SCHEDULE G

REGULATIONS, STANDARDS AND SPECIFICATIONS FOR THE DESIGN AND INSTALLATION OF DRAINAGE SYSTEMS

This is Schedule G of the Corporation of the Village of Lytton Subdivision and Development Servicing Bylaw No. 483, 1998.

Clerk

SCHEDULE G

REGULATIONS, STANDARDS AND SPECIFICATIONS FOR THE DESIGN AND INSTALLATION OF DRAINAGE SYSTEMS

G - 1.0 GENERAL

Where the provisions of Schedule A of this Bylaw require the construction of a storm drainage system, the Owner shall provide a storm drainage system including sewer mains, manholes, service connections, and all related appurtenances consistent with the standards and specifications contained in this Section. Each lot shall have a storm sewer service unless advised otherwise by the Approving Officer.

G - 1.01 Approval of Engineering Drawings Required Prior to Construction

Engineering drawings which show detailed design of the necessary works together with Technical Specifications shall be submitted to the Approving Officer for approval prior to the commencement of construction. The drawings shall show overland drainage systems, the alignment and size of pipes, proposed grades, distances between manholes, manhole invert elevations, existing ground line, proposed final ground line over the pipe, location of all service connections to the property line, all easements, pipe bedding requirements and all other details as may be required.

G – 1.02 Where Storm Drainage Collection System Not Required

Where storm drainage facilities are not required at the time of development, the Village of Lytton may require rights-of-way to be provided by the Owner to allow for the eventual installation of these facilities. Such rights-of-way shall be registered in favour of the Corporation of the Village of Lytton at the Owner's expense. In this instance, the Owner will be required to provide for surface drainage as required by the Approving Officer, with all catch basins and other appurtenances designed to facilitate connection to the future storm sewer system.

G - 1.03 Stormwater Drainage Plan

All drainage systems in the Village of Lytton shall be designed in accordance with the primary purpose to limit the effect of peak flows and volumes of runoff on private and public property, receiving streams, and watercourses. The Owner's Engineer shall prepare a Stormwater Drainage Plan at a maximum 1:1000 scale, that will explicitly indicate existing and proposed drainage courses and drainage areas, together with estimated runoff flows and proposed drainage works.

G - 1.04 Minor and Major Drainage Systems

The drainage system shall consist of two components, the minor and the major systems. The minor system will consist of underground conduits, open channels and watercourses designed to convey a 5 year return period flow for residential, industrial, commercial, institutional, and high density residential areas. The major system will consist of surface flood paths, roadways and watercourses designed to convey the 100 year return period flow. In special conditions where surface flood paths cannot be established, pipes and culverts of the minor system may be enlarged to accommodate the major system flow.

G - 1.05 Adequate Drainage

All subdivisions shall be adequately drained throughout the year. Where the whole or part of any proposed subdivision is wet or subject to intermittent or periodic flooding, approval of the subdivision will be withheld until the Approving Officer is satisfied that appropriate steps have been taken to drain the land or otherwise remedy such wet or flooding conditions.

G - 1.06 Existing and Natural Watercourses

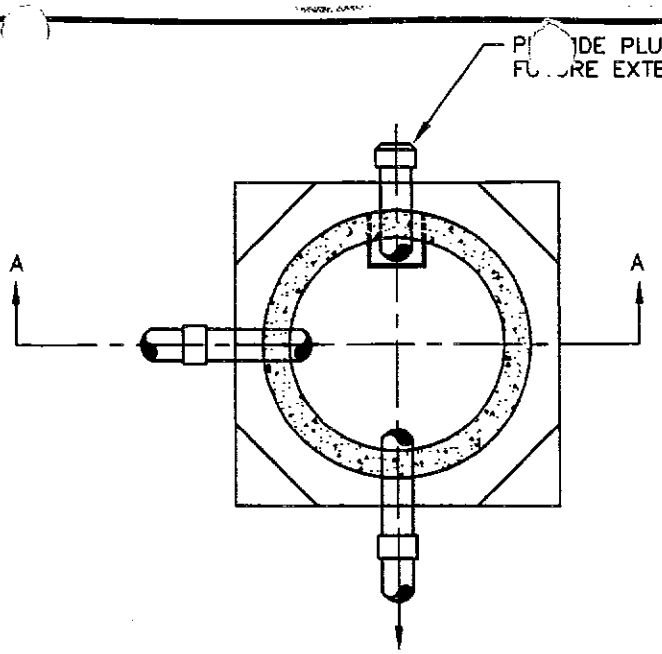
Where a subdivision is traversed by a watercourse, drainage way or stream, a right-of-way shall be provided along such watercourse or its planned re-alignment of a width deemed necessary by the Approving Officer for construction, maintenance, conservation, and beautification purposes.

No natural drainage course shall be altered or diverted unless such alteration or diversion has been approved by the Village of Lytton, the Provincial Ministry of the Environment and the Federal Department of Fisheries and Oceans.

Storm water shall only be discharged from a subdivision to a drain, ditch, watercourse, stream or other waterway as may, in the opinion of the Approving Officer, be adequate to receive the discharge therefrom, or which has been declared a part of the Village of Lytton drainage system.

G - 1.07 Drainage Systems Through Private Property

Where it is necessary to construct a drainage system through privately-owned land, the Owner shall obtain or grant a right-of-way in favour of the Corporation of the Village of Lytton to guarantee the right of access, in perpetuity, to the drain area facility in perpetuity.



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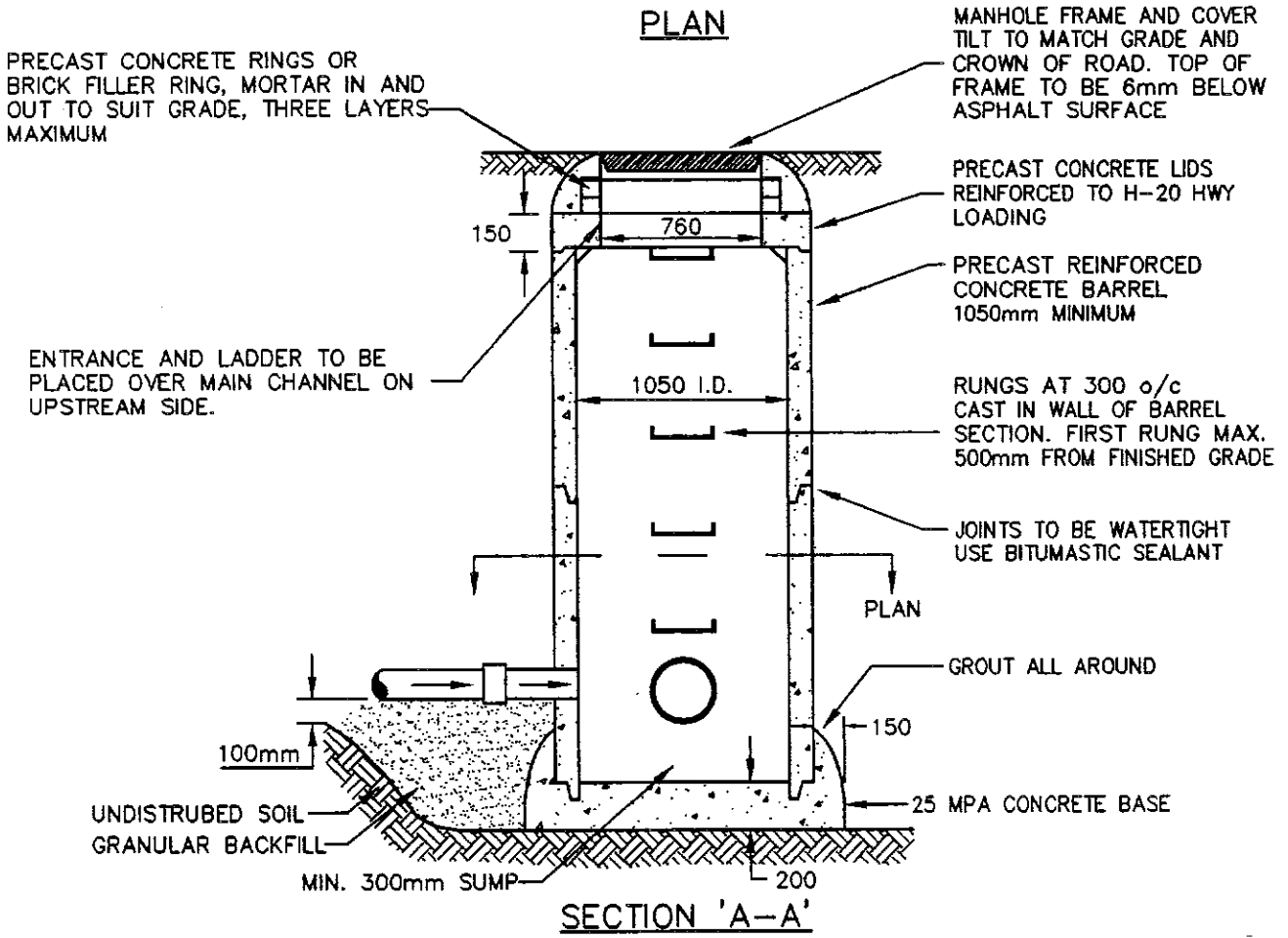

SECTION 'A-A'

