transition Lighting Distance

Design Speed (km/h)	Minimum Transition Distance (m)
50	210
60	250
70	295
80	335
90	375
100	420
110	460

7.1.6 Underground Streetlight Wiring

All underground streetlight writing shall be in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.8.3.

7.1.7 Marking Tape

The marking tape shall be in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.8.4. The marking tape shall be 75mm wide polyethylene or copolymer material, color red, with repeating black lettering “Caution – Buried Electric Line” or Similar message.

7.1.8 Grounding

All grounding procedures shall be in accordance with OPSS 609 Grounding.

7.1.9 Testing

Conduct tests for continuity and tests to measure insulation resistance between each conductor and ground and between each pair of conductors in a circuit. Any circuits which have phase-to-ground resistance less than 0.5 megohm or a phase-to-phase resistance less than 1.0 megohm shall be replaced.

7.2 Sidewalks and Bikeways

Tables 51 and **52** below describe the illuminance levels for sidewalks, walkways, and bikeways.

Table 51: Illuminance Levels for Sidewalks

Pedestrian Activity	Maintained Average Horizontal Illuminance (lux)	Horizontal Uniformity Ratio E_{avg}/E_{min}	Minimum Maintained Vertical Illuminance (lux)
High	≥20.0	≤4.0	≥10.0
Medium	≥5.0	≤4.0	≥2.0
Low	≥3.0	≤6.0	≥0.8

Table 52: Illuminance Level for Walkways and Bikeways

Description	Maintained Average Horizontal Illuminance (lux)	Maintained Average Vertical Illuminance (lux)
Walkways for Bikeways and Security	NA	≥5.0
Walkways for Bikeways and Guidance	≥5.0	NA
Pedestrian Stairways for Security	NA	≥5.0
Pedestrian Stairways for Guidance	≥5.0	NA
Pedestrian and Cyclist Tunnels for Security	NA	≥54.0
Pedestrian and Cyclist Tunnels for Guidance	≥43.0	NA

7.3 Parking Lots

Table 53 below shows the basic parking lot illumination level as well as the enhanced parking lot illumination level.

Table 53:Illuminance Level for Parking Lots

Description	Maintained Average Horizontal Illuminance (lux)	Uniformity Ratio E_{avg}/E_{min}
Basic Parking Lot Illumination Level	10.0	5.0:1
Enhanced Parking Lot Illumination	25.0	5.0:1

7.4 Electrical Equipment

7.4.1 Standard Equipment

Electrical Equipment requirements and procedures shall be in accordance with OPSS 610 Removal of Electrical Equipment and Materials, OPSS 614 Installation of Power Supply Equipment, and OPSS 616 Footings and Pads for Electrical Equipment. High mast lighting poles require specific concrete bases and maintenance platforms which must be in accordance with OPSS 631 Concrete Footings and Maintenance Platforms for High Mast Lighting Poles.

7.4.2 Traffic Signal Equipment

Traffic Signal Equipment shall be in accordance with OPSS 620 Traffic Signal Equipment and Electrical Traffic Control Devices.

7.5 Site Preparation

Site Preparation to be in accordance with OPSS 310 Construction Specification for Hot Mix Asphalt, OPSS 490 Construction Specification for Site Preparation for Pipelines, Utilities, and Associated Structures, OPSS 401 Construction Specification for Trenching, Backfilling & Compacting, and OPSS 801 Construction Specification for the Protection of Trees. In addition to these standard specifications, the following shall apply:

7.5.1 Access

Any access to the site must be done in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.4.1. The contractor shall provide all necessary flaggers, signs, warning lights and barricades that are required to protect public and pedestrian traffic.

7.5.2 Trees and Shrubs

The contractor shall protect from injury all trees and shrubs on or near the line of work and on private property in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.4.2.

7.5.3 Cutting Existing Pavement

The contractor shall ensure that all roadway pavements be saw cut by means of suitable mechanical sawing equipment capable of producing a straight clean vertical face in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.4.3.

7.5.4 Earth Excavation

All trenching operations must be in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.4.4.

7.6 Concrete Encased Duct Bank Installation

Concrete Encased Duct Bank Installation to be in accordance with OPSS 401 Construction Specification for Trenching, Backfilling and Compacting, OPSS 603 Construction Specification for Installation of Ducts and OPSS PROV 1350 Material Specification for Concrete - Materials and Production. In addition to these standard specifications, the following shall apply:

7.6.1 Concrete

The contractor shall ensure that concrete for all ductwork must have a maximum aggregate of 9.5mm (3/8”) and strength of at least 20 MPa (3000 psi). Other specifications must be in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.5.1.

7.6.2 Excavation

Excavation practices regarding concrete-based duct installation must be in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.5.2.

7.6.3 Duct Bank Construction

Construction procedures for the duct bank construction shall follow PUC Services Supplementary Specifications Electrical Works Section 1.5.3.

7.6.4 Testing Conduit

When a conduit between any two points has been laid, the testing requirements shall follow PUC Services Supplementary Specifications Electrical Works Section 1.5.4.

7.7 Electrical Chambers Installation

Electrical Chambers Installation to be in accordance with OPSS 602 Construction Specification for Installation of Electrical Chambers. In addition to this standard specification, the following shall apply:

7.7.1 Manholes

Manhole specifications including mortar mix, bricks, and manhole access must be in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.6.1.

7.7.2 Precast Concrete Electrical Chambers

Precast concrete electrical chambers must be in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.6.2.

7.7.3 Electrical Hand Boxes

Electrical hand boxes shall be designed and implemented in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.6.3.

7.8 Cable Installation

Cable Installation to be in accordance with OPSS 604 Construction Specification for Installation of Cable. In addition to this standard specification, the following shall apply:

7.8.1 Coils and Slack Cable

Sufficient cable shall be provided at each enclosure to permit future connections in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.7.1.

7.8.2 Cables in Ducts and Direct Buried

All cables shall be installed in accordance with the details shown on the contract drawings and PUC Services Supplementary Specifications Electrical Works Section 1.7.2.

When services cross roadways, the wiring shall be encased in ducts. Ducts shall be PVC Type 2 DB-10, double-walled, 100mm diameter, colored grey, and suitable for direct burial.

7.8.3 Sand Bedding for Direct Buried Cable

Sand bedding used for direct buried cable should be in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.7.3. The sand should consist of clean, hard, uncoated grains free from organic matter, vegetable loam, alkali, or other deleterious substances.

7.9 Site Restoration

Backfilling and Compacting to be in accordance with OPSS 309 Construction Specification for Cold Mixed, Cold Laid, Open and Dense Graded Bituminous Mix, OPSS 310 Construction Specification for Hot Mix Asphalt, OPSS 350 Construction Specification for Concrete Pavement and Concrete Base, OPSS 351 Construction Specification for Concrete Sidewalk, OPSS 353 Construction Specification for Concrete Curb and Gutter Systems, OPSS 355 Construction Specification for the Installation of Interlocking Concrete Pavers, OPSS 401 Construction Specification for Trenching, Backfilling and Compacting, OPSS 492

Construction Specification for Site restoration Following Installation of Pipelines, utilities and Associated Structures, OPSS 802 Construction Specification for Topsoil and OPSS 803 Construction Specification for Sodding. In addition to these standard specifications, the following shall apply:

7.9.1 Trench Backfill

Trench backfill procedures shall be in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.9.1.

7.9.2 Topsoil and Sod

The installation and payment procedures for topsoil and sod shall be in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.9.2

7.9.3 Restoring Municipal Roadways

Backfill, compactions and restoration for all excavations must meet municipal requirements in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.9.3.

7.9.4 Restoring Pavement

Restoring and repairing pavement shall be in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.9.4.

7.9.5 Hot Mix Patching

Hot Mix Patching Shall be in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.9.5.

7.9.6 Placing Concrete

Concrete shall be placed 150mm thick in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.9.6.

7.9.7 Placement of Concrete

The thickness of sidewalk sections shall be 150mm thick for all sections in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.9.7.

7.9.8 Expansion Joints

Expansion joints shall be recessed 6mm and placed at 6.0-meter intervals and at each end of the repair in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.9.8.

7.9.9 Joints

Expansion joints shall be depressed 6mm and placed at 6.0-meter intervals and at each end of the repair in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.9.9.

7.9.10 Interlocking Bricks

Interlocking brick procedures shall be in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.9.10.

7.10 PUC POLE AND EQUIPMENT SUPPORT

PUC pole and equipment support must be in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.10.

7.11 HAZARDOUS MATERIALS

The classification and procedures surrounding hazardous materials shall be in accordance with PUC Services Supplementary Specifications Electrical Works Section 1.11.

8. PLANS/ REPORTS/ DESIGN BRIEF REQUIREMENTS

8.1 Design Briefs/Functional Site Servicing Brief

8.1.1 Functional Stormwater Management Plan/Report

Prior to the City granting approval for the construction of Stormwater Management Infrastructure, the developer shall submit, for approval of the Engineering Division, a complete set of construction drawings prepared by a Professional Engineer for the roadways showing details of the proposed construction. The construction drawings shall be drafted and submitted in accordance with **Section 8.2** and supplemented by a Functional Stormwater Management Report prepared by a Professional Engineer. The requirements are described in the sections below.

