Village of Montrose

SUBDIVISION AND DEVELOPMENT SERVICING BYLAW NO. 441, 1992

SCHEDULE C - SUBDIVISION AND DEVELOPMENT SERVICING, DESIGN AND CONSTRUCTION REQUIREMENTS

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DESIGN AND CONSTRUCTION REQUIREMENTS

This is Schedule C as referred to in Section 9 of the Village of Montrose Subdivision and Development Servicing Bylaw No. 441, 1992.

Gerald A. Henke
CLERK

Acting MAYOR Joan Lobes

Village of Montrose

DEVELOPMENT AND DEVELOPMENT SERVICING BYLAW NO. 441, 1992

SCHEDULE C - SUBDIVISION AND DEVELOPMENT SERVICING, DESIGN AND CONSTRUCTION REQUIREMENTS

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DEFINITIONS

RTAC	Roads and Transportation Association of Canada
ASTM	American Society for Testing and Materials
CSA	Canadian Standards Association
AWWA	American Water Works Association
kPa	Kilopascal
lpd	Litres per day
USgpd	US Gallons per day
mPa	Megapascal
psi	Pounds per square inch
mm	Millimeters
m	meter
ft	feet
in	inches
m/s	Meters per Second
HPS	High Pressure Sodium
IES	Illuminating Engineering Society

SECTION 1.0 - HIGHWAYS

Section 1.0 sets out standards for the dimensions, locations, alignment and gradient of highways, and standards and specifications for the design, construction, materials utilized and installation of works related to roadways.

1.01 Highway Classifications

For the purpose of establishing standards, highways are classified into the following categories:

.1 Rural Street - means a street designed to permit low speed traffic within a neighbourhood and direct access to adjacent properties.

.2 Collector Street - means a street which carries traffic from local streets and includes the principal entrance streets for circulation of traffic within a subdivision.

.3 Local Street - means a street designed to permit low speed travel within a neighbourhood and direct access to adjacent properties.

.4 Cul-de-Sac - means a highway with only one point of intersection with another highway and which terminates in a vehicle turning area, referred to as the "terminus".

.5 Lane - means a highway more than 3 m but not greater than 10 m in width, intended to provide secondary access to parcels of land. A lane is not a partial highway.

.6 Walkway - means a path located within a public right-of-way to provide for pedestrian movement.

1.02 Highway Standards

.1 Different highway standards will be required for different classes of highways. The required standards for right-of-way widths, pavement widths, curb and gutter, sidewalk and shoulders are set out in Schedule A "Level of Works and Services".

.2 Notwithstanding the right-of-way widths specified in Schedule A, where due to terrain or soil conditions, the provision of curb and gutter, sidewalks or gravel shoulders along with cut and fill slopes within the required right-of-way is unfeasible, the Approving Officer may require widening of the road right-of-way.

1.03 Intersection Standards

Standards for intersections are as follows:

.1 Intersection Spacing - no intersection shall be less than 40 meters from any other intersection or likely future intersection. Measurement shall be made along the center line of the intersected highway and between the center lines of the intersecting streets.

.2 The intersection approach angle shall be as near as possible to 90 degrees, with a minimum permissible angle of 70 degrees and a maximum of 110 degrees.

.3 Y-shaped intersections shall be avoided.

.4 Intersections with more than four legs shall not be approved.

.5 Intersections shall not be located on or near sharp horizontal curves or near the crest of any vertical curve.

In areas of steeper terrain, the intersection standards listed above may be altered or relaxed subject to approval in writing by the Superintendent of Works.

1.04 Intersection Design Criteria

.1 Unless otherwise indicated, intersection design standards shall conform to the latest edition of T.A.C. Geometric Design Standards. Where due to steep terrain the application of these design criteria would prove impractical or unfeasible, the criteria set out below may be altered or relaxed subject to approval in writing by the Superintendent of Works.

.2 At street intersections, the minor street shall be constructed with an approach grade of not greater than 3%, for a distance of not less than 15 metres back from the proposed edge of asphalt of the major road.

.3 Minimum K values of vertical curves at intersections shall not exceed those shown in Table 1 below.

TABLE 1

INTERSECTING STREET	MINIMUM K VALUES (in metres)	
	Crest	Sag Curve
Collector	7	6
Local	4	4

.4 Grades of major roads through intersections shall not exceed 75% of the maximum allowable grade for the following distances from the intersecting road curb line.

Collector	30 metres
Local	15 metres

1.05 Roadway Design Criteria

.1 Design Speed

Roadways shall be designed to T.A.C. Geometric Design Standards unless otherwise specified.

.2 Cross-Section

All roads shall be designed with a 2% crown unless otherwise approved by the Superintendent of Works. Under certain adverse topographical conditions, such as developments on steep side hills, roads may be crossfalled at 2% towards the high side ditch with the approval of the Superintendent of Works.

.3 Horizontal Alignment

Table 2 below provides the minimum required center line radius for the two main roadway classifications.

TABLE 2

ROADWAY CLASSIFICATION	DESIGN SPEED	MINIMUM CENTRELINE HORIZONTAL RADIUS (metres)		
			Superelevation (m/m)	
	km/hr	Normal Crown	0.02	0.04
Collector	60	120	110	100
Local	50	65	---	---

.4 Curb Returns

Table 3 below details required curb return radii for the various road classifications.

At intersections of roads without curb and gutter, the pavement shall be placed to the same radii as for roads with curb and gutter.

TABLE 3

ROAD CLASSIFICATION	CURB RETURN RADII (metres)
Industrial	9
Collector	8
Local	6

.5 Vertical Alignment - Road Grades

a) Minimum longitudinal road grades shall not be less than 0.50 percent.

b) Maximum grades shall not exceed those shown in Table 5 below unless it can be justified to the Superintendent of Works that short pitches exceeding the maximums will improve intersection design.

c) Where due to steep terrain the application of these road grade standards would prove impractical or unfeasible, the standards set out in Table 4 below may be relaxed subject to approval in writing by the Superintendent of Works.

TABLE 4

ROAD CLASSIFICATION	MAXIMUM GRADE	
COLLECTOR	8%	
LOCAL	8%	
CUL-DE-SAC		
Entrance	uphill 2%	downhill 2%
Terminus	uphill 6%	downhill 6%
INDUSTRIAL	8%	
LANES	8%	

Maximum grades are to be reduced by 1% for each (or part of each) 30 metres that the centerline radius is less than 150 metres.

.6 Vertical Curves

Vertical curves are to be designed to provide safe stopping sight distances. Vertical curve lengths are calculated by the following equation L = KA

where L = length of vertical curve
K = a constant related to lines of geometry of a parabolic curve
A = algebraic difference in grades in percent

Table 5 below specifies minimum K values to be used for vertical curve design

TABLE 5
MINIMUM K VALUES (in metres)

ROADWAY CLASSIFICATION	DESIGN SPEED	CREST CURVE		SAG CURVE
	km/h	MINIMUM	DESIRABLE	
Collector	60	10	15	9
Local	50	7	10	6

The length of flat section vertical curve is to be minimized in order to provide proper curb & gutter or ditch drainage at the top of crest curves and at the bottom of sag curves.

.7 Cul-de-Sacs

All dead end roads must be provided with a cul-de-sac bulb. Unless otherwise approved by the Superintendent of Works, cul-de-sac roads shall not be greater than 150 metres in length.

1.06 Road Base Design Requirements

.1 The Superintendent of Works may, in areas where poor soil conditions exist, request a pavement structure design from a Geotechnical Engineer.

.2 The following minimum road base requirements outlined in Table 6 may be used when the applicant is not requested to submit a pavement structure design.

