
Trunk Connection Guidelines

2019



**ARROW
UTILITIES**

1.0 GENERAL

1.1 Definitions

In this document, unless the context otherwise indicates, the following definitions shall apply:

- .1 “ARROW” refers to the ARROW Utilities, formerly operating as the Alberta Capital Region Wastewater Commission.
- .2 “Change Authorization” means a written communication issued by the ARROW authorizing a departure from these Guidelines.
- .3 “Applicant” refers to municipalities or their representatives who submit the connection request to the ARROW.
- .4 “Connection Manhole” refers to the new or existing manhole located on the Regional Wastewater Trunk System where the Trunk Connection will be made.
- .5 “Connection Upstream Manhole” refers to the new manhole located on the applicant’s Sub-Trunk and connected directly to the Connection Manhole.
- .6 “Contractor” means the person, firm, or corporation which undertakes the installation of the Trunk Connection.
- .7 “Design” means the designs, reports, studies, engineering drawings, technical specifications, and associated documents, including the execution and implementation of such, pertaining to the Trunk Connection.
- .8 “Designer” or “Consultant” means the professional engineer responsible for the Design of the Trunk Connection.
- .9 “Guidelines” refers to the standards, design criteria, material specifications, construction specifications, and typical detail drawings provided in this document.
- .10 “Municipality” refers to the ARROW member municipalities and/or EPCOR, who owns the sewer system of the City of Edmonton, for which the Trunk Connection will provide wastewater servicing.
- .11 “Prime Contractor” is as defined by the Occupational Health and Safety Act – Alberta.
- .12 “Regional Wastewater Trunk System” includes all gravity trunk sewers, manholes, and related infrastructure which comprises the regional wastewater trunk system owned and operated by the ARROW.
- .13 “Sub-Trunk” refers to the primary sanitary sewer main collecting wastewater from the subject service area, which will be connected to the Regional Wastewater Trunk System at the Trunk Connection. The Sub-Trunk may be a gravity sewer main or a pressurized forcemain.
- .14 “Trunk Connection” refers to the proposed connection of the Sub-Trunk to the ARROW’s Regional Wastewater Trunk System.

1.2 Objective

- .1 The objective of these Guidelines is to provide a clear guiding framework for the design and construction of sanitary sewer connections to the ARROW’s Regional Wastewater Trunk System.

1.3 Use of These Guidelines

- .1 These Guidelines represent the *minimum* requirements of the ARROW. More stringent planning, design, and/or construction criteria should be applied by the Municipality as appropriate.
- .2 The Municipality is responsible for ensuring that the connections are designed and constructed in accordance with these Guidelines.
- .3 These Guidelines are not intended as comprehensive specifications to facilitate construction. The ARROW understands the need for these Guidelines to be flexible to allow for various different connection configurations. The ARROW accepts no responsibility for the completeness or adequacy of the suggested specifications or details presented herein.
- .4 The ARROW's acceptance of the Design covers only compliance of the Design with respect to these Guidelines and is not a warranty of the Design.
- .5 Notwithstanding the requirements of these Guidelines, the Municipality and Consultant shall remain fully responsible for the Design.

1.4 Interpretation

- .1 The ARROW reserves the right to final decision regarding the interpretation of the intent of these Guidelines.
- .2 Where two or more applicable standards govern the Design, the more restrictive shall apply.
- .3 Wherever other standards are referred to in these Guidelines, the current edition of such standards shall apply.

1.5 Revisions to these Guidelines

- .1 The ARROW reserves the right to alter, revise, or update these Guidelines from time to time based on new or improved knowledge or innovations.
- .2 Any revisions to these Guidelines will be established following reasonable notice to member municipalities.

1.6 Alternatives

- .1 Where a departure from these Guidelines might achieve a better design with regard to infrastructure quality, safety and environmental considerations, functionality, operation and maintenance requirements, or life cycle costs, the Municipality is encouraged to present a change proposal to the ARROW.
- .2 The ARROW will review such change proposals on a case-by-case basis.
- .3 The proposal shall include sufficient detail regarding the proposed method or material to be used in the Design, including justification with respect to the impact on infrastructure quality, safety and environmental considerations, functionality, operation and maintenance requirements, and life cycle costs. The ARROW may request additional information as required to make an informed decision regarding the proposed Design.
- .4 No departure from these Guidelines shall be permitted except with written authorization of the ARROW. A Change Authorization shall be issued recording any such revision. A Change Authorization is only valid for the Trunk Connection under consideration.
- .5 Notwithstanding review and acceptance of any such proposal by the ARROW, the Municipality and Consultant shall remain fully responsible for the Design.