A Storm Water Management (SWM) plan will be required for all new developments and re-developments. The SWM plan shall incorporate a combination of Best Management Practices (BMP), Low Impact Development (LID), and end-of-pipe facilities, such as SWM ponds and oil/grit separators, as appropriate.

A detailed design must be performed for each stormwater system that is to be built in the City of Sault Ste. Marie. A SWM report shall accompany each design submission and the owner's engineer shall include calculations to support the design of the SWM system and related quality and quantity requirements.

The Engineer must retain a copy of all design information supplied to the Developer and the Engineer will submit to the Public Works and Engineering Division computational sheets, and related model output used to determine design flows, hydraulic capacity of components of the drainage systems and the entire drainage system and estimates of the depth and extent of flow in open channels.

Acceptance of design documents by the Public Works and Engineering Division does not relieve the Engineer of the responsibility for proper design, nor does it imply that the Public Works and Engineering Division has checked the plans, technical briefs, and supplementary calculations for compliance with this document. Additional copies of any plans, technical briefs, and supplementary calculations as deemed necessary by the Director of Engineering may be required.

All developments are required to comply with the Storm Water Rate and Volume Control and Quality Standards and must submit a Stormwater Management Design Brief. The requirements and scope of the Design Brief will be in accordance with Sault Ste Marie Stormwater Management Appendix K and shall be prompted by a qualified person approved by the City Engineer. Below is an outline of the contents to be included in a typical Stormwater Design Brief for new development designated as Major Site Alteration:

- The description, location, and dimensions of all proposed site alteration activities.
- Drainage Agreement(s) signed by both owner/applicant and the affected property owner, if applicable.
- A key map showing the location of the site, site boundaries, number of hectares of the site, the site address or legal description, the nearest major intersection, a legend, scale, and a north arrow; and,
- A list of all required and/or obtained permits from other regulatory agencies (i.e. SSMRCA, MNRF, DFO, etc.).
- The location of the regulatory storm flood line and fill regulation lines.
- The location and type of existing vegetative cover.
- The location and dimensions of any existing and proposed stormwater drainage systems and natural drainage patterns on and within thirty (30) metres beyond the site boundary; and,

- The location and dimensions of utilities, structures, roads, highways and paving on the site within thirty (30) metres beyond the site boundary.
- The location, dimensions and use of the buildings and other structures existing or proposed to be erected on the site.
- The location of driveways on each site and all easements and right-of-way over, under, across or through each site.
- The location and dimension of all proposed access routes from roadways.
- The location and dimensions of all proposed staging areas for equipment; and,
- An indication on the drawing of the directions of overland flow and overland flow routes.

The following tables shall be provided in the SWM report:

- Pre-development flows for each return period
- Uncontrolled post-development flows for each return period.
- Stage-storage-discharge for storage areas
- Controlled post-development flows for each return period.
- A summary table comparing pre-development flows and controlled post-development flows for each return period.

The following appendices shall be included

- Existing and Proposed Runoff Calculations.
- Storage Calculations and Stage-Storage Discharge.
- Storm Sewer Design Sheet(s).
- Stormwater Management Facility Operation and Maintenance Manual; and Existing and Proposed Storm Catchment Drawings.
- Ponding Areas, extents, and depths/ hydraulic grade lines.

8.1.1.1 Erosion and Sediment Control (ESC)

The Erosion and Sediment Control (ESC) Design Brief should propose BMPs to control the discharge of sediment and/or other potential pollutants from the site. A provision should instruct the installation of ESC measures before initiation of site alteration. The ESC plan is part of the overall stormwater management design brief and should encompass the following:

- The measures should consider the protection of receiving water bodies, wetlands, and storm sewer inlets.
- The control measures should show significant effort to minimize the following:
    - Disturbance of natural soil cover and vegetation.
    - Exposed soil and unstable soil conditions.
    - Off-site sediment transport on trucks and equipment.
    - Work in and adjacent to water bodies and wetlands; and
    - Compaction of site soils.
- Narrative regarding the potential for discharge of sediment and/or other potential pollutants from the site.
- Identification of a person knowledgeable and experienced in the application of erosion prevention and sediment control BMP's who will oversee the implementation of the ESC Plan.

- Description of the ESC measures used and an operating and maintenance plan for each measure must be developed.
- A schedule of the anticipated start and completion dates of each land disturbing or land developing activity including the installation of erosion control measures needed at the site to meet the requirements of these standards.
- Any specific chemicals and the chemical treatment systems that may be used for enhancing the sedimentation process on the site and how compliance will be achieved must be described.
- The nature of stormwater runoff and run-on at the site, including factors such as expected flow from impervious surfaces, slopes, and site drainage features.
- If any stormwater flow will be channelized at the site, the applicant must design BMP's to control both peak flow rates and total stormwater volume to minimize erosion at outlets and to minimize downstream channel and stream bank erosion.
- Drainage works shall be designed to minimize erosion and the impairment of water quality on receiving streams as a result of storm water run-off.
- Provisions for the maintenance of the site and control measures and a schedule for monitoring procedures during construction including a mud tracking prevention program which describes the procedure for mud tracking prevention and road clean up and designating a contact person for such a program throughout each land disturbing and land developing activity.
- The specifications for any Oil/Grit Separator models proposed for a development must be signed and sealed by a Professional Engineer. The required submission of information for review and approval by the City must include design computations including estimated performance, supported with well-documented sizing (computer modelling) program and CADD details.

8.1.1.2 Stormwater Management – Rate and Volume Control, Quality Control

The rate, volume, and quality control calculations and requirements listed below are required within the rate, volume, and quality control section of the Stormwater Management Design Brief.

- The expected amount, frequency, intensity, and duration of precipitation, and the criteria for the design of the major/minor storm water systems including runoff coefficients, storm return period, initial inlet time, pipe friction factors, etc.
- Calculations showing the peak flows of storm water to be handled by the major/minor storm water systems from within the development, for tributary areas outside the development, and for backwater effects during the major storm event.
- The design engineer shall also provide calculations to verify that surface drainage under major storm conditions will not result in significant erosion or flooding.
- Water balance and groundwater requirements of other authorities having jurisdiction shall be confirmed, accounted for, and documented in the design brief.
- Descriptions of all major/minor storm systems including all water courses, contributing areas, manholes, catch basins, pipes, outfalls, as well as the major storm route, and all drainage easements/rights of way.
- An indication of the extent of the flooded area expected during the major storm event.
- Supporting calculations for the sizing and design of all stormwater quantity and quality control facilities.
- Calculations showing development will not increase the bounce in water level or duration of inundation beyond the specified limit in immediately downstream receiving wetlands.
- The number of hectares of impervious surface for both pre- and post-construction must be specified.

- Methods used to minimize soil compaction and preserve topsoil must be described. Minimizing soil compaction is not required where the function of a specific area of the site dictates that it be compacted.
- The location, dimensions, design details and design calculations of all site control measures, including plan and profile drawings of stormwater management facilities, rate control devices, and erosion control devices necessary to meet the requirements of these standards; and
- Standard details and/or specifications for the BMP's used on the project must be included.
- The engineer is to generate hydrographs to assess the performance of the stormwater pond and shall include these in the stormwater management report.
- HY8 modelling shall be used for culvert analysis and a report provided showing hydraulic grade lines and energy grade lines.
- The location of lakes, streams, wetlands, channels, ditches, other water courses, Environmental Protection Zones, and all other water bodies that will receive stormwater from the construction site, during or after construction, on and within three hundred (300) metres beyond the site boundary shall be specified.
- Ponding areas, extents, and depths, including hydraulic grade lines shall be shown on the plans and profiles.
- Calculations confirming the downstream stormwater management system will have adequate capacity to convey the discharge from the proposed new stormwater drainage system.
- Details regarding the erection of proper signage surrounding stormwater management ponds. The signs must detail the purpose of the pond, phone number for further information and any other relevant information, all at the cost of the developer.

8.1.1.3 Grading Design

The grading design brief shall contain the following elements:

- The location and dimensions of all proposed temporary stockpiles for fill, soil and other materials.
- Calculation of cut and fill volumes and volumes to imported or exported from site.
- The location and identification of predominant soil types, rock outcrops, and groundwater levels.
- Description of current land use, vegetation, drainage patterns, or existing structures.
- Summary of grading and drainage strategies used to manage runoff and prevent erosion.
- A minimum of one on site geodetic benchmark shall be noted.
- Assurance that the grading design complies with MECP standards and standards described herein.
- Summary of design criteria including factors of safety, slope angles, and slope gradients.
- Summary of all drainage facilities which will be constructed, the size and location of all proposed drainage easements and the limits of any flooding anticipated as a result of a major storm event.

Notes:

- No alterations to existing boundary elevations of adjacent lands shall be undertaken unless written agreement with the adjacent property owner has been obtained and submitted in a format acceptable to the City of Sault Ste Marie.
- If at the design plan submission stage (i.e. application for a building permit) it is known that surface water run-off from the owner/applicants' lot must flow across either adjacent and/or downstream properties, the owner/applicant must submit written confirmation of agreement to accept the surface water flow in perpetuity from the affected property owner.