TABLE 6

ROAD CLASSIFICATION	SUC-BASE THICKNESS	BASE THICKNESS	ASPHALT THICKNESS
COLLECTOR/RURAL	300 mm	150 mm	75 mm (2 lifts)
LOCAL	300 mm	100 mm	50 mm
CUL-DE-SAC	300 mm	100 mm	50 mm

The Superintendent of Works reserves the right to require that where a total of 75 mm of asphalt is required by this Bylaw, that the 75 mm be placed in either one or two lifts depending on weather conditions and other factors.

1.07 Clearing

.1 All roadway rights-of-way and lanes shall be cleared their full width, grubbed and all refuse completely disposed of.

.2 Where possible, topsoil shall be removed and stored on site for later replacement on lots.

.3 Leaning or dangerous trees or snags outside the clearing area shall be removed.

.4 Burning shall be carried out in accordance with the provision of the Forest Act and regulations thereto and the applicable Village of Montrose Bylaws.

1.08 Grading

Topsoil shall be removed for the full width of the right-of-way and the roadway, lane and boulevard areas shall be graded to the approved profiles and cross-sections. The completed subgrade profile shall be constructed to a tolerance of 30 mm and all soft, spongy or unstable areas which may exist or develop shall be excavated to a firm base and backfilled to grade with compacted selected material. All utility trenches within the subgrade section shall be excavated to a firm base and backfilled to grade with compacted select material. Acceptable subgrade material is to be compacted to 100% Standard Proctor Density.

1.09 Road Cut and Fill Slopes

.1 Cut and fill slopes shall be accommodated entirely within the road right-of-way. When necessary, the Approving Officer may require additional road dedication to contain the cut and fill slopes within the right-of-way and require that road construction be completed prior to submission of the subdivision plan.

.2 Unless otherwise approved by the Superintendent of Works, cut and fill slopes shall conform to the following:

. 1 vertical to 2 horizontal;

The Superintendent of Works may request that for embankments and excavations greater than 2 metres in height, a geotechnical report be submitted to substantiate the recommended design slopes.

.3 Rock cuts shall be constructed to .75 vertical to 1.0 horizontal.

1.10 Boulevard Grading

.1 Boulevards shall be smoothly graded from the back of the curb and/or back of the sidewalk to the property line and restored with 100mm of raked topsoil.

.2 The grade of the boulevard to the property line shall not exceed 3% unless approved in writing by the Superintendent of Works.

1.11 Earthwork Compaction

.1 Embankments

Embankments shall be compacted to at least 95% of standard maximum dry density when tested in accordance with the Standard Proctor method, ASTM Standard D698.

.2 Subgrade Compaction

Prior to placement of road subbase gravel, the subgrade shall be shaped to design cross-section and the top 150 mm depth shall be compacted to at least 100% Standard Proctor density, ASTM Standard D698.

1.12 Roadway Construction Materials

.1 Right to Reject Material

The Superintendent of Works shall have the right to reject any material delivered to the site which has no prior approval. All sampling and testing shall be done in accordance with ASTM or CSA Standards.

.2 Road Sub-Base

The material for the road sub-base course shall be 75 mm minus pitrun gravel composed of inert durable materials, free from soft disintegratable particles.

When tested in accordance with ASTM Standards C136, the material shall meet the gradation requirements and shall be uniformly graded as follows:

Sieve Size	Percent Passing
75 mm (3 inch)	100%
25 mm (1 inch)	50 - 85
0.15 mm (#100)	30 - 60
0.075 mm (#200)	2 - 8 (wet sieving conforming to ASTM C-117)

The granular sub-base shall be placed and compacted to at least 100% Standard Proctor Density, ASTM D698.

.3 Road Base for Paved Roads and Road Surface for Gravel Roads

Granular base course material and the road surface material for gravel roads shall be uniformly graded 19 mm crushed gravel of which not less than 60% of the material retained on the No. 4 sieve is fractured rock. Base course and gravel road surface materials shall have the following gradation limits:

Sieve Size		Percent Passing
19	mm (3/4 inch)	100%
9.5	mm (3/8 inch)	60 - 100
4.75	mm (#4)	40 - 80
2.36	mm (#8)	30 - 60
1.18	mm (#16)	20 - 45
0.300	mm (#50)	8 - 20
0.075	mm (#200)	2 - 8 (wet sieving)

The granular base course shall be placed and compacted at least 100% Standard Proctor Density ASTM D698.

.4 Shoulders

The materials for finishing road shoulders shall be as specified for sub-base and road base. The shoulder material shall be watered and compacted to 100% of Standard Proctor Density, ASTM D698.

1.13 Construction Schedule, Certification, and Restoration Work

.1 Construction Schedule and Certification

Before commencement of the works, the applicant shall prepare a construction schedule satisfactory to the Approving Officer, based upon completing the various phases or parts of the work. During installation and construction, the Applicant's Engineer shall certify that each phase or part is complete and meets all standards and requirements. The Applicant shall not proceed to a subsequent construction phase prior to the inspection of the preceding phase by the Approving Officer. If the Approving Officer is not given proper notice and has not had ample opportunity to carry out the proper inspections, he may take whatever steps he deems necessary including exposing or removal of the works.

.2 Restoration Work

Where restoration work is necessitated by reason of construction through a built up or established area, work shall proceed in such a manner that testing, manhole construction, house service connections, restoration of private easements, boulevards, roads, and general site cleanup are completed no later than thirty (30) days after commencement of construction of the works through a built up or established area. If the restoration is not completed within this time, the Village reserves the right to enter upon the property, carry out or complete the restoration and charge the cost of such work to the Applicant.

1.14 Asphaltic Hot Mix Concrete

All asphaltic concrete pavement for roads and lanes shall be manufactured and placed in accordance with the standards set out in this Schedule and only after all required services are installed and approved.

.1 Asphalt Cement

Asphalt cement shall conform to ASTM Standard D946 for asphalt cement used in pavement construction. The asphalt cement shall be uniform in character, free of water and shall not foam when heated to 177 degrees C.

.2 Aggregate

All aggregate particles shall be clean, tough, durable, moderately sharp and free from coatings of clay, silt, loam and other deleterious material. Combined aggregates shall be free of clay or silt balls or any other aggregations of fine material.

a) Coarse aggregate shall be all material retained on a 4.75 mm sieve and shall conform to the soundness and abrasive requirements in ASTM Designation D692-54.

b) Fine Aggregate

Fine aggregate shall be all material passing the 4.75 mm sieve and shall conform to ASTM Designation D1073-54.

c) Mineral Filler

The mineral filler shall conform to ASTM Designation D242 and shall have the following gradation:

4.75 mm (#4) sieve	100% passing
0.15 mm (#100) sieve	90 - 100% passing
0.075 mm (#200) sieve	70 - 100% passing

d) Gradation

The mixed aggregates shall meet the following gradation limitations by wet sieve analysis:

19.0	mm	100%
12.5	mm	80 - 100%
9.5	mm	70 - 90%
4.75	mm	50 - 70%
2.36	mm	35 - 50%
0.600	mm	18 - 30%
0.300	mm	7 - 15%
0.075	mm	4 - 8%

.3 Asphalt Primer

Asphalt Primer shall be MC-30, or as specified by the Asphalt Institute.

.4 Asphalt Tack Coat

Bituminus tack coat shall be SS-1 or SS-1h asphalt emulsion, or as approved.