PLOT DATE: 98/04/30 10:40am RH

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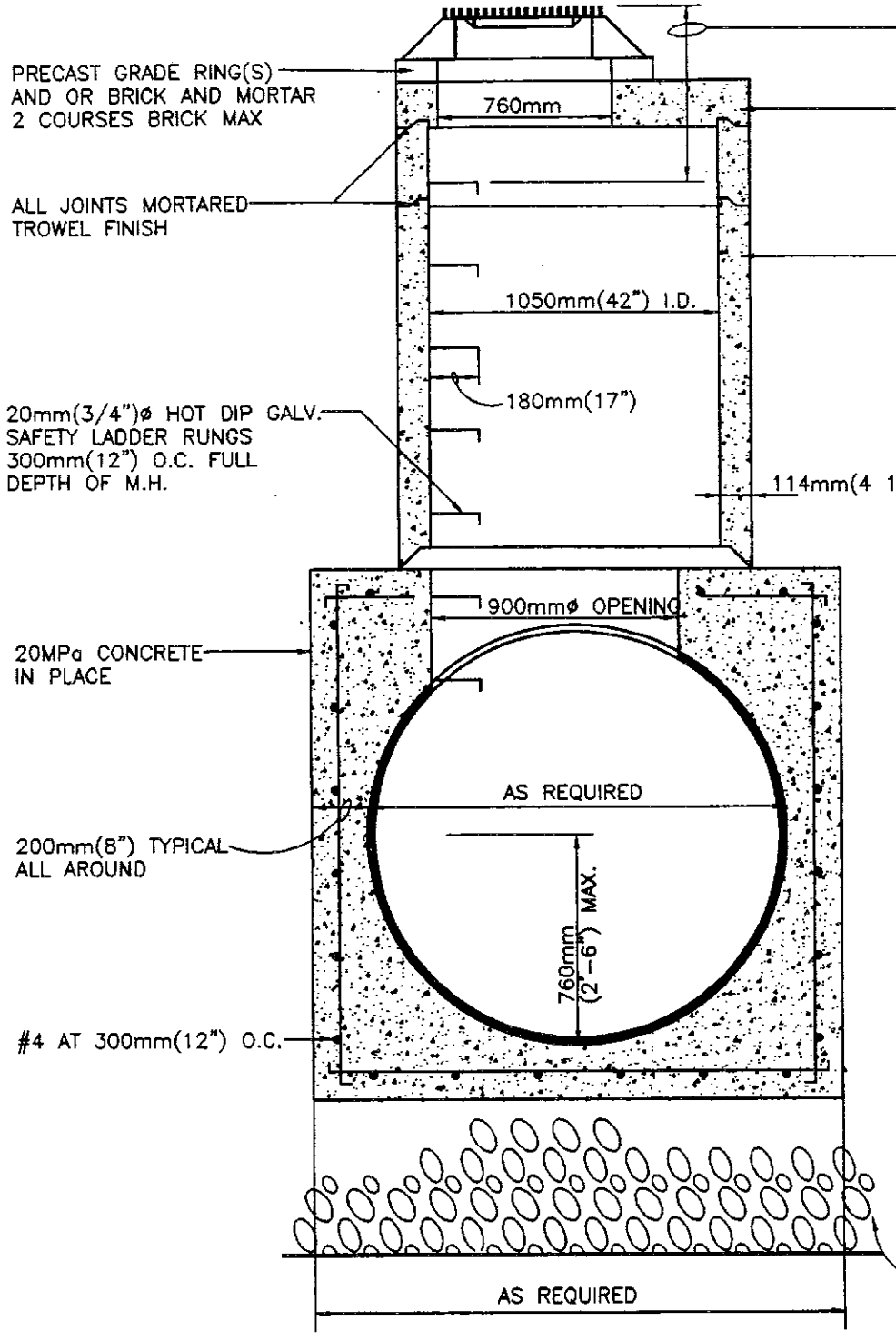
VILLAGE OF LYTTON	SCALE: NOT TO SCALE	TITLE: TYPICAL MANHOLE & BASE DETAILS FOR DRAINAGE MAIN UP TO 400mm DIA.	
	DATE DRAWN: MAR. 1998 / LATEST REVISION DATE: MAR. 1998		
	APPROVED BY:	SECTION: SCHEDULE G DRAINAGE SYSTEMS	REVISION No. 0 / DWG No. G-1



NOTE:
FOR SEWERS LARGER THAN ø380mm(15")

PLOT DATE: 98/04/30 10:45am RH

PROJ. CAD FILE No.: J:\STDDET\LYTSTD\G-2.DWG

VILLAGE OF LYTTON	SCALE: NOT TO SCALE	TITLE: MANHOLE FOR LARGE DIAMETER SEWERS	
	DATE DRAWN: MAR. 1998 / LATEST REVISION DATE: MAR. 1998		
	APPROVED BY:	SECTION: SCHEDULE G DRAINAGE SYSTEMS	REVISION No. 0 / DWG.No. G-2

G - 2.0 DESIGN CRITERIA

G - 2.01 Sizing of Systems

The system shall be of sufficient capacity to accommodate all tributary areas as defined by the Village. For drainage areas 20 hectares and smaller, the Rational formula shall be used:

$Q = KCIA$

Where: Q = Flow in m^3/s
K = Constant to establish units of compatibility (.00278)
C = Dimensionless runoff coefficient
I = Rainfall intensity in mm/hr
A = Runoff area in hectares

For the minor system, the 5 year frequency curve shall be used. For the major system, and for special structures such as in the design of storm retention basis, underpass drainage or arterial roads, the 100 year rainfall curve shall be used.

The time of concentration, or inlet time, will vary with topography and the nature of the drainage areas, but will generally be fifteen minutes or greater for residential areas. Inlet times shall be determined by the Design Engineer.

Runoff coefficients for storm sewer design shall be assumed to be not less than the values specified in Table G.1.

TABLE G.1
RUNOFF COEFFICIENTS

Description of Area	Runoff Coefficient
Commercial	
• Downtown	0.82
• Neighbourhood	0.60
Industrial	
• Light area	0.65
• Heavy area	0.75
Residential	
• Suburban	0.30
• Single – family	0.40
• Multiunits – detached	0.55
• Multiunits – attached	0.65
• Apartment dwelling area	0.60
Parks, cemeteries	0.15
Playgrounds	0.25
Unimproved areas	0.15

Runoff coefficients other than those specified in this section shall be used only with the express written consent of the Approving Officer.

For tributary areas greater than 20 hectares, the method used by the Design Engineer to calculate storm flows shall be approved by the Approving Officer.

G - 2.02 Design Grade

The minimum design grade shall be calculated by use of the Manning Formula such that a minimum velocity of 0.6 m/s shall be maintained during the design flow.

Pipes shall be designed to carry the required quantity when flowing 3/4 full for pipes sized 450 mm and smaller. Pipes sized 525 mm or larger shall be sized to carry the required quantity when flowing full.

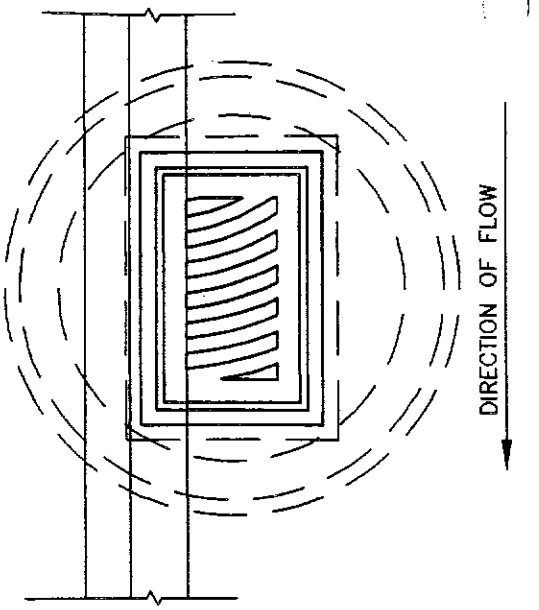
G - 2.03 Roughness Coefficients

Roughness coefficients for use with the Manning's Formula shall be as specified in Table G.2.

TABLE G.2
ROUGHNESS COEFFICIENTS

Pipe or Channel Material	Roughness Coefficient
Concrete Pipe	0.013
PVC Pipe	0.011
Corrugated Metal Pipe	
• Unpaved	0.024 - 0.033
• 25% paved	0.021 - 0.028
• 100% paved	0.013
Smooth Asphalt	0.012
Asphalt or Concrete Paving	0.014
Packed Clay	0.030
Light Turf	0.200
Dense Turf	0.350
Dense Shrubbery	0.400

Minimum velocity of pipes, flowing full, shall be 1.0 m per second.



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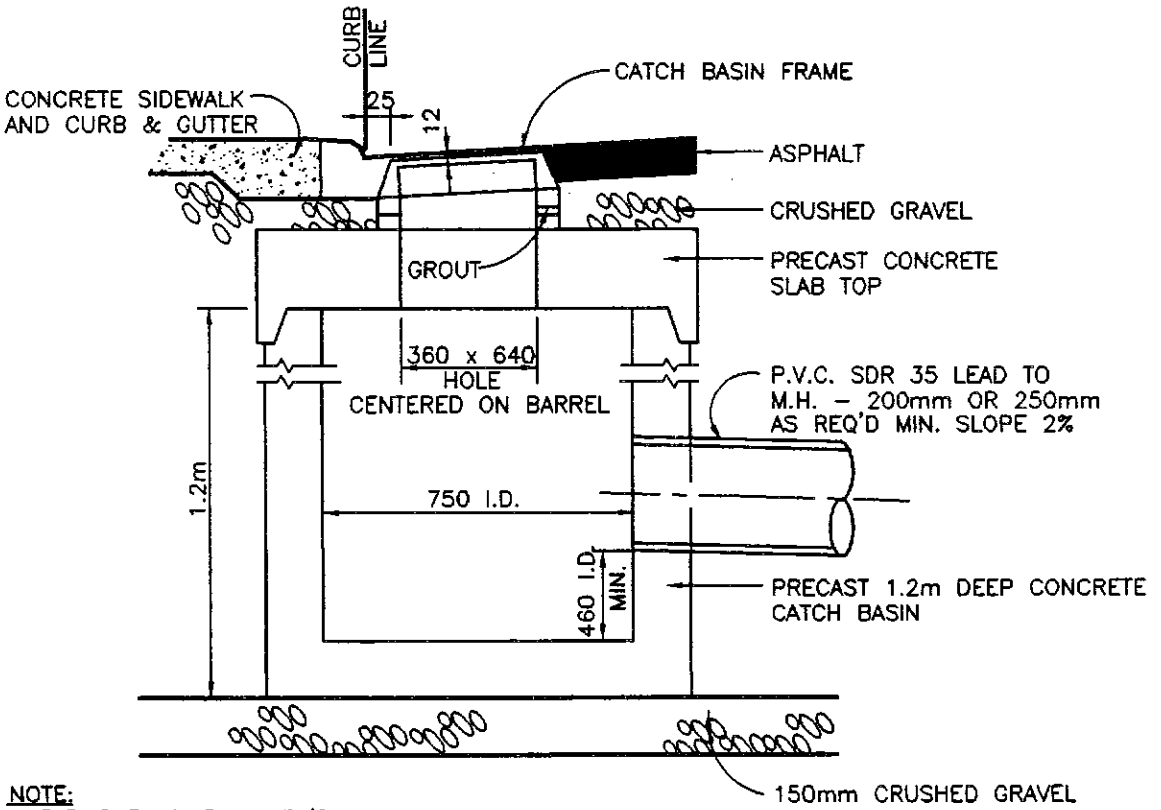