- If during construction, altercations to the design plan have to be made to drain water across either adjacent and/or downstream properties, letters of acceptance from the affected property owners must be received with the final as-built Lot Grading Plan.

8.1.1.4 Operation and Maintenance

The operation and maintenance plan is a required subsection of the Stormwater Management Design Brief, and it shall include the calculations and procedures listed below.

- A maintenance plan that includes, but is not limited to, who will conduct the maintenance, type of maintenance needed, maintenance intervals, standard inspection forms, and demonstrating that at the time of final stabilization, the stormwater facilities conform to design specifications.
- Methods to be used for final stabilization of all exposed soil areas must be described. Final stabilization is not complete until all requirements outlined below are complete:
- All soil disturbing activities at the site have been completed and all soils are stabilized by a uniform perennial vegetative cover with a density of 70 percent of its expected final growth density over the entire pervious surface area, or other equivalent means necessary to prevent soil failure under erosive conditions.
- The permanent stormwater management system is constructed and is operating as designed. Temporary or permanent sedimentation basins that are to be used as permanent water quality management basins have been cleaned of accumulated sediment. All sediment has been removed from conveyance systems and ditches are stabilized with permanent cover.
- All temporary synthetic and structural erosion prevention and sediment control BMP's (such as silt fence) have been removed. BMP's designed to decompose on site (such as some compost logs) may be left in place.
- For residential construction only, individual lots are considered finally stabilized if the structure(s) are finished and temporary erosion protection and down-gradient perimeter control has been completed.
- For construction projects on agricultural land (e.g., pipelines across crop, field pasture or range land) the disturbed land has been returned to its preconstruction agricultural use.
- The OGS should be cleaned of sediment, accumulated oils and grease, debris and other pollutants as needed to ensure the continued proper operation of the system. The maintenance protocol for the OGS shall be reviewed and given to the City of sault Ste Marie prior to installation.

8.1.2 Functional Site Servicing Plan/Report

Prior to the City granting approval for the construction of roadways, electrical systems, water servicing systems, sanitary sewer systems, etc., the developer shall submit, for approval of the Engineering Division, a complete set of construction drawings prepared by a Professional Engineer showing details of the proposed construction. The construction drawings shall be drafted and submitted in accordance with **Section 8.2** and supplemented by a Functional Site Servicing Report prepared by a Professional Engineer which includes a Transportation System, Electrical System, Watermain, and Sanitary Sewer Design Brief. The requirements for each design brief are listed in the sections below.

8.1.2.1 Transportation Design Brief

- Detailed description of the project site, including the existing conditions and any constraints.
- Geodetic elevation of the water table including estimates of potential variations.
- Make reference to the design criteria outlined in **Section 6.0.**
- Design of grades to ensure proper drainage on roadways, walkways, parking lots, etc.

- Identify the proposed use of the land served by the road as well as traffic volumes and loads to be expected for different development scenarios as per **Section 6.7**.
- A detailed description of the traffic control devices and an analysis of the impact of the project on the local traffic conditions.
- Determine road base requirements required to accommodate construction traffic on partially completed roadways.
- Determine proposed design for pavement structure, road base, subbase and any subsurface drainage and specify the thickness of the asphalt and granular layers.
- Determine the horizontal and vertical alignment of roads including cross sections.
- Specifications for curb and gutter types and their locations.
- Specifications for the alignment, width, and material proposed for sidewalk construction. Accessibility precautions should be in accordance with **Section 6.4.**
- Specifications for the layout and design of parking lots, including dimensions, orientation, and flow of traffic.
- Specifications for ramps and stairs, including materials, riser and tread dimensions, and handrails.
- Determine the effect of existing and future services located under the roadbed.
- Description of the safety measures implemented for both pedestrian and vehicular safety.
- Identification of transportation system improvements required to mitigate adverse impacts.
- Consultants contact information.
- Transportation context for the horizon year and time periods for analysis.
- Any supporting data used in the analysis.

8.1.2.2 Electrical Systems Design Brief

- Description of the project site, including existing conditions and site constraints.
- A load analysis including the current electrical demands, projected electrical demands, and peak demands.
- Load calculations to support the load analysis, including diversity factors, coincidence factors, and load factors.
- Anticipated functional performance of the circuit (i.e. maximum voltage, maximum current, operating temperature range, and maximum load).
- Performance and environmental requirements on the circuit. This could include voltage and current operating tolerances, humidity, altitude, and vibration operation tolerances.
- Safety features installed on circuits to prevent shock to user, prevent damage to connected devices, and mitigate fire hazards.
- Street Light intensity calculations and specifications in accordance with **Section 7.1.**
- Design of lighting systems including luminaire types, locations and spacing, and control systems. This should also include emergency lighting if applicable.
- Descriptions of cable types, as well as the routing of cables and any protective measures. These shall be in accordance with **Section 7.8.**
- Descriptions of any electrical equipment to be used, including standard equipment and traffic control equipment in accordance with **Section 7.4.**
- Design of grounding systems, including specifications for grounding electrodes and conductors.
- Requirements for bonding various electrical components and systems.
- Safety systems associated with the electrical design (i.e. surge protection and arc flash protection).

- The design of energy saving measures or sustainability considerations.
- Design of control and automation systems, if applicable. This could include lighting controls, HVAC controls, and integration of electrical systems with the building management system (BMS).
- An operation and maintenance plan which includes regular inspections and repairs.
- Identification of any potential risks and associated mitigation measures.
- Procedures for testing circuits or other electrical systems. This shall include a test plan, test procedures, expected results, as well as any equipment and resources needed to perform the tests. Testing shall be in accordance with **Section 7.1.9.**
- Consultants contact information.

8.1.2.3 Watermain Design Brief

- Description of the project site, including existing conditions and site constraints.
- A demand analysis describing the current and projected water demands, including peak demand scenarios.
- Procedures and materials to be used for the backfilling and compacting process in accordance with **Section 5.2.4.**
- A hydraulic flow analysis showing hydraulic calculations, projected flow rates, velocities, and pressures throughout the system.
- Determine grade, size, direction of flow, and required depth of cover.
- An analysis of fire flow demands and operating conditions during fire flow scenarios.
- A proposed layout including alignment, clearances, sizing, and depth of cover. These shall follow the design guidelines listed in **Section 5.1** and **5.2.**
- Specifications for pipe materials (Ductile Iron, PVC, HDPE), valves, and fittings. These shall be in accordance with **Section 5.2.8,** and **5.2.11.**
- Types and locations of valves, hydrants, flow meters, etc.
- Procedures for pressure testing and disinfection procedures. These shall be in accordance with **Section 5.2.15 and 5.2.16.**
- A temporary water service plan in accordance with **Section 5.3.**
- Design Briefs for temporary water systems shall be submitted in accordance with PUC Special Provisions Waterworks Section 493.04.01.
- Consultants contact information.

8.1.2.4 Sanitary Sewer Design Brief

- Describe the project site, the existing conditions, and any site constraints.
- List any applicable standards, specifications, or permits relevant to the project.
- Determine the required number service connections.
- Determine population density, per capita wastewater generation rate, peaking factor used and explain how the design satisfies the MECP Design Criteria for Sanitary Sewers and **Section 2.**
- Determine the current and projected sewer flow demands for the project area, including peak demand scenarios.
- Show calculations for pipe sizing, determine the horizontal and vertical alignment of the sewer, determine the clearances to other services and utilities, and determine the depth of cover to ensure protection and functionality, in accordance with **Section 2.**
- Determine grade, direction of flow, and material of all pipes in the sewer system.

- Provide a capacity analysis which analyzes the network capacity to handle projected flows.
- Provide a calculation of hydraulic gradients and slopes to ensure gravity flow and self-cleaning velocities. Show hydraulic grade line elevation at point of connection to City main.
- Provide calculations to show estimated velocities.
- Include specifications for all joints and connections used in accordance with **Section 2.**
- Determine what source water protection plan area the works are located within, whether there are vulnerable areas within the project area, and determine whether the works constitute a significant threat.
- If applicable, determine the location and design of pump stations, as well as pumping equipment (i.e. pumps, controls, etc.). Also, provide design considerations for power supply and backup systems.
- Provide procedures for testing sewer lines (e.g. air tests, infiltration tests), and provide the testing results.
- Describe the flow path and receiving plant of the sewage works, and how the downstream systems (receiving sewers, pumping station, etc.) have been affected.
- Invert information for service connections at property line and at point of connection to sewer main.
- Provide information on sanitary maintenance holes including top and invert elevation, and specifications for safety platforms and drop structures.
- Provide a downstream sanitary sewer analysis. If the calculated capacity of the sewer exceeds 70% pipe full, (including flows from the development), then an hydraulic grade line analysis shall be completed and shown on a plan/profile drawing(s). If the calculated capacity exceeds 100% or the hydraulic grade line exceeds the pipe obvert at any location then the basement elevation shall also be shown on the plans.
- For properties which will not be serviced by sanitary sewers, the location of the proposed septic field and alternate septic field location shall be shown along with the proposed design finished grade elevation of the septic fields.
- Consultants contact information

8.1.3 Geotechnical Report

A Geotechnical Report is a sub-surface investigation that analyses soil and bedrock composition to determine its structural stability and its ability to accommodate development. It is done to determine geotechnical design parameters and if there may be significant challenges in the conceptual designs, land requirements, detailed design, and construction stages of a development and to supplement Stormwater Management Reports or Hydrogeological Studies. It is prepared by A registered professional engineer qualified in geotechnical engineering. All reports and drawings must be stamped, signed and dated by a qualified professional, licensed in the Province of Ontario. The required contents must be included in the Geotechnical Study:

- Purpose and scope of services, site and project description.
- Geologic setting (overview of regional geology, local stratigraphy, groundwater occurrence).
- Subsurface conditions including soil and groundwater conditions, and bedrock (if applicable).
- Information and location of groundwater sampling ports.
- Soil physiochemical behaviors to identify soil corrosivity.
- Service installation recommendations and design parameters.
- Road construction and pavement design.
- Retaining structure design parameters.
- Foundation recommendations and design parameters.

