City of Duncan

Works and Services Bylaw No. 3158, 2017

(With Amendments to October 16, 2017)

This consolidation is not a legal document. Certified copies of the original bylaws should be consulted for all interpretations and applications of the bylaws of this subject.

Works and Services Amendment Bylaw No. 3158.01, 2017 – Adopted October 16, 2017

CITY OF DUNCAN

BYLAW NO. 3158, 2017

A BYLAW TO IMPOSE REQUIREMENTS AND SET STANDARDS FOR THE PROVISION OF WORKS AND SERVICES IN CONNECTION WITH THE SUBDIVISION AND DEVELOPMENT OF LAND.

WHEREAS the *Local Government Act* provides that the City Council may by bylaw regulate and require the provision of works and services in respect of the subdivision of land, and may, as a condition of approval of a subdivision or the issue of a building permit, require that the owner of land provide works and services in accordance with such standards on the land being developed and on the adjacent highway; and

AND WHEREAS *the Local Government Act* authorizes the City to require that the owner of land being subdivided or developed provide excess or extended services; and

AND WHEREAS the *Community Charter* authorizes the City to delegate its powers, duties and functions to an officer or employee of the City;

NOW THEREFORE the Council of the City of Duncan in open meeting assembled, hereby ENACTS AS FOLLOWS:

1. **Title**

This Bylaw may be cited as the "Works and Services Bylaw No. 3158, 2017".

2. **Definitions**

"City"	Means City of Duncan.
"crossing"	Means a sidewalk, curb or boulevard crossing for vehicular access.
"developer"	Means the owner of land in respect of which a subdivision application or building permit application has been made.
"Director"	Means the person appointed to the position of Director of Public Works and Development Services by Council.
"drainage system"	Means a system of works designed and constructed to collect, convey, or dispose of surface and other storm water.
"lane"	Means a highway 10m or less in width.

"local road"	Means a highway so designated in Schedule "A."
"Owner"	Means an owner as defined in the *Land Title Act* or his/her duly authorized representative.
"parcel"	Means parcel as defined in the *Land Title Act*, but does not include a highway.
"Engineer"	Means a Professional Engineer who is registered or licensed under the *Engineers and Geoscientists Act*.
"sanitary sewer system"	Means a system of works designed and constructed to collect, convey or dispose of sanitary sewage.
“security”	Means cash or a clean, unconditional, irrevocable and automatically renewing letter of credit drawn on a chartered bank or credit at which demand may be made on the letter of credit.
"storm water management plan”	Means a plan indicating the means by which storm water will be managed within and through a subdivision or development.
"subdivision"	means the subdivision as defined in the Land Title Act.
"street"	Means a highway greater than 10m in width.
"Surveyor"	Means a land surveyor licensed and registered in the province of British Columbia.
"walkway"	Means a highway intended primarily for pedestrian traffic or a pedestrian pathway adjacent to the portion of the highway that is developed for vehicular traffic.
"water system"	Means a system of works designed and constructed to supply, convey and distribute potable water as defined in the Drinking Water Protection Act.
"works and services"	Means any service, facility or utility which is required by this Bylaw.

3. **Interpretation**

3.1 References in this Bylaw to MMCD shall be interpreted as references to the Municipal Infrastructure Design Guideline Manual and the Master Municipal Specifications and Standard Detail Drawings in Volume II of the Platinum Edition of the Master Municipal Construction Documents published by the Master Municipal Construction Documents Association, and includes:

a) the definitions of such terms used in the Master Municipal Specifications and Standard Detail Drawings as are set out in the General Conditions in Volume II; and
b) all documents supplemental to the Master Municipal Specifications, the Standard Detail Drawings and the relevant definitions set out in the General Conditions that are issued from time to time by the Association, but excludes all references to measurement and payment in the Master Municipal Specifications.

Bylaw 3158.01 amended 4.1 b)

4. Works and Services Requirements

4.1 As a condition of:

a) the approval of a subdivision; or
b) the Issuance of a Building Permit, where the value of construction, excluding the value of tenant improvements to an existing building, as determined for the purposes of calculating the building permit fee under the Fees and Charges Bylaw, is greater than $500,000;

the Developer is required to provide works and services in accordance with the standards established in this Bylaw on the site being subdivided or developed and on that portion of a highway immediately adjacent to the site being subdivided or developed, up to the center line of the highway. Alternatively, the Developer may enter into an agreement with the City to construct and install the required works and services by a date specified in the agreement, and provide to the City security in the amount of 115% of the cost estimated by the Consulting Engineer as the cost of installing and paying for the works and services.

Bylaw 3158.01 added section 4.1.1

4.1.1 Not withstanding section 4.1 b), if the building permit value is less than $800,000 the required offsite works and services will be limited to up to the centre line of the highway on the longest frontage only.

4.2 If the works and services have not been constructed in accordance with the standards prescribed by this Bylaw and an agreement mentioned in section 4.1, the security shall be forfeit to the City and the City may, but is under no obligation to, complete the works and services or such portion of the works and services as the security will cover any portion of them, and apply the security to the cost of doing so. If the cost incurred by the City exceeds the amount of the security, the amount of the deficiency shall be a debt owed to the City by the Developer, payable upon receipt of the City's invoice for the work.

4.3 Upon the completion of construction of the works and services required by an agreement mentioned in section 4.1 by the Developer to the satisfaction of the Director, the City shall return 90% of the security to the Developer and may retain the balance to secure the Developer's obligation to repair and make good any defect in the works and services that becomes apparent during the one-year period following such completion of the works and services, or such further period as the Director may specify in writing in respect of any particular aspect of the works and services.

4.4 During the period mentioned in section 4.3, the Developer shall repair and make good any defect or deficiency in the works and services of which the Director has given the Developer notice in writing. Upon the Developer's failure to do so within the time specified by the Director, the City may, but is under no obligation to, repair and make good the defect or deficiency and apply the retained security to the cost of doing so. If the cost incurred by the City exceeds the amount of the security, the deficiency shall be a debt owed to the City by the Developer, payable upon receipt of the City's invoice for the work.

4.5 Upon the expiry of the period mentioned in section 4.3 the City shall return to the Developer any portion of the security that the City has retained, other than such portion as the City requires to repair and make good any defect or deficiency that the Developer has not repaired or made good as of that date despite having been given notice to do so.

4.6 The Director may from time to time, prescribe the form of agreement to be used where the City is entering into an agreement mentioned in section 4.1; execute and deliver such agreements on behalf of the City; require that such agreements be drafted in a form that is registrable under s. 219 of the *Land Title Act* against title to the land being subdivided or built upon, and provide that each such agreement shall require the Developer to:

a) repair and make good all defects and deficiencies appearing in the works and services during a period of at least one year following the completion of construction;
b) carry third party liability insurance in an amount and form acceptable to the City, in respect of claims arising out of death, personal injury or damage arising from the construction of the works and services on highways or other property of the City; and
c) indemnify the City and save it harmless in respect of all costs and expenses it may incur as a result of faulty workmanship or defective material in the works and services, in respect of which the City has provided notice to the Developer prior to the City's final acceptance of the works and services.

4.7 Where a parcel being created by a subdivision fronts on a highway, the Approving Officer may exempt a parcel from the statutory or bylaw minimum frontage requirements.

5. **Works and Services Standards**

5.1 The works and services required by this Bylaw are the following:

a) highways, boulevards including street trees and other landscaping, boulevard crossings, culverts, transit facilities, sidewalks, walkways, , curbs and gutters, traffic signs and signals, street lighting and conduit, electrical wiring, conduit and vaults and pads for transformers for underground wiring (hydro and telecommunications);
b) water distribution systems connected to the City's water distribution system including, without limitation, fire hydrant systems, valves and valve chambers, meters and meter chambers, pump stations and reservoirs;
c) sewage collection systems connected to the City's sewage collection system including, without limitation, lift stations, manholes and sewage holding facilities,; and
d) drainage collection systems connected to the City's drainage collection system including, without limitation, enclosed storm sewers, catch basins, manholes, ditches, gates, storm water retention and detention facilities, and environmental control facilities, except that in the case of a subdivision creating 3 or fewer parcels in a block face of which the parent parcel constitutes less than 50% of the frontage, abutting an existing highway with open ditches, the drainage collection system may, with the approval of the Director, drain to the open ditch, and except to the extent that Schedule D permits on-site drainage disposal.