1.7 Requirements by Other Authorities

- .1 It is the responsibility of the Municipality and Consultant to ensure the Design conforms to all applicable statutes, laws, bylaws, regulations, ordinances, orders, directives, permits, licenses and requirements of governmental or other public authorities having jurisdiction, and all amendments thereto.

Without limiting the Municipality and Consultant's responsibility in this regard, the Municipality and Consultant shall:

- a) Obtain all permits required for the work and abide by the stipulations of the permits.
- b) Abide by all regulations of Alberta Environment with respect to public health and sewerage systems.
- c) Abide by the by-laws and regulations of the Province and/or the Municipality in which the work is located, and abide by the laws and regulations with regard to stream crossings and public safety.
- d) Abide by regulations of the Board of Transport Commissions and the National Energy Board and all pipeline agencies having jurisdiction with regard to highway, railway, and pipeline crossings.
- e) Abide by regulations of the Occupational Health and Safety Act of Alberta Labour.

1.8 Trunk Connection Request - Submission Requirements

- .1 A Trunk Connection request shall be submitted through the Municipality to the ARROW for approval. The submission shall be addressed to the General Manager of the ARROW.
- .2 Submissions are required for new connections only. They are not required for new collection systems constructed upstream of a previously approved connection.
- .3 Design Brief

Submit one (1) electronic copy of a design brief detailing the methodology used in the design of the proposed Trunk Connection. The design brief should clearly demonstrate conformance of the Design with these Guidelines. The report shall be signed and sealed by a professional engineer, licensed to practice in the Province of Alberta. The information provided in the design brief shall include, but may not necessarily be limited to, the following, as applicable to the Design:

- a) Service area
- b) Type of development
- c) Population calculations
- d) Average and peak flow calculations
- e) Inflow/infiltration calculations
- f) Pipe design calculations
- g) Backflow protection if there is potential for basement flooding
- h) Description of any special materials or methods required for construction
- i) Description of quality control testing and inspection to be instituted during and following construction
- j) Materials and construction specifications

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- k) Anticipated construction schedule
- .4 Service Area Overall Plan
- a) Provide one (1) electronic copy of an overall plan of the service area showing the Sub-Trunk system upstream of the Trunk Connection.
 - b) The plan must clearly illustrate the alignment, diameter, grade, and direction of flow of all sewer mains comprising the Sub-Trunk. The plan must also identify, delineate, and indicate the area of each local drainage basins contributing drainage to the Sub-Trunk.
 - c) Drawings shall be drawn using metric units and shall be signed and sealed by a Professional Engineer registered in the Province of Alberta.
- .5 Trunk Connection Detailed Design Drawings
- a) Provide one (1) electronic copy of detailed design drawings of the Trunk Connection which clearly demonstrate conformance with these Guidelines.
- .6 As it is not the ARROW's function to restrict or direct regional growth, wastewater servicing must be provided to member municipalities as required in accordance with the criteria defined in the ARROW's Level of Service Policy. The following items are subject to specific ARROW approval:
- a) The size of the Trunk Connection in relation to service area.
 - b) The allowable design flow, which must be lower than the Level of Service limit.
 - c) The design infiltration standard and testing.
 - d) The provisions for metering of direct connections.
 - e) Where use of an existing ARROW easement has been approved by the ARROW, the plans and specifications for work carried out within the easement.

All other information required as part of the Trunk Connection request submission is not subject to specific approval but must be provided to assist in planning, operation, maintenance and protection of the ARROW's overall regional wastewater collection and treatment system.

1.9 Trunk Connection Request – Review and Approval

- .1 The ARROW will initiate review the Trunk Connection request within twenty working days of submission. Incomplete or incorrect submissions may delay the review and approval process.
- .2 If the ARROW determines that the Design meets these guidelines, the application will be approved by the General Manager.
- .3 If relaxations of these Guidelines are required, the application will be presented to the ARROW Board of Directors for review and approval.
- .4 Final approval of the Trunk Connection rests solely with the ARROW.

1.10 Post-Approval Requirements

- .1 The Municipality making the Trunk Connection is responsible for all construction costs.
- .2 The Municipality is responsible for obtaining and paying for all necessary temporary and permanent easements from landowners to construct the Trunk Connection within the ARROW easement.