- Frost protection recommendations and design parameters.
- Temporary shoring.
- Drainage recommendations and design parameters.
- Seismic design recommendations.
- Explanation and/or justification of the number of boreholes (recommend consultation with City).
- Confirmation of the feasibility of the conceptual stormwater management design from a geotechnical perspective. This must include a test pit or borehole in the location of all stormwater management facilities including low-impact development locations (if known at the time of the geotechnical investigation).
- Address any side slope stability concerns, hazardous soils, berm construction (with the appropriate materials and compaction), specifications of a liner (if required), high groundwater table and/or bedrock issues.
- Locations of investigation on site and servicing plans.
- Factors of safety, feasibility and risk assessment.
- Mitigation measures and monitoring programs where necessary.
- Determination of the location of the seasonably high groundwater level after the ground has thawed to account for the high groundwater table associated with the snowmelt event.
- Discussion and conclusions.
- Recommendations regarding below grade watertight structure(s) and/or requirement of Environmental Compliance Approvals (ECA) from Ministry of Environment Conservation and Parks (MECP) where applicable.
- Figures and illustrations including site plan, borehole location plan, and typical cross-section drawings.
- Log of boreholes showing soil types and there depths.
- Lab test data.

8.1.4 Phasing Plan

A phasing plan describes the timings of when each stage of your development will be completed. The project manager should prepare this report in support of a Draft Plan of Subdivision or Condominium Application. It shall contain the following contents:

- Overall Development Plan: This plan should provide an overview of the entire subdivision and identify the number of phases required to complete the development.
- Schedule of Phases: The plan should provide a schedule of the proposed phases and identify the approximate timeframe for each phase.
- Site Plan: The site plan should show the location of all proposed improvements, including lots, streets, utilities, and other infrastructure.
- Design Standards: The plan should comply with all applicable design standards and regulations, such as setbacks, lot size, and zoning requirements.
- Utility Plan: The plan should include a utility plan that identifies the proposed locations of water, sewer, and electrical infrastructure for each phase.
- Phasing Criteria: The plan should identify the criteria for determining when each phase is complete and ready for occupancy.
- Construction Details: The plan should include general construction details for each phase, such as grading, drainage, paving, and landscaping.

- Environmental Impact: The plan should evaluate the environmental impact of the proposed development and identify measures to mitigate any negative impacts.
- Community Amenities: The plan should identify any community amenities, such as parks, recreational areas, and public spaces.
- Financing Plan: The plan should include a financing plan that outlines the estimated costs for each phase and identifies the source of funding for each phase.

8.2 Drawing and Submission Requirements

8.2.1 General Drawing Standards

- All drawings must be drawn on paper with overall dimensions of 24'' x 36'' (ARCH D).
- All drawings must be in metric.
- All drawings must contain a title block with the full municipal address, and a legend identifying all symbols, hatching, shading, and linework used within the plan.
- Plans and Profiles must be drawn in the style of the City Typical Drawing for a subdivision street, using the City legend and scales of 1:100, 1:250 or 1:500 (1:200 may be used in special cases). Profiles must have the same horizontal scale as the plan, with a 1:5 vertical exaggeration.
- All drawings must have North oriented up or to the right of the page. The North arrow shall be located in the title block where designated or should be close to the top and right-hand side of the sheet.
- All drawings shall be in greyscale except for company logos, revision clouds, and revision triangle which should be shown on the drawing in red when plotted.
- Each street in the subdivision must be shown on a separate plan/profile drawing.
- The zero chainage shall start at 10+000 and shall increase from South to North or West to East. It shall be located at the production of the intersecting street property line or at the start of the subdivision.
- Typical chainage on plan views should be indicated every 50m with a chainage label, with a tick mark every 10m.
- Sections shall be drawn left to right looking up at chainage (i.e. starting at sta: 10+100 looking towards 10+110).
- Where elevations are provided on the drawing, a benchmark shall be indicated and/or prescribed. Where possible, the elevations shall be geodetic, NAD83.
- Where possible, the profile shall be a vertical projection of the plan and shall be drawn below the plan. Separating curved roadway sections is permitted.
- All non-standard details (standard would be OPSD's) which will be used for construction shall be shown on a separate drawing (see **Section 8.2.3**). Where a detail is used only once it may be shown on the Plan on which it occurs.
- The General Plan must show the watermain, valves, hydrants, storm and sanitary sewers with manholes, pipe size and direction of flow. Scale shall be 1:250 or 1:500.
- Each drawing shall have a unique sheet identifier which consists of the following:

  i) A sheet size identifier followed by a hyphen ("A1-").

  A4 – Letter sheet size

  A4 - Letter (2) sheet size

  A4 – Letter "L" sheet size

  A4 – Letter "L(2)" sheet size

A3 – 11 X 17 portrait sheet size
A1 – 24 x 36 horizontal title block sheet size
A1 – 24 x 36 vertical title block sheet size

ii) A single uppercase character discipline designator followed by a hyphen

G – General Drawing
Leg – Legend
C – Civil
S – Structural
L – Landscape
M – Mechanical
E – Electrical
N – Notes

iii) A two-digit numerical sheet sequence number ("##")

iv) Optional user defined suffixes ("-000") i.e. Revision #

- Line weights for the following conditions are: Proposed/Removals/As-Constructed – Dark, Existing Conditions – Grey, Future Works – Phantom Grey.
- CAD digital stamps are not permitted.
- All drawings must be signed, stamped, and dated by a Professional Engineer.

8.2.2 Drawing Types

The following drawing types are to be completed at the specified project stage and shall be drawn to the standards listed in **Section 8.2.1**. The drawings shall be submitted as a package and contain the required drawings described in **Section 8.2.3.**

8.2.2.1 Preliminary Construction Drawings

After draft plan approval, the Developer shall employ a firm of engineering consultants acceptable to the City for the purpose of designing all services for the development. The services for the development shall be designed for the actual site conditions that are encountered in the area to be serviced. The standards contained in this manual are minimum standards only. Site conditions and good engineering practice shall dictate the work which shall be carried out.

All construction drawings shall be georeferenced and tied to G.P.S. Reference points. All elevations shall refer to a metric geodetic datum CGVD28. Horizontal datum shall be referenced to NAD83 CSRS (current edition).

The consultant shall submit one (1) electronic pdf set and two (2) prints of each of the following drawings to the Director of Engineering for comment. They shall include at a minimum:

- Boundaries of all work to be carried out shall be clearly indicated and all drainage and service easements are to be shown.
- A reference to source drawings used for existing service infrastructure.
- Typical cross-sections showing road base details and sub-surface drainage works.
- A Title Page and Legend in accordance with **Section 8.2.3.1** and **8.2.3.2.**
- A General Plan in accordance with **Section 8.2.3.3.**
- An Existing Conditions and Removals Plan in accordance with **Section 8.2.3.4.**

- A Grading and Drainage Plan in accordance with **Section 8.2.3.5.**
- A Landscaping plan in accordance with **Section 8.2.3.6.**
- An Erosion and Sediment Control Plan in accordance with **Section 8.2.3.7.**
- A Stormwater Management Plan in accordance with **Section 8.2.3.8.**
- Plan/Profile Drawings for all roads, sidewalks, storm and sanitary sewers, sub-surface drainage works, watermains, electrical and gas utilities, roadway illumination devices, and any other relevant infrastructure. The plan/profile drawings shall be in accordance with **Section 8.2.3.9.**
- A lot grading plan (in accordance with **Section 8.2.3.10**) showing how each lot will be drained and how the water will be discharged from the area to be developed as a whole, including: directions of storm flow and contributing areas, back of lot drainage systems, major storm routes and outfall details.
- Details and notes in accordance with **Section 8.2.3.11.**

8.2.2.2 Construction Drawings (IFC)

Construction drawings are issued following the acceptance of the preliminary construction drawings and shall contain everything that the preliminary construction drawings show and be to the same scale plus:

- Indicate all legal plans, registered plans and reference plans;
- All survey bars, street lines, lot lines and lot numbers;
- All lot dimensions, intersection radii and all curve data;
- Any other underground services contemplated for the development (i.e. gas, hydro, telephone, cable T.V.). These services need only to be shown in the plan view;
- Names of streets and/or lanes (public and private) abutting the site.
- The consultant shall make all required corrections to his drawings and resubmit them until final approval is received.
- Upon receipt of the drawings approved by the Director of Engineering, the consultant shall forward to the City two (2) additional sets of drawings and specifications of the development services, and one (1) CAD version (sent with e-transmit) of the same. These drawings are to be used by various City departments dealing with the construction of the development. Additional sets of drawings and specifications shall be supplied to the Director of Engineering if required.