5.2 The works and services described in section 5.1 must, in all cases, be provided on the land being subdivided or in respect of which a building permit is being issued, and on that portion of any highway or lane immediately adjacent to the parcel that is the subject of the subdivision or building permit application, as the case may be, up to the centre line of the highway or lane, or in a utility statutory right of way.

5.3 The works and services required by section 5.1 must be constructed and installed at the cost of the Developer to the standards set out in the City's technical specifications except to the extent that such standards may have been varied by development variance permit or board of variance order, and in accordance with such technical specifications as may be prescribed by the Director from time to time.

5.4 If works and services of the type described in section 5.1 are already in existence on or in the highway or lane adjacent to a parcel being subdivided or in respect of which a building permit is being issued or in a utility right of way, and the works and services do not comply with the standards specified in section 5.3, the Developer must alter the works and services so that they comply with the standards, and the provisions of section 4.1 regarding agreements and security apply to the alterations or as specified by the Director.

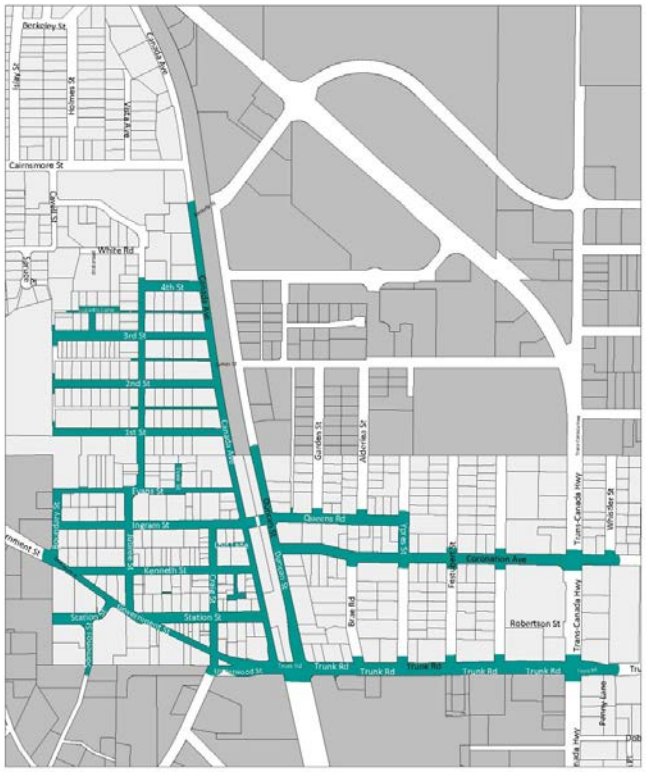
Bylaw 3158.01 amended section 5.5

5.5 Despite section 5.4, in the case of electrical and telecommunications wiring including conduit and vaults along the frontage of the parcel along highways identified below in Figure 1, the obligations of the Developer under this Bylaw for undergrounding existing overhead electrical and telecommunications wiring and transformers adjacent the parcel, in the case of a building permit application, are limited to $1500 per linear metre of frontage as follows:

a) for the first $500,000 of building permit value, up to 25 linear metres of frontage; and
b) for each additional $100,000 of building permit value, up to 5 additional metres of frontage.

5.5.1 The Developer shall contribute the amount that is $1500 per linear metre of frontage to the City in lieu of undertaking the work of undergrounding the existing overhead electrical and telecommunications wiring and transformers, and the City shall deposit the amount in a reserve fund established for the construction of underground services in the vicinity of the site being subdivided or developed.

Figure 1 – BC Hydro and Telecommunications Undergrounding Required Zone



5.5.2 The Developer shall not be required to contribute to the undergrounding of the existing overhead electrical and telecommunications wiring and transformers in the case of subdivisions that create fewer than two additional parcels;

5.5.3 The undergrounding of overhead electrical and telecommunications wiring and transformers is the sole responsibility of the Developer, including the cost of pad mounted transformers necessary to service the development if existing overhead transformers are unable to service the development; and

5.5.4 The Director may require, where a pad mounted transformer is required for current or future construction of underground services for the parcel, a statutory right of way on the applicable parcel.

5.6 The Director may require a Developer to pay to the City, in lieu of constructing or altering works and services required by this Bylaw, cash in the amount determined by the Director to be the cost of designing and constructing or

altering the works and services as of the time of approval of the subdivision or issuance of the building permit including any land acquisition costs, if the Director determines on the basis of sound civil engineering practice or economies of scale that the works should be constructed or altered at a later time or concurrently with the construction or alteration of works and services serving adjacent or nearby parcels of land, and in such cases the City shall deposit the funds into a reserve fund established for the construction or alteration of the works and services.

5.7 The works and services required by this Bylaw shall be provided in dedicated highways, unless the Director has approved the location of the works and services in a utility statutory right of way granted to the City, in which case the statutory right of way, including any required plan of right of way, must be prepared at the cost of the Developer, in terms satisfactory to the Director, and deposited concurrently with the deposit of the subdivision plan in the case of a subdivision application and prior to the issuance of the building permit in the case of a building permit application. Where an existing utility right of way is of insufficient width to accommodate the works and services, the Director may require the granting of additional right of way area to the City and this section applies to the preparation and deposit of a revised plan of statutory right of way.

6. **Excess and Extended Services Requirements**

6.1 The Council delegates to the Director the powers of the Council under the *Local Government Act* (LGA) to:

a) require a Developer to construct excess or extended works and services as defined in section 507 of the LGA;

b) determine whether the cost to the City to provide the excess or extended works and services would be excessive and, in that event, that the cost must be paid by the Developer;

c) determine the benefit of the excess or extended service that may be attributed to each of the parcels of land that will be served by the works and services; and

d) impose latecomer charges under section 508 of the *LGA* including interest calculated annually at the rate of 10%, commencing when the excess or extended services were completely constructed.

6.2. For the purpose of section 6.1, the Director may prescribe the form of agreements with Developers regarding the collection and remittance of latecomer charges, which agreements may be combined with works and

services agreements mentioned in section 4.1, and execute and deliver such agreements on behalf of the City.

7. **Administration and Inspection**

7.1 Every Developer shall pay to the City, prior to the approval of a subdivision or issuance of a building permit to which this Bylaw applies, a works and services administration and inspection fee calculated in accordance with the City of Duncan Fees and Charges Bylaw.

7.2. The Director and any other person the Council may designate to administer this Bylaw may enter at all reasonable times on any land to which this Bylaw applies, to ascertain whether the requirements of the Bylaw are being met.

7. Schedules

Schedule A	Highway Works
Schedule B	Water Supply Works
Schedule C	Sewage Collection Works
Schedule D	Drainage Works
Schedule E	Street Lighting Design Specifications

8. Severability

8.1. The provisions of this Bylaw are severable. If, for any reason, any provision is held to be invalid by the decision of a court of competent jurisdiction, such decision shall not affect the validity of the remaining provisions of this Bylaw.

PASSED FIRST READING 2017-APR-18
PASSED SECOND READING 2017-APR-18
PASSED THIRD READING 2017-APR-18

ADOPTED 2017-APR-24

Phil Kent, Mayor

Karen Robertson,
Director of Corporate Services

SCHEDULE A

HIGHWAY WORKS

1. **General**

1.1 Classification

1.1.1 Refer to the definitions in the City's Technical Specifications which shows the designated arterial and collector system within the City.

1.2 Widths

1.2.1 Streets shall be designed to the right of way and pavement widths required in Schedule A Table 2 of this Bylaw for the appropriate classification and type of land use. Normally, the required width will be shown on the sketch plan sent to the Developer.

2. **Geometrics**

2.1 General

2.1.1 Roadway geometrics are to be governed by the design speed required for each type of road as designated. Values of all the parameters with the exception of grades should be in accordance with the Transportation Association of Canada (TAC) Manual of Geometric Design Standards for Canadian Roads and Streets. Some of these parameters are summarized in the tables below along with revised grade standards.