NOTE:
A FLEXIBLE JOINT IS REQ'D ON ALL LEADS, MAX. 500mm FROM CATCH BASIN

SECTION

VILLAGE OF LYTTON	SCALE: NOT TO SCALE	TITLE: TYPE 1 CATCHBASIN DETAIL	
	DATE DRAWN: MAR. 1998 / LATEST REVISION DATE: MAR. 1998		
	APPROVED BY:	SECTION: SCHEDULE G DRAINAGE SYSTEMS	REVISION No. 0 / DWG No. G-3

PLOT DATE: 98/03/30 10:45am RH

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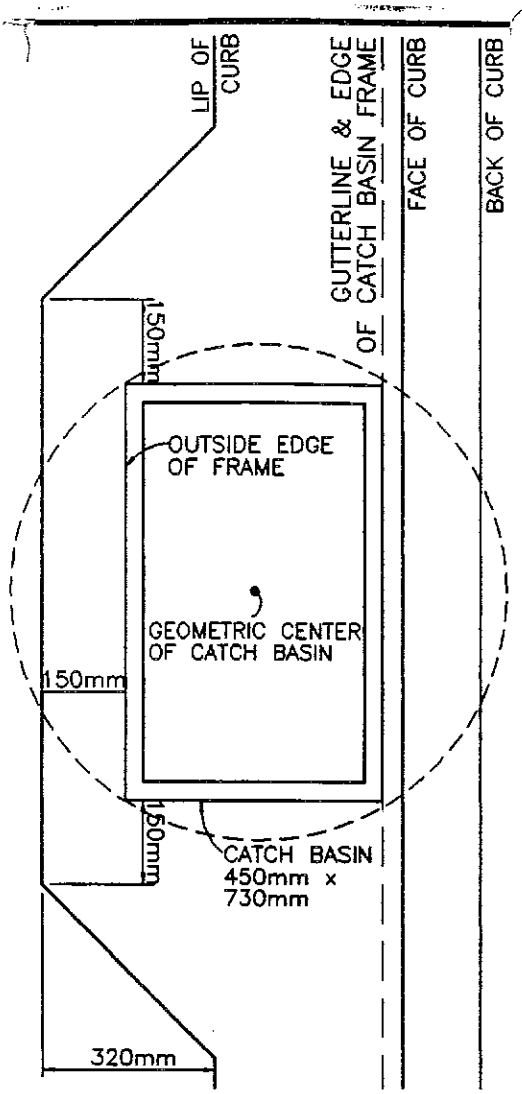

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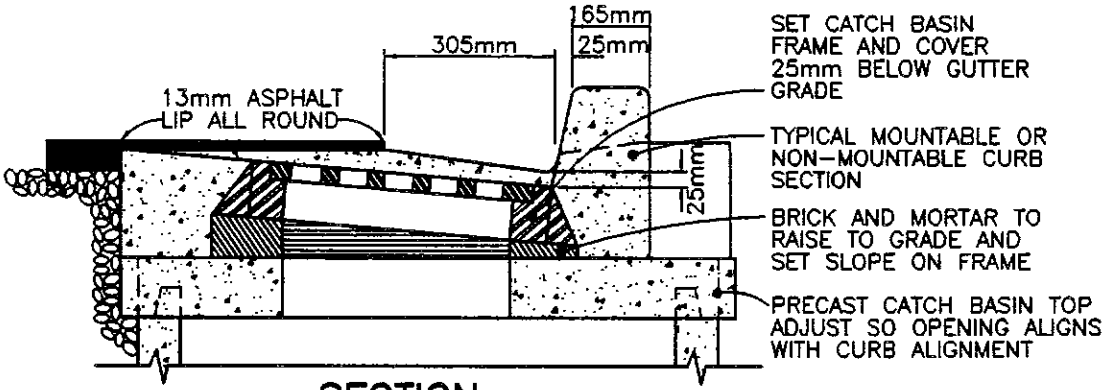

SECTION

NOTE:

1. THE TOP OF CATCH BASIN FRAME SHALL BE SET 25mm BELOW THE GUTTERLINE ELEVATION.
2. CONCRETE BRICKS SHALL BE USED TO BUILD UP CATCH BASINS, TO DESIGN TILT & GRADE. EXPOSED BRICKWORK SHALL BE NEATLY GROUTED & BRUSHED.

PLOT DATE: 98/04/30 10:45am RH

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VILLAGE OF LYTTON	SCALE: NOT TO SCALE	TITLE: TYPICAL CATCHBASIN FRAME & GRATE INSTALLATION IN GUTTER
	DATE DRAWN: MAR. 1998 / LATEST REVISION DATE: MAR. 1998	
	APPROVED BY:	SECTION: SCHEDULE G DRAINAGE SYSTEM / REVISION No. 0 / DWG No. G-4

There are no maximum allowable velocities except that the designer shall ensure that supercritical flow does not occur. Where grades exceed 15%, scour protection may be needed and anchor blocks will be required. These criteria may be modified by the Approving Officer to meet local conditions.

G - 2.04 Minimum Pipe Size

Minimum pipe size shall be 250 mm for mains, 200 mm for catch basins leads, 100 mm for residential service connections, and 150 mm for non-residential service connections. The minimum pipe size for mains accepting flows from open ditches shall be 400 mm and suitable silt traps shall be provided.

G - 2.05 Culverts

Where an open ditch system is required to cross a road, street or driveway, the ditch shall be enclosed by means of a culvert. All culverts shall be of sufficient size to properly drain all of the area naturally draining into the channel or ditch feeding into the culvert but shall be a minimum 400 mm diameter. Allowance shall be made for future flows as a result of full development of the upstream tributary area.

G - 2.06 Location of Storm Mains

Storm sewer mains shall, wherever possible, be located in the road right-of-way as shown on the applicable Standard Drawings. Where the location of the sewer main within the road right-of-way is not practical due to topography or other factors, the sewer main shall be located in a utility right-of-way registered in favour of the Corporation of the Village of Lytton and having a width of not less than 6.0 metres. The Approving Officer may require a utility right-of-way wider than 6.0 metres in the case where services in addition to storm sewer will be placed in the same right-of-way or where the depth of the sewer main requires a wider easement. There shall be a minimum clear lateral distance between the outside walls of storm sewers and sanitary sewers of 0.75 m. The entire length and width of utility right-of-ways shall be graded to facilitate future access with maintenance vehicles.

G - 2.07 Alignment of Storm Mains

Storm sewer mains shall generally be designed to follow a straight alignment between manholes. Curved alignments within rights-of-way shall be subject to the approval of the Approving Officer and provided that the pipe is set at a grade greater than the specified minimum and pipe alignment is at a parallel offset with an established boundary. In these cases, the radius of curvature shall be twice the minimum radius recommended by the pipe manufacturer. Small deflection pipe bends may b used to keep curved mains on the specified alignment.

G - 2.08 Depth of Cover

The minimum depth of storm sewer mains shall be sufficient to provide all service connection piping with a minimum cover of 1.5 m to the top of the service, anywhere within the finished right-of-way. In no instance shall the cover over the crown of the main be less than 1.5 m.

G - 2.09 Manholes

Manholes shall be installed at a maximum spacing of 150 metres and in the following locations:

.1 All changes in grade.
.2 All changes in alignment, including non-curvilinear sewers.
.3 All changes in pipe size.
.4 All pipe junctions.
.5 All intersections.

Where, in the opinion of the Approving Officer, the grades of sewer pipes are sufficient to provide proper cleaning, the maximum spacing of manholes may be increased to 150 metres.

Manholes shall normally be constructed in accordance with the details as shown on the applicable Standard Drawings. In cases where these details will not suffice, a detailed design drawing must be approved by the Approving Officer.

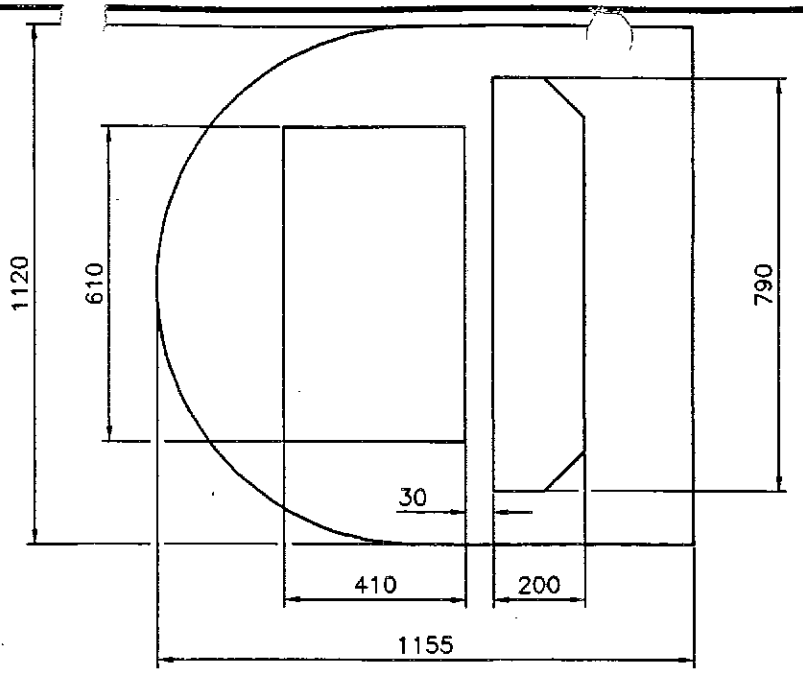
The relative elevations of storm sewers entering and leaving a manhole are to be such as to ensure that the manhole does not substantially reduce the hydraulic capacity of the system. Minimum fall through the manhole shall be 30 mm.

