

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL**  
**SECTION 2 - CONSTRUCTION DESIGN CRITERIA**  
**SUB-SECTION 2.4 - SANITARY SEWER SYSTEM**

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**2.4.1 DESIGN FACTORS**

The sanitary sewer system shall be of sufficient capacity to carry peak flows plus infiltration. The following factors shall be used in the design of sanitary sewage systems.

Residential

- Population Density: 40 persons/ha (minimum)
- Peak Sewage Flow: 4.0 x average flow
- Infiltration: 6,000 L/ha/day

Where an existing water distribution system is to be used, sewage flows shall be 90% of the water consumption rate.

Commercial, Industrial and Institutional

- Peak Flow: 3.0 x Average Flow
- Infiltration: 6,000 L/ha/day

Minimum velocity to be 0.70 m/s or greater

Maximum velocity to be 3.0 m/s or less

Average flow shall be calculated upon the worst expected building type, consistent with the zoning and building Bylaws.

Pipe sizing shall be determined by utilizing Manning's Formula.

Gravity sewer mains shall run straight from manhole to manhole.

It is recommended that all sanitary sewers be designed with the following:

- No sanitary sewer shall have a slope of less than 0.1%;
- Start of the run on any main shall be 50% higher than minimum slope or 0.60%;
- Maximum slope will be based on limiting the maximum flow velocity to 3.0 m/s; and
- The minimum slopes permitted for various sewer sizes are as follows:

SANITARY SEWER SIZE	MINIMUM SLOPE WITH A STRAIGHT ALIGNMENT	MINIMUM SLOPE WITH A CURVED ALIGNMENT
200 mm	0.40%	0.40%
250 mm	0.28%	0.31%
300 mm	0.22%	0.25%
375 mm	0.15%	0.18%
450 mm	0.12%	0.15%
525 mm	0.10%	0.13%
600 mm and larger	0.10%	0.10%

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**2.4.2 SANITARY SEWER MAIN MATERIALS**

The minimum size for sanitary sewer mains shall be 200 mm in diameter.

Pipe for the sewer main shall conform to one of the following:

MATERIAL	CLASS
CONCRETE PIPE	ASTM C14, Class III, NON-REINFORCED. ASTM C76, ASTM C655-85a, Class III, REINFORCED
HDPE PIPE	ASTM D3350/F714, and D2837 ASTM D1248, PE 3408 AWWA C-906-90 Minimum Series 160, IPS, with a working stress of 5000 KPa
DUCTILE IRON PIPE ASPHALTIC COATED	Min Pressure Class 350 to 300 mm Dia. Approved Pressure Class, larger than 300 mm Dia. ANSI / AWWA C150 A21.50
PVC PIPE	Class 100 DR 25 ASTM 1784 rubber gasket joints

Pipe classes shall be determined to withstand subsequent superimposed loadings.

Various factors affecting the pipe class shall be taken into account, and pipe class shall be evaluated as per standard engineering practice.

**2.4.3 INSULATION**

Gravity sanitary sewers may be insulated as follows, in accordance with a thermal analysis under normally expected operating conditions:

Density	35.2 kg/m <sup>3</sup> minimum ASTM D1622
Closed cell content	90% minimum ASTM D2856
Water absorption	4.0% by Volume ASTM D2842-69
Thermal conductivity	0.023 W/m @ 22 degrees Celsius ASTM C518
System Compressive strength	Modified ASTM D 1621 with 50 mil Jacket. Approximately 414 to 552 KPa, varies with pipe diameter.
Thickness	Minimum 50 mm

Insulated sanitary sewers shall have a jacket using high-density polyethylene carbon black, factory applied by continuous extrusion or approved tape-wrap method, specified as follows:

Tape Jacket Material	Polyethylene UV inhibited, formulated for superior cold weather properties (to -45°C)
Sealant	Butyl Rubber and resin
Tensile strength	21 MPa Minimum (ASTM D 1000) 8.93 kg/cm width
Thickness	1.14 mm minimum for extruded polyethylene or 2 cross raps for a total minimum thickness of 1.27 mm for the tape wrapped polyethylene application.

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A pipe shall be located at the centre of the insulation material. An allowable tolerance on this specification is as follows:

- Total diameter of insulation pipe structure shall in no instance be less than the pipe diameter plus 100 mm.
- The minimum thickness of insulation on any side of the pipe at any location shall be 50 mm.