Classification	**Design Speed km/h**	**Max Grade**		**Min Stopping (m)**	**Max Superelev %**	**Min* Radius (m)**
		Desir %	**Absol %**			
Arterial	60	6	9	85	6	130
Collector	60	8	10	85	6	130
Local	40	10	12	45	**	50
	50	10	12	65	**	90
* Where grades exceed maximum desirable the minimum radius for horizontal curves must be increased						
** Not applicable for local streets						

2.2 Grade

2.2.1 Desirable minimum gutter grade shall be 0.50% with absolute minimum being 0.30%.

2.2.2 Maximum grade for downhill cul-de-sacs shall not exceed 8%.

2.2.3 Absolute maximum grade may only be used where:

a) Desirable grade cannot be obtained due to topographical constraints;
b) The geometric design of intersections can be improved by increasing grade on minor street to avoid compromising design of major street.

2.3 Vertical Curvature

Classification	**Design Speed km/h**	**K Values**			
		Crest Curves (m)		**Sag Curves (m)**	
		Min	**Desir**	**Min**	**Desir**
Arterial and Collector	60	15	20	10	20
Local	40 50	4 7	5 10	4 6	7 11

2.3.1 Use of K values below desirable may only be used where justified by topographical constraints and in the case of sag curves where street lighting is provided.

2.3.2 Vertical curve length is calculated by the equation: L=KA

Where: L – Length in meters

A – Algebraic difference in grades in percent

K – Given in above table

2.3.3 Vertical curves may be omitted where the algebraic difference in grades does not exceed 2% for local streets and 1% for other streets.

2.4 Cross-Slopes

2.4.1 Roadways shall generally be constructed using a centerline crown.

2.4.2 Under adverse topographic conditions, offset crown or cross fall may be used.

2.4.3 Minimum cross-slopes shall be 2.5%, with a maximum 4%.

2.4.4 Centerline valley may be used for lanes or local roads in mobile home subdivisions or similar developments.

3. **Intersections**

3.1 General

3.1.1 Intersections shall be as near as possible to right angles. The minimum angle of intersection shall be 70° and the maximum angle 110°. Intersections on horizontal curves will normally not be acceptable.

3.1.2 The minimum spacing between intersections along a street shall be 60 m.

3.1.3 At every unsignalized intersection the crossing site distance requirements shall be checked. If these requirements cannot be met an alternate design shall be submitted by the Consultant Engineer to the Director for consideration.

3.2 Curb-return Radii at Intersections

Street	**Intersecting Street**	**Minimum Radius (m)**
Collector	Arterial	9.0
	Collector	7.5
Local	Arterial	9.0
	Collector	7.5
	Local	6.0

3.3 Vertical Curvature at Intersections

Providing the minor intersecting street is marked as a STOP, the following K values may be used for the minor street:

	K Values			
	Crest Curves (m)		**Sag Curves (m)**	
Classification	**Min**	**Desirable**	**Min**	**Desirable**
Collector	4	6	4	6
Local	2	4	2	4

3.4 Cross-slope at Intersections

3.4.1 At intersections the cross fall of the minor street shall be varied to suit the cross fall of the major street.

3.4.2 The maximum rate for changing cross fall at intersections shall be as follows:

a) Collector 4% in 30m
b) Local 6% in 30m

3.5 Cul-de-Sacs

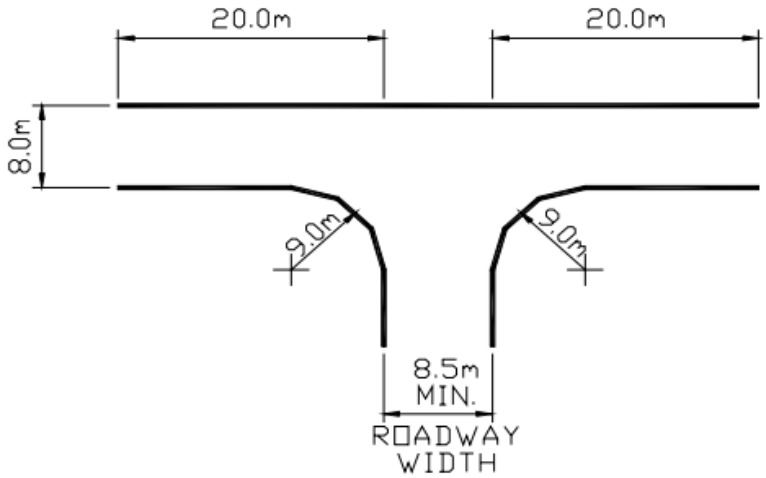
The maximum length of cul-de-sac measured from the centerline of the intersecting street to the center of the cul-de-sac is 150 meters. Cul-de-sac shall conform to the minimum dimensions given in the following table:

Circular or Circular Offset Cul-de-sac Dimensions

Classification	**R/W Radius (m)**	**Outer Edge of Pavement Radius (m)**
Local Residential with Center island *	16	14.0
Local Residential without island	14	12.0
Industrial ** without island	17	14.5

*A cul-de-sac with a center island shall have a minimum road width of 9 meters.

** Tee or Hammerhead type may be used for industrial cul-de-sacs and shall have the following minimum dimensions



3.6 Clearances at Aerial Utilities

Type	Vertical Clearance* (m)
Communications and guy wires	4.6
Hydro conductors 0-750 V	4.6
Hydro conductors 750-22000 V	5.0
Hydro conductors 22000 – 90000	5.5

*From final ground surface (subject to change based on Hydro and Telephone authorities)

3.7 Signs, Poles and Trees

3.7.1 Horizontal clearance from edge of travel lane to edge of pole or sign:

3.7.1.1 Roadways without curbs 2.0 m.

a) Roadways with curbs 0.3 m minimum while 1.0 m preferable except where sidewalk is adjacent to curb in which case 1.76m is preferable. At no time may any pole or sign base be placed within the sidewalk. Additional road dedication must be granted where more space is required to achieve this.

b) Use of minimum clearance to be justified by safety appurtenances such as poles with break-away or frangible bases or sign poles of light weight fabrication.

3.7.1.2 Horizontal clearance between lighting pole and hydro pole shall be 2.5m.

3.7.1.3 Vertical clearance between lighting pole and hydro lines shall be in accordance with BC Hydro Specifications.

3.7.2 For Trees

3.7.2.1 Horizontal clearance from edge of travel lane to roadside edge of tree trunk shall be a minimum of 2.0 m.

3.7.2.2 Horizontal clearance from edge of driveway, curb return or above ground utility to tree trunk shall be 2.5 m.

3.7.2.3 Vertical distance from tree branches to the finished road grade shall be greater than 4.9 m.

4. **Sidewalks and Walkways**

4.1 Independent Walkways

4.1.1 Grades - where walkways are not an integral part of a roadway the following shall apply:

		Maximum Longitudinal Grade		Cross Slope		
				Min	Maximum	
R/W Width (m)	Pavement Width (m)	Desired %	Absolute %		Desired %	Absolute %
2.5	1.8 (minimum)	7	9	2	4	6

*Where walkway serves as emergency vehicle access a right of way width of 3.5m is required

**The portion of the walkway in the boulevard area shall be flared outwards at 45 degrees to meet the back of the curb or sidewalk as appropriate

4.1.2 Absolute grade and cross slopes may be used only where desirable values cannot be obtained due to topographical constraints.

4.1.3 In cases when the Absolute grades will be exceeded, concrete steps complete with handrails conforming to the latest edition of the Workers' Compensation Board Regulations shall be installed as part of the walkway.

4.2 Fencing and Bicycle Baffles

4.2.1 Unless otherwise specified, walkways shall be provided with a 1.5 m high chain link fence on each side located 0.2 m from the side property line. The fence shall terminate at the road property line at each end.

4.2.2 Bicycle baffles shall be placed at each end of the walkway. If the walkway also serves as emergency vehicle access, the bicycle baffles shall be removable at the fence line as shown in the Standard Drawing.

4.3 Sidewalks on Road Right of Way

4.3.1 Widths of sidewalks shall be in accordance with the following table:

Classification	Land Use**	Minimum Width (m)	
		Adjacent to Curb	Separate from Curb

Arterial	Low density residential	Not desirable	1.5
	High density residential	Not desirable	1.8
	Commercial	2.5	1.8
	Industrial	Not desirable	1.5
Collector	Low density residential	Not desirable	1.5
	High density residential	1.8	1.5
	Commercial	1.8	1.8
	Industrial	Not desirable	1.5
Local	Low density residential	1.5	1.5
	High density residential	1.5	1.5
	Commercial	1.8	1.8
	Industrial	Not desirable	Not desirable

**Land use refers to the predominant land use within the specific block.

4.3.1.1 Generally sidewalk alignment constraints shall be identical to those of the adjacent roadway.

4.3.1.2 Cross-slope shall be 2% towards the gutter or ditch on the roadway.

4.4 Wheelchair Ramps

4.4.1 Wheelchair ramps shall be formed at all intersections where curbs separate sidewalks or walkways from roadways. Wheelchair ramps shall normally be located at the midpoint of the curb return.