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- .3 The applicant or its connection contractor is responsible for getting a permit from ARROW control room before commencing connection works
 - .4 The applicant or its connection contractor is responsible for informing the ARROW 72 hours in advance to conduct construction inspection on site and providing quality control and testing document for ARROW's review. The connection cannot be buried or backfilled before the inspection. The ARROW's inspector will issue an acceptance letter to the contractor if the connection work meets our requirement.
 - .5 Following the acceptance of the construction of the Trunk Connection, the Municipality will continue to own the section of the connection outside of the ARROW's right of way and be responsible for its maintenance; while the ARROW will own the section of the connection within the right of way and be responsible for its maintenance.
 - .6 During the connection process, the party requesting the connection will provide a plug or other form of isolation to the ARROW system until such time it is verified that either water consumption account data is available or the wastewater flow monitoring device is installed.
 - .7 Within one month of completion, provide the ARROW with the following information for the Trunk Connection:
 - a) Construction photographs
 - b) Report acknowledging that all required testing has been successfully completed
 - c) Closed-circuit television inspection report
 - d) Leakage test and QA/QC results
 - .8 Plan of Record Drawings
 - a) Within six months of completion, plan of record drawings of the Trunk Connection shall be submitted to the General Manager of the ARROW.
 - b) Submit electronic files of recording drawings, one in AutoCAD format and one in PDF format.
 - c) Drawings shall be drawn using metric units and shall be signed and sealed by a Professional Engineer registered in the Province of Alberta.

2.0 DESIGN GUIDELINES

2.1 General

- .1 The Sub-Trunk tying into the Regional Wastewater Trunk System shall conform to the design standards of the Municipality.
- .2 Connections to the Regional Wastewater Trunk System shall be by Sub-Trunk only. The Regional Wastewater Trunk System is dedicated to regional servicing of the ARROW's member municipalities, and will not be incorporated as part of local servicing networks. Individual property connections are not permitted.
- .3 The Trunk Connection must flow by gravity and tie in to the Regional Wastewater Trunk System at a Connection Manhole from the Connection Upstream Manhole. No direct connections are permitted. A typical Trunk Connection is shown in **Figure 1** in **Section 5.0** of these Guidelines.
- .4 If the Sub-Trunk consists of a pressurized forcemain, the pipe must first discharge into a Connection Upstream Manhole and then a gravity connection provided to the Connection Manhole. H₂S and Odour control measures shall be included in the design to minimize the H₂S and odour release at the discharge manhole.

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- .5 The Connection Upstream Manhole shall have no significant changes in direction and the Trunk Connection shall have no significant changes in slope, compared to the incoming Sub-Trunk.
 - .6 The Connection Upstream Manhole shall not be a drop manhole.
 - .7 Only separated sanitary collector system connections will be accepted by the ARROW. Connections of non-separated sewer systems, which include direct conveyance of surface runoff and/or subsurface drainage, are not permitted. Examples of non-separated systems include sewers which convey roof, road, or other surface runoff, and weeping tile or other subsurface drainage.
 - .8 The Municipality may not direct residential sump pump discharge to the Sub-Trunk without prior approval of the ARROW. Approval shall be contingent on the Municipality being able to clearly demonstrate the need for such a system configuration.

2.2 Design Criteria

- .1 Service Area
 - a) The Trunk Connection and Sub-Trunk shall be designed to maximize the service area.
 - b) At a minimum, the service area shall be at least 16 hectares.
- .2 Pipe Size
 - a) The minimum pipe size for the Trunk Connection shall be 250 mm diameter.
- .3 Depth
 - a) The Trunk Connection pipe shall be installed at a depth sufficient to ensure the pipe is below the anticipated seasonal frost penetration depth.
 - b) The depth of installation of the Trunk Connection shall not exceed 6 m at the Connection Manhole.
 - c) If the manhole invert at the location where the connection is to be made is deeper than 6 m, an internal drop pipe shall be used or a new manhole with internal drop pipe shall be constructed over the Regional Wastewater Trunk System pipe. See Figure 2 for the connection manhole with internal drop pipe.
- .4 Flow Monitoring
 - a) All connections will require the installation of a flow monitor as close to the connection as possible.
 - b) The monitoring manhole will shall be designed and constructed to be a Parshall Flume manhole at the Applicant's cost.
 - c) The ARROW will provide the supply and install the flow monitoring devices at our cost.
 - d) If the Sub-Trunk consists of a pressurized forcemain, the flow monitoring system, if required, may consist of a metering station located at the lift station.
 - e) The ARROW will consider alternatives proposed by the Applicant to suit the limitations of a particular connection.

3.0 MATERIAL SPECIFICATIONS

3.1 General

- .1 Only new materials shall be used in the construction of the Trunk Connection.

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- .2 Any materials which are defective in manufacture or which are damaged prior to installation shall be rejected.
 - .3 Where specific materials are specified in these Guidelines, the ARROW shall consider applications for substitute products which can be considered comparable in terms of these Guidelines. Written acceptance of such must be obtained from the ARROW before any substitution can be made.

