

**CITY OF WHITEHORSE SERVICING STANDARDS MANUAL
PART 2 - CONSTRUCTION DESIGN CRITERIA
SECTION 2.5 – STORM DRAINAGE SYSTEM**

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SECTION 2.5 – STORM DRAINAGE SYSTEM

2.5.1 DESIGN FACTORS

Storm sewers are to be designed as a separate system and are to be of sufficient capacity to carry stormwater runoff. The following criteria is to be used in the design of the stormwater system.

The Rational Method of storm sewer:

$$Q = \frac{CIA}{360}$$

Where Q = the quantity of runoff in cubic meters per second

I = the intensity of rainfall in millimeters per hour

A = the contribution area in hectares

C = the runoff coefficient

The five-year rainfall intensity table for the City is to be used for minor storm sewers and a 100-year rainfall intensity table is to be used for major storm sewers and overall drainage systems. Duration time is to equal inlet time plus flow time.

The following runoff coefficients are to be used with a maximum inlet time of 15 minutes:

- | | |
|-------------------|------|
| • Open space | 0.15 |
| • Residential | 0.35 |
| • Industrial | 0.70 |
| • Commercial | 0.70 |
| • Multiple Family | 0.70 |
| • Pavement | 0.90 |

The minimum velocity is to be 1m/s. Where velocities in excess of 3m/s are attained, special provisions are to be made to protect against displacement by erosion or impact.

Pipe sizing is to be determined by using Manning's Formula. The Rational method is to be used for areas less than 10 hectares. A computer model is to be used in areas greater than 10 Ha. A maximum Manning's "n" of 0.013 for smooth walled storm pipe and "n" of 0.016 for concrete gutters and paved roads is to be used.

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2.5.2 GENERAL LOCATION REQUIREMENTS

TABLE 2.5.2.1 – CLEARANCE REQUIREMENTS

FEATURE	MIN. HORIZONTAL CLEARANCE
MANHOLE OR CATCH BASIN AND TRANSFORMER OR POWER MAIN	3.0m
CATCH BASIN LEAD AND WATER VALVE	3.0m
CATCH BASIN AND WATER SERVICE	2.0m

2.5.3 STORMWATER MAIN MATERIALS

**TABLE 2.5.2.1
STANDARDS FOR STORMWATER MAIN MATERIAL**

MATERIAL	STANDARD
Non-reinforced concrete pipe	ASTM C14, Class 3
Reinforced concrete pipe	ASTM C76 / D655
CSP <ul style="list-style-type: none"> • Galvanized; • Aluminized Type II; and • Polymer Coated 	CSA G401 ASTM A760 ASTM A760 ASTM A762
Ductile Iron	ASTM A716
HDPE	CGSB 41-GP-25M

Stormwater mains are to be a minimum of 300 mm in diameter.

Pipe classes are to be determined to withstand subsequent superimposed loadings.

Factors affecting the pipe class are to be taken into account, and the pipe class is to be evaluated as per standard engineering practice.

2.5.4 MANHOLES

Manholes are to be reinforced concrete, manufactured as follows:

- Bases are to either be precast reinforced concrete or poured in place.
- Barrels are to be min. 1200 mm diameter, precast according to ASTM C478.

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- Tops are to be conical precast tops. Slab tops are to 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 are to 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 meters, safety platforms are to be provided and installed at mid-depth according to the manufacturer's recommendations and as noted on the standard drawings in Section 4.
- Ladder rungs are to be galvanized steel, aluminum, or polypropylene plastic precast into the barrels at maximum 400 mm spacing.
- Where manholes are located in gravel, holes in the lid are to be plugged.
- Joints are to be o-ring rubber gasket.
- Cement mortar for pipe joints, manhole and catch basin construction is to be made of 1 part Portland cement, 1.5 parts clean, sharp sand, and clean water to provide workability.

Frost covers are to be manufactured in four sections according to the standard drawings in Section 4 and are to 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 27.5 MPa

Floating manhole frames are to be used in all paved roadways.

Weholite may be used for Storm Manholes.

2.5.5 CATCH BASINS

Catch basin barrels with precast base and precast slab top are to be:

- 600 mm ID pipe barrel conforming to ASTM C478;
- 900 mm ID pipe barrel conforming to ASTM C478; or
- 1,200 mm ID pipe barrel conforming to ASTM C478.

Weholite and Armtex CSP may be used for Catch basins providing they meet all requirements listed in this section.