5. **Driveways**

General

5.1 The selection of the location of driveways shall be based on the latest edition of Guidelines for Driveway Design and Location, an Institute of Transportation Engineers Recommended Practice Manual.

5.1.1 Width at Property Lines:

Land Use	Minimum Width (m)	Maximum Width (m)
Residential: Individual Driveway Common Driveway	3.5 6.0	7.0 9.0
Commercial and Industrial (one-way)	4.5*	6.0*
Commercial and Industrial (two-way)	6.0*	15.0*

6. Pavement Structures

General

6.1 Pavement design shall be based on one of the following methods:

6.1.1 Past history of successful pavements in adjacent similar areas.

6.1.2 For new roads or total reconstruction of existing roads, any design method covered in Part 5 “Structural Design” of the TAC Pavement Management Guide. Pavement design shall include consideration of the subgrade soil type, frost susceptibility, moisture conditions and subgrade drainage provisions.

6.1.3 For existing roads where only overlay is needed, the design methods covered in The Asphalt Institute’s latest edition of Manual MS – 17 Asphalt Overlays and Pavement Rehabilitation.

6.2 Road Design Criteria

6.2.1 Design life for all classifications of roads shall be minimum 20 years.

6.2.2 Where the Benkelman Beam design method is used, the design deflections (mean plus two standard deviations) shall be as follows:

a) Local & Lanes 1.5 mm
b) Collector 1.3 mm
c) Arterial & Industrial 0.85 mm

6.2.3 Where existing pavements are to be overlaid, the minimum thickness of asphaltic concrete pavement overlay shall be at least two times the maximum aggregate size, but in no case to be less than 25 mm.

6.3 Pavement Structure

6.3.1 Regardless of the method used for pavement structure design, pavement structures shall be at least equal to or greater than the minimum pavement structures shown below.

6.3.2 Minimum pavement structures shown below are based on the in-situ soil classification as defined in the Unified Soil Classification System (Figure 1).

Figure 1 - Unified Classification System for Soils

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION AREA
COURSE-GRAINED SOILS (MORE THAN 50 PERCENT BY WEIGHT LARGER THAN 0.075mm SIEVE)	GRAVELS MORE THAN HALF COURSE. GRAINS LARGER THAN 4.75mm SIEVE	CLEAN GRAVEL (LITTLE OR NO FINES)	GW	WELL GRADED GRAVELS LITTLE OR NO FINES	CONTENT OF FINES LESS THAN 5 PERCENT
			GP	POORLY GRADED GRAVELS AND GRAVEL SAND MIXTURES LITTLE OR NO FINES	
		DIRTY GRAVEL (WITH SOME FINES)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12 PERCENT
			GC	CLAYEY GRAVELS, GRAVEL-SAND-(SILT) CLAY MIXTURES	
	SANDS MORE THAN HALF FINE. GRAINS SMALLER THAN 4.75 mm SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	CONTENT OF FINES LESS THAN 5 PERCENT
			SP	POORLY GRADED SANDS, LITTLE OR NO FINES	
		DIRTY SANDS (WITH SOME FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12 PERCENT
			SC	CLAYEY SANDS, SAND-(SILT) CLAY MIXTURES	
FINE GRAINED SOILS (MORE THAN 50 PERCENT BY WEIGHT PASSING 0.075mm SIEVE)	SILTS, LOW COMPRESSABILITY	W_L <50%	HL	INORGANIC SILTS & VERY FINE SANDS ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART
		W_L >50%	HI	INORGANIC SILTS, MICACIOUS OR DIATOHACIOUS, FINE SANDY OR SILTY SOILS	
	CLAYS, HIGH COMPRESSABILITY	W_L <30%	CL	ORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS	
		30%<W_L <50%	CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	
		W_L >50%	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	ORGANIC SILTS AND CLAYS	W_L <50%	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
		W_L >50%	OH	ORGANIC CLAYS OF HIGH PLASTICITY	
	HIGHLY ORGANIC SOILS		PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG OUTDOOR ODOUR, AND OFTEN FIBROUS

6.3.3 Soils at the subgrade level having classifications of MH, CH, OH, and P+ require special treatment or total removal and replacement with soil having a higher classification.

6.4 Minimum Pavement Structure Using Asphaltic Concrete Pavement:

Road Classification	**Minimum thickness with subgrade soil Class C or better**	**Minimum thickness with subgrade soil Class ML/CL/OL**
Local roads and Lanes	50 mm asphaltic concrete 75 mm base course 150 mm sub base	65 mm * asphaltic concrete 75 mm base course 150 mm sub base
Collector	75 mm **asphaltic concrete 75 mm base course 175 mm sub base	75 mm ** asphaltic concrete 75 mm base course 300 mm sub base
Arterial and Industrial	75mm *** asphaltic concrete 100mm base course 200mm sub base	100 mm *** asphaltic concrete 150 mm base course 300 mm sub base

**to be places in two lifts; 50mm and 25mm
***to be places in two lifts; 50mm and 25mm >

2nd lift to be places after the installation of all underground services and construction of buildings.

NOTE: The requirement for placing asphalt concrete in two lifts may be waived by the Director in cases where he/she considers it to be impractical to do so (i.e. minor road widening).

6.5 Minimum Structures for Sidewalks, Walkways, and Driveways

6.5.1 All sidewalks, walkways and driveways shall be constructed of Portland Cement Concrete. Composition of the concrete structure shall be as follows:

Item	**Structure**
(a) Sidewalk, walkways except those adjacent to mountable curbs	(b) 100mm Portland cement concrete; 75mm base course
(c) Driveway crossings	(d) 150mm Portland cement concrete; 75mm base course
(e) Sidewalk adjacent to mountable curbs	(f) 150mm Portland cement concrete; 75mm base course

6.5.1 Concrete Curbs

The type of concrete curbs to be used shall be determined from the following table:

Classification	**Curb Type**
Arterial and collector	Curb with gutter, barrier
Local: Low density High density	Curb with gutter, mountable Curb with gutter, barrier

SCHEDULE B

WATER SUPPLY WORKS

1. **Sizing of Watermain**

   1.1 Watermain shall be sized in accordance with the City's Water Distribution System Computer Model which has incorporated the following design parameters.

2. **Design Flow**

   2.1 The design flow for watermain shall be based on the greater of the following:

   a) Peak Hour Demand: 2,100 liters per capita per day for residential areas, and 60,000 liters per hectare per day for commercial and industrial areas.
   b) Peak Day Demand Plus Fire Demand: 1,400 liters per capita per day for residential areas, and 40,000 liters per hectare per day for commercial and industrial areas plus the applicable fire demand at a location where the pressure drop would be most critical.

3. **Fire Demand**

   3.1 Fire demands shall be determined based on the latest edition of the Insurance Bureau of Canada's publication "Water Supply for Public Fire Protection – A Guide to Recommended Practice". However, the fire demands so determined shall not be less than the minimum fire demands shown below corresponding to the various developments:

Type of Development	Minimum Fire Demand
Single Family Residential	60 litres/second
Apartments	120 litres/second
Townhouses	120 litres/second
Commercial	150 litres/second
Institutional	150 litres/second
Industrial	190 litres/second

4. **Design Computations**

4.1 Use the Hazen-William's Formula:

$$Q = \frac{CD^{2.63}S^{0.54}}{0.00374}$$

Where: Q = Rate of flow in liters per second

D = Nominal pipe diameters in mm

S = Slope of hydraulic grade line in m/m

C = Roughness coefficient (100 for mains up to 200mm diameter and 110 for mains greater than 200mm)

5. **Water Pressure**

5.1 The water distribution system shall be designed to supply water at pressures within the following ranges:

a) Minimum pressure at peak hour demand = 140 kPa
b) Maximum pressure at low demand = 1050 kPa
c) Minimum pressure at the fire test location under peak day demand excluding hydrant losses = 140 kPa

6. **Minimum Pipe Size**

6.1 Distribution mains – 150mm in residential areas and 200mm in industrial and commercial areas

6.2 Fire hydrant connection – 150mm

7. **Practical Design Considerations**

7.1 Looping of Watermains

7.1.1 Except in cul-de-sacs of 150m or less in length, all watermains shall be looped.

7.2 Blow-off Assemblies

7.2.1 All dead end water mains, whether permanent or temporary, shall be provided with blow-off assembly as shown on the Standard Drawings.