3.2 Gravity Sewer Mains

Gravity sewer mains shall be polyvinyl chloride (PVC), high density polyethylene (HDPE), fiberglass reinforced pipe (FRP), concrete pipe, or other material pipes approved by ARROW.

- .1 PVC Pipe and Fittings
 - a) PVC pipe shall be acceptable for 250 mm to 900 mm diameter sewer mains.
 - b) PVC pipe and fittings shall meet CAN/CSA-B182.2 and ASTM-D3034 with locked-in elastomeric ring gasket and integral bell system joint type. All PVC pipe shall be tested by the manufacturer and marked in accordance with CAN/CSA-B182.2.
 - c) Minimum pipe dimension ratio shall be DR35. Strength design, considering trench and road loading, shall be integral to pipe design process.
 - d) Pipe shall be installed within two years from the production date indicated on the certification.
 - e) Joint lubricants shall be compatible with gasket material.
- .2 HDPE Pipe and Fittings
 - a) HDPE pipe shall be acceptable for 250 mm to 900 mm diameter sewer mains
 - b) HDPE pipe and fittings shall be manufactured to meet the requirements of ASTM F714.
 - c) Fusing of pipe joints shall meet the requirements of ASTM D2657 and performed as per ASTM D3261. Installation practices shall follow the standard practices as set forth in ASTM F585.
 - d) All pipe and fittings shall be manufactured from a resin certified to PE 4710 material. The minimum hydrostatic design basis at 23 °C shall be 11 MPa (1600 psi) as determined in accordance with ASTM D2837.
 - e) Minimum pipe dimension ration shall be DR32.5. The wall thickness shall be sufficient to support the worst combination of internal and external installation and operating loads. The wall thickness tolerance shall be within plus 10%.
- .3 Reinforced Circular Concrete Pipe and Fittings
 - a) Reinforced concrete pipe shall be acceptable for sewer mains with a diameter of 250 mm and up.
 - b) Pipe and fittings shall meet CAN/CSA-257.2 and ASTM-C76, concentric reinforcing, designed for flexible rubber gasket joints to CAN/CSA-257.3, and constructed with Type 50 sulphate resistant Portland cement to CAN/CSA-A3000.
 - c) Strength design, considering trench and road loading, shall be integral to pipe design process. D-load shall be as determined by load analysis.

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- d) Lined Pipe and Fittings
 - i) Reinforced concrete gravity sewer mains and fittings greater than 750 mm in diameter must be lined with a suitable liner, non-susceptible to surface damage from H₂S and suitable for use in sanitary sewers.
 - ii) Liner shall be PVC or HDPE and shall be cast into the interior pipe wall.
 - iii) Liner shall be free of cracks, cleavages, or other defects adversely affecting the protective characteristics of the material.
 - iv) The lining shall be repairable at any time during the life of the pipe or the structure.
 - v) In accordance with ASTM-D412, the minimum tensile strength across welded joints shall be 14 MPa.
 - vi) Pipe liner thickness and anchor spacing shall be designed for the full hydrostatic pressure, with a minimum design life of 50 years.
 - vii) Liner shall be T-Lock, as manufactured by Ameron Protective Lining Products for PVC liner, or Sure-Grip, as manufactured by Agru America for HDPE liner, or accepted alternate.
 - viii) Alternate pipe liner materials, non-susceptible to surface damage from H₂S, may be proposed and will be reviewed by the ARROW.

.4 Fiberglass Reinforced Polymer (FRP) pipe

- a) FRP Pipe shall be acceptable for sewer mains with a diameter of 250 mm and up.
- b) FRP pipe shall be manufactured from fiberglass reinforcing materials, polyester resin and pure silica sand. The pipe shall conform to ASTM D3262
- c) Pipe shall have a minimum long-term stiffness of 317 kPa (46 psi) when tested in accordance with ASTM D2412.
- d) Joints shall meet the requirements of ASTM D4161. Gaskets shall meet the requirements of ASTM F477.

3.3 Manholes

- .1 Manholes shall be minimum 1,200 mm in diameter.
- .2 Manhole materials shall be reinforced concrete, constructed of Type 50 sulphate resistant cement.
- .3 Precast manhole sections, adjusting neck rings, and steps shall conform to CAN/CSA-A257.4 and ASTM-C478. Use precast eccentric conical top sections, in accordance with ASTM-C478, where depth to top of the pipe is greater than 2.0 m; otherwise use precast flat top sections.
- .4 Wherever possible, pre-benched standard manhole bases shall be used and shall include pre-cored connections with watertight joints, Duraseal, or accepted alternate.
- .5 Manhole joints shall meet the requirements of CAN/CSA-257.3 and ASTM-C443. All joints to be sealed with a suitable non-shrink grout.