8.2.2.3 Preliminary As-Built Drawings (Subdivisions and Condominiums)

After the completion of the underground services and building connections, and prior to clearance by the Director of Engineering for the issuance of building permits, preliminary street servicing plans including fire hydrant flow testing results, and preliminary service connection drawings showing as-built details shall be certified by the consulting engineer. The location of the completed house service connections must be determined in the field and shown on the preliminary as-built drawings with plus chainage measured from the downstream maintenance hole to the point where the lateral connects to the main. The location of the lateral at the street line must also be dimensioned on the drawing.

These plans must provide sufficient detail to locate services prior to the completion of the roads. The services include but are not limited to water supply lines, sanitary sewer systems, storm sewer systems, natural gas lines, electrical power cables, telecommunications cables, fiber optic networks, and district heating and cooling systems (where applicable).

The preliminary as-built drawings shall be submitted to the city for acceptance (see Step 8 under Section 2.3 and 3.3 in the City of Sault Ste Maire's "*Plan of Subdivision, Condominium, and Site Plan Control Application Process"*). The preliminary as-builts shall be submitted as two (2) complete sets of hard copy

as-built prints, and one (1) CAD drawing package sent with e-transmit (i.e., complete with pen settings, block and symbol libraries, etc.)

8.2.2.4 As-Built Drawings

After the completion of all underground servicing works and surface works, the consulting engineer certifies the construction, provides inspection reports, testing reports, and a deficiency list to the approval of the City of Sault Ste Marie. In addition, the engineer coordinates any necessary revisions/rectifications. Next, the as-built drawings along with other supporting construction documentation is submitted to the City. The as-builts shall be submitted as two (2) complete sets of hard copy as-built prints, and one (1) CAD drawing package sent with e-transmit (i.e., complete with pen settings, block and symbol libraries, etc.). The as-built drawings shall include the following information:

- All as-constructed elevations including watermain inverts and sewer main inverts;
- All pipe lengths between manholes and watermain lengths between valves;
- All pipe sizes, material and bedding;
- Ministry of Environment Certificate of Approval numbers for sewer and water works;
- All final grades;
- Rock profiles, if rock was encountered;
- All new building connections are to be shown and dimensioned in the plan view, so that they can be readily located;
- All electrical illumination installations;
- All dimensions are to be from legal survey lines, or survey bars, not buildings or poles. Water system appurtenances such as hydrants, valves or boxes, are to be dimensioned to each other and to legal survey lines or survey bars;
- All off-set dimensions are to be 90° from street lines;
- Dimensioning may be indicated by chainage so long as 10+000 chainage is on an established survey bar or legal survey line;
- As-constructed dimensions shall be designated by the Symbol (ASB) after the dimensions;
- Any other changes including property or lot division shall be shown;
- Overall drawings need not have dimensioning but shall be pictorially correct and any pipe sizes or pipe lengths shall be as-constructed pipe sizes or lengths.
- AutoCAD based design drawings shall be required and submitted on a medium acceptable to the City in ".DWG" format. (The version of AutoCAD shall be compatible with the present version in use by the Engineering Division's Office) The AutoCAD drawings are to be based on one drawing unit equals one metre and shall be tied to NAD 83 Horizontal control. (Where non-standard AutoCAD fonts, menus, line types, etc. are used, a copy of these files shall be supplied to the City.)

Upon initial acceptance (see **Section 10.2**), the City will issue a letter of Initial Acceptance, and the maintenance periods begin.

Prior to final acceptance (see **Section 10.3**), a hard copy report outlining the condition of the sewer shall be submitted for the review of the Engineering Division. The hard copy report shall be accompanied by a colour electronic copy of the sewer inspection coded using WRc Defect Coding Standards. The format and media of the electronic copy shall be approved by the Director of Engineering.

8.2.2.5 Service Connection Drawings (Lateral Records)

Individual lot drawings to a scale of not less than 1:200 on 216 mm x 279 mm paper, showing in plan view the location and tie-ins of all water, sanitary sewer, storm sewer service connections and any easements in

relationship to the property lines and houses shall be submitted. This information is required for the city record books which are used for maintenance purposes.

The final as-built service connection drawing shall also show the finished grade elevation at the front wall of the building.

8.2.2.6 Record Drawings

When all of the work is completed one complete set of good quality reproducible signed and sealed “Record Drawings” drawings shall be submitted to the Director of Engineering. These drawings shall be submitted prior to Final Acceptance being granted for the services within the developed land.

8.2.3 Standard Drawing Submission Package

Drawing packages shall contain drawings submitted in the following order and each drawing shall contain the information described below. All drawings are drafted in accordance with the standards listed in **Section 8.2.1.** In addition, each drawing shall contain a title block which specifies the drawing title and number, company and client, scale, date, revision information, north arrow, and any other relevant notes the described components.

8.2.3.1 Title Page

The title page should contain the following information: project title, drawing title, project number, date, client information, designer and engineer information, company logo, revision information, scale, approval signatures, project location, key plan, and a list of drawings within the drawing package.

8.2.3.2 Legend

The legend should specify key symbols, line types, abbreviations, material specifications, any hatching/patterning, colour codes, and any additional relevant information that helps in the understanding of the drawing.

8.2.3.3 General Plan

The general plan shall depict the overall general site plan and all services associated with it. It contains the proposed path of the road, sidewalks, driveways, and utilities. It shall indicate property lines, topographic features such as trees, buildings, contours, water bodies and other proposed infrastructure. The location and dimension of roadways, including lane widths, shoulders, intersections, and medians shall also be specified.

8.2.3.4 Existing Conditions and Removals

The drawing should contain existing conditions which specify property boundaries, topography, buildings and structures, existing above and below ground utilities, existing roads and paths, any existing significant trees or landscaped areas, any existing rivers, streams, lakes, or ponds, any impervious services, fences, or walls. The existing conditions drawings should also specify infrastructure conditions such as surface types, existing locations and types of lighting, existing signage, and information about existing drainage patterns (if applicable). The drawing should also contain existing benchmarks and reference points, grid lines, and relevant geotechnical data.

The drawing may also show the elements to be removed including buildings and structures, roads, driveways, sidewalks, vegetation, fences and walls, above and below ground utilities (water, sewer, gas, electric, telecommunications), lighting, signage, and drainage features. It should also contain demolition

details including cutlines, removal boundaries, protection measures, disposal, and relocation notes. Any hazardous materials or environmental protection measures should also be indicated.

8.2.3.5 Grading and Drainage

The proposed site layout information shall include the following:

- Footprint of buildings including limits of underground structures (if applicable).
- Building elevation information including finished floor elevation (FFE), basement floor elevation (BFE), entrance elevation, and minimum building opening elevation.
- Site layout including proposed streets, lots and approximate location of proposed structures.
- Proposed location of entrances, accesses, vehicular accesses, internal driveways and ramps, stairs, doors, and utilities, air intakes/exhausts and their respective grades and elevations.
- All land to be conveyed to the city including right of way and lane widenings.
- Identify proposed landscaping works as shown on landscaping plans and indicate their respective grades and elevations relative to the building and the adjacent street or lane.

The drainage elements on the drawing shall include the following:

- The location of the development within the total topographic drainage area.
- All existing watercourses including creeks, ponds and wetlands indicating direction of flow.
- Existing overland flow routes (i.e. direction of flow, spill points)
- Boundaries of catchment and sub-catchment areas tributary to each set of catch basins, infiltration pond(s), or drainage channel(s), indicating the direction of flow, drainage area, and where appropriate, runoff coefficients.
- The location and layout of the proposed stormwater drainage system including swales, maintenance holes, catch basins, and all storm sewers indicating pipe material, diameter, slope, and direction of flow.
- The size and location of any proposed post-development stormwater storage and retention facilities, including hydraulic grade lines.
- The location of outfalls, or connections to existing systems.
- Details to show how rear lot drainage will be directed to the street.
- The drainage pattern for individual lots, the limits of the entire development as well as the surrounding areas including all rear yard catch basins, pipes, swales, proposed grades and slopes including steepness.
- Ponding limits and depths (hydraulic grade lines).

The grading plans shall show details of the existing and proposed grading of the property and shall include:

- Existing grading and elevation information as follows:
    - Top elevation of catch basins, area drains, maintenance holes, and gutters.
    - Top and bottom elevation of curbs and curb depressions
    - Top and bottom elevation for existing retaining walls (both sides of wall)
    - Existing one (1) metre contours (maximum) and all existing natural drainage courses on the land to be developed.
    - Existing elevations within the interior of each lot.