1.15 Asphalt Mix Design

The mix design shall meet the following specifications:

Characteristic	Requirement
Asphalt cement viscosity grade	AC8
Asphalt cement content (by total wt. of mix)	4.5 - 7.0%
Compaction blows per end of specimen	75
Stability @ 68 degrees C.	545 Kg
Flow Index	8 - 16
% voids total mix (compacted)	3 - 5
% V.M.A.	14 (minimum)
Mixing temperature	143° C - 157° C
Asphalt cement temperature	135° C - 148° C
Aggregate temperature	140° C - 162° C

1.16 Asphaltic Concrete Surfacing

Asphaltic concrete shall not be placed prior to approval of the base coarse, tack coat or prime coat by the Superintendent of Works. The hot mix placement temperature shall be between 124 degrees C. and 148 degrees C. for a 75 mm mat thickness.

1.17 Compaction of the Mix

After compaction, the finished pavement shall conform to the following minimum density requirements:

April 15 - Aug 31	- 97% of Marshall design density - ASTM D1559-76
After Aug 31	- 98% of Marshall design density - ASTM D1559-76

1.18 Cold-Mix Asphaltic Concrete

Cold-mix asphaltic concrete shall not be permitted, unless approved by the Superintendent of Works.

1.19 Lanes

.1 Where service lanes for vehicular traffic are provided in commercially zoned subdivisions, the requirements for subgrade preparation and surfacing of lanes shall be as for street surfacing.

.2 Lanes may be provided where terrain and natural features render vehicular access impracticable and where:

a) they form an extension of any existing system of lanes; or
b) they are necessary to provide secondary access in order that reasonable traffic flow can be assured on the main highway.

1.20 Street and Traffic Control Signs

The Applicant shall deposit with the Village funds equal to the cost of providing and installing street name and traffic control signs. Signs will be installed by the Village when all works are completed by the Applicant.

1.21 Street Names

Street names shall be assigned by the Village.

SECTION 2.0 - CURB, GUTTER AND SIDEWALKS

2.01 General

In areas where curb and gutter are to be provided, non-mountable concrete curbs are required for all collector roads and in commercial zones. Mountable concrete curbs shall be installed in all other areas where curb and gutter are mandatory. Curbs, gutters and sidewalks shall be installed in accordance with the design standards set out in this section. All curb, gutter and sidewalk sections shall be monolithic and to the dimensions described in the Standard Drawings contained in Section 7.0 of this Bylaw.

2.02 Design Standards

.1 Curb Return

Curb return radii shall conform to Table 3 of Section 1.05.4 of this Schedule.

.2 Concrete

Concrete shall conform to CSA-A23 and the mix design shall conform with the following:

a) Minimum compressive strength - 32 MPa at 28 days.

b) Maximum aggregate size.

c) Slump - 50 mm +/- 20 mm

d) Air entrainment - 5% to 7%.

e) Cement shall be Type 1 Normal or Type III High Early.

f) Other additions may be used only if prior approval is obtained from the Superintendent of Works.

2.03 Construction Standards

.1 Subgrade Preparation

a) All topsoil, organic soils, frozen materials, roots or other deleterious materials shall be removed. The subgrade shall be compacted to 100% of a Standard Proctor density, ASTM D698.

b) Granular sub-base and base course materials shall conform to the Road Base Specifications set out in Section 1.12 of this Schedule and shall be placed to a minimum of 0.3 m beyond the back edge of the curb or sidewalk.

.2 Construction Joints

Construction joints shall be installed at sidewalk crossings and along the surface of existing structures where the sidewalk butts up to the surface. The material used shall be bituminous fibre, conforming to ASTM-D 545 and shall be installed throughout the entire depth of the sidewalk. The construction joint shall be exposed with a 6 mm radius edger.

.3 Contraction Joints

Contraction joints shall be constructed every 3 m by means of an approved marking tool which has a minimum width of 32 mm and a minimum depth of $\frac{1}{3}$ of the thickness of the concrete. The edges of the tool shall be rounded off with a 6 mm radius. Contraction joints shall be the full width of and perpendicular to the longitudinal axis of the sidewalk, curb and gutter, invert crossing or median section.

.4 Finishing

a) When the concrete has partially set up, the surface shall be worked with wood and steel trowels. Under no circumstances shall water be sprinkled onto the surface of the concrete in order to provide a more workable surface.

b) After steel trowelling the surface to a smooth, even finish the sidewalk shall be broomed transversely; curbs, gutters, invert crossings and medians shall be left with a smooth trowel finish. No mortar coat or water shall be used. After brooming, the edges shall be rounded with an edger, having a minimum width of 32 mm and a minimum depth of 13 mm. Invert crossings shall be surface jointed after brooming as shown.

.5 Curing and Protection

Freshly deposited concrete shall be protected from premature drying and extreme temperatures. It shall be maintained with minimal moisture loss at a relatively consistent temperature for a period of time necessary for hydration of the cement and proper curing of the concrete.

Curing and protection of concrete shall conform to Section 21 of CSA Standard CAN3-A23.1-M77.

.6 Concrete Test Results

All concrete test results shall be submitted to the Superintendent of Works. Three concrete test cylinders shall be taken for each class of concrete poured from each day's construction, or from every 50 cubic metres placed. One cylinder will be tested at 7 days, two cylinders will be tested at 28 days.

Concrete failing to meet the minimum 28 day compressive strength shall be removed and replaced.

SECTION 3.0 - WATER SYSTEM

3.01 General

.1 The standards and specifications set out in this Section shall apply to all waterworks construction by, for, or in the Village of Montrose. All standards not specifically covered in this Section shall be in accordance with the appropriate A.W.W.A. Standards or as directed by the Superintendent of Works.

3.02 Installation of Watermains

All materials, including pipe fittings, shall be installed to applicable A.W.W.A. and C.S.A. Standards for the installation of the particular type or class of material being used and to any additional requirement as set out by the materials manufacturer. All water mains shall be installed to a minimum depth of 1.8 metre clear cover from the crown of the pipe to the finished grade of the street directly above the pipe. All pipe shall be bedded, backfilled and compacted in accordance with this Section.

3.03 Connection to Existing Systems

Connection of a new water distribution system to existing municipal mains, or the turning on of water into new mains must be carried out by the applicant under the direction of the Village. Application for connection must be made to the Approving Officer and adequate advance notice for undertaking such work shall be provided.

3.04 Design Standards

.1 Design Pressure

.1 Generally water systems shall be designed for pressures in the range of 280 KPa (40 psi) to 700 KPa (100 psi), with 280 KPa (40 psi) measured under peak hourly demand conditions and the 700 KPa (100 psi) measured under static conditions. The minimum pressure shall be measured or calculated at the main floor of the highest proposed house, and an allowance made for pressure loss in the service line to the house wall. Reservoir level shall be assumed at mid-point for calculation of minimum pressure, and full for calculation of maximum static pressure.

.2 The maximum daily demand condition shall be assumed to be:

.1 9050 lpd (2390 US gallons per day) per single family dwelling, mobile home, medium density rowhouses, townhouses or duplex dwelling unit.
.2 3200 lpd (850 US gallons per day) per high density apartment dwelling unit.

.3 Water systems shall be designed to ensure that fire flows as required by the Insurers Advisory Organization (IAO) are available for required durations and within acceptable pressure limits but shall not be less than 3640 litres per minute at a residual pressure of not less than 140 Kpa.

.2 Minimum Pipe Size

.1 Mains shall be sized to carry the peak hourly flow rate or peak daily flow rate plus the fire flow rate, which ever is greater.

.2 Mains shall be sized using Hazen-Williams formula with C-120 and maximum flow velocity for peak hourly demand rate of 2.0 m per second. For fire flow, plus the maximum daily rate, the flow velocity shall not exceed 4.0 m per second.

.3 Supply mains in residential areas in all subdivisions shall be a minimum of 150 mm diameter. In high density or commercial areas, the minimum water main size shall be 200 mm diameter.