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- .6 Manhole steps shall be standard safety type, forged of 6061-T6 polyethylene coated aluminum alloy with a minimum tensile strength of 260 MPa or approved alternate.
- .7 Frames and Covers
- a) Manhole frames and covers shall be constructed of iron conforming to ASTM-A48.
 - b) Frames for manholes on paved surfaces shall be Norwood NF-90 floating type with rubber gasket seal and vent holes, as manufactured by Norwood Foundry Ltd., or accepted alternate.
 - c) Frames for manholes not on paved surfaces shall be Norwood NF-39 with vent holes, as manufactured by Norwood Foundry Ltd., or accepted alternate.
- .8 Exterior Damp-Proofing
- a) Exterior damp-proofing is required for all manholes.
 - b) Exterior damp-proofing to consist of either a 15 mm thick coating of cement mortar, two coats of bituminous compound sealant, or two coats of Vandex Super waterproof coating, or approved equivalent.
 - c) Mortar to conform to CSA-A179, Type 50 sulphate resistant cement.
 - d) Bituminous compound sealant to conform to CGSB-37-GP-9MA.
 - e) Exterior manhole joints shall be sealed with 228 mm wide, 1 mm thick elastomeric film wrap – Rubr Nek RU116. Joint wrap shall be applied on top of dried waterproof coating.
- .9 Corrosion Resistant/Proof Manholes
- a) The ARROW requires the installation of either corrosion resistant or corrosion proof manholes which are non-susceptible to surface damage from H₂S
 - b) Corrosion resistant manholes are constructed of concrete with a suitable liner/coating, such as polyvinyl chloride (PVC), high-density polyethylene (HDPE), or an approved epoxy liner such as Epoxy NPR 5304 or Raven 405 with a minimum 2 mm thickness, cast into the interior pipe wall. Corrosion proof manholes are constructed of PVC, HDPE or FRP.
 - c) Where corrosion resistant or corrosion proof manholes are requested by the ARROW or proposed by the Design, provide the ARROW with the manufacturer's specifications for review and acceptance.
- .10 Non-shrink grout to be pre-mixed compound consisting of non-ferrous aggregate, cement, water reducing and plasticizing agents, capable of developing a minimum compressive strength of 16.5 MPa at 2 days and 48 MPa at 28 days. Master Builders Embeco, or approved alternate.
- .11 All miscellaneous metal used inside manholes, or buried as part of manholes, shall be Type 304 L stainless steel. All inserts and insert bolts shall be stainless steel.
- .12 Marker posts shall be constructed of 75 mm diameter steel pipe and painted fluorescent red.
- .13 For manholes exceeding 7 m in depth, the ARROW may stipulate additional requirements for manholes.
- .14 The ARROW may require safety platforms and/or lockable covers be provided where safety or security risks may be a concern.

3.4 Bedding and Backfill

.1 Class A Bedding

Concrete, complying with the following:

- a) Concrete shall be made with Type 50 sulphate resistant Portland cement to CAN/CSA-A3000.
- b) Maximum slump 75 mm, compressive strength of 25 MPa at 28 days.
- c) In freezing weather, provide concrete with a temperature of not less than 10°C, and maintain this temperature for 72 hours.

.2 Class B Bedding

- a) Sand, complying with the following gradation:

Sieve Size	Percent Passing
9.5 mm	100
4.75 mm	90 - 100
150 µm	20 max.

.3 Gravel

- a) Pit-run gravel shall comply with the following gradation:

Sieve Size	Percent Passing
75 mm	100
4.75 mm	80 maximum
0.5 mm	60 maximum
75 µm	10 maximum

- b) Gravel for stabilization of trench bottoms

- i) Well graded sandy gravel - 75 mm maximum size complying with the following gradation:

Sieve Size	Percent Passing
75 mm	90 - 100
4.75 mm	20 - 50
0.5 mm	5 - 25
75 µm	0 - 5

- ii) Washed rock - 75 mm maximum size with maximum 5% passing the 4.75 mm sieve.

.4 Native Fill

- a) Native fill is material excavated from trench excavation and approved by the Consultant for use as fill. Native fill material shall be free of stones larger than 200 mm, organic material, and other deleterious material.