- A field survey of the existing site topography at a contour interval not to exceed one half of one metre determined in accordance with the Canadian Geodetic Datum and with spot elevations along the property to clearly show the existing drainage patterns on the site and the adjacent sites. These extend into adjacent lands to understand the potential impacts of drainage both from and to adjacent lands, i.e. a minimum of thirty (30) metres beyond the site boundary.
- Existing elevations at six (6) meter intervals along property lines, driveways, sidewalks, walkways, and other paved areas.

- Proposed grading and elevation information as follows:
  - Top elevation of catch basins, area drains, maintenance holes, and gutters.
  - Top and bottom elevation of curbs and curb depressions, including curb restoration, limits, and transitions.
  - Top and bottom elevation for proposed retaining walls (both sides of wall). Cross sections with elevations (bottom and top of wall) for walls over 0.6 meters in height.
  - Finished road elevations and grades, including but not limited to centerline, back of curb, back of sidewalk. Centerline road elevations are to be shown every 15 meters.
  - Finished grade elevations at all lot corners at each proposed building and at appropriate locations around large or multi-level buildings.
  - Finished grade spot elevations along all swales, ditches, at each catch basin and at appropriate intervals on large sites such as parking lots and open space areas.
  - Proposed boulevard/sidewalk widening or narrowing and their proposed grades and impact on curb height.
  - Proposed elevations at six (6) meter intervals along property lines, driveways, sidewalks, walkways, and other paved areas.
  - If there are any changes to overland flow routes, they are directed away from adjacent properties, existing and proposed buildings.
  - Proposed spill location
  - Maximum ponding level during 100-year storm events.
- In areas where in the opinion of the Director of Engineering, existing or future ground water levels may compromise basement construction, the following shall be shown on the Grading Plan:
  - Elevation of existing ground water table elevation.
  - Estimate of future ground water table elevation.
  - Minimum foundation footing elevation.

8.2.3.6 Landscaping Plan

The landscaping plan drawing shall include detailed representations of both natural and built features of a site. Key components include the layout of plantings, such as trees, shrubs, and ground covers, specifying species, sizes, and placement. It also illustrates hardscape elements like walkways, patios, retaining walls, and water features, detailing materials and dimensions. Irrigation systems are depicted, with specifications for piping and sprinkler placement. Lighting designs, including types and locations of fixtures, are included for aesthetic and safety purposes.

The landscaping plan shall show:

- Existing/proposed easements and encroachments
- Indicate in plan and section, existing/proposed pedestrian clearway widths

- Identify all improvements to adjacent public boulevards and sidewalks, including but not limited to: trees, shrubs, hedges, plantings or other ground cover, permeable paving materials, street furniture, ramps, waste and recycling containers, lighting and bicycle parking and storage facilities
- Label all hardscape materials and provide design details for paving and other hard landscape elements on the site and in adjacent boulevards.
- Label materials and provide schematic construction details of significant hard landscaping elements, including furniture, seating, fences, railings, screen walls, living walls, retaining walls, play equipment and weather protection elements (sun and wind screens)
- Plant lists keyed to locations on the site, including the species, size, height, and root condition of all trees shrubs and plants, indicating native species
- Planting details of proposed trees, shrubs and other plants
- Indicate in plan and section, soil volumes for trees and other plantings
- Soil is retained on-site or adjusted or replaced with soil of equal or better quality
- Location, size, number and species of existing trees that are to be retained/protected (including trees on adjacent properties within six (6) metres of the subject site's property lines)
- Tree protection plan notes for trees being protected, including those on adjacent private and City-owned property including public streets.
- The location of and dimensions of any design features which promote sustainability and effective stormwater management and delineate which of these would be assumed by the City (i.e. within the boulevard or on private property)

For roof(s) which are wholly or in part landscaped, including green roofs, provide Landscape and Planting Plans for each level of roof with landscape, including:

- Proposed rooftop hard and soft landscaping in plan with location, dimensions and materials of paved areas including walkways and patios, as well as furniture, seating, planters, lighting, railings and other elements including weather protection (sun and wind screens)
- Dimensioned cross-sections showing hard and soft landscaping elements, including materials, soil depths, volumes and insulation for planters
- Plant lists and planting details for all plant material, including location of plant material, species, number of plants, size, height, and root condition for all plants, indicating native species
- Location and details of roof lighting fixtures (also shown on Lighting Plan)
- Relevant cross sections and dimensions for green roofs and/or cool roofs

Provide additional level of detail in the Landscape Plan for applications that include heritage considerations. These plans are to be cross referenced with any lighting and landscape plans approved under the Ontario Heritage Act.

8.2.3.7 Erosion and Sediment Control (ESC) Plan

ESC elements should include but may not be limited to the following requirements:

- Description of areas within the site that have potential for serious erosion or sediment transportation problems.
- Location of where the control measure is implicated
- A delineation and description of the measures to be undertaken to prevent erosion and to retain sediment on the Site, including but not limited to, the designs and specifications for swales, dikes, drains, and sediment control ponds.
- A delineation and description of the vegetative measures to be used, including, but not limited to, mulches, types of seeds and fertilizers and their application rates, the type, location and extent of pre-existing and undisturbed vegetation types.

8.2.3.8 Stormwater Management Plan

The stormwater management facility drawing shall contain an overall layout of the stormwater management facility within the project site, its location relative to the surrounding structures, property lines, and topographic features, and the inlet and outlet points for stormwater entering and leaving the facility. The drawings should also clearly identify the components of the facility such as ponds, basins, swales, weirs, spillways, headwalls, grates, forebays, or berms. Designated areas for sediment accumulation, overflow structures, and access points for maintenance shall also be clearly identified. The drawing shall show the ponding areas, with the associated 10-year and 100-year ponding areas, and the hydraulic grade lines.

This drawing should also contain details specific to the facility such as inlet details, rip rap details, access road sections, reinforcement details, berm details, headwall grate details, outlet control structure details, or any other relevant sections and details.

8.2.3.9 Servicing/Roadway Elements and Profile Drawings (For Subdivisions/ Condominiums)

The drawing shall contain a plan view, which is a top-down horizontal view of the project area. It shows the locations of utilities including gas, sewer, water, electric, and telecommunication lines, manholes, cleanouts, curb stops, watermain valves, and junction boxes. It should also include the future connections to existing watermains with the specifications for tee or wye connections, and hydrant connections. The service radius of hydrants shall be specified. Drainage elements including catch basins, storm drains, culverts, and swales shall be specified. Roadway features including curbs and gutters shall also be specified. Hydraulic grade lines of all sewers shall be shown on the profile drawings for all infrastructure to be assumed by the City of Sault Ste Marie.

The profile view is a vertical section cut along the alignment, showing the changes in elevation and vertical alignment of features. It contains an existing ground line representing the existing terrain elevations along the alignment, and a proposed grade line showing the designed elevations of the road, utility line, and manholes. It describes detailed information about the vertical curves and slopes including lengths, grades, and elevations at key points. Station numbers are to be located along the profile indicating key elevations. The profile also shows the utility connections between sanitary/storm manholes with their corresponding slope, size, length, and material.

Both the plan and the profile view contain relevant annotations indicating limits of construction, possible conflict areas, saw cut areas, etc.

8.2.3.10 Lot Grading Plan (For Subdivisions/Condominiums)

The typical lot grading details drawing displays the typical front, cross, and side slope drainage, each with its associated top view and side profile. It shows how the yard grades will be designed to achieve a specific drainage type and flow towards the designated outlet (e.g. swale). This drawing also contains the subdivision lot drainage requirements which includes the minimum yard slope, catch basin notes, direction and location of drainage flows, rear and side lot swale notes, embankment requirements, and any other relevant information regarding topography, elevations, or drainage.

8.2.3.11 Details and Notes

The details and notes should contain component details showing enlarged and detailed views of specific components or assemblies. These are most often typical details such as a typical road cross section or a typical tree planting detail. It can also include detailed illustrations of how different elements are connected, sectional views showing the interior structure of components, profiles and elevations of specific elements, details of architectural and structural features, and utility details.

This drawing can also include material specifications, construction methods, standards and codes, installation instructions, safety notes, quality control measures, or tolerances and allowances.

8.3 Specifications

A Schedule of Prices shall be submitted as an appendix within the contract documents. This schedule shall include the estimated quantity and unit price of each item, along with the corresponding specification number. Each specification shall reference the relevant Ontario Provincial Standard Specification and any applicable amending special provisions.