3.05 Materials

All materials and equipment utilized shall conform to the following standards and to the latest edition of the pertinent AWWA and CSA Standard Specifications for materials and equipment. All material shall be new non-corrosive and of the best quality available. Alternative materials shall be covered by the latest AWWA and CSA specifications. All material must be approved by the Ministry of Health for use in public water supply systems.

.1 Pipe

Pipe sizes 150 mm and larger shall be ductile iron (Ductile), or polyvinyl chloride (P.V.C.) as directed by the Superintendent of Works.

a) Ductile Iron Pipe

Ductile Iron pipe shall conform to AWWA Standard C151/A21.51-81.

Class: The pipe wall thickness shall be designed for each application in accordance with AWWA C150/A21.50-81.

Pipe Joints: Pipe joints shall be a rubber gasket type conforming to AWWA C110/A21.10-82 such as Bell-tite, Tyton or approved equal.

Cast Iron Fitting Hubs: Hub connections shall be Bell-tite, Tyton, Ter-Mech or approved equal.

Cathodic protection may be required at the discretion of the Superintendent of Works.

b) Polyvinyl Chloride (P.V.C.)

Polyvinyl Chloride pipe shall conform to AWWA Standards C900-81 with the following particular requirements:

Class: All pipe shall be Class 150 or better.

.2 Main Line Valves

Line valves 150 mm and larger shall be Canada Valve or Terminal Village or equivalent gate valves conforming to AWWA Standard C500-80. Valves shall be iron-body, bronze-mounted, solid wedge or double- disc gate, non-rising stem with flanged or hubbed ends to suit. Flanges shall have Class 125 Standard drilling. Valve stems shall be fitted with a standard AWWA nut and shall turn clockwise to close.

All valves shall have the manufacturer's name and catalogue number moulded as an integral part of the valve body.

On distribution mains throughout the subdivision, valves shall be installed to isolate sections of main no greater than 200 m in length.

Valves shall be flanged directly onto mainline fittings.

.3 Cast Iron Fittings

Cast iron fittings such as bends, tees, crosses, adaptors, end caps, etc., shall be flanged or hubbed to suit. Flanges shall be standard Class 125 cast iron flanges.

.4 Fire Hydrants

All hydrants shall be equivalent in all respects to Terminal Village C71P compression type hydrants and shall be equipped with two 64 mm nominal I.D. outlets, 8 threads per 25.4 mm, conforming to the B.C. Standard hose thread and one 130 mm outside diameter pumper port conforming to American National Fire Hose Coupling Threads.

Fire hydrant spacing shall conform to the latest issue of the Insurers Advisory Organization (IAO) recommendations; however, in any case, fire hydrants shall not be spaced greater than 120 metres apart in low density residential areas.

Access paths to hydrants shall be graded to all hydrants separated from the road by a ditch or as otherwise directed by the Superintendent of Works. The access pad shall generally be at the same grade elevation as the road shoulder with a culvert installed in the ditch.

.5 Valve Boxes

Valve boxes shall be telescopic Nelson type cast iron, or equivalent. Riser pipe shall be 150 mm diameter minimum.

.6 Service Connections

Service connection pipe up to and including 50 mm diameter shall be Type K soft copper tube conforming to ASTM specification B88M. Services shall be continuous with no joints.

Corporation main stops shall be Mueller standard brass, compression type.

Curb Stops shall be stop and drain compression type Mueller brass or equivalent with an inverted key and Mueller adjustable service box and lid.

Service saddles shall be of the double strap type with bronze body and stainless steel straps, Mueller or approved equal.

All bushings, reducers, unions and nipples shall be standard brass, Mueller or approved equal.

.7 Coupling Clamps

Upon approval from the Superintendent of Works, joining of two plain end pipes may be by use of Robar stainless steel clamps or approved equal.

.8 Air Release

Provisions for air release shall be provided at all critical high points throughout the water system. Should conventional means for air release not be sufficient or non-existent on the designed system, installation of air and vacuum release valves shall be required

3.06 Pipe Bedding Material

.1 Pipe bedding shall be undertaken in strict accordance with the manufacturer's bedding requirements for the type of pipe utilized. Sand bedding, where required, shall be clean, well graded sand with a maximum aggregate size of 6 mm with not more than 8% by weight passing the No. 200 sieve.

.2 Bedding material shall be provided in accordance with the standard drawings contained in Section 7.0. of this Schedule.

3.07 Main Offsets from Centre Line and Depth of Bury

.1 Water distribution mains shall be installed 3.0 metres from the center line of road on the opposite side as the storm sewer.

.2 The minimum depth of bury from finished ground elevation to the top of the pipe shall be 1.8 metres.

.3 The minimum clearance between watermain and sewer main crossings shall be 450 mm.

.4 Where watermains are installed under the roadway or roadway shoulder, a 1.5 metres diameter asphalt apron shall be placed around all valves and appurtenance structures.

3.08 Service Connections

.1 Service connections are defined as the installation from the connection at the main up to and including curb stop and service box marked "WATER".

.2 Service connections shall be installed in accordance with the standard drawings contained in Section 7.0 of this Schedule. A water connection shall be installed, wherever possible, in a common trench with the sanitary sewer connection, provided that the water service is located a minimum 300 mm above the sewer service. Where this minimum vertical separation cannot be provided, the water and sewer services shall be separated a minimum of 3 metres.

.3 The minimum depth of bury for services from finished ground to the top of the pipe shall be 1.8 metres.

.4 Each dwelling to be sited on a parcel created by a subdivision shall have an individual 20 mm water service connection. For multiple unit residential or larger scale commercial projects, the size of service connection shall be determined by the Superintendent of Works based on available pressure and estimated demand.

3.09 Thaw Wires

The Superintendent of Works may require that thaw wires be installed from the watermain to property line parallel to the copper service connection. Thaw wires shall be 2/0 coated copper wire, seven strand or better.

3.10 Horizontal Reaction Blocks

Horizontal reaction blocks shall be placed between undisturbed soil and all fittings whose deflection is greater than 10 degrees. Reaction blocks for each type and size of fitting shall be sized to conform to the bearing areas specified on the standard details. Reaction block concrete shall not be placed over the joints between the fitting and the pipe. Concrete shall have a minimum compressive strength of 20 mpa.

3.11 Vertical Reaction Blocks

.1 Vertical reaction blocks shall be placed above or below vertical fitting deflections of greater than 5 degrees (grade change of 9%).

The quantity of concrete required shall be calculated on the basis of the following:

Calculate the total head at the fitting:

H = 71 metres (surge) + elevation difference between reservoir and fitting in metres.

$$\text{Concrete required } (m^3 \text{ of concrete}) = \frac{2 \times 1000 \, H \, A \sin \frac{1}{2} \angle \times 1.5}{2405}$$

Where H = Calculated head at the fitting
A = Area of the Pipe in square metres.
$\angle$ = Deflection angle of the fitting.

.2 Steel restraining bars between the fitting and the concrete shall be shaped to the fitting and be a minimum of 15mm diameter and shall be galvanized or bituminous coated.

3.12 Cross Trench Bridging

20 MPa concrete shall be used to backfill pipes installed under existing main crossings to protect against settlement of the upper main. The haunching shall extend one metre clear of each side of the crossing main.

3.13 Pipe Anchors

.1 Pipe anchors shall be placed around watermains laid at grades of 33-1/3% and steeper, and shall be constructed in accordance with the standard details.

.2 All pipe anchors shall be constructed with 20 MPa concrete and shall project a minimum of 200 mm into undisturbed soil at the bottom and sides of the trenches.