7.3 Location

7.3.1 Service connections: normally at center of parcel frontage.

7.3.2 Separation from sanitary sewer: minimum separation of watermains from sanitary sewers or services shall be as outlined in Section 5 – Sanitary Sewers.

7.4 Minimum Depth of Cover

7.4.1 Mains and services shall be of sufficient depth to:

a) Prevent freezing.
b) Clear other underground utilities
c) Otherwise not less than 1.0m.

7.5 Valving

7.5.1 In general, valves shall be located in intersections in a cluster at the pipe intersection with a minimum of:

a) 4 valves at “X” intersection;
b) 3 valves at “T” intersection;
c) not more than 200m apart;
d) not more than one hydrant isolated; and
e) the location of the gate valves shall be such that interruptions to water supplies to adjoining properties are minimized in the event that isolation of a section of main becomes necessary.

7.5.2 Gate valves of the same diameter as the nominal pipe size shall be used for watermains up to and including 400mm diameter. On watermains 450mm and larger, gate valve sizes may be reduced by one-third rounded up to the nearest nominal valve size.

7.5.3 Butterfly valves with mechanically assisted operating gear boxes may be substituted for gate valves 450mm diameter and larger.

7.6 Hydrant Spacing

7.6.1 Fire Hydrants shall be located in general at street intersections and spaced as follows:

a) Not more than 140 m apart nor 90 m from the furthest dwelling; or
b) In accordance with the latest edition of “Water Supply for Public Fire Protection – A Guide to Recommended Practice” published by the Insurance Bureau of Canada.

7.6.2 The final location of hydrants is subject to the approval of the City's Fire Chief.

7.7 Hydrant Connections

7.7.1 Hydrants shall be connected and secured by:

a) flanged joints where hydrant is connected to valve on main; or
b) tie rods or joint restraints where hub joints are used.

7.8 Service Connection

7.8.1 The minimum size of water service connections shall be 19 mm. Service connections 100 mm and larger shall be connected to the watermain with a tee and a gate valve complete with 50 mm square operating nut and valve box assembly. Service connection installation details shall conform to the Standard Drawings.

7.9 Thrust Blocking & Joint Restraints

7.9.1 Concrete thrust blocking or joint restraints shall be provided at tees. In all cases, the Consultant Engineer shall be responsible to verify that the sizes shown chosen are adequate for his design. If larger thrust blocks are required, he/she shall clearly specify the size of thrust blocks for the various types of soil conditions and the design pressure on the Design Drawings.

7.10 Minimum Pipe Grade

7.10.1 Watermains shall be designed with a minimum grade of 0.1%.

7.11 Air Valves

7.11.1 Air valves shall be installed at all summits (greater in elevation difference than 1 pipe diameter) in the main and also at abrupt changes in vertical grade from steep to flat sections. The air valves shall be double acting air release and vacuum valves sized according to normal and extreme operating conditions expected.

7.12 Test Points and Chlorination must meet the American Water Works Association (AWWA) Standards as prescribed by local Health Authority.

7.13 Fire Line Connection

7.13.1 It shall be the Consultant Engineer's responsibility to adequately size the fire line connections. Fire line connections shall be terminated at the property line with a detector check valve assembly.

7.14 Pipe Materials and Specifications (See Construction Specifications).

7.15 Structural Design

7.15.1 The structural design of watermains shall be the responsibility of the Consultant Engineer. Live loads on the watermain conduit shall include Highway loads on the pipe and an impact factor of 1.5. Ductile iron and Polyvinyl Chloride (PVC) AWWA. C-900 pipes shall be considered as rigid and flexible conduits respectively when selecting the design methods. The minimum Class of Bedding and the limit of the trench width at the top of the pipe shall be as shown on the Standard Drawings. In cases where more stringent construction requirements are necessary to achieve the required field supporting strength of the watermain conduit, the designer shall specify both the Class of Bedding and the maximum trench width at the top of the pipe on the Design Drawings.

SCHEDULE C

SEWAGE COLLECTION WORKS

1. Design Parameters

1.1 Per Capita Flow

1.1.1 New systems shall be designed on the basis of an average daily per capita flow of not less than 360 liters/day. For existing systems, an additional per capita allowance shall be made where the measured average annual flow exceeds this value and immediate remedial measures are not proposed.

2. Peaking Factor

2.1 Population densities corresponding to various Zoning designations are given in Table 1 of this section – Population Densities by Zoning Designation. The peaking factor shall remain constant at 2.5.

3. Infiltration

3.1 Average infiltration rate = 0.1 litres per second per hectares

4. Design Flows

4.1 Residential Design flow Qr = (population x per capita flow x peaking factor) + infiltration.

4.2 Industrial design flow Qi shall be calculated based on the projected employee population and types of industries proposed for the area. Special consideration shall be given to the design of sanitary sewers for areas where heavy water consumption industries are proposed.

5. Pipe Sizing Formula

5.1 For gravity sewers use Manning's formula:

$$Q = \frac{AR^{0.667}S^{0.5}}{n}$$

Where Q = Design flow in m^3/s

A = Cross sectional area in m^2

R = Hydraulic radius (area/wetted perimeter) in m

S = Slope of hydraulic grade line in m/m

n = Roughness coefficient = 0.013 for all pipes acceptable for use in sanitary sewers

NOTE: Reduction in pipe sizing shall not be made downstream irrespective of increase in carrying capacity of sewers due to increase in grade.

6. Velocity

6.1 Gravity sewers minimum V = 0.61 m/s @ design flow.

6.2 There are no maximum allowable velocities, however, where grades exceed 15%, the Consultant Engineer shall address sewer scour and anchoring problems and modify the sewer design to suit local conditions.

7. Minimum Pipe Diameter

7.1 Collector sewer 200mm.

7.2 Service connections 100mm for single family.

7.3 Service connections 150mm for two or more dwelling units and commercial units.

8. Minimum Pipe Grade

8.1 The following are minimum pipe grades for the remaining gravity sewer system. Steeper grades are desirable. Under special conditions, if detailed justifiable reasons are given, slopes less than the following may be permitted. It must be recognized that decreased slopes may cause additional sewer maintenance expense.

Pipe Diameter (mm)	Minimum Grade (m/100m)
100 (service connections)	1.25
200	0.40
250	0.28
300	0.22
350	0.17
375	0.15
400	0.14
450	0.12

9. Radius of Curvature

9.1 Minimum radius = 60m

9.2 Maximum joint deflection shall be as recommended by pipe manufacturer.

9.3 Only one vertical or one horizontal curve is permitted between manholes.

10. Hydraulic Losses Across Manholes

10.1 The following criteria shall be used:

a) The crown of the downstream pipe shall not be higher than that of the upstream pipe.
b) Minimum drop in invert levels across manholes:
    i. Straight run – 50 mm drop
    ii. Deflections up to 45° - 50 mm drop
    iii. Deflections 45° to 90° - 50 mm drop
c) An outside drop pipe shall be installed when the drop between inverts exceeds 0.6 m. See Standard Drawings.

11. Sewer Location

11.1 Service connections are normally at 2.4m from low side of parcel boundary.

11.2 Separation from water mains:

a) Minimum 3.0 m horizontally.
b) Minimum 0.5 m vertical clearance below water mains and in separate trench if 3.0 m horizontal clearance is not possible.

11.3 Sanitary sewers may be laid in a common trench with storm sewers. However, in these cases, the Consultant Engineer must make adequate checks to ensure that a minimum clearance of 0.4 m is maintained between pipes and that conflicts do not exist at the connections, manholes and utility crossings.

12. Service Connections

12.1 Sanitary connections are to be installed with inspection chambers as shown on the Standard Drawings.

12.2 All service connections shall enter the main between 2 and 10 o'clock position above the springline at the top of the pipe. Connections to new mains shall be made using manufactured wye fittings. Connections to existing mains shall be made using manufactured saddles. Single connections shall be permitted only.