There shall be no change in the grades of pipe between manholes.

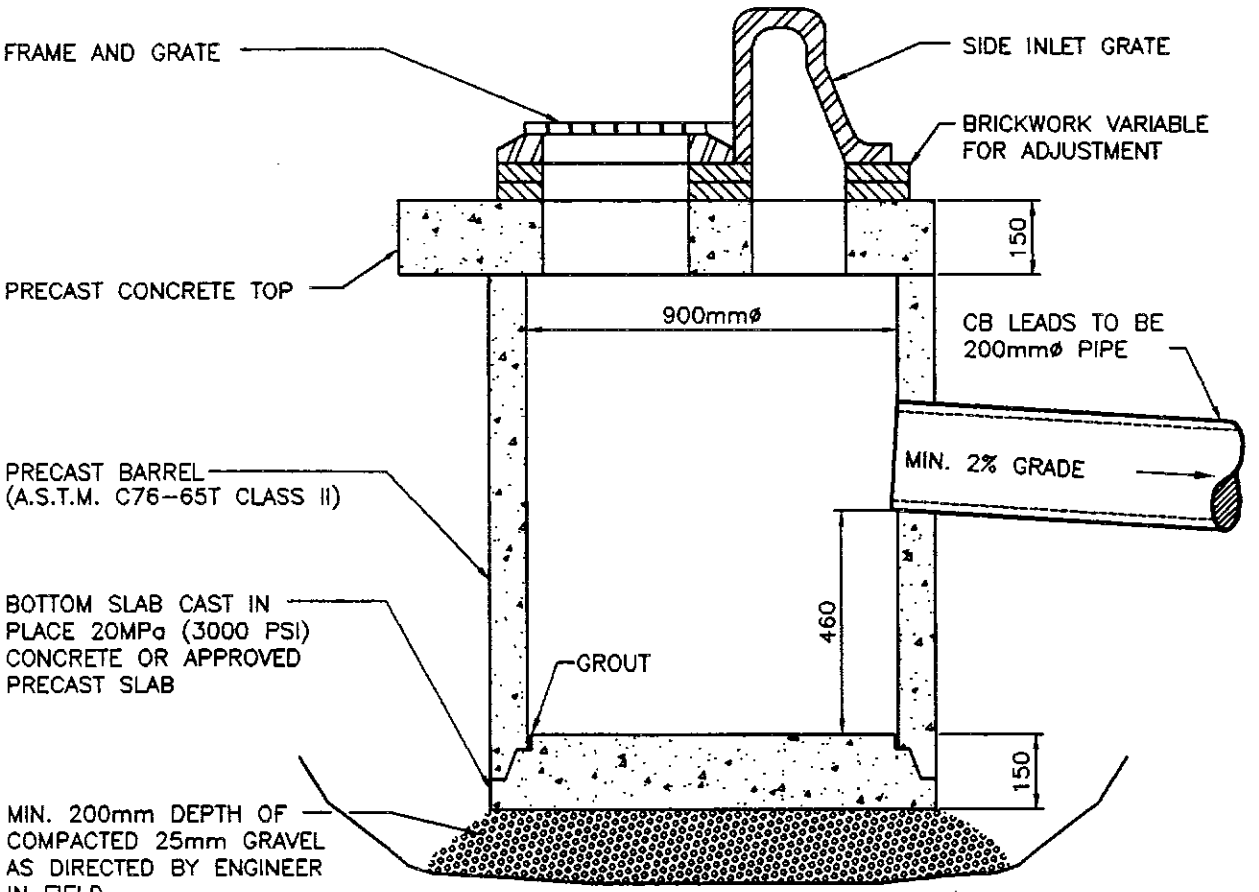
G - 2.10 Catchbasins

Catchbasins shall be constructed as shown on the applicable Standard Drawing.

Catchbasins shall be located on each side of the road at a maximum spacing of 75 m along the drainage path, at all intersections, 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. Catchbasin spacing shall be designed in accordance with the following:



CONCRETE TOP PLAN



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PLOT DATE: 98/04/30 10:45am RH

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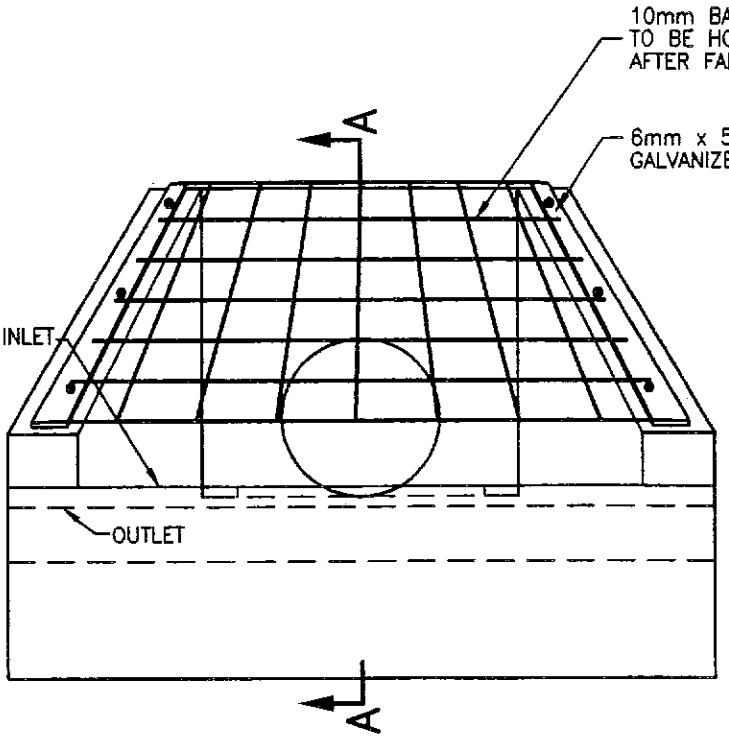
VILLAGE OF LYTTON	SCALE: NOT TO SCALE	TITLE: TYPE II CATCHBASIN DETAIL	
	DATE DRAWN: MAR. 1998 / LATEST REVISION DATE: MAR. 1998		
	APPROVED BY:	SECTION: SCHEDULE G DRAINAGE SYSTEMS	REVISION No. 0 / DWG.No. G-5



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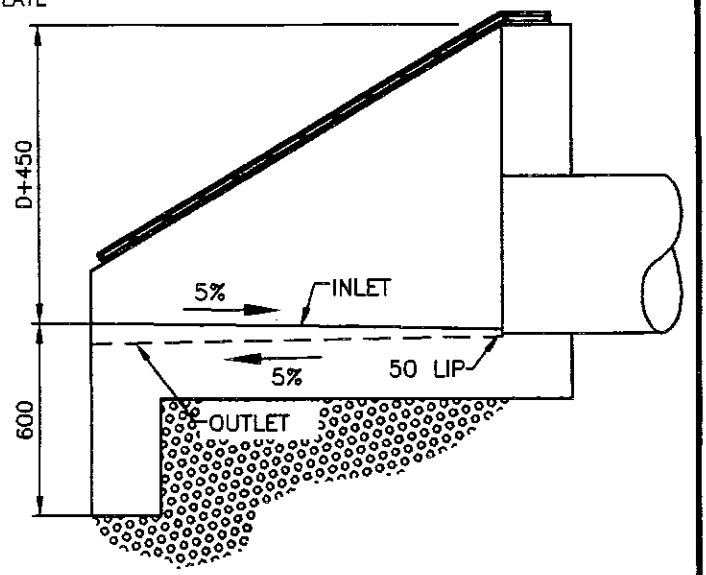
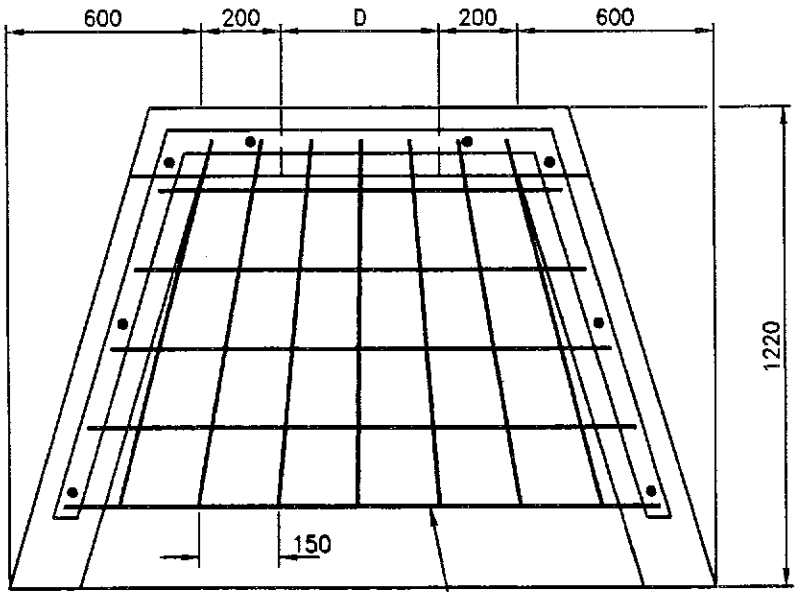


SECTION A–A



PLAN

NOTES:

1. ALL WALLS & SLABS 200mm
2. CONCRETE MIN. 25 MPa
3. BASE SHALL BE 150mm COMPACTED PIT RUN
4. REINFORCING WALL SHALL BE 15M @300 EACH WAY. EACH WALL & SLAB. MIN. BOND LENGTH ON CORNER BARS 460mm
5. PLACE RIPRAP 300mm THICK FOR 5m FROM INLET & OUTLET STRUCTURE
6. GRILLAGE SHALL BE HOT DIPPED GALVANIZED FASTENED TO THE STRUCTURE WITH 10mm BOLTS; 3 ALONG EACH SIDE, 2 ALONG THE TOP

PLOT DATE: 98/04/30 10:45am RH

PROJ. CAD FILE No.: J:\STDDET\LYTSTD\G-6.DWG

VILLAGE OF LYTTON	SCALE: NOT TO SCALE	TITLE: CONCRETE INLET & OUTLET STRUCTURE	
	DATE DRAWN: MAR. 1998 / LATEST REVISION DATE: MAR. 1998		
	APPROVED BY:	SECTION: SCHEDULE G DRAINAGE SYSTEMS	REVISION No. 0 / DWG No. G-6

Road Grade	Catchbasin Inlet Capacity
Type 1 Catchbasin (Standard Drawing G-3)	
$\geq 3\%$	20 L/s
$< 3\%$	30 L/s
At Low Point	50 L/s
Type 2 Catchbasin (Standard Drawing G-5)	
$\geq 3\%$	20 L/s
$< 3\%$	30 L/s
At Low Point	70 L/s

G - 2.11 Catchbasin Leads

Catch basin leads shall discharge into a manhole and not directly into the storm sewer pipe wherever possible.