.3 Anchors on all sizes of ductile iron pipe and polyvinyl chloride cast pipe shall be cast on every second joint abutting the downhill portion of the bell.

3.14 Erosion Protection

Trench backfill on steep sideslopes shall be placed in a manner to eliminate erosion due to surface runoff. Design drawings shall identify the means to be used for erosion protection.

3.15 Watermain Disinfection and Flushing

.1 All watermains, fittings, services and appurtenances shall be disinfected and flushed to the satisfaction of the Superintendent of Works and in compliance with the requirements of the Ministry of Health.

.2 Providing the inside of the pipe installed is clean, the water system may be chlorinated in accordance with the AWWA Standard C601-81, Section 7, hypochlorite tablets (with 3-3/4 grams of available chlorine per tablet). The number of tablets required for various sizes of pipe shall conform to the following table:

Length of Pipe Section (m)	Diameter of Pipe (mm)					
	50	100	150	200	250	300
4 metres	1	1	2	2	3	5
5.5 metres	1	1	2	3	5	6
6 metres	1	1	2	3	5	7
9 metres	1	2	3	5	7	10
12 metres	1	2	4	5	9	14

.3 The tablets shall be attached to the top of the main by using a non-toxic waterproof glue.

.4 If in the Superintendent of Work's opinion, the mains were constructed without due cleanliness or should the mains have to be re-chlorinated because of the ineffective chlorination with tablets, chlorination shall be undertaken by the continuous feed method (AWWA Standard 601-81) until satisfactory tests have been proved.

.5 After 24 hour chlorination retention time, all mains, services and appurtenances shall be completely flushed of sand, silt, dirt, chlorinated water and other foreign material. The Developer shall ensure that flushed water does not create a hazard or nuisance to the public, nor to public and private property. Where practical, watermains shall be flushed into storm sewers or where no storm sewers or reasonable drainage areas exist, the Developer shall flush mains into a tanker truck and dispose of it away from the site. The Developer shall take full responsibility for damage to persons or property caused by his flushing operations.

.6 After the main has been satisfactorily flushed, the Developer shall collect water samples from sections of the system as prescribed by the local Health Inspector. The samples shall be submitted to the Ministry of Health for testing with test results reported directly to the Superintendent of Works by the Ministry of Health.

3.16 Watermain Testing

.1 All water mains shall be pressure tested with water to AWWA Standards at a minimum of 1030 KPa (150 lbs./sq. in.) or 1.5 times the working pressure of the main, whichever is greater, for a minimum duration of two hours. The system shall be tested in sections which shall be defined as the length of watermain between two consecutive mainline valves including services, hydrants, fittings and all other appurtenances. The working pressure of the
test section shall be the normal working pressure of the line at the lowest elevation within the section. Leakage pressure tests may be conducted on more than one section at a time; however, the allowable leakage for the total test length may not exceed the allowable leakage of the shortest test section.

.2 The Superintendent of Works shall calculate the test pressure and shall determine the leakage rate.

.3 The allowable leakage shall be determined by the following formula:

$$L = \frac{ND\ \ P}{131{,}000}$$

where:

L = allowable leakage in litres per hour
N = number of joints in test section
D = nominal diameter of pipe in millimeters
P = square root of test pressure in kilopascals

Examples of allowable leakage in litres per hour per 50 couplings:

PIPE DIAMETER	TEST PRESSURE - 1030 KPa (L/hr per 50 couplings)
100	1.22
150	1.84
200	2.45
250	3.06
300	3.67
350	4.28
400	4.90
450	5.51
500	6.12
600	7.35

.4 All leaks shall be repaired and all air pockets removed from the watermain test section and the test continued until the leakage is less than the allowable leakage calculated by the Superintendent of Works.

.5 A conductivity test on steel and ductile iron watermains shall be undertaken in the presence of the Engineer to confirm that an electrical current can be passed through the test section. The conductivity test shall be undertaken after backfill is complete.

4.01 Sanitary Sewer System

The standards set out in this section shall apply to and govern sanitary sewerage systems installed in the Village of Montrose. The design of these systems shall comply with the design principles of the Waste Management Branch as defined in a publication entitled "Guidelines for Assessing Sewerage Works".

4.02 Design Standards for Sanitary Sewer Systems

.1 Design Flow

a) The design flow for sanitary sewers in the Village shall be calculated on the basis of the following criteria:

Average Daily Flow	365 litres (80 Igals)/capita/day
Infiltration Allowance	5180 litres (1140 Igals)/hectare/day

b) the ratio of Peak Flow divided by the average daily flow shall be known as the Peak Factor. The Peak Factor shall be calculated by using the Harmon Formula as follows:

$$\text{Peak Factor} = \frac{18 + \sqrt{P}}{4 + P}$$

where P is the service population in thousands

.2 Pipe Sizes

a) Minimum pipe diameters shall be:

Mains	200 mm
Service Connections	100 mm

b) Where a sanitary sewer main extension in low density residential areas is not conceivable, the final 300 metres of main may be 150 mm diameter.

c) The pipes shall be designed, using the Manning Formula with roughness coefficient n = .013 for concrete pipe and n = o.011 for PVC pipe, at the design flow with a minimum velocity not less than 0.75 metres per second.

d) Pipe sizes and grades shall be selected so that the sewers flow to a maximum of ¾ full at peak hour design flow.

.3 Depth of Mains

Mains shall be designed to connect all possible basements on the assumption that the service pipe leaves the building at the closest point to the sewer at a pipe crown elevation 0.45 metres below the basement floor level and runs at a slope of not less than 2.0% to connect to the crown of the sanitary sewer main.

.4 Sanitary Sewer Manholes

a) Manholes shall be installed at the end of each line; at all changes in grade, size or alignment; at all intersections; and at distances not greater than 122 metres for sewers 375 mm or less.

b) Standard manholes shall be 1050 mm inside diameter.

c) The maximum drop between pipe inverts shall be 200 mm. Where drops greater than 200 mm occur, the pipe inverts shall exceed 600 mm and an outside drop structure installed.

.5 Anchoring

a) Sanitary sewer mains installed at grades steeper than 20% shall be anchored in accordance with the standard detail drawings.

b) 20 MPa Concrete shall be used for anchor construction.

4.03 Minimum/Maximum Velocity

.1 Minimum velocity for pipe flowing ¾ full shall be 0.75 m per second.

.2 Where velocities greater than 4.5 metres per second occur, an energy dissipation manhole shall be installed at the discretion of the Superintendent of Works.

4.04 Main Offsets from Centre Line and Minimum Depth of Bury

.1 Sanitary sewer mains shall be installed along road center line.

.2 The minimum depth of bury from finished ground elevation to the top of the pipe for mains and services shall be 1.5 metres unless otherwise approved by the Superintendent of Works.

4.05 Sanitary Sewer Service Connections

.1 100 mm diameter sewer services (or larger if required), shall be installed to the property line in accordance with the standard drawings. The service shall be installed, wherever possible, in a common trench with the water service, provided that the water service is located not less than 300 mm above the sewer service. The sewer service shall generally be offset 1.5 metres from the low corner of the lot. Deviation from the required location for the sewer service may be permitted in instances where topographic features dictate a more desirable location of the service connection.

.2 Service connections shall be made with an approved branch wye or wye saddle and be installed in a straight line and at uniform grade from the terminus at the property line to the 45 degree long radius bend at the main.

.3 The ends of service connections shall be not more than 300 mm short of the property line. The ends of all service connections shall be sealed with watertight plugs or caps and marked with 50 mm x 100 mm stakes placed vertically with one end in the bottom of the trench and in contact with the watertight plug or cap and the other end protruding at least 0.6 metres above ground level. The depth of service pipe invert below the top of the 50 mm x 100 mm marker stake shall be marked on the stake.