.5 Fillcrete

- a) Portland Cement to CAN/CSA-A3000.
- b) Fillcrete mix design shall conform to the following table:

Compressive Strength at 28 Days (MPa)	Slump (mm)	Entrained Air (% by volume)	Maximum Aggregate Size (mm)	Minimum Cement (kg/m ³)
Minimum 0.15	100 ±25	Minimum 6.0	5	30
Maximum 0.40		Maximum 8.0		

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- c) To be produced in accordance with CAN/CSA -A23.1-C18.

4.0 CONSTRUCTION

4.1 General

- .1 The following articles present the minimum requirements for some key, typical construction procedures for construction of the Trunk Connection. These minimum requirements must be met or exceeded by the detailed construction specifications and drawings developed by the Consultant for the Trunk Connection
- .2 It is the responsibility of the Municipality to ensure any damage to the ARROW's infrastructure caused by the construction of the Trunk Connection is repaired to the satisfaction of the ARROW.
- .3 In addition to regular supervision carried out by the Municipality and Consultant, the ARROW may periodically inspect construction of the Trunk Connection. Should the ARROW note any method or material being employed that is contrary to the accepted Design, the ARROW shall bring such to the attention of the Municipality. If remedial action is not taken to the satisfaction of the ARROW, the ARROW will notify the Municipality to issue a stop work order.
- .4 It shall be the responsibility of the Municipality and Consultant to ensure that the Contractor successfully completes all necessary testing.
- .5 Where the work of the Contractor fails to meet the specifications of the accepted Design, the Municipality and Consultant shall be responsible to ensure such work is rectified and retested accordingly.

4.2 Protection of Work, Property and Life

- .1 The Contractor shall maintain continuous and adequate protection of the work from damage and shall protect the ARROW's property and adjacent property from damage caused during construction. The Contractor shall make good any damage to the work, the ARROW's property, or adjacent property caused during construction.
- .2 The Contractor shall provide, erect, and maintain all protection devices as may be necessary for the preservation of public health and safety.

4.3 Occupational Health and Safety

- .1 The Contractor shall comply with the provisions of the Occupational Health and Safety Act – Alberta.
- .2 The Contractor shall be assigned the role of Prime Contractor pursuant to the Occupational Health and Safety Act and is responsible for ensuring compliance with all applicable laws relating to safety by all employees, subcontractors, suppliers, other workers, and visitors on the work site.

4.4 Quality Assurance

- .1 The Consultant must maintain detailed records of all inspections and testing conducted over the course of construction. These records shall be provided to the ARROW upon request.

4.5 Quality Control Testing

- .1 The Municipality shall retain the services of independent testing laboratories or agencies to conduct all quality control testing.

.2 Minimum quality control test frequencies, specified as follows, are the minimum number required for the Trunk Connection.

- a) Field densities (ASTM-D2167 or ASTM-D2922):
 - i) Pipe Bedding - one for each 25 m of pipe installed.
 - ii) Pipe Zone Backfill - one for each 25 m of pipe installed.
 - iii) Trench Backfill - one for every 100 m of trench of 1.0 m fill depth.
- b) Moisture density curves (ASTM-D698):
 - i) Pipe Bedding - one for each 25 m of pipe installed.
 - ii) Pipe Zone Backfill - one for each 25 m of pipe installed.
 - iii) Trench Backfill - one for every 100 m of trench of 1.0 m fill depth.
- c) Sieve analyses (ASTM-C136):
 - i) Pipe Bedding - one for each 25 m of pipe installed.
 - ii) Pipe Zone Backfill - one for each 25 m of pipe installed.
 - iii) Trench Backfill - one for every 100 m of trench of 1.0 m fill depth.

4.6 Site Preparation

- .1 Maintain slopes and adequate drainage during grading.
- .2 Do not allow mixing of different fill materials.
- .3 Locate, mark, and protect all utilities and appurtenances (i.e. manholes, catch basins, valves, and hydrants).
- .4 Prior to stripping of topsoil, the Contractor shall have an approved Clubroot Management Plan in place.

4.7 Clearing

- .1 Cut, dig, remove, and dispose of all timber, brush, windfall, stumps, and rubbish except such trees and shrubs that are designated for preservation.
- .2 Preserve such designated trees and shrubs from scarring, barking, or other injury during construction operations.
- .3 Leave ground surface in a condition suitable for stripping of topsoil.

4.8 Grubbing

- .1 Excavate, remove and dispose of all roots, stumps, submerged logs, corduroy and similar objectionable matter to a minimum depth of 0.3 m.
- .2 Fill holes and level areas disturbed by grubbing. Leave ground surface in a condition suitable for stripping of topsoil.