Catch basin leads shall have a minimum cover of 0.6 m, except for PVC pipe which shall have a minimum cover of 0.9 m.

G - 2.12 Service Connections

Storm sewer service connections shall only be used for foundation perimeter drains and roof drains unless otherwise approved by the Approving Officer.

The diameter of storm sewer service connections shall be determined by the Design Engineer, but shall be 100 mm diameter minimum for a single family residential service and in no case shall a non-residential service connection be less than 150 mm.

Service connections shall be made with an approved branch wye with a 45 degree radius bend at the main and be installed in a straight line and at a uniform grade from the terminus at the property line. An approved wye saddle may be used to connect a 100m diameter service to an existing main. The minimum pipe grade for sewer service pipes shall be:

- 2% for 100 mm service pipe
- 1% for 150 mm service pipe

For services 200 mm and larger, a manhole shall be installed at the intersection of the main and service.

Sewer services shall be installed 9 metres from the lowest lot corner in accordance with the applicable Standard Drawings and shall be installed, in an individual trench.

Where storm services are required a Le-Ron inspection chamber shall be installed 0.30 m from the property line on all services shown on the applicable Standard Drawing.

G - 2.13 Pipe Class and Bedding Class

The quality of pipe and bedding shall be so selected such that the installation will adequately support the loads to be placed on it during construction and in operation. Pipe class and bedding class must be identified on all engineering drawings. Pipe shall have at least Class B bedding, as defined by the Standard Drawings.

For concrete pipe, the calculations shall follow the method shown in the latest edition of the *Water Pollution Control Federation Manual of Practice No. 9.* A safety factor of 1.5 shall be used for concrete pipe and the bedding classifications shall be as identified on the Standard Drawing.

For PVC pipe, the calculations shall follow the methods outlined in the latest edition of the Uni-Bell Plastic Pipe Association publication *Handbook of PVC Pipe - Design and Construction.*

For CSP pipe, the calculations shall follow the methods outlined in the latest edition of the American Iron and Steel Institute publication *Handbook of Steel Drainage & Road Construction Products.*

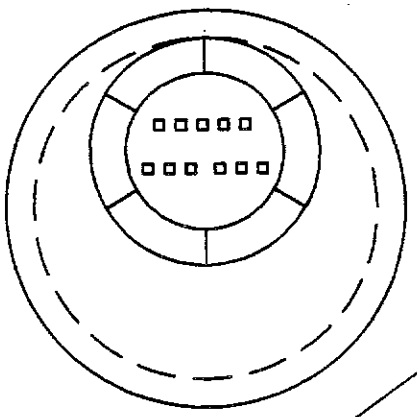
G - 2.14 Major Flow Routing

All overland flows in excess of 0.05 cu.m./sec shall have specifically designed flow routes, that are protected and preserved by restrictive covenants or rights-of-way. The major flow routing shall normally be provided along roads and in natural watercourses. In some cases, the major flow may also be carried alongside the road in grassed swales, across country in rights-of-way and along public walkways.

In special circumstances, or where desired to enable lower building elevations, the pipes and culverts, which form a part of the minor system, may be enlarged or supplemented to accommodate the major flow. All habitable areas of buildings shall be above the major flow hydraulic grade line, except where specific flood prevention measures have been taken and which are acceptable to the Approving Officer.

The proportion of flow to be carried along the major routing shall be the total major flow less the flow carried in the minor system.

Where the road is used to accommodate major flow, it shall be formed, graded and sufficiently depressed below the surrounding property lines to provide adequate hydraulic capacity. On arterial roads, the 100 year hydraulic grade shall not be higher than centreline of the pavement with the maximum flow depth not to exceed 300 mm.



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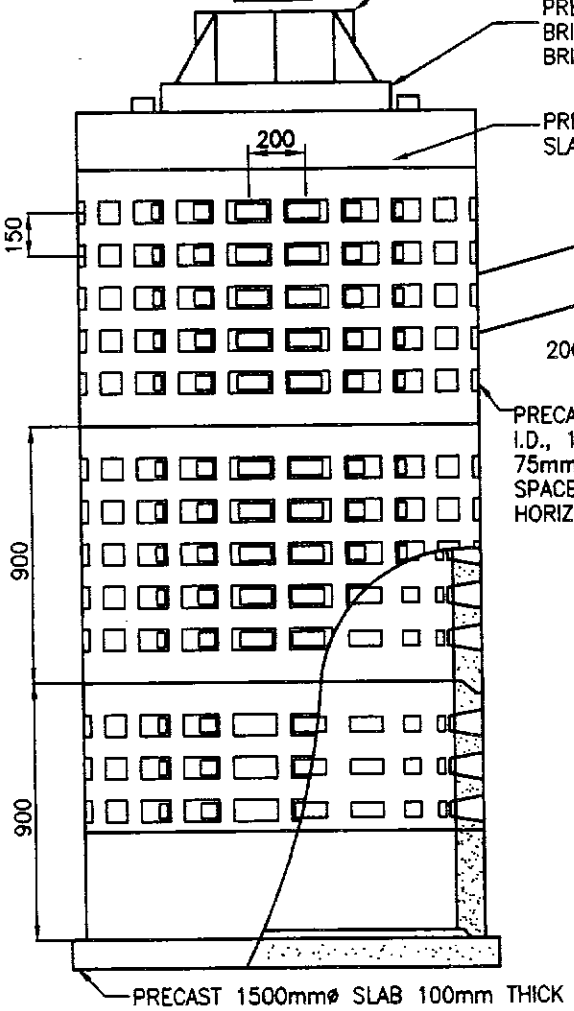

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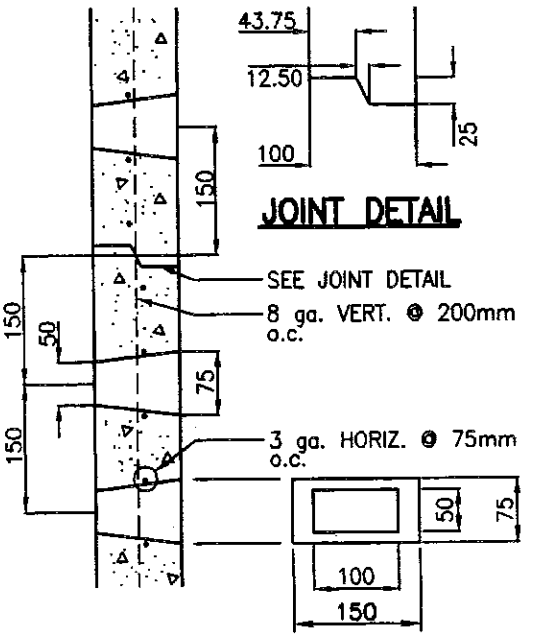
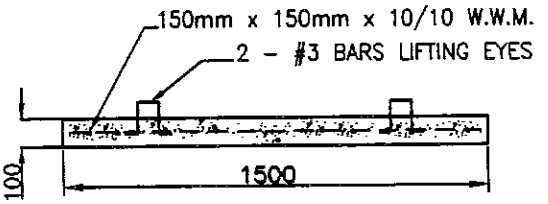


SECTION – BARREL



SECTION – BOTTOM SLAB

NOTE

1. WHERE DRYWELLS ARE PERMITTED BY THE APPROVAL OFFICER:
   A) MANHOLE RUNGS SHALL BE INSTALLED
   B) NUMBER OF DRYWELLS TO BE DETERMINED BY A HYDROGEOLOGIST
2. FOR INSTALLATION DETAILS SEE STD. G–8