.4 When the sewer main is 3.6 metres or more in depth, service risers may be installed close to the main when the service depth is less than the sewer main.

4.06 Materials

.1 Pipe

The following type of pipe shall be C.S.A. approved for sanitary sewer mains and services:

Polyvinyl Chloride (PVC) Pipe

For 150 mm to 375 mm sizes, the pipe and fittings shall conform to ASTM D3034-73, and shall have a minimum SDR of 35. For diameters greater than 375 mm, the pipe shall be Perma-Loc 320 and Perma-Loc 70 ribbed gravity sewer pipe conforming to ASTM F794083. 100 mm and 150 mm sanitary sewer services shall have a minimum SDR of 28. The pipe shall be coloured green for in-ground identification as sewer pipe.

Concrete Pipe

For pipes greater than 375 mm diameter, concrete pipe may be utilized. Non-reinforced pipe to ASTM C14 and reinforced pipe to C76. Rubber gasket joints to conform to ASTM C443.

.2 Precast Manhole Sections

a) Precast concrete manhole sections shall be 1050 mm inside diameter with 115 mm wall thickness, reinforced concrete pipe of at least Class II in accordance with ASTM Standard C76 with tongue and groove joints. Manhole sections shall have 19 mm galvanized steel steps cast in the concrete as shown on the standard drawings.

b) Joints shall be made water tight.

c) Cover slabs for manholes shall be reinforced to withstand H-20 highway loading conditions.

.3 Cast Iron Manhole Frames and Covers

Covers and frames shall be cast iron of an approved pattern to withstand H-20 loading. The clear opening of the frame shall be 500 mm in diameter. The cover shall have a weight of 66 Kg. The frame shall be of the round base pattern having a weight of 84 Kg. Bearing faces of the cover to frame shall be machined for a nonrocking fit. Covers shall have two only 22 mm diameter lifting holes with bolt plug assembly as shown on the standard drawings. Frames shall have three only 22 mm diameter levelling holes. Covers and frames shall be Dobney Foundry Pattern C20, or approved equal. The wording "SANITARY SEWER" shall be embossed on each cover.

.4 Concrete

Poured in place concrete shall have a 28 day strength of 20 MPa.

4.07 Infiltration, Air and Exfiltration Tests

.1 Infiltration Test Requirement

Where the surface level of existing groundwater in the backfilled trench is one metre or more above the top of the pipe throughout the entire test section, an infiltration test shall be used to determine leakage into the pipe.

.2 Air Test

Where the groundwater surface level is less than one metre above the top of the pipe at the lowest point in the test section, or where groundwater at the time of testing is not apparent, a low pressure air test shall be carried out. Air pressure tests shall be the minimum time allowed for the pressure within a sewermain section to drop from 24.1 KPa to 17.2 KPa. The minimum time-air pressure loss for various diameters of pipe are as follows:

Pipe Diameter (length 122m)	Minimum Time for Air Pressure To[1] Drop from 24.1 KPa to 17.2 KPa
100 mm	3 minutes, 46 seconds
150 mm	5 minutes, 42 seconds
200 mm	10 minutes, 08 seconds
250 mm	15 minutes, 49 seconds
300 mm	22 minutes, 47 seconds
375 mm	35 minutes, 36 seconds

1. Minimum time taken from Unibell Handbook of PVC pipe - Table 67 and 68.

Copies of the test results shall be submitted to the Superintendent of Works on the Village's standard test forms.

.3 Infiltration/Exfiltration Test

Where the groundwater level is below the pipe invert throughout the section, an exfiltration test may be used. The test section shall be sealed at its lower extremity by means of a watertight plug. The test section shall be filled with water such that a minimum hydrostatic head of 600 mm is placed on the pipe at its upper extremity. The head of water on the pipe shall be taken as the distance from the top of the pipe to water surface at the point of measurement. The test pressure shall be maintained above the 600 mm minimum head for a period of not less than one hour.

The rate of exfiltration shall be calculated from the amount of water which must be added to maintain the original water level at the upper end.

The maximum allowable infiltration/exfiltration rate shall be 4.61 litres/mm of pipe diameter/24 hours/kilometer of sewer main. Rates for various pipe sizes are as follows:

Pipe Diameter	**Maximum Allowable Infiltration/ Exfiltration Rate in Litres Per Lineal Metre of Main per 24 Hours**
100 mm	0.461
150 mm	0.692
200 mm	0.922
250 mm	1.153
300 mm	1.383
375 mm	1.614

Copies of the test results shall be submitted to the Superintendent of Works on the Village's standard test forms.

.4 Manholes shall be tested with water to prove they are completely water tight.

.5 If leakage is detected, the leak or leaks shall be found and repaired by approved measures. The testing shall be repeated in these sections until leakage is within acceptable limits.

4.08 Cleaning and Flushing

All sewer mains, manholes and services installed shall be flushed of all deposits of silt, sand, gravel, debris and other objectionable materials. All sewer mains shall be flushed clean and a suitable sized plug passed through each test section to ensure no obstructions exist. The Superintendent of Works shall witness all flushing operations. Mains other than those on curves shall be straight, and have a clear visibility between manholes.

4.09 Video Inspections

The Superintendent of works may require a video inspection report be submitted where conventional testing indicates the section may not conform to specifications or for sections which cannot be adequately tested by conventional means.

4.10 Forcemains

.1 Pipe

Pipe sizes 100 mm and larger shall be polyvinyl chloride (PVC) or Ductile Iron (D.I.), conforming to AWWA and CSA standards;

a) Polyvinyl Chloride (P.V.C.)

Polyvinyl Chloride class and series pipe shall conform to AWWA C900 or ASTM D2241.

b) Ductile Iron Pipe (D.I.)

Ductile Iron Pipe shall conform to AWWA C151.

Cathodic protection may be required at the discretion of the Superintendent of Works.

.2 Fittings

Cast iron fittings shall conform to watermain specifications.

.3 Pipe Bedding Material

Pipe bedding material and installation shall be in accordance with the watermain specification.

.4 Reaction Blocks

Reaction blocks shall be placed in accordance with the watermain specifications.

.5 Pipe Anchors

Pipe anchors shall be placed in accordance with the watermain specifications.

.6 Testing

Forcemains shall be tested to AWWA standard at 1.5 times the working pressure for a duration of two hours. The allowable leakage shall be calculated by the AWWA formulae noted in the watermain specifications.

Copies of the test results shall be submitted to the Superintendent of Works on the Village's standard test forms.

.7 Depth of Bury

The minimum depth of bury from finished ground elevation to the pipe shall be 1.8 metres unless otherwise approved by the Superintendent of Works.

SECTION 5.0 - STORM DRAINAGE

5.01 Drainage Plan

For each new subdivision, a drainage plan shall be prepared and approved by the Approving Officer. The drainage plan shall be presented on a contour map at a scale of not less than 1:2500 with contour intervals of not more than 2 metres. The drainage plan shall indicate how storm drainage will be handled within the subdivision, including:

.1 proposed method of handling surface runoff, including runoff from the 1 in 100 year design storm;

.2 major overland flow route and discharge points to natural drainage courses;

.3 provision of drainage right-of-way where required;

.4 measures to prevent ponding of water on highways and parcels within the subdivision; and

.5 measures to prevent erosion and other forms of property damage.

The drainage plan shall ensure that no storm water runoff shall be disposed to the community sanitary sewer system.

5.02 Natural Drainage Courses

Where a parcel to be subdivided is traversed by a natural drainage course, there shall be provided either:

.1 a drainage right-of-way conforming to the general alignment of the drainage course of such a width as may be designated by the Approving Officer; or

.2 provision made for an alternate drainage system to the satisfaction of the Approving Officer.