13. Pipe Materials and Specifications (See Construction Specifications)

14. Structural Design

14.1 The structural design of sanitary sewer and force-main installations shall be in accordance with the latest edition of ASCE Manuals and Reports on Engineering Practice No. 37 – Design and Construction of Sanitary and Storm Sewers. Live loads on the sewer conduit shall include Highway H-20 loading and an impact factor of 1.5. The minimum Class of Bedding and the limit of the trench width at the top of the pipe shall be as shown on the Standard Drawings.

14.2 In cases where more stringent construction requirements are necessary to achieve the required field supporting strength of the sewer conduit, the Consultant Engineer shall specify both the Class of Bedding and the maximum trench width at the top of the pipe on the Design Drawings.

15. Sanitary Connections and Building Elevations

15.1 Every existing parcel that is passed in the extension of the sanitary sewer system shall be provided with a sanitary sewer connection. The Consultant Engineer shall send a registered letter to the owner of each such parcel to request the owner to identify a preferred location. Copies of the correspondence shall be forwarded to the Engineering Department for record purposes. All such locations are subject to the approval of the Director and the Director shall specify locations for parcels whose owners do not respond. For new parcels in a subdivision and for existing parcels when the property owner gives his permission, the connection shall be extended 1.5 meters into the parcel.

15.2 Elsewhere the service connection to existing properties shall be terminated at the property line with the inspection chamber located as shown on the Standard Drawings.

15.3 The design elevation of the inspection chamber for each property shall be specified on the Design Drawings. In selecting the invert of the chamber, the following must be taken into account:

a) Gravity connection to all known outlets is possible.
b) Gravity connection to possible house connections passing under the foundation footings is possible. An allowance of a minimum 0.5 meters below basement slab elevation to invert of connection at that point is required.

c) The minimum and maximum depths of the inspection chamber crown at the property line shall be 1 meter and 3 meters respectively.
d) In servicing a property where no dwelling exists, the invert of the inspection chamber shall be 1.5 meters lower than the average ground elevation at the 7.5 meter setback from the front property line unless topographic constraints make this depth impractical.

16. Service Connection Entering Manhole

16.1 Service connections entering manholes shall not be in an adverse direction to the flow in the sewer main nor shall the crown of the connection be at a lower elevation than the crown of the highest sewer main.

17. Force-Mains

17.1 The pipe materials and specifications for sanitary force-mains shall conform to the the City`s Technical Specification.

17.2 Pipe Sizing

17.2.1 For force-mains use Hazen-Williams formula:

$$Q = \frac{CD^{2.63}S^{0.54}}{0.00374}$$

Where Q = Rate of flow in L/s

D = Internal pipe diameter in m

S = Slope of hydraulic grade line in m/m

C = Friction coefficient = 120 for all pipes acceptable as sewage force-mains

17.2.2 Minimum size of force-main shall be 100mm diameter.

17.3 Velocity

17.3.1 At the lowest pump delivery rate (i.e. occurring at the pump cut-off level), a minimum velocity of 0.76 meters per second shall be maintained in the force-main. The maximum velocity occurring in the force-main shall not exceed 3.5 meters per second.

17.4 Air Relief Valve Assembly

17.4.1 An air relief valve assembly consisting of a saddle, brass nipples, Mueller Mark II Oriseal isolating valve and automatic sewage air relief valve housed in a manhole shall be placed at high points in the force-main to prevent air locking.

17.5 Connection to Manhole

17.5.1 Force-mains shall enter the receiving manhole at a point not greater than 450mm above the highest pipe crown in the manhole. The direction of the force-main shall not be adverse to the flow through the manhole.

SCHEDULE D

DRAINAGE WORKS

1. General

1.1 The extent of the tributary drainage areas of the storm drainage system under design shall normally be in accordance with the natural contours of the land. However, that it is the Consultant Engineer's responsibility to confirm the extent of the drainage areas with the Director prior to design, and to incorporate the designs for the minor and major flows into an ultimate overall coordinated drainage system.

1.2 Storm drainage systems shall be designed using either the conventional method or the storm water management concept specified by the Director.

1.2.1 Conventional Method

1.2.1.1 Design shall be based on the Rational Formula. This method is limited to the design of the Minor System for storms of 1 in 10 year return only.

1.2.2 Storm Water Management Concept

1.2.2.1 This method involves the employment of one of the Hydrograph Methods stated herein (see Item 3.1.2). Dependent upon the hydraulic capacity of the downstream drainage system, the design under this concept may require the provision of detention facilities to limit the peak runoff after development to that which occurred before development. Under this concept, the integrated design of both the Minor and Major systems are necessary.

2. Minor and Major Systems

2.1 The design of each new drainage under the Storm Water Management Concept System shall consist of the following components:

a) The Minor System shall consist of pipes, open channels and water courses which convey flows of a 5-year return frequency. The system shall include driveway culverts.
b) The Major System is the route followed by runoff waters when the capacity of the Minor System is exceeded. It shall consist of surface flood paths, roadways and water courses which convey flows of a 100-year return frequency. The system shall include culverts crossing roadways.

3. **Design Parameters**

3.1 Design Flows

3.1.1 Design flows shall be computed using one or more of the following methods:

a) Rational Formula:

Q = AIR/360

Where Q = Design flow in m3/s

A = Drainage area in ha

I = Rainfall intensity in mm/hr

R = Runoff coefficient (see Item 6.3.5)

The Rational Formula is applicable to small watersheds (approximately 8 ha or less) with drainage systems not including detention facilities.

b) Isochrone Method

The Isochrone Method is a relatively simple way of estimating the runoff hydrograph for an urban catchment. The basis for constructing the hydrograph is a diagram of runoff-time-area and rainfall hyetograph.

c) SCS Method

This method can be widely applied to all types of hydrology in urban drainage. The SCS method can be used in hand calculations for small drainage basins

d) Deterministic Methods

This method quantifies runoff from rainfall and/or snowmelt by simulating the effects of the various components of the process. The often involves the use of a computer model. The model chosen must be approved by the Director.

3.2 Hydrograph Methods

3.2.1 Hydrograph methods are required for larger areas and for any drainage system including detention facilities. Acceptable calculation methods include the following:

3.2.1.1 Manual Methods:

a) Modified Rational Method

b) Soil Conservation Service Graphical Method

3.2.1.2 Computer Modelling:

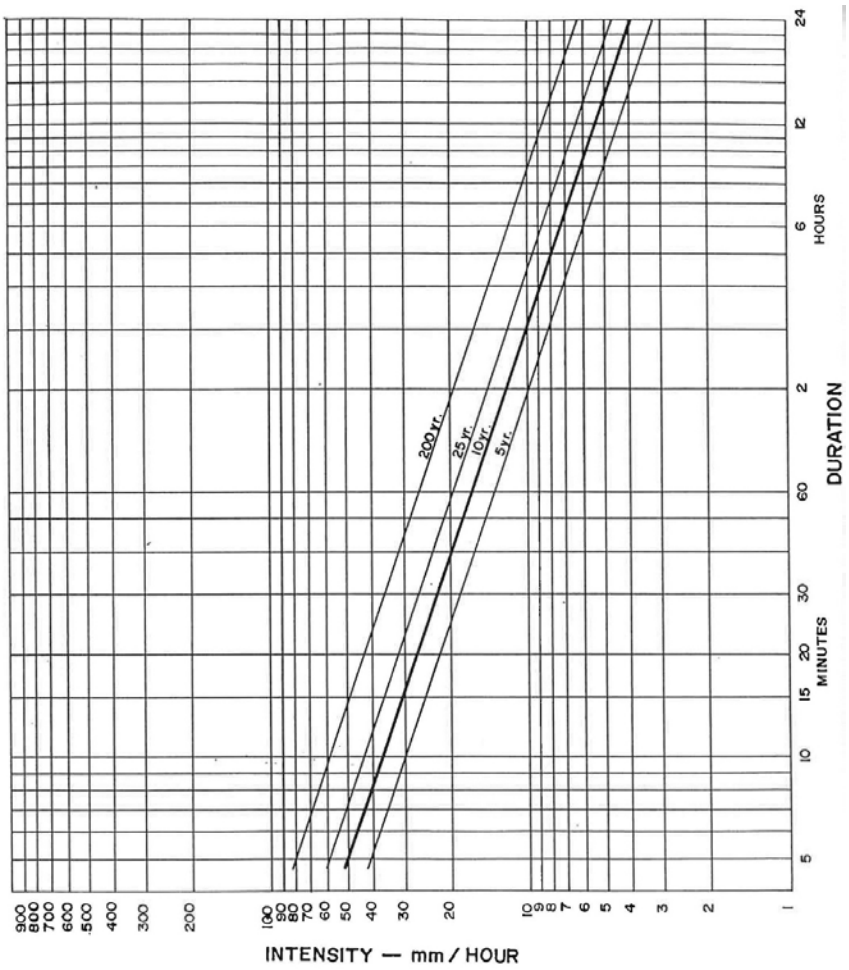
a) SWMM

b) Other storm water management models which have been validated with actual rainfall-runoff measurements in surrounding municipalities.