PLOT DATE: 98/04/30 10:45am RH

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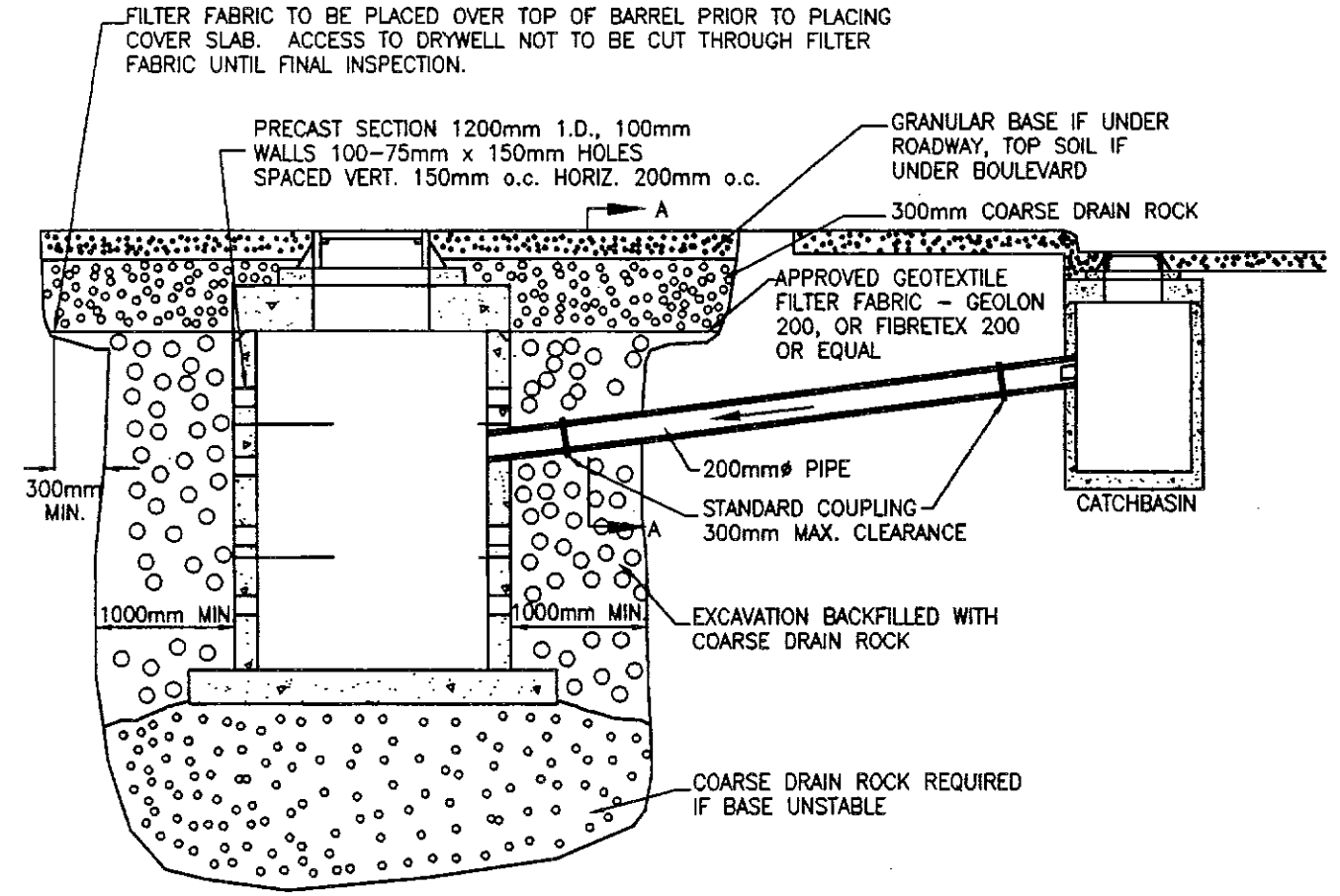
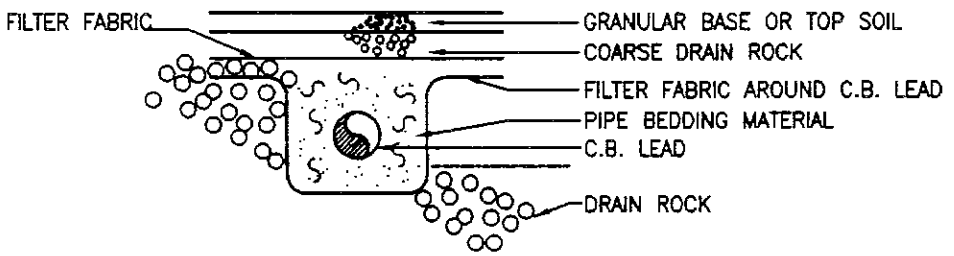
VILLAGE OF LYTTON	SCALE: NOT TO SCALE	TITLE: DRAINAGE DRYWELL	
	DATE DRAWN: MAR. 1998 / LATEST REVISION DATE: MAR. 1998		
	APPROVED BY:	SECTION: SCHEDULE G DRAINAGE SYSTEMS	REVISION No. 0 / DWG No. G–7





SECTION A-A

PLOT DATE: 98/04/30 10:50am RH

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VILLAGE OF LYTTON	SCALE: NOT TO SCALE	TITLE: DRAINAGE DRYWELL INSTALLATION REQUIREMENTS	
	DATE DRAWN: MAR. 1998 / LATEST REVISION DATE: MAR. 1998		
	APPROVED BY:	SECTION: SCHEDULE G DRAINAGE SYSTEMS	REVISION No. 0 / DWG.No. G-8

On collector and local roads, the entire roadway may be used as a major flood path with the maximum flow depth not to exceed 300 mm.

Where roadways used for major flows intersect, care shall be taken to lower the intersection to allow flows to pass over the cross street. Where major flow routes turn at intersections, similar care in the road grading design is required.

In areas where surface major flow routes cannot be provided, a pipe system will be designed to accommodate the required major flow, and sufficient inlet capacity will be provided to accommodate introduction of the major flow into a piped system.

Major flow routing over 0.05 cu.m./s shall be shown on the engineering drawings and sufficient design shall be carried out to provide assurance to the Approving Officer that no property damage or endangering of public safety will occur under major flow conditions. The Design Engineer shall provide the Approving Officer with the depth of flow along the major flow route and shall show on the Design Drawings the hydraulic grade line above the design curb and gutter or above the finished surface of other drainage courses. The discharge point from the development for the major flow route shall be coordinated with the downstream routing to outfalls as determined by the Corporation of the Village of Lytton. Where major flow outfalls to a receiving watercourse, the velocity shall not exceed 1.5 m/s, or energy dissipaters shall be provided to minimize erosion.

The use of catchbasin inlet control devices to separate major and minor hydraulic grade lines may be allowed, subject to the satisfaction of the Approving Officer regarding the suitability of such control devices. Where catchbasin inlet control devices are used, building elevations may be controlled by the hydraulic grade line occurring in the minor system.

G – 2.15 Drainage Drywells

Where drainage drywells are used as a means for disposal, drainage drywell wall surface areas shall be sized using Darcy's empirical law:

$$Q = Aki$$

Where: Q = rate of flow in m^3/s
A = cross-sectional area of soil through which flow takes place in m^2
K = coefficient of permeability in m/s
i = hydraulic gradient over a given flow distance.

Typical values for the Coefficient of Permeability, K, are presented in Table G.3.

TABLE G.3
TYPICAL VALUES OF COEFFICIENT OF PERMEABILITY

Typical Soil	Relative Permeability	Typical Value of K, m/s
Coarse Gravel	High Permeability	Over 10^{-3}
Sand, Fine Sand	Medium Permeability	10^{-3} to 10^{-5}
Silty Sand, Dirty Sand	Low Permeability	10^{-5} to 10^{-7}
Silt	Very Low Permeability	10^{-7} to 10^{-9}
Clay	Practically Impervious	Less than 10^{-9}

Upon determination of permeability factor, a safety factor of 2 shall be applied.

Drainage drywells shall, unless otherwise approved by the Approving Officer, be located in the road boulevard or in other lands dedicated to the Village for the purpose of drainage disposal.

The depth of the drywell will vary in accordance with the requirements derived from Dary's empirical law.

Drainage drywells shall be constructed as shown on the applicable Standard Drawings.

G - 3.0 MATERIALS

G - 3.1 Pipe and Fittings

.1 Pipe for gravity storm sewer mains and for services of 200 mm in diameter and larger may be any of the following:

.1 reinforced concrete pipe conforming to ASTM C76. Pipe strength (Class III min.) shall be specified for the trench conditions under which the pipe will be installed and operated. Joints shall conform to ASTM C443; or

.2 polyvinylchloride (PVC) pipe up to 900 mm in diameter, S.D.R. 35, conforming to ASTM D3034 and DSA B182.2, stiffness (F/Y) of 320 kPa at 5% deflection conforming to ASTM D2412, complete with approved rubber gasket joints. Maximum pipe length shall be 4 metres.

.2 Pipe for 100 mm and 150 mm storm sewer connections shall be Polyvinylchloride (PVC) pipe, S.D.R. 28, conforming to ASTM D3034 and CSA B182.1, complete with rubber gasket joints. Maximum pipe length shall be 4 metres.

.3 Sewer fittings shall correspond with the respective main and service pipes and shall conform with consistent specifications for main pipe.

.4 Pipes and fitting for storm sewer force mains shall be as approved for watermains in accordance with Sections E - 3.01 and E - 3.02.

.5 Other types of pipe may be used only with the written consent of the Approving Officer.

G - 3.02 Pipe and Fitting Joints

Sewer pipe and fittings shall be jointed with a rubber gasket or other preformed, factory-manufactured gasket or approved material.

G - 3.03 Service Junctions

Connection of services to new storm sewermain shall be made using a wye fitting. The type of joint of the service connection pipe to the sewer main shall conform with the type of joints on the sewer main.

Service wye saddle shall only be used to connect a 100 mm diameter service to an existing main. Where service saddles are used, they shall be equipped with steel straps. Service saddles shall only be used with the approval of the Approving Officer.

G - 3.04 Manholes

Precast concrete manhole sections shall conform to ASTM C478 and shall be minimum 1050 mm diameter with 115 mm wall thickness for mains less than 450 mm diameter; for mains greater than 450 mm diameter, the precast manhole sections shall conform to the diameters specified on the Standard Drawings. Concrete for cast-in-place manholes shall have a minimum compressive strength of 20 Mpa at 28 days.

Concrete for cast-in-place manhole bases and benching shall have a minimum compressive strength of 20 Mpa at 28 days.

Precast manhole bases of a design and construction quality acceptable to the Approving Officer will be accepted in lieu of cast in place bases.

Cover slabs shall be precast reinforced concrete to withstand H-20 loading conditions.

Manhole rungs shall be 20 mm diameter steel, hot dipped galvanized after bending, or an approved aluminum alternate, at 300 mm o.c., cast into the wall of the manhole

section, or set in 30 mm holes filled with epoxy cement. Rungs shall protrude 125 to 150 mm from the manhole wall. If precast manhole barrels are used having inset wire lifting lugs, the lugs shall be galvanized.

G - 3.05 Manholes Frames and Covers

Covers and frames shall be cast iron of an approved pattern to withstand H20 loading. 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 pit. The cover shall have 2 - 22 mm diameter lifting holes. The lid shall be embossed with "Storm Sewer".