No natural drainage course shall be altered or diverted unless in accordance with a drainage plan prepared in compliance with Section 5.01 and approved by the Approving Officer.

5.03 Design Standards for Storm Drainage

.1 Design Flow

a) The design flow at any point in a storm water collection system shall be calculated by the Rational Formula:

$$Q = C \times I \times A \times 0.00278$$

in which,

Q = Design Flow (m^3/sec)
C = Run-off Coefficient
I = Rainfall Intensity (mm/Hr)
A = Area drained (hectare)

b) Residential systems shall be designed for rainfall intensities which are expected to return on the average once every five years (Return Period - 5 years). Commercial systems shall be designed for a Return Period of 10 years. The rainfall intensity shall be derived from the most recently available rainfall intensity curves for the Montrose area.

.2 Time of Concentration

The time of concentration shall be the estimated time required for rain falling on the farthest point in the drainage area to reach the point in the sewer system under design. The inlet time for rain to reach catch basins shall be assumed to be a minimum of 10 minutes in residential subdivisions and commercial areas.

.3 Run-Off Coefficient

a) Run-off coefficients for storm sewer design shall not less than the values given in the following table:

Description of Area	Run-Off Coefficient
Commercial-downtown	0.80
Residential-single family	0.40
Residential-multi-family (eg. townhouses)	0.55
Apartment Areas	0.65
Parks and Playgrounds	0.25
Unimproved Areas including hillsides	0.15
Asphalt Streets	0.95
Parking Lots - Paved	0.95

b) The derivation of run-off coefficients to be used for storm sewer design shall include consideration of relative areas of roofs and pavement.

c) Ground slope and soil permeability shall also be considered, however, the run-off coefficients shall in no case be less than the values set out above.

.4 Open Drainage Channels

In areas where open ditches are the primary means of drainage, ditches must be designed to allow for all potential sources of stormwater runoff. Rip rap protection of ditches and energy dissipation measures shall be implemented if deemed necessary by the Superintendent of Works and as indicated in the standard drawings. Perforated drains shall be installed as per the standard drawings if deemed necessary by the Superintendent of Works.

.5 Outfalls

Outfalls shall be located such that the outflow of storm water will not cause or present the potential of erosion of Crown, private or municipal property. Energy dissipation measures shall be implemented if deemed necessary by the Superintendent of Works. Outfall locations shall be approved by the Approving Officer.

.6 Culverts

a) Minimum culvert diameters shall be:

Roadway Crossings	450 mm
Driveway Crossings	300 mm

b) Roadway crossing culverts shall be sized to accommodate the 1 in 25 year return period.

c) Cement/sand bag end structures in accordance with the standard detail drawings shall be installed on the ends of each roadway culvert.

5.04 Minimum Pipe Diameters, Hydraulic Capacity, and Velocities

.1 Minimum pipe diameters shall be:

Mains	250 mm
Catch basins leads	200 mm

.2 The hydraulic capacity shall be calculated using Mannings formula. The roughness coefficients for the various pipe materials are as follows:

PVC	N = 0.011
Concrete	N = 0.013
Corrugated Metal Pipe	N = 0.025

Maximum/Minimum Velocities shall be 4.5 m/s and 0.75 m/s respectively. For mains 375 mm and less, the design depth of flow shall be limited to $\frac{3}{4}$ of full depth. For mains 450 mm and larger the design depth may be increased to the full depth of pipe.

5.05 Main Offsets and Depth of Bury

.1 Storm sewer mains shall be installed 3.0 metres from the road centerline on the opposite side as the sanitary main.

.2 The minimum depth of bury from finished ground elevation to the top of pipe for mains shall be 1.5 metres. Minimum cover for catch basin leads shall be determined by the sump requirements and pipe diameter but under no circumstances shall be less than 0.9 metres.

.3 Mains shall be designed to drain the basements of all possible buildings on the assumption that the service connection leaves the closest point to the sewer of the proposed basement at a crown elevation 0.6 metre below the proposed floor level and runs at a slope of not less than 2.0% to connect crown to crown to the storm sewer main.

5.06 Energy Dissipation

.1 Where velocities greater than 3.0 metres per second occur, an energy dissipation manhole shall be installed at the discretion of the Superintendent of Works.

5.07 Manholes and Catch Basins

.1 Manholes

.1 Manholes shall be installed at the end of each line; at all changes in grade, size or alignment; at all intersections; at distances not greater than 122 metres for sewers 375 mm or less; at distances not greater than 150 metres for sewers up to 600 mm; and at distances no greater than 180 metres for sewers greater than 600 mm.

.2 Standard manholes shall be 1050 mm inside diameter.

.3 Wherever possible, pipe grades shall be designed so that pipe crowns are at the same elevation at the manhole.

.2 Catch Basins

.1 For road grades of up to 2.0%, the maximum distance between inlets, or prior to initial pickup of surface flow is 150 metres. For road grades in excess of 2.0%, the maximum distance between inlets, or prior to initial pickup of surface flow is 100 metres. For road grades in excess of 3.0%, side inlets shall be provided for catch basins.

.2 Catch basins shall be located at all low points, or spaced at intervals such that not more than 10% of the gutter flow reaching each inlet will pass on to the next inlet downstream, provided this carry-over is not objectionable to pedestrian or vehicle traffic and the inlet is not in a sump.

.3 Catch basins shall be located at intervals such that surface drainage does not exceed gutter or flow channel capacities, to eliminate overflow to driveways, boulevard margins, sidewlaks, or private property.

.4 Catch basins shall be located at all intersections in such a manner to minimize interference with crosswalks.

.5 Side inlet catch basins only shall be provided.

.6 Catch basin leads shall be connected to a manhole.

5.08 Materials

.1 Storm Sewer Pipe

The following types of pipe shall be CSA approved for storm sewer mains:

a) Concrete Pipe

Concrete storm sewer pipe shall be Class III or better conforming to ASTM Standard C76 for Reinforced Concrete Pipe and Class III or better conforming to CSA A257 and ASTM C14 Non-Reinforced Concrete Pipe. Rubber O-ring gaskets for concrete sewer pipe shall conform to ASTM C-443.

b) Polyvinyl Chloride (PVC) Pipe

For 150 mm to 375 mm sizes, the pipe and fittings shall conform to ASTM D3034-73, and shall have a minimum SDR of 35. For diameters greater than 375 mm, PVC pipe shall be Perma-Loc 320 and Perma-Loc 70 ribbed gravity sewer pipe conforming to ASTM F794-83.

c) Corrugated Steel Pipe (for ditched driveway and roadway crossings only)

Corrugated steel pipe shall be in accordance with "specification for corrugated steel pipe products" No. 501-78 metric as prepared by the Corrugated Steel Pipe Institute and to CAN 3 - G401.

.2 Precast Manhole Sections

a) Precast concrete manhole sections shall be 1050 mm inside diameter with 115 mm wall thickness, reinforced concrete pipe of at least Class II in accordance with ASTM Standard C76 with tongue and groove joints. Manhole sections shall have 19 mm galvanized steel steps cast in the concrete as shown on the standard drawings.

b) Joints shall be made water tight by grouting or the use of water proofing agents.

c) Lower slabs for manholes shall be reinforced to withstand H-20 highway loading conditions.