9. CONSTRUCTION STANDARDS

9.1 Supervision of Construction of Development Services

All construction work shall be performed under the review of a Consulting Firm acceptable to the City. All costs associated with the retaining of professional engineers for supervision will be borne by the Developer. The engineering firm that is hired to provide resident supervision for and inspect all work carried out in the subdivision will report to the Director of Engineering. The duties of the firm shall include (without limiting the generality of the foregoing) the following:

- Provide an instrument check of the Contractor's line and grade for sewers and/or waterlines;
- Carry out detailed inspection of construction to ensure that the work is done in accordance with the approved plans and specifications and the standards contained in this document;
- Carry out all necessary testing and inspection of materials and equipment installed;
- Investigate, report and advise of any unusual circumstances which may arise during construction;
- Provide weekly written reports on work progress and construction methods, including copies of the results of materials and equipment testing;
- Maintain a daily diary recording special instructions;
- Carry out final inspection at the conclusion of construction at the end of the maintenance period and as part of the acceptance program of the City;
- Obtain field information for modification of the construction drawings.
- Provide detailed final inspection, liaison and other assistance required to expedite the acceptance and takeover of the work and submit a certificate that the work is compete and was completed in accordance with the standards of the City of Sault Ste. Marie;
- Record all construction details necessary and modify the construction drawings to show the work as-built and to prepare service connection drawings as per the City of Sault Ste Marie standards for each lot in the developed land;
- Supply to the City two (2) sets of good quality reproducible as-constructed drawings illustrating the installed services; and one (1) electronic pdf set.
- Arrange and attend monthly site meetings during construction.

9.2 Start of Construction

No construction work shall take place on the development until the following requirements have been met:

- All construction drawings shall be approved by the Director of Engineering;
- Any approvals from the Ministry of the Environment for sewer, stormwater management facilities, and/or water systems shall have been received by the Director of Engineering;
- Approvals that may be required from any other governmental body that has jurisdiction over the development shall have been received by the Director of Engineering;
- Any zoning amendments shall have been approved;
- All bonding and insurance requirements shall have been met;
- Any monies to be paid to the City as a requirement of the Subdivision/Condominium Agreement or Site Plan Control Agreement shall have been paid;
- The Engineering Division shall be in receipt of a properly signed copy of the Development Agreement;

- A pre-construction meeting shall be held with the City, the PUC, the Developer and the consultant, who will inspect the work, present;
- The Developer shall have received written permission from the Director of Engineering to start work.

9.3 Road Closures

If the development construction requires an existing City road/street to be closed the Developer/Contractor must submit a “Road/Sidewalk Closure” application to the Director of Engineering for approval prior to closure. This requirement shall apply to the closure of a single lane of traffic, and/or a full road closure. Applications must be submitted four (4) days prior to the planned date of closure.

If a full road closure is required for more than seven (7) days on an arterial or collector road detour signage shall be mandatory. Detour signage may be required for shorter duration closures at the discretion of the Director of Engineering.

9.4 Sidewalk Closures

If the development construction requires an existing City sidewalk to be closed the following shall apply:

- If the sidewalk is located in a business district, or services a large volume of pedestrian traffic, the Developer/Contractor must submit a “Road/Sidewalk Closure” application to the Director of Engineering for approval prior to the closure. Applications must be submitted 4 days prior to the planned date of closure.
- All closed sidewalks must be identified with a “Sidewalk Closed” sign placed at the nearest point of sidewalk intersection on either side of the closed area so that pedestrians can take an alternate route without having to backtrack.
- The portion of sidewalk that is intended to be closed must be barricaded so that pedestrians cannot unintentionally access it (e.g. at the excavation point, start of construction zone).
- Barricades must remain in place until the new sidewalk can be poured or until a temporary cold patch asphalt surface is installed. A temporary gravel sidewalk surface will not be permitted. The entire perimeter of the excavation must be barricaded, unless it is located inside a closed section of road.

10. ACCEPTANCE OF DEVELOPMENT

10.1 Basis of Acceptance

Prior to accepting any services, the Developer shall provide the City with deeds for all lands and easements required by the City for park, recreation and/or school purposes, for drainage systems and sewer outlets. The Developer shall also have submitted whatever cash deposit that may be required in the development agreement for enlargement or extension of existing underground services, or for any other purpose, and received "As-built Prints" outlined in **Section 8**.

Acceptance of the development is subject to and contingent upon inspections which will be carried out in accordance with **Section 10.**

It should be noted that the City reserves the right to make whatever connections that may be required from time to time to any development services when in the opinion of the Director of Engineering such services are ready for use. This shall not constitute acceptance of these services.

10.2 Initial (Provisional) Acceptance

An inspection by City staff will be carried out on written certification from the consulting engineer that the services have been installed in accordance with City of Sault Ste. Marie Engineering Design Guidelines and Standards and that the consultant has inspected the works prior to submitting the written certification. Any costs relating to inspections by City staff for Acceptance inspections shall be billed to the Developer. The written certification and request for "Initial Acceptance" shall be accompanied with two (2) complete sets of hard copy as-built prints, one (1) CAD drawing package (sent with e-transmit) of the completed subdivision, one copy of the sewer camera inspection report, a copy of all material testing reports, and a copy of all commissioning reports. The Initial Acceptance submission shall include a list of any known deficiencies identified by the consultant. While all major deficiencies must be corrected prior to acceptance, the City may permit Initial Acceptance subject to the correction of minor outstanding items within a specified timeframe.

The Developer will be notified of any deficiencies which shall be corrected before “Initial Acceptance”. The Developer shall be responsible for making any repairs to any appurtenances or for any grade changes which adversely affect the appurtenances until a "Certificate of Final Acceptance" has been issued. Any emergency repair work performed by City prior to the issuance of a "Certificate of Final Acceptance" will be charged to the Developer.

When "Initial Acceptance" is warranted, the Developer will be notified in writing. When an acceptable maintenance guarantee has been deposited with the City, a certificate will be issued by the Director of Engineering stating the date of initial acceptance and start of the maintenance period. This certificate will also indicate to which section(s) of the development the "Initial Acceptance" applies.

The maintenance and warranty period shall generally be one year from the date of initial acceptance, except for tree planting, which shall have a two-year warranty, and pavement, which has a warranty of either one year from the date of initial acceptance or two years from the placement of top lift (whichever is greater).

10.3 Final Acceptance

An inspection similar to the "Initial Acceptance" inspection will be carried out prior to the expiration of the maintenance periods. This inspection ensures that all deficiencies have been addressed, no further repairs are required, and the services have performed satisfactorily during the warranty period. Any outstanding deficiencies shall be corrected before final acceptance.

If significant changes were made during the maintenance period (i.e. deficiencies, service relocations, etc.), updated as-built drawings shall be submitted as two (2) complete sets of hard copy as-built prints, and one (1) CAD drawing package (sent with e-transmit). If no major changes were made, confirmation that the previously submitted as-builts are still valid must be obtained.

Should "Final Acceptance" be warranted the City will issue a "Certificate of Final Acceptance" and will return the unused portion of the maintenance guarantee. In addition, the City takes over maintenance of the public services.

Following the final assumption of municipal infrastructure and expiry of all maintenance and warranty periods, the consulting engineer shall submit final record drawings to the satisfaction of the City of Sault Ste Marie. These record drawings must reflect the complete, as-constructed condition of all municipal infrastructure. Record drawings shall be signed and sealed by a licensed Professional Engineer and submitted as two (2) complete sets of hard copy as-built prints, and one (1) CAD drawing package (sent with e-transmit). These drawings will serve as the City's permanent engineering record and may be used for future asset management or maintenance.

10.4 Acceptance of Sections of the Development

Initial acceptance of separate sections of a development may be granted provided that the required work for each section to be accepted is complete and provided that the necessary performance guarantees are kept in force for all other sections of the development. At the discretion of the City Engineer, for Subdivision Agreements, initial acceptance will not be granted until approximately 85% of lots within the Plan of Subdivision, or within the section requested to be accepted, are developed. Acceptance of a section of a development is subject to the approval of the Director of Engineering and the sections which may be accepted independently are as follows:

10.4.1 Underground Services

All underground services shall be complete and be certified by the consulting engineer that the works were constructed in accordance with the City of Sault Ste. Marie Engineering Design Guidelines and Standards.

All hydrants shall operate correctly and not leak.

All valves shall operate correctly and have a plumb valve box with the valve operating spindle centered in the valve box. There shall not be debris in the valve box.

All sewers shall be clean and free flowing.

All sewers shall pass the required mandrel testing.

All sewers shall be within the specified allowable infiltration/exfiltration limit.

All manholes shall be complete and have all joints in the barrel correctly mortared and watertight.

All catch basins shall be complete with leads properly mortared and any holes, joints, etc. correctly mortared and watertight. The catch basin sump shall be reasonably clean.

Leakage tests should be specified. This may include appropriate water or low-pressure air testing. The testing methods selected should take into consideration the range in groundwater elevations during the test and the anticipated elevation during the design life of the sewer.

Prior to acceptance, all sewers shall be inspected using pan and tilt closed circuit television sewer inspection camera. A hard copy report outlining the condition of the sewer shall be submitted for review by the Director of Engineering. The hard copy and electronic copy of the report shall be accompanied by a

colour video of the sewer inspection. The electronic format of the video and computer disk shall be approved by the Director of Engineering.

Flushing and disinfecting watermains shall be done in accordance with PUC Waterworks Special Provisions Section 441.07.25.

10.4.2 Building Connections

The "Building Connections" portion of the development is that portion of the underground services which connects the sewer and/or watermains with each lot in the development. The following work shall be complete before "Initial Acceptance" will be considered for the "Building Connection" portion of the development.