3.3 Rainfall Intensity/Duration/Frequency (IDF) Curves

3.3.1 IDF Curves shown in Table 1 shall be used for all calculations requiring such information. Additional rainfall data for the City of Duncan may be obtained from the Regional Office of Atmospheric Environment Service of Environment Canada.

Figure 1 - IDF Curves



3.4 Rainfall Return Frequency

3.4.1 The following return frequencies shall be used for design:

3.4.1.1 Minor Systems:

a) Conventional Design - 10-year return
b) Storm Water Management - 5-year return

3.4.1.2 Major Systems:

a) 100-year return

3.5 Time of Concentration

3.5.1 Use the following formula:

TC = TI + TF

Where: TC = Time of concentration for use as duration on IDF curve to get rainfall intensity.

TI = Inlet time (Minimum: 10 minutes)

For undeveloped areas, use Uplands Method to obtain TI.

TF = Flow time in channels and pipes based on Manning's Equation.

3.6 Runoff Coefficients (For Rational Formula)

Land Type	**Coefficient**
Low density residential	0.40
Medium density residential	0.60
High density residential	0.70
Park or golf course	0.20
Churches or schools	0.75
Roof or pavement	0.95
Grassland	0.20
Cultivated	0.40
Woodland	0.25

3.7 Hydraulic Calculations

3.7.1 Storm Sewers and Open Channels

3.7.1.1 Use Manning's Formula:

$$Q = \frac{AR^{0.667}S^{0.5}}{n}$$

Where Q = Design flow in m3 /s

A = Cross sectional area in m2

R = Hydraulic radius (Area/wetted Perimeter) in m

S = Slope of hydraulic grade line in m/m

N = Roughness coefficient

= 0.013 for concrete pipe

= 0.024 for corrugated steel pipe (unpaved)

= 0.02 for gravel lined channels

= 0.013 for concrete or asphalt lined channels

= 0.05 for natural streams and grassed channels

= 0.010 for pvc with smooth interior walls

3.7.2 Culverts

3.7.2.1 Use the applicable inlet control or outlet control methods referred to in the latest editions of:

a) Handbook of Steel Drainage and Highway Construction Products, by American Iron and Steel Institute
b) Handbook of Concrete Culvert Pipe Hydraulics, by Portland Cement Association.

3.8 Velocity and Pipe Grade

3.8.1 Storm sewers minimum V = 0.75 m/s at half or full flow. The minimum pipe grades shall correspond to the minimum velocity. Steeper grades are desirable.

3.8.2 There are no maximum allowable velocities; however, where grades exceed 15%, the Consultant Engineer shall address sewer scour and anchoring problems and modify the sewer design to suit local conditions.

3.9 Minimum Depth of Cover

3.9.1 The minimum depth of cover shall be as follows:

3.9.1.1 Culverts across roads and driveways: minimum 0.3m provided that pipe has been designed to withstand deadload and H-20 highway loads complete with impact factor of 1.5.

3.9.1.2 Storm sewers shall not be of sufficient depth to:

a) Permit gravity service connections to adjoining properties.
b) Properly service all of the tributary lands upstream of the future storm sewer extension point.
c) Prevent damage from live surface loading. Normally the minimum depth to satisfy this criteria is 1.0m.

3.10 Minimum Pipe Diameter

3.10.1 Storm Sewers 250mm

3.10.2 Culverts - crossing and trails 300mm

3.10.3 Catch-basin Leads 150mm

3.10.4 Service Connections for single dwellings 100mm

3.10.5 Service connections for two or more dwellings or commercial 150mm

3.11 Distance Between Manholes

Pipe size (mm)	**Maximum Distance (m)**
375 and smaller	125
450 to 750	155
900 and larger	185

3.11.1 Manholes are also required at every pipe size change, every line or grade change which cannot be accommodated by the allowable radius of curvature and every intersecting sewer. The upper end of the storm sewer where further extension of the sewer is infeasible shall be terminated with a standard 1050 mm benched manhole.

3.11.2 At manholes where future storm sewer extensions are likely, one pipe length shall be extended beyond the manhole with the end capped as stub for future tie-in.

3.12 Minimum Radius of Curvature

3.12.1 Minimum radius = 60m for pipes up to 600 mm diameter. 22 1/2° mitres may be used for larger pipes.

3.12.2 Maximum joint deflection shall be as recommended by the pipe manufacturer.

3.12.3 Only one vertical or one horizontal curve is permitted between manholes.

3.13 Hydraulic Losses in Manholes

3.13.1 The following criteria shall be used:

3.13.1.1 The crown of the downstream pipe shall not be higher than that of the upstream pipe.

3.13.1.2 Minimum drop in invert levels across manholes:

a) Straight run – 50mm drop
b) Deflections up to 45° - 50mm drop
c) Deflection 45° to 90° - 50mm drop

3.13.2 An outside drop pipe shall be installed when the drop between inverts exceeds 0.6m. See Standard Drawings.

3.14 Sewer Location

3.14.1 Service Connections: normally at 3.0m from low side of parcel boundary.

3.14.2 Separation from water mains if possible:

3.14.2.1 Minimum 3.0m horizontally.

3.14.2.2 Minimum 0.5m vertical clearance below water mains.

3.14.3 Sanitary sewers may be laid in a common trench with storm sewers.

3.14.4 However, in these cases, the Consultant Engineer must make adequate checks to ensure that a minimum clearance of 0.4m is maintained between pipes and that conflicts do not exist at wye connections, manholes and utility crossings.

3.15 Service Connections

3.15.1 For new parcels in a subdivision and for existing parcels when the property owner gives his permission, the connection shall be extended 1.5 meters into the property. Elsewhere the service connection to existing properties will be terminated at the property line.

3.15.2 Where a concentration of ground water exists, storm connections to these areas (ie. other utility trenches) shall be provided.

3.15.3 All service connections shall enter the storm sewer between 2 and 10 o'clock position above the springline at the top of the pipe. Connections to new sewer shall be made using manufactured wye fittings. Connections to existing mains shall be made using manufactured saddles. Single connections shall be permitted only.

3.16 Catch-basins

3.16.1 Catch-basins shall be provided at regular intervals along roadways, at intersections, and at low points.

3.16.2 Catch-basins shall be spaced to drain a maximum area of 500 m^2 on road grades up to 5% and 400 m^2 on steeper grades.

3.16.3 Catch-basin grates are to be set 13 mm below the gutter line. The gutter and blacktop are to be shaped to form a dish around the grate

3.17 Pipe Materials and Specifications (See City of Duncan`s Technical Specifications)

3.18 Structural Design

3.18.1 The structural design of storm sewer installations shall be in accordance with the latest addition of ASCE Manuals and Reports on Engineering Practice No. 37 – Design and Construction of Sanitary and Storm Sewers. Live loads on the sewer conduit shall include Highway H-20 loading and an impact factor of 1.5. The minimum Class of Bedding and the limit of the trench width at the top of the pipe shall be as shown on the Standard

Drawings. In cases where more stringent construction requirements are necessary to achieve the required field supporting strength of the sewer conduit, the Consultant Engineer shall specify both the Class of Bedding and the maximum trench width at the top of the pipe on the Design Drawings.

3.19 Storm Connections and Drainage of Adjoining Properties

3.19.1 Every existing parcel that is passed in the extension of the storm sewer system shall be provided with one storm sewer connection. In cases where several drain tiles outlet into an existing ditch from one property, these tiles shall be connected to the new storm sewer. Where no storm drains or tiles exist from an adjoining parcel, the Consultant Engineer shall send a registered letter to the owner of each such parcel to request the owner to identify a preferred location. Copies of the correspondence shall be forwarded to the Engineering Department for record purposes. All such locations are subject to the approval of the Director and the Director shall specify locations for parcels whose owners do not respond.