G - 3.06 Pipe

CSP shall be used for culverts only and shall consist of galvanized corrugated steel pipe designed to carry H-20 loading in accordance with the *American Iron and Steel Institute* "Handbook of Steel Drainage and Highway Construction Products", latest edition.

G – 3.07 Drainage Drywells

Drywells shall be 1,200 mm diameter and shall be as per Article 3.04 and the Standard Drawings. Drywells shall have 75 mm x 150 mm holes through the walls spaced vertically 150 mm on centre and horizontally 200 mm on center.

G - 3.08 Pipe and Fitting Joints

Under certain approved conditions, storm sewer mains may be installed without gaskets or grouting to facilitate infiltration of ground water.

Suitable precautions such as shimming must be taken on these installations to ensure pipe to pipe alignment with no projecting inside edges or pipe misalignment.

G - 3.10 Catch Basins

Catch basin barrels shall be pre-cast concrete conforming to ASTM C478. All catch basin barrels shall be 900 mm in diameter. Concrete cover slabs shall be designed to withstand H-20 loading conditions. Catch basins shall be fitted with "Sur-Trap" trapping hoods, or equivalent.

Cast iron frames, grates and side inlets shall be as listed on the Approved Product List or as approved by the Approving Officer.

G - 3.11 Headwalls

Headwalls for storm sewer inlets and outlets shall be designed by the Design Engineer and subject to the approval of the Approving Officer. As a minimum, the design shall include reinforced concrete slab, wingwalls and headwall, 30 mpa concrete at 28 days, 38mm diameter galvanized pipe handrail, hinged and galvanized trash grate.

G - 4.0 WORKMANSHIP

G - 4.01 Trench Excavation

Trenches shall be excavated in accordance with Workers' Compensation Board requirements to suit the cross-section shown on the Standard Drawing. Open trenches through existing paved surfaces will be allowed only with the prior express consent of the Approving Officer. When trenches are permitted through existing pavement areas the pavement shall be saw-cut in straight continuous lines parallel to the trench centreline prior to the commencement of trenching operations. Cages shall be used where practical to reduce the width of trench excavation and provide adequate safety for workers.

If trenches are excavated wider than the specified widths, a higher class of pipe or special bedding may be required.

Rock excavation in trenches shall provide a minimum clearance of 150 mm below the pipe for pipes 600 mm in diameter or less, and 250 mm for pipes larger than 600 mm in diameter.

Excavation for manholes, fittings and other appurtenances shall be to the lines which will permit the assembly of these sections and to permit adequate backfill and compaction.

Where an existing structure or underground installation may be affected by the works, it is the responsibility of the Owner to inform the owner of such facility sufficiently in advance that the owner may make an inspection and specify the protective measures to be undertaken.

Where an unforeseen or other obstruction is encountered which interferes with the designed alignment or grade, the construction shall cease until such time as revised proposals are approved by the Approving Officer.

Any over-excavation of the trench subgrade beyond the specified depth shall be backfilled with select material and compacted to 100% Standard Proctor Density.

When the bottom of a trench is found to consist of unstable material which, in the opinion of the Design Engineer, cannot be removed and replaced with competent

bedding material, a pile foundation or other structural support in accordance with plans prepared by the Design Engineer shall be constructed.

In areas of clay or other impermeable soils, where over excavation of the trench subgrade is required, the over excavation shall continue to a point where ponding of water in the trench bottom will be avoided.

G - 4.02 Pipe Installation

Prior to installing pipe all standing water shall be drained or pumped from the trench.

Pipe shall be carefully lowered into the trench in a manner that will prevent damage to the pipe. Pipe shall be jointed in strict accordance with the manufacturer's recommended practice. When pipes are not being installed, the open end of the newly laid pipeline shall be protected with a suitable bulk head to prevent the entry of any foreign material.

Trench conditions shall be such that pipe jointing can be accomplished without getting muck, silt, gravel and other foreign material into the pipe.

The grade of every pipe length shall be checked before the pipe is backfilled. Any part of the trench excavated below grade shall be regraded with approved material thoroughly compacted.

All pipe must be laid to the design lines and grades within the following tolerances:

.1 Horizontal deviation from the approved alignment shall not exceed 60 mm and the rate of deviation shall not exceed 40 mm in 10 metres; and

.2 Vertical deviation from true grade varies with the grade and shall not exceed the limits shown in the following table.

Grade	Max. Departure From Design Elevation	Max. Rate of Deviation
Over 5%	30 mm	20 mm in 10 metres
2% to 5%	15 mm	10 mm in 10 metres
Less than 2%	6 mm	10 mm in 10 metres

G - 4.03 Granular Bedding and Backfill in Pipe Zone

The pipe zone is considered as being the depth of trench between the trench bottom and a level 300 mm above the top of the pipe.

The pipe zone backfill shall be hand placed and thoroughly compacted to a density of 95% Standard Proctor Density in layers not exceeding 150 mm using hand tampers.

G - 4.04 Backfill Above Pipe Zone

In Road Areas

.1 In road areas trench backfill material shall be placed in layers not exceeding 300 mm in thickness and compacted by mechanical means to a minimum of 95% Standard Proctor density.

The water content of the material shall be controlled to achieve the required density.

In Non-Road Areas

.2 In easements and other non-roads areas, native trench material may be used for trench backfill above the pipe zone. Backfill shall be placed and compacted to 90% Standard Proctor Density.

G - 4.05 Manholes

Manholes shall be constructed as shown on the applicable Standard Drawings.

All water shall be removed from the excavation prior to placing concrete. Concrete shall be placed only on a firm base. If the bottom of the excavation is unsuitable for support, it shall be excavated to a firm base and backfilled to the required grade with pipe bedding material.

Manhole channelling shall be constructed as shown on the Standard Drawings. The channel shall be constructed to form a smooth transition through the manhole. Channelling is to be formed using half pipe or fittings whenever possible. Where it is impossible to use half sections of pipe or fittings, the channel will be formed in the manhole base in a manner approved by the Approving Officer.

Precast sections shall be placed plumb with joints mortared inside and outside and exclude the entrance of groundwater.

Drop structures shall be constructed as shown on the Standard Drawing.

G - 4.06 Stubs

Blind stub sections for connection of future sewers to the manholes shall be installed as directed by the Approving Officer. The stub shall be plugged at the end with a watertight removable plug.

G - 4.07 Service Connections

.1 Storm sewer service connections shall be installed in accordance with the applicable standard drawings, and shall comprise:

.1 a wye fitting connection to the sewermain;
.2 a long radius sweep between the wye and the start of the service pipe;
.3 100 mm or 150 mm PVC DR 28 building sewer service pipe;
.4 a Le-Ron Inspection Chamber installed 0.30 m from the property line;
.5 a minimum 2.0 m length of pipe shall extend into the lot; the end of the pipe and the end cap shall be painted with green paint; and
.6 a 50 x 100 mm marker stake shall be set at the end of the sewer service pipe (end cap) with the bottom of the stake set flush with the invert of the service pipe. The marker stake shall be set perfectly plumb, extend at least 1.0 m above the surface be painted green, and have the distance between the top of the stake and the service invert clearly marked in metres with a black felt pen.

.2 All storm sewer services shall be tested with the mains.

G - 4.08 Pipe Casings

Pipe casings shall be installed as shown on the Standard Drawing. The sewer pipe shall be blocked at each joint to ensure line and grade is maintained and the casing is to be sealed at both ends with joint filler with proper care taken to ensure that the pipe remains on line and grade and does not float. The annular space between the sewer pipe and the casing pipe shall be filled with 14 mm sand, as specified in Section G – 3.09.

A length of 6 mm polypropylene rope shall be laid alongside the carrier pipe inside the casing to assist future retrieval.

G - 4.9 Asphalt Restoration

If the edges of the cut asphalt have become ragged as a result of the construction operation, asphalt shall be saw-cut to form a straight line prior to placing new asphalt. The edges of the existing asphalt shall be thoroughly cleaned and coated with an approved bituminous bonding agent prior to placing the hot asphalt mix. The finished grade of the asphalt surface shall conform with that of the existing surface such that no rises, depressions or ridges result from the repaving process.

G - 4.10 Cleaning and Flushing

Prior to testing, the storm sewer pipe shall be cleaned by flushing, or the use of mechanical equipment as necessary to remove all foreign material from the pipe. After

paving and landscaping and before subdivision acceptance, the storm lines shall be flushed to remove any deleterious material deposited by associated construction works. No water from the flushing and cleaning process shall enter the existing service system.

G - 4.11 Force Mains

Force mains shall be constructed and tested in accordance with Schedule E or as specified by the Approving Officer.

G - 4.12 Leakage Tests

Sewer Mains

Sewer mains shall be tested by a low pressure air test. All tests should be witnessed by the Approving Officer and at least 24 hours advance notice shall be provided.

Pipe mains and services shall be clean and plugged in preparation for the test. An air supply system should have adequate valves to isolate the test section and to vent off excess air. Pressure gauges should be clean and functional. Adequate blocking shall be placed behind all plugs to prevent plugs from blowing out. Blocking should allow the plugs to move approximately 6 mm.

If the ground water level with respect to the pipe is not known, this level shall first be determined at the lowest point of the line under test. The external ground water pressure shall then be calculated (depth of ground water in meters above invert of pipe multiply by 9.8 = pressure in KPa).

The section of pipeline under test shall be gradually surcharged to a pressure of 27.6 KPa above ground water pressure as determined above. Time will be allowed for the air temperature to stabilize (not less than 5 minutes). If the pressure drops below 24.2 KPa (pressure refers to the amount of pressure above ground water pressure), the 24.2 KPa pressure shall be maintained from the make-up air supply. If the pressure does not drop to 24.2 KPa during the period of stabilization, the air shall be released slowly until the pressure drops to 24.2 KPa.

The time is then measured for the period that the resultant air pressure drops 6.9 KPa from 24.2 to 17.3 KPa. If the time measured equals or exceeds the specified time, the test may be stopped, the readings recorded, including pressure readings, and the test considered satisfactory.