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Catch basin manholes are to be used only at the beginning of the storm main, or in place of a catch basin when the lead exceeds 30 m.

For commercial or multifamily developments, with a stormwater system designed to connect to the City of Whitehorse storm drainage system, the connection is to occur at a storm manhole or to the storm main through a storm service line. Connection to a catch basin or catch basin manhole is not permitted.

Catch basin manhole frames, covers and grates are to be in accordance with the Standard Drawings included in Section 4 of this manual.

Typical profiles include:

- Top-inlet, standard round-top catch basins. Standard of acceptance:
 - Norwood Foundry F-39 (with grate installed at 90° to direction of traffic) ; or
 - Trojan Foundry TF-39.
- Top-inlet, standard round-top lane paving catch basin manhole. Standard of acceptance:
 - Norwood Foundry F-38 (with grate installed at 90° to direction of traffic); or
 - Trojan Foundry TF-38.
- Standard side inlet for 190 mm straight- face curb and gutter. Standard of acceptance:
 - Norwood F-36 or F-36A (with bicycle friendly grate); or
 - Trojan Foundry TF-36 BP or TF-36A BP.
- Standard side inlet for rolled curb and gutter. Standard of acceptance:
 - Norwood F-33 (with bicycle friendly grate);
 - Trojan Foundry TF-33.
- Standard for high capacity side inlet for rolled curb and gutter. Standard of acceptance:
 - Norwood Foundry SK-7 or DK-7; or
 - Trojan Foundry TK-7.

The minimum size of catch basin lead is to be 300 mm diameter.

The minimum grade on a catch basin lead is to be 1.0%.

The maximum length of a catch basin lead is to be 30 m.

If a lead of over 30 m in length is required, a catch basin manhole is to be installed at the end.

Catch basin leads are to be Concrete or Ductile Iron and are to conform to Section 2.5.3.1.

Power is not permitted cross catch basin leads.

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2.5.6 OUTFALL STRUCTURES

Concrete pipe is to be used for any outfall structure larger than 600 mm in diameter. For pipe diameters less than 600 mm, CSP will be allowed.

Precast outfall structures are to be protected from erosion by riprap or other suitable means. Riprap is to be sized and placed in accordance with the standard drawings in Section 4.

Where an outfall is placed in an existing watercourse, sluice gates are to be installed.

2.5.5 BIO-SWALES

In conditions where a bio swale is deemed necessary, the following are components to be considered in the design:

- Infiltration rate;
- Slope;
- Plant species; and
- Maintenance requirements.

2.5.7 STORMWATER MAIN INSTALLATION AND LOCATION

Mains are to be installed in accordance with manufacturer's recommendations and are to provide a minimum depth of cover of 1.2 m below final finished grade.

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

Mains are to be located a minimum of 3.0 m from proposed curb or property line unless approved by the Engineer.

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

2.5.8 MANHOLE, CATCH BASIN MANHOLE AND CATCH BASIN INSTALLATION AND LOCATION

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

The maximum distance between manholes is not to exceed 125 m unless approved by the Engineer.

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

Manholes are to be installed in accordance with the standard drawings in Section 4.

Floating manhole frames and covers are to be used in all roadways.

Where possible, catch basin manholes and catch basins are not to be located in bike lanes.

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Where catch basins or catch basin manholes pose potential thermal impacts on surrounding water-mains, rigid insulation is required. Insulation installation is to be engineered and specified in a detail included in the Engineering Drawing Set for the project.

Trench walls are to be in accordance with the Yukon Occupational Health and Safety Regulations. Pipe zone widths are to be as shown on the Standard Details in Section 4 of this manual.

Where the inlet of a pipe is 1 m or greater above the outlet, use a drop structure in accordance with Standard Detail in Section 4 of this manual.

Stormwater runoff is not to be required to flow a distance greater than:

- 150m along roadway gutters without reaching a catch basin or other inlet to the minor storm drainage system.
- 180m along the surface of lanes and walkways to a point of interception.

The depth of ponding at roadway sag locations and depressions is not to exceed 150mm and should not reach the rim elevation of any sanitary manhole. Inlet capacity provisions must consider the entire contributing area that may drain to the design location.

2.5.9 TRENCHING AND BACKFILLING

Backfilling is to 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 is to 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 is to be compacted with mechanical tampers to a minimum of 95% Standard Proctor Density at optimum moisture content in 300 mm lifts. The top meter of backfill is to be compacted to 98% Standard Proctor Density.

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

2.5.10 INSPECTION AND TESTING

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

Stormwater 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.

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