4.9 Topsoil Stripping and Stockpiling

- .1 Strip all areas to be excavated for structures, pipes, or roadways.
- .2 Strip the full depth of topsoil or organic material.
- .3 Frozen topsoil may be stripped by ripping provided a minimum of 2 passes are made, the first of which shall not exceed 50% of the topsoil depth.

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- .4 Stockpile and windrow topsoil temporarily and dispose of stripped material that is unsuitable for replacement. Stockpile in a manner that will not endanger persons, the work, or adjacent property.
 - .5 Ensure stockpiles of topsoil, common excavation, and borrow materials are sufficiently separated. Maintain a minimum of 1.0 m separation between topsoil and common excavation material when stockpiling.
 - .6 If the topsoil and subsoil are mixed and the topsoil is adversely affected, engage a soils specialist to determine the necessary remedial work and complete the required remedial work.
 - .7 Stripping and stockpiling shall be completed in accordance with the requirements of the approved Clubroot Management Plan, where applicable.
 - .8 Protect completed portions of the work from damage. Repair damaged areas as required.

4.10 Trench Excavation

- .1 Any recommendations of the geotechnical/hydrogeological report regarding trenching methods shall be duly incorporated into the construction specifications and drawings and observed by the Contractor.
- .2 Where required, temporary protective structures, bracing, shoring, shafts, and sheeting shall be designed by a Professional Engineer registered in Alberta.
- .3 Observe safety regulations of the Occupational Health and Safety Act with regard to protection of the work, property, and structures adjacent to the Work and maintenance of the trench widths.
- .4 Existing pipelines shall be exposed by hand digging or hydro-excavating. Hydro-excavating is the preferred method of confirming the location of existing buried utilities.
- .5 Interfering Services
 - a) Provide for the uninterrupted flow of all watercourses, sewers, and drains encountered during the work.
 - b) Support existing water mains, sewer mains, gas lines, and other pipes to protect them from damage.
 - c) Provide for the protection and uninterrupted service of all power transmission lines, telephone lines, cable lines, data lines, and fibre optic lines.

4.11 Alignment and Grade

- .1 Lay pipe to the required alignment and grade, with manholes and all other appurtenances at the locations identified on the drawings.
- .2 Provide minimum 2.60 m depth of cover on sewer mains, unless otherwise prescribed by the geotechnical report. Where depth of cover is less than the minimum required to avoid installation within the frost zone, provide insulation.
- .3 Acceptable tolerances are as follows:
 - a) Alignment – the centreline of the pipe shall not be more than 100 mm off the specified alignment.
 - b) Elevation – the pipe invert shall not be more than 6 mm plus 0.01 mm per mm diameter of the pipe off the specified elevation.

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- c) Joints – for concrete pipe, deflections at joints shall not exceed that specified by CAN/CSA-A257. For PVC or FRP pipe, deflections at joints shall not exceed those recommended by the manufacturer.

.4 All pipe shall be laid sloping in the desired direction with no reversed grades on any pipe lengths.

.5 Maintain grade sheets for the installation of the pipe.

4.12 Pipe Bedding and Pipe Zone Backfill

.1 Class B bedding shall be used for all areas with suitable soil conditions. Where unstable soil conditions exist, Class A bedding or better shall be used.

.2 For Class A Bedding:

- a) Place a cradle of concrete bedding under the pipe and the full width of the trench.
- b) Place sand above the concrete and compact to minimum 95% of Standard Proctor Density to 300 mm above the top of the pipe.

.3 For Class B Bedding:

- a) Place sand bedding under the pipe and the full width of the trench and compact to minimum 95% of Standard Proctor Density.
- b) Place selected native soil or sand above the bedding and compact to minimum 95% of Standard Proctor Density to 300 mm above the top of the pipe.

.4 Provide bell or coupling holes as required and support the pipe uniformly and continuously throughout its length.

.5 Backfill in the pipe zone shall be sand complying with the gradation specified in **Article 3.4.2a).**

.6 Granular bedding and pipe zone backfill shall be placed and compacted in uniform lifts not exceeding 150 mm in depth.

4.13 Pipe Installation

.1 General

- a) Follow manufacturer's instructions for pipe installation. Installation of PVC pipe and fittings shall be in accordance with CAN/CSA-182.11.
- b) Do not allow contents of existing sewers or sewer connections to flow into the trench.
- c) Do not use heavy vibratory equipment for compaction of backfill until at least 1 m of backfill has been placed over the pipe.
- d) When pipelaying is complete, the pipe must be thoroughly cleaned of all dirt, stones, rubbish, and debris.
- e) Do not install PVC pipe and fittings in areas that are, or may be, contaminated with organic solvents, petroleum products, or other materials which may negatively affect the structural integrity of the PVC product.