- Suitable arrangements shall be made with the Director of Engineering to provide the necessary financial guarantees to ensure that any damage to existing facilities during the construction of the buildings on any undeveloped lots will be repaired by the Developer.
- All building connections shall be installed to the building line of each lot in the development.
- Two copies of the service connection drawings shall be submitted to the Director of Engineering for each developed lot in the development.
- The curb stops shall operate correctly. The curb box shall be straight and plumb with no debris in it.

10.4.3 Surface Works

The surface works of a development shall mean all works not mentioned in the underground services portion or the house connections portion of the development and shall include (without limiting the generality of the foregoing) valve box top sections, curb box tops, manhole frames and covers, catch basin frames and grates, roads, curbs, boulevards, fire hydrants, sidewalks, ditches, parks, landscaping, and stormwater management facilities. The following work shall be completed prior to the granting of "Initial Acceptance" for the surface works portion of the development.

- All surface works shall be complete and be certified by the consulting engineer that the works were constructed in accordance with City of Sault Ste. Marie standards.
- The concrete work shall have been inspected by the consulting engineer and been repaired according to **Section 10.4.3.1** below. Testing cost of the asphalt mix is to be paid by the Subdivider or Contractor.
- The asphalt work shall have been inspected by the consulting engineer and been repaired according to **Section 10.4.3.2** below.
- The stormwater management works have been inspected by the consulting engineer and have been repaired according to **Section 10.4.3.3** below.
- All valve boxes, fire hydrants, curb boxes, manholes, catch basins and any other appurtenances shall be set at the correct finished grade and be undamaged.
- All parkland development within the stage for which acceptance is being requested shall be completed and acceptable to the Parks Division.
- Suitable arrangements shall be made with the Engineering Division to provide the necessary financial guarantees to ensure that any damage to existing facilities during construction of the buildings on any undeveloped lots will be repaired by the Developer.
- A certificate signed by the consultant shall be submitted for each and every lot certifying that the property has been graded in conformity with the lot grading plan.
- The developer shall prepare and distribute septic field operation and maintenance information packages to the owner/occupant of all occupied lots within the development (rural developments

only) in accordance with the City of Sault Ste. Marie Development requirements and Algoma Public Health for on-site subsurface sewage treatment facilities.

- Testing Cost of the asphalt mix is to be paid by the Subdivider or Contractor.
- As a condition of the issuance of an occupancy permit, the lot grading plan(s) will be checked and certified by an Ontario Land Surveyor (drainage professional) verifying the lot grades and building set back dimensions. A certification letter and drawing shall be prepared by the OLS and submitted to the City detailing the proposed and as constructed grades.

If the City determines that:

- Grading has not been done in accordance with the Grading Control Plan,
- Grading has been done in accordance with the Grading Control Plan, but drainage problems remain, or
- Sufficient topsoil has not been left in the appropriate areas,

The Owner shall re-grade the project, or the affected part thereof, adding a sufficient amount of topsoil if necessary, or construct catch basins, swales or other structures that may be necessary to correct such problems, as required by the Director of Engineering for the City of Sault Ste Marie.

10.4.3.1 Policy for Acceptance of Concrete Work in Developments

The following conditions apply for Initial Acceptance:

a) Sidewalk slabs with cracks larger than 4mm shall be replaced.
b) Sidewalk slabs with more than one crack of any size shall be replaced.
c) Sidewalks with differential settlement of 12mm or more shall be replaced.
d) Sidewalk slabs with spalled surfaces shall be replaced.
e) Sidewalk slabs with a crack of any size which has concrete breaking or spalling away at the edges of the crack shall be replaced.
f) Sidewalk slabs with a corner broken off may be saw cut and repaired at this stage.
g) Curbs and/or gutters which have spalled may be patched at this stage.
h) Repairs or patching done to broken curb and/or relocated/widened driveways shall be restored.
i) Materials testing reports submitted
j) Inspector reports and diary submitted

The following conditions apply for Final Acceptance:

- Items a) and e) for initial acceptance will also apply for "Final Acceptance".
- Sidewalk slabs with a corner broken off shall be replaced.
- Curbs and/or gutters which have spalled shall be replaced.

Any work which was repaired for "Initial Acceptance" and has deteriorated shall be replaced.

10.4.3.2 Policy for Acceptance of Asphalt Work in Developments

a) The quality and acceptance of Hot Mix Asphalt shall be in accordance with OPSS.MUNI 310.08.
b) The asphalt surface appearance must be in accordance with the following:

- Each course after final compaction shall be uniform texture and shall be free of defects such as segregation, fat spots, oil spills, roller marks, and any other defects. The determination of whether an area is defective or not shall be made by the Contract Administrator at his sole discretion and shall be binding.

- Areas of medium segregation may be left in place for binder courses but are considered defective for surface courses. Areas of severe segregation are considered defective for binder and surface courses. 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 Contract Administrator, all at the contractor's expense.
- When segregation is observed by the Contract Administrator, the Contractor will be notified in writing and shall take immediate corrective action. If the segregation continues, the Contract Administrator may issue a stop work order until the problem with segregation is corrected.
- If segregation becomes evident within the maintenance period, the Contractor shall remove and replace the segregated areas or place a 30mm overlay of the same mix for the length of the segregated area, should grades allow. Corrective measures shall be performed during the maintenance period at the Contractor's expense.

c) Where the material supplied or workmanship is found to be unacceptable or borderline, the Contract Administrator reserves the right to order the removal and replacement or overlay of the subject asphalt and/or extend the maintenance period for an additional period.

d) Where the Contract Administrator chooses to exercise this right, the Contractor's maintenance security, or an appropriate portion thereof, shall be retained until the Contract Administrator is either satisfied as to the quality of the materials and workmanship or order removal and replacement of the subject asphalt.

10.4.3.3 Policy for Acceptance of Stormwater Management Works

- A functional stormwater management report has been provided and accepted by the City.
- All stormwater management facilities have been inspected and maintained, and an acceptable Operation and Maintenance Manual provided to the Engineering Division. For oil/grit separators, the unit(s) are to be vacuumed and cleaned out in accordance with the manufacturer's recommendations.
- All fire hydrants shall be acceptably painted in accordance with NFPA standards, and have all gaskets, screws, caps, etc. intact.
- All ditches shall be clean and flow correctly.
- All manholes and catch basins shall have the frames securely mortared on.

10.4.4 Electrical Works

The electrical portion of the development shall mean all related underground & surface construction. The following works shall be completed prior to the granting of "initial acceptance" for this portion of the development.

- The underground wiring shall be complete & inspected by the consultant, PUC and the Electrical Safety Authority. The Engineering Division shall receive a copy of the acceptance certificate as issued by the Electrical Safety Authority pertaining to this work.
- The street light poles, luminaires & brackets shall be in place with all necessary wiring & electrical connections completed. This work shall be inspected by the consultant, PUC and the Electrical Safety Authority. The Engineering Division shall receive a copy of the acceptance certificate as issued by the Electrical Safety Authority pertaining to this work.
- All valve boxes shall be plumb and straight.

10.5 Development Sureties and Summary of Holdbacks

Acceptable forms of Surety to the City of Sault Ste Marie shall be:

- Letters of Credit
- Material of Performance Bonds
- Certified Checks

In conjunction with the execution of the Development Agreement, the following sureties shall be submitted to the City:

10.5.1 Installation of Underground Services

100% of the construction cost as estimated by the engineering consultant. Supporting quotations from contractors are encouraged.

10.5.2 Installation of Building Connections

100% of the construction cost as estimated by the engineering consultant. Supporting quotations from contractors are encouraged.

10.5.3 Installation of Surface Works

100% of the construction cost as estimated by the engineering consultant. Supporting quotations from contractors are encouraged.

10.5.4 Installation of Electrical Systems

100% of the construction cost as estimated by the engineering consultant. Supporting quotations from contractors are encouraged.

10.6 Release of Development Sureties of Holdbacks

At various milestones of construction and warrantee expiration, upon application to the City of Sault Ste. Marie, the City shall partially release the sureties until such time as final acceptance is granted and all sureties then released. The following schedule of surety release is summarized as follows:

10.6.1 Initial Acceptance of Underground Services

Upon initial acceptance of Underground Services in accordance with **Section 10.2** and **10.4.1**, 90% or $10 000 CAD (whichever is more) of the surety shall be released to the developer.

10.6.2 Initial Acceptance of Building Connections

Upon initial acceptance of Building Connections in accordance with **Section 10.2** and **10.4.2**, 90% or $10 000 CAD (whichever is more) of the surety shall be released to the developer.

10.6.3 Initial Acceptance of Surface Works

Surface Works may, at the discretion of the developer, be released in three (3) phases:

1. Upon initial acceptance of the concrete works in accordance with **Section 10.2 and 10.4.3.1**, 90% or $5000 CAD (whichever is more) of the surety shall be released of the total submitted cost estimate for the curb and sidewalks (excluding granular bedding) and concrete collars around catch basins.

2. Upon initial acceptance of the asphalt base course in accordance with **Section 10.2 and 10.4.3.2,** 90% or $10 000 CAD (whichever is more) of the surety shall be released of the total cost estimate for the base course asphalt.
3. Upon initial acceptance of the surface course asphalt in accordance with **Sections 10.2 and 10.4.3.2**.

APPENDIX A

Standard Drawings