3.19.2 The design elevation and depth of service connections at the property line for each property shall be specified on the Design Drawings. In selecting the invert of the service connections, the following must be taken into account:

3.19.2.1 Gravity connection to all known outlets is possible (where doubt exists regarding the depth of outlets, install the connections as deep as possible).

3.19.2.2 Drainage of all existing buildings is possible.

3.19.2.3 In servicing a property where no dwelling exists, the invert of the service connection shall be 1.5 meters lower than the average ground elevation at the 7.5 meter set back from the front property line unless topographic constraints make this depth impractical.

3.20 Service Connections Entering Manholes

3.20.1 Service connections entering manholes shall not be in an adverse direction to the flow in the sewer main.

3.21 Inlet and Outlet Structures

3.21.1 The Standard Drawing shall be used as a guide for designing inlet and outlet structures for storm sewers and culverts. Temporary inlet and outlet

structures may be constructed of sand/cement mix bags provided that provincial and federal regulations are met. However, permanent structures shall be constructed of reinforced concrete.

3.21.2 The structural and erosion protection requirements for inlet and outlet structures shown on the Standard Drawings are the minimum requirements only. It is the Consultant Engineer's responsibility to verify that these minimum requirements are adequate for any proposed inlet and outlet structures shown on the Design Drawings. If more stringent requirements are necessary to meet the design operating conditions the Consultant Engineer shall provide complete details of the inlet and/or outlet structures on the Design Drawings.

3.21.3 Trash screens and safety grillages as shown on the Standard Drawings shall be installed at inlets and outlets respectively for all storm sewer pipes over 450 mm in diameter.

3.21.4 Special designs will be required for inlet and/or outlet structures that are different than those shown on the Standard Drawings.

3.21.5 Safety Handrails as shown on the Standard Drawings shall be installed at inlets and outlets where the depth to the channel bottom exceeds 1.5m.

3.22 On Site Considerations

3.22.1 Site and Lot Grading

3.22.1.1 As part of the drainage system Design Drawings, the proposed site and lot grading plan for all developments shall be included. The grading plan shall show as a minimum the proposed elevations at intersections of property lines and the general direction of surface run-off within the site of the proposed development as well as the adjoining properties. In preparing the grading plan, the Consultant Engineer must ensure that adequate provisions are made to prevent the occurrence of drainage problems on adjoining properties. Normally, each parcel should be graded to drain to the municipal storm drainage system, independent of adjacent parcels where possible.

3.22.1.2 The grading plan shall also show the minimum habitable floor elevations on those properties located along a major flood route. The minimum habitable floor elevation thus shown must not be lower than the Major System Hydraulic Grade Line.

3.22.2 Foundation Drains

3.22.3 A gravity connection to the municipal storm drainage system may be made only where the habitable portion of a dwelling is above the Major System Hydraulic Grade Line. Otherwise, only a pumped connection will be permitted. On side-slope developments double storm sewers may be required to permit a gravity connection to the parcels located on the down slope side of the road.

3.22.4 Roof Drainage

3.22.4.1 Provided that a site is graded away from the building and such that surface water does not flow to adjacent parcels, roof drainage may be discharged to the ground and dispersed via splash pads at the downspouts.

3.22.4.2 If site grading in accordance with Section 3.22.1 above is not possible, roof drainage shall be discharged into the municipal drainage system.

3.22.4.3 On flat roofs, controlled-flow roof drain devices may be installed to provide temporary storage and retard the discharge to the ground or storm sewer system.

3.23 Major System Design Considerations

3.23.1 Major Flow Routing

3.23.1.1 All overland flows shall have specifically designed flow routes located within municipal rights-of-way. The major flow routing shall normally be provided along roads and in natural water courses. In some cases (ie. at sags in roads) it may be necessary to route the major flow across country within a designated right of way.

3.23.1.2 When economical, the Consultant Engineer is urged to consider the enlargement of the pipes and culverts, which form a part of the Minor System to accommodate the major flow.

3.23.1.3 At intersections when the major flow route passes, care shall be taken to lower the intersection to allow flows to pass over the cross street.

3.23.1.4 Where the major flow route turns at intersections, additional care in the intersection grading design is required.

3.23.1.5 In areas where normal major flow routes cannot be provided, the Minor System shall be increased in size to accommodate the major flows.

3.24 Need for Perforated Drains

3.24.1 During his site investigations the Consultant Engineer must consider whether or not there will be a need for perforated drains to be installed behind the proposed curbs or sidewalks to intercept water. If there is a need, the engineer shall clearly show this requirement on his Design Drawings. Should the Consultant Engineer fail to identify the need for such drains, the Director may order such drains to be installed during the construction period or during the 1 year maintenance period thereafter should it become evident to him that such drains are required in order to protect the City's or the public's interests. The costs associated with the installation of such drains when ordered by the Director shall be assumed by the Developer.

SCHEDULE E

STREET LIGHTING DESIGN SPECIFICATIONS

1. All public highways and hard surfaced walkways shall have street lighting installed.

2. The type, colour and standard of street light shall be in accordance with the applicable road or walkway cross section for the location of the development.

3. All wiring to service these lights shall be installed underground in ducts and labelled in the junction box.

4. Lighting shall be designed by an Engineer for any public street lighting on collector and arterial roads and at local road intersections with the above noted classifications.

5. Designer to consider wattage and distribution to avoid lighting trespass,.

6. The design shall not consider existing BC Hydro davit arms and are to note their removal on the design drawings.

7. Conduits must be extended to the limits of the project and contain a string in the junction box.

8. Designer must confirm no overhead or underground conflicts prior to construction.

9. Lighting levels shall be in accordance with the most recent edition American National Standard for Roadway Lighting published by Illuminating Engineering Society of North America.

10. For trails and walkways that are not adjacent to roadways, low mount pedestrian lighting such as bollards is permitted.

11. Nothing shall be attached in any manner to a streetlight pole or base without the permission of the Director.

12. Davit (‘cobra’) overhead street lighting shall use GE Evolve light-emitting diode (LED) lighting fixtures of the following model numbers:

    a) ERS20E3C1540
    b) ERS10B3A1540

This requirement may be waived by the Director should the lighting be installed in an area of existing high-pressure sodium (HPS) lighting. In areas where HPS lighting is required, designs are to use Philips Lumec Helios Series fixtures.

13. Construction shall be in accordance with MMCD and the BC Electrical code published by the BC Safety Branch.

14. Where street light installation shall have a controller base with a secure lockable compartment provided in accordance with the manufacturer's specifications, unless the new street lights are connecting to an existing circuit with a controller base.

15. The controller base shall include on/off/auto switch, photo cell override and a hydro disconnect. The on/off/override switch and panel shall be designed to accommodate the number of lights in the circuit as well as seasonal lighting and be upgradeable for future extensions.

16. Concrete Bases

    a) Shall be in accordance with MMCD
    b) The Director may approve a poured in place concrete base if site conditions preclude the installation of a pre-cast concrete base. Poured in place concrete base must be designed and certified by the Engineer.

17. Where traffic signals, electrical outlets, irrigation timers, signage or other forms of infrastructure that require electrical power other than a streetlight, then a BC Hydro approved metered service is required.

18. Electrical outlets are required for all davit (cobra) streetlights unless waived by Director

19. In cases where the streetlighting might be extended, the Director may require the conduits to be upsized.

20. All streetlights to be fitted with an anti-cycling device.

21. Streetlights must be fitted with an appropriate baffle or shield to deflect light away from private residences without compromising the effectiveness of the light on roads and walkways.

22. All street lights requiring banner arms shall have the banners supplied and installed at the time of street light installation.

23. All streetlights with basket arms must include irrigation.

24. Drawings

a) All submission and as constructed drawings must include:
   i. Controller base locations
   ii. Photo cell locations
   iii. Power source locations
   iv. Illuminance drawings showing isoline levels
   v. Table showing IESNA lighting design criteria and design achieved illumination levels and uniformity
   vi. Volt drop calculations
   vii. Conduit and wiring size

b) Construction Acceptance for all street lighting will require:

   i. Provincial electrical declaration.
   ii. Summary of connected loads.
   iii. All lights must be energized and functioning.
   iv. Inspection record and electrical as-builts.