Remove insulation from pipe where pipes connect to manholes. Any exposed pipe outside of the manhole shall then be reinsulated.

**2.4.4 MANHOLE MATERIAL**

Manholes shall be reinforced concrete, manufactured as follows:

- Bases shall either be precast reinforced concrete or poured in place.
- Barrels shall be 1200 mm diameter, precast according to ASTM C478.
- Tops shall be conical precast tops. Slab tops shall be constructed to ensure a minimum of 300 mm from the top of the slab to the bottom of asphalt or surface course gravel.
- Slab tops shall be used where the distance from the bottom of the rings to the MH base is less than 2.2m.
- Where depth of the manhole from the lowest invert to the top of the frame exceeds 6.0 metres, safety platforms shall be provided and installed at mid-depth according to the manufacturer's recommendations and as shown on the standard drawings in Section 4.
- Ladder rungs shall be galvanized or aluminium, precast into the barrels at maximum 400 mm spacing.
- Sanitary covers and frames shall be either Norwood Foundry or Dobney Foundry as shown on the standard drawings in Section 4. Where manholes are located in gravel, holes in the lid shall be plugged.
- Joints shall be o-ring rubber gasket.
- Cement mortar for pipe joints, manhole and catch basin construction shall be made of 1 part Portland cement, 1.5 parts clean, sharp sand, and clean water to provide workability.

Frost covers shall be manufactured in four sections according to the standard drawings in Section 4. Frost covers shall be installed in manholes less than 2.5m deep and low flow conditions and at the top end of the distribution system unless otherwise directed by the Engineer. Frost covers will be installed in all manholes where insulated pipe is used.

Concrete for Manholes and Appurtenances:

Cement	Type 50
Maximum Slump	75 mm
Class	25 MPa

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**2.4.5 SEWER MAIN INSTALLATION AND LOCATION**

Uninsulated mains shall be installed to provide a minimum depth of cover of 2.8m from the obvert of the main to the gutter line or lowest surface cross-section point, or as thermal analysis and design dictates.

Mains shall be installed to provide adequate sewer service connection depth at the property line.

Mains shall be located within the road right-of-way in accordance with the standard drawings in Section 4.

Crossings to be installed as per Standard Dwg. A2.3

Mains shall be located a minimum 1.5m from proposed curb or property line.

Pipe bedding shall be provided for all mains in accordance with the standard drawings in Section 4.

**2.4.6 MANHOLE INSTALLATION AND LOCATION**

Manholes shall be located at the end of each line and at all changes in pipe size, material, grade, and alignment.

The maximum distance between manholes shall not exceed 110m unless approved by the Engineer.

Inverts in manholes at changes in direction shall have at least 50 mm fall across manhole.

Manholes shall be installed in accordance with the standard drawings in Section 4. Floating manhole frame and cover shall be used in all roadways.

Trench walls shall be in accordance with the Yukon Occupational Health and Safety Regulations. Pipe zone widths shall be as shown on the standard drawings in Section 4.

**2.4.7 TRENCHING AND BACKFILLING**

Backfilling shall be carried out with selected native or imported material in 300 mm lifts to a minimum of 95% Standard Proctor Density. Backfill 1.0 m below the top of Subgrade shall be compacted to 98% Standard Proctor Density. Trenches that do not extend beneath the road surface, compact to 95% Standard Proctor Density.

Backfill around manholes shall be compacted with mechanical tampers to a minimum of 95% Standard Proctor Density at optimum moisture content in 300 mm lifts. The top metre of backfill shall be compacted to 98% Standard Proctor Density.

Sand bedding or other approved granular material in the pipe zone shall be compacted to a minimum of 95% Standard Proctor Density in maximum lifts of 150 mm.

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**2.4.8 INSPECTION AND TESTING**

Prior to acceptance, a video camera inspection shall be carried out for all sewer lines up to and including 750 mm in diameter. A manual visual inspection shall be carried out for sewer lines with diameters greater than 750 mm.

Sewer mains and manholes are subject to an infiltration and exfiltration test. The maximum allowable infiltration and exfiltration is 1.0 L/hour per 10 mm of pipe diameter /100m length of pipe.

Sewer mains shall be tested for alignment by means of a light test. The illuminated interior of the pipe shall not show any substantial misalignment or displacement. 75% of the full inside diameter must be visible from manhole to manhole.