The time specified shall be as per Table G.1. If the time measured does not equal or exceed the specified time, the section of sewer main shall be checked for excessive leakage, and after repairs are made the pipeline shall be retested in the same manner.

TABLE G.1

Pipe Diameter (mm)	Time in Minutes
100	2 min. 30 sec.
150	3 min. 45 sec.
200	5 min. 00 sec.
250	6 min. 16 sec.
300	7 min. 30 sec.
375	9 min. 22 sec.
450	11 min. 15 sec.
525	13 min. 08 sec.
600	15 min. 00 sec.

Manholes

Upon the entire completion of the manhole installations, watertight plugs or seals shall be inserted on inlets and outlets of each new storm sewer manhole. The manhole filled to the underside of the top concrete slab. The water level shall be recorded at the beginning and end of the 2 hour test period and the leakage shall not exceed 0.3% of the manhole volume per hour. If the permissible leakage is exceeded, defects shall be corrected and the test repeated until the installation is acceptable. Plugs and water shall be removed after the test. All manhole tests shall be witnessed by the Approving Officer, and at least 24 hours advance notice is required.

G - 4.13 Materials Testing

The Village shall be provided with copies of all sieve compaction test results pertaining to bedding, backfill and road restoration.

G - 4.14 Video Inspection Tests

Before paving of asphalt surfaces, all sewer mains shall require a closed circuit televised inspection by the Owner to check jointing, possibility of debris in the pipe, leakage, alignment and grade of the sewer pipe. Any deficiencies discovered shall be rectified prior to paving.

Television equipment shall consist of a self contained camera and a monitoring unit connected by a coaxial cable. This equipment shall be specifically designed and constructed for such inspection purposes. The camera shall be mounted on adjustable

skids to facilitate the inspection of different sizes of pipe. The camera and skids shall be small enough to insure passage through a 150 mm dia. sewer. The camera shall be waterproof and shall have a remotely controlled adjustable self-contained lighting system capable of producing at least 100 foot candles of light. The lighting system shall be capable of lighting the entire periphery of the pipe.

Picture quality shall be such to produce a continuous 500 line resolution picture showing the entire periphery of the pipe. Picture quality and definition shall be to the satisfaction of the Approving Officer.

Measurement of defects shall be made by devises having a proven accuracy of plus or minus one percent. Cable markings if used, shall not be spaced at a distance of more than 600 mm along the length of the cable. Any type of measurement system used shall be subject to inspection by the Approving Officer.

Direct voice communication shall be established between the monitoring station and the camera towing device. This may be accomplished by a direct line of communication or radio. No loudspeaker devices shall be allowed.

Equipment shall be mounted in an appropriate type vehicle. Electrical power for the system shall be self-contained and shall not require removal for each set-up. External power sources from public or private residences shall not be permitted. Ample sound dampening shall be applied to the vehicle and equipment.

A television work report, in log form, shall be maintained during the inspection. This log shall show the exact location of each leak or fault discovered by the television - e.g. open joints, broken, cracked or collapsed pipe, presence of grease, roots, debris, accumulation, obstructions, infiltration, water depth variations, and other points of significance. The reference location shall include the distance away from the reference manhole and also the position of the leak or fault as referenced to the crown of the pipe using clock face notation.

The report shall include the location of all service connections together with a statement of opinion as to whether or not the service connections are leaking. Protrusions of the service connections into the mainline shall be noted with reference to the degree of protrusion.

Photographs of all sewer defects shall be taken. The photographs shall be co-ordinated with the written report by reference numbers. A minimum of one photograph per line shall be taken to show a representative view of the workmanship, as well as additional photographs of deficiencies as required.

Each manhole section of pipe shall be located on the report form in such a way as to be readily identifiable. Identify such items as name of subdivision, street names, manhole numbers, type of pipe, joint length, direction of flows, pipe diameter, manhole depth,

inspection date, names of the inspection technician, persons viewing, and video tape identification numbers.

Three copies of a final typewritten report with corresponding photographs and one copy of video tapes shall be furnished to the Approving Officer within two weeks after the completion of the inspection. This report shall contain no less than one photograph per manhole section inspected and additional photographs as required to show line faults and representative line conditions.

Full colour video tapes shall be of a format acceptable to the Approving Officer. All video tapes shall be numbered and cross indexed to the typewritten report. Video tape footages to fault locations shall also be cross indexed to the typewritten report, as well as referenced to the description of the fault included on the video tape. Tapes shall be in the VHS format.

To insure photographic quality 35 mm still photographic cameras shall be designated. Polaroid or similar cameras that do not produce negatives for rapid reproduction will not be acceptable. All still photographs shall be in colour.

If, during the inspection procedures the television camera will not pass through the entire manhole section, the equipment shall be reset in a manner so that the inspection can be performed from the opposite manhole.

Prior to inspection, all lines shall be cleaned thoroughly to remove dirt, grease, sand and other foreign and objectionable debris from inside the pipe and manholes so that cracks and other faults may be observed.

A small diameter poly rope or similar line shall be installed in the sewer in advance of the inspection in order that the camera traction cable may be drawn through the sewer. This line shall be installed on a manhole to manhole basis with the line being tied off at each individual manhole to facilitate the quick removal of any portion of this line should the need arise due to mainline sewer blockages or other emergency situations.

Interference to the normal flow of traffic shall be kept to a minimum. The equipment shall be arranged so that one lane of traffic is maintained at all times.

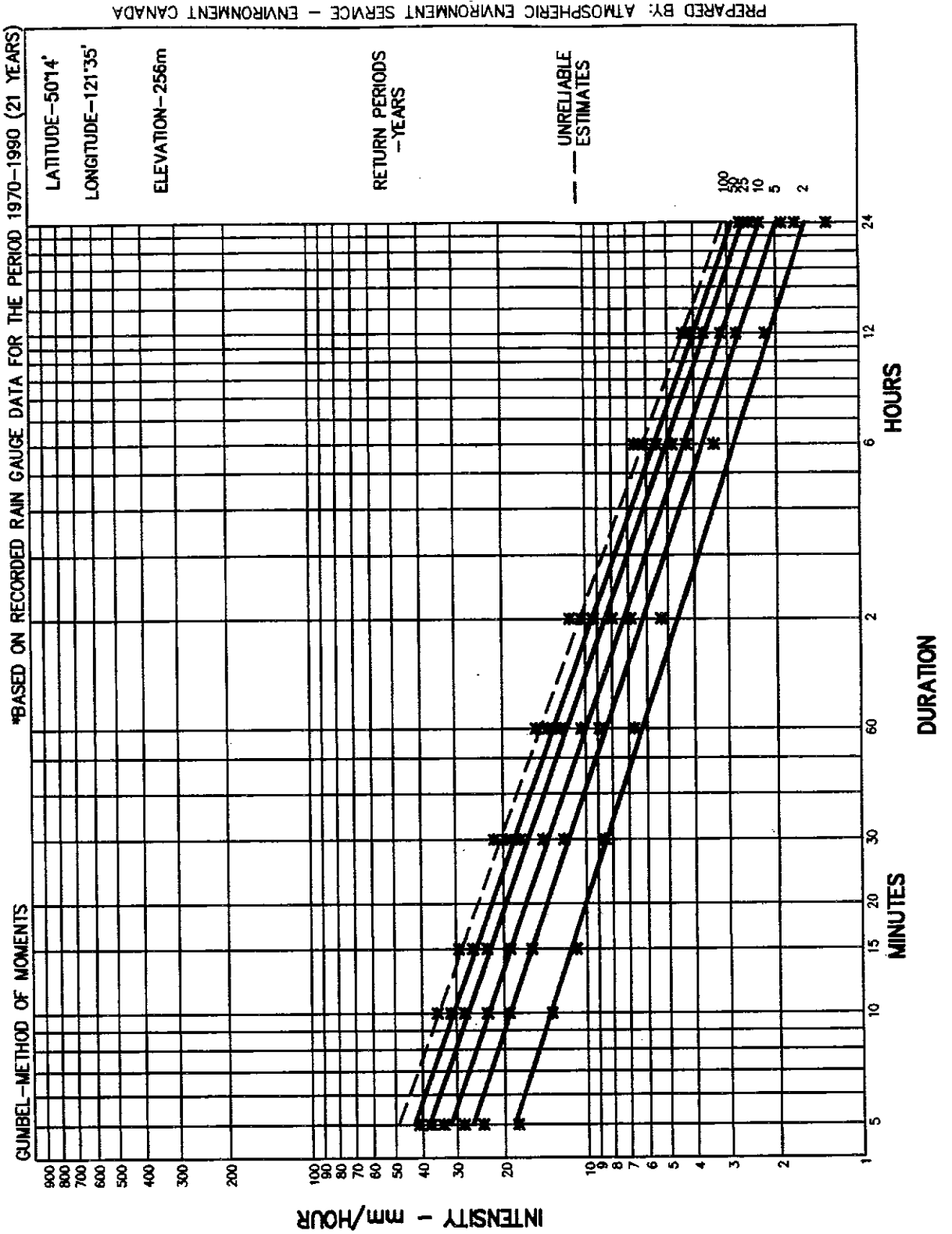
G - 4.15 Construction Record Drawings

Prior to Construction Completion, the Owner shall deposit with the Village one computer diskette (3½") in AutoCAD (latest release) format showing all the information requested by this schedule and conforming to the criteria set out in Schedule J.

PLOT DATE: 98/04/30 10:55am RH

PROJ. CAD FILE No.: J:\STUDET\LYTSTD\G-9.DWG

SHORT DURATION RAINFALL INTENSITY–DURATION FREQUENCY DATA FOR LYTTON



VILLAGE OF LYTTON	SCALE: NOT TO SCALE	TITLE: RAINFALL INTENSITY–DURATION GRAPH	
	DATE DRAWN: MAR. 1998 / LATEST REVISION DATE: MAR. 1998		
	APPROVED BY:	SECTION: SCHEDULE G DRAINAGE SYSTEMS	REVISION No. 0 / DWG No. G–9