.2 Laying Pipe

- a) Lay pipe with the bells upgrade, and proceed upgrade.
- b) Produce a smooth, uniform invert.

.3 Joining Pipe

- a) Join pipe in accordance with the manufacturer's recommendations.
- b) Clean and check the sealing surfaces to ensure that they are smooth, concentric, and free from imperfections that might affect the sealing performance of the gasket.
- c) Lubricate sliding surfaces and couple the pipes immediately.

.4 Connecting to the Regional Wastewater Trunk System

- a) Notify the ARROW in writing at least ten (10) working days prior to connecting to the Regional Wastewater Trunk System. Include a work plan identifying necessary flow control and a contingency plan detailing the procedures to be observed in the event of problems during the connection process or other emergency. Written acceptance must be received from the ARROW at least 48 hours before conducting the connection.
- b) In the event that the ARROW must initiate flow controls on the Regional Wastewater Trunk System to accommodate the tie in, the ARROW may prescribe a specific work schedule, additional work procedures, and contingency measures for the tie in.

.5 Manhole Break-Ins

- a) Break-in holes shall be made by coring through the manhole wall or by carefully chiseling the hole. Blunt tools, including sledgehammers, shall not be used to put holes in manholes.
- b) Break-in holes shall not exceed a reasonable size to permit the smooth movement of the new pipe into the manhole.
- c) All due care shall be taken to avoid damage to surrounding areas of the manhole. Any areas of the manhole that have been damaged during the break-in shall be repaired.
- d) Following installation of the new pipe, the break-in area shall be suitably repaired and grouted, providing a watertight seal around the pipe. Exterior waterproofing and joint wrapping, and interior coating, shall be satisfactorily repaired, if applicable.
- e) The flow channel in the manhole shall be modified to provide a smooth continuation of flow from the break-in pipe through the manhole.

4.14 Setting Manholes

.1 General

- a) Bases shall be placed on solid, unfrozen ground.
- b) Construct manhole unit plumb and true to alignment and grade.
- c) Cover all interior and exterior joints with suitable non-shrink grout.
- d) Plug all lifting holes with non-shrink grout.

.2 Manhole Benching

- a) Build pipes and stubs into manholes and form smooth flow channels, or use pre-benched manhole base sections.
- b) Benching shall provide smooth inverts on regular curves through the manhole.

.3 Manhole Completion

- a) Backfill around the manhole with sand, as specified in **Article 3.4.2a)**, or fillcrete. Sand backfill shall be placed and compacted to minimum 98% Standard Proctor Density in uniform lifts not exceeding 150 mm in depth.
- b) Wherever possible, set the conical tops such that the vertical side is on the right hand side of the manhole, when looking upstream.
- c) Ensure manhole steps are aligned.
- d) Place frame and cover on top section to the required elevation and adjust tops flush with finished grades. If adjustment is required, use concrete grade rings, placed with non-shrink cement mortar. Parge, make smooth and watertight.
- e) Install a marker post for manholes not located on roadways.

4.15 Trench Backfill

.1 Trench backfill is defined as backfill above the pipe zone.

.2 Place backfill in a dry trench.

.3 Backfill as close as possible to pipe laying operations so that trenches are left open no longer than absolutely necessary.

.4 Protect all open excavations when construction is not ongoing with fencing, barricades, flashing lights, etc., and provide watchmen for site security and public safety if required.

.5 Plan the backfilling operation so that exposure of the backfill material to frost is kept to a minimum.

.6 Do not use large frozen chunks of soil as backfill.

.7 Classes of Trench Backfill

a) Class I (Arterials and Collector Roads)

- i) Place pit-run gravel or sand in uniform 150 mm lifts over the whole width of the trench, each lift compacted to minimum 95% of Standard Proctor Density.
- ii) Remove all surplus excavated material.
- iii) Bring the compacted granular material up to the original grade and restore the surface to original or better condition.

b) Class II (Residential Roads, Lanes and Non-Paved Areas)

- i) Place native backfill material in uniform lifts not exceeding 150 mm over the width of the trench, each lift compacted using mechanical compaction equipment. Compact to minimum 95% of Standard Proctor Density.
- ii) Backfill material shall be free of wood, brush, or other perishable, objectionable material. No rocks larger than 200 mm shall be present in the backfill material.
- iii) The moisture content of the backfill material shall be controlled as necessary to achieve the necessary compaction. Supply and add water if it is necessary to increase moisture content. Spread and dry backfill material if moisture content is above optimum.
- iv) Supply and place imported material if moisture content cannot be adjusted.
- v) Where the excavated material is unsuitable for backfilling purposes, use imported material.