.3 Cast Iron Manhole Frames and Covers

Covers and frames shall be cast iron of an approved pattern to withstand H-20 loading. The clear opening of the frame shall be 500 mm in diameter. The cover shall have a weight of 66 kg. The frame shall be of the round base pattern having a weight of 84 kg. Bearing faces of the cover to frame shall be machined for a non-rocking fit. Covers shall have 2 only 22 mm diameter lifting holes with bolt plug assembly as shown on the standard drawings. Frames shall have 3 only 22 mm diameter levelling holes. Covers and frames shall be Dobney Foundry Pattern C20, or approved equal. Covers shall have the following wording permanently embossed thereon:

"STORM SEWER"

.4 Precast Catch Basin Sections

Catch basin sections shall be 900 mm inside diameter precast reinforced concrete pipe Class III conforming to ASTM C-76.

.5 Catch Basin Frames and Covers

Catch basin frames and covers shall be as specified on the standard drawings and shall be cast iron construction.

.6 Poured in place concrete shall have a 28 day strength of 20 MPa.

5.09 Storm Sewer System Testing

.1 Infiltration Test Requirement

Where the surface level of existing groundwater in the backfilled trench is one metre or more above the top of the pipe over the entire test section, an infiltration test shall be used to determine leakage into the pipe.

Copies of the test results shall be submitted to the Superintendent of Works on the Village's standard test forms.

.2 Air Test

Where the groundwater surface level is less than one metre above the top of the pipe at the lowest point in the test section, or where groundwater at the time of testing is not apparent, a low pressure air test shall be carried out. Air pressure tests shall be the minimum time allowed for the pressure within a sewer main section to drop from 24.1 KPa to 17.2 KPa. The minimum time-air pressure loss for various diameters of pipe are as follows:

Pipe Diameter	Minimum Time for Air Pressure To Drop from 24.1 KPa to 17.2 KPa
100 mm	3 minutes, 46 seconds
150 mm	5 minutes, 42 seconds
200 mm	10 minutes, 08 seconds
250 mm	15 minutes, 49 seconds
300 mm	22 minutes, 47 seconds
350 mm	35 minutes, 36 seconds

Copies of the test results shall be submitted to the Superintendent of Works on the Village's standard test forms.

.3 Exfiltration Test

Where the groundwater level is below the pipe invert throughout the section, an exfiltration test may be used. The test section shall be sealed at its lower extremity by means of a watertight plug. The test section shall be filled with water such that a minimum hydrostatic head of 600 mm is placed on the pipe at its upper extremity. The head of water on the pipe shall be taken as the distance from the top of the pipe to water surface at the point of measurement. The test pressure shall be maintained above the 600 mm minimum head for a period of not less than one hour.

The rate of exfiltration shall be calculated from the amount of water which must be added to maintain the original water level at the upper end.

The maximum allowable infiltration/exfiltration rate shall be 4.61 litres/mm of pipe diameter/24 hours/kilometer of sewer main. Rates for various pipe sizes are as follows:

Pipe Diameter	Maximum Allowable Infiltration/ Exfiltration Rate in Litres Per Lineal Metre of Main per 24 Hours
100 mm	0.461
150 mm	0.692
200 mm	0.922
250 mm	1.153
300 mm	1.383
375 mm	1.614

Copies of the test results shall be submitted to the Superintendent of Works on the Village's standard test forms.

.4 Manholes shall be tested with water to prove they are completely water tight.

.5 If leakage is detected, the leak or leaks shall be found and repaired by approved measures. The testing shall be repeated n these sections until leakage is within acceptable limits.

5.10 Cleaning and Flushing

All storm sewer mains, manholes, catch basins and services installed shall be flushed of all deposits of silt, sand, gravel, debris and other objectionable materials. All mains shall be flushed clean and a suitably sized plug passed through each test section to ensure no obstructions exist. The Superintendent of Works shall witness all flushing and plug-pulling operations. Mains other than those layed on curves shall be straight and have a clear visibility between manholes.

5.11 Video Inspections

The Superintendent of Works may require a video inspection report be submitted where conventional testing indicates the section may not conform to specifications or for sections which cannot be adequately tested by conventional means.

SECTION 6.0 - POWER, TELEPHONE, CABLEVISION AND STREET LIGHTING

6.01 General

.1 Where the installation of underground power, telephone and cable- vision distribution systems is required, the developer shall be responsible for meeting all the requirements of the utility companies and government agencies concerned. Design drawings prepared by the utility companies shall be submitted for approval together with all other required plans for the subdivision.

.2 Where overhead electrical power is to be provided, installation of street lights on the poles will be permitted.

6.02 Liaison with Power Company

.1 It is the responsibility of the developer to carry out liaison and obtain approvals from West Kootenay Power and Light Company for the installation of street lighting. Where underground electrical power is to be installed, the developer shall submit to the Superintendent of Works drawings approved by West Kootenay Power of the street lighting layout together with all other required plans of the subdivision.

.2 Where overhead power is to be provided, it is the responsibility of the developer to carry out liaison with West Kootenay Power prior to submission of the subdivision drawings to the Superintendent of Works to ensure that pole locations will not conflict with other underground utilities. Further, the developer shall provide written evidence from West Kootenay Power that complete street lighting services can be provided from power poles. Written confirmation of serviceability from power poles shall be submitted complete with design drawings for the subdivision road and services.

6.03 Street Lighting Standards and Luminaires

.1 Pole standards shall be a minimum of 11 gauge octagonal steel anchor base type with 2.5 m davit and a height of 7.9 m for local roads and 9.0 m for collector roads. Poles shall be complete with anchor bolts, nuts, nut covers, handhole and water tight cover assembly, grounding stud, fuse and terminal block assembly. See Standard Drawing L-1.

.2 Luminaires shall be High Pressure Sodium Cobra Head Fixtures, 150 watt Landmark 150 - L2HS150P2V, 120/240 volt for local and collector roads, or equivalent. Photocells shall be Fisher Pierce 6660 or 6690, or equivalent.

6.04 Conductors

.1 Provide stranded copper conductor minimum #12 AWG for lighting.

.2 Provide RW90 X-LINK polyehtylene insulated wire.

.3 Wiring at 120/240 volts shall be 300 volt insulated.

6.05 Grounding

Each standard shall be grounded by means of a continuous #8 AWG bare stranded copper ground conductor installed in the non-metallic conduit and connected to a grounding plate or a 19 mm diameter grounding rod 3 metres long at each service in accordance with the Provincial Electrical Code.

6.06 Lamp Standard Bases

Bases for davit standards shall be precast or cast in place trapezoidal bases as shown on Standard Drawing L-2 The base shall be 460 mm square at the top, 810 mm square at the bottom and 1.5 metres deep.

6.07 Frangible Bases

The Superintendent of Works may require that frangible bases be used for lamp standards installed on roads not requiring curb and gutter. Frangible bases shall conform to standard drawing L-4.

6.08 Offsets

Lamp standard bases shall be located as shown on the standard drawings.

6.09 Painting

Poles shall be factory painted inside and outside with one coat of metal primer. Poles shall be finished by being hot dipped galvanized or painted with hard dry metal aluminum paint, or equivalent.

6.10 Refractors

All refractors shall be polycarbonate.

6.11 Recommended Average Horizontal Illumination

(From IES Roadway Lighting Practice)

AREA CLASSIFICATION

Roadway and Walkway Classification	Commercial Areas		Residential Areas	
	Foot Candle	Lux	Foot Candle	Lux
Collector	1.2	13	0.6	6
Local	0.9	10	0.4	4
Lanes	0.6	6	0.4	4
Pedestrian Walkways and Sidewalks	0.9	10	0.2	2

Note: The levels recommended represent average illumination on the roadway when the light source is at its lowest output and when the luminaire is in its dirtiest condition.

Recommended Uniformity Ratio

The maximum average to minimum uniformity ratio of horizontal illumination for roadways shall be as follows:

3:1 for arterial roads and commercial areas;
6:1 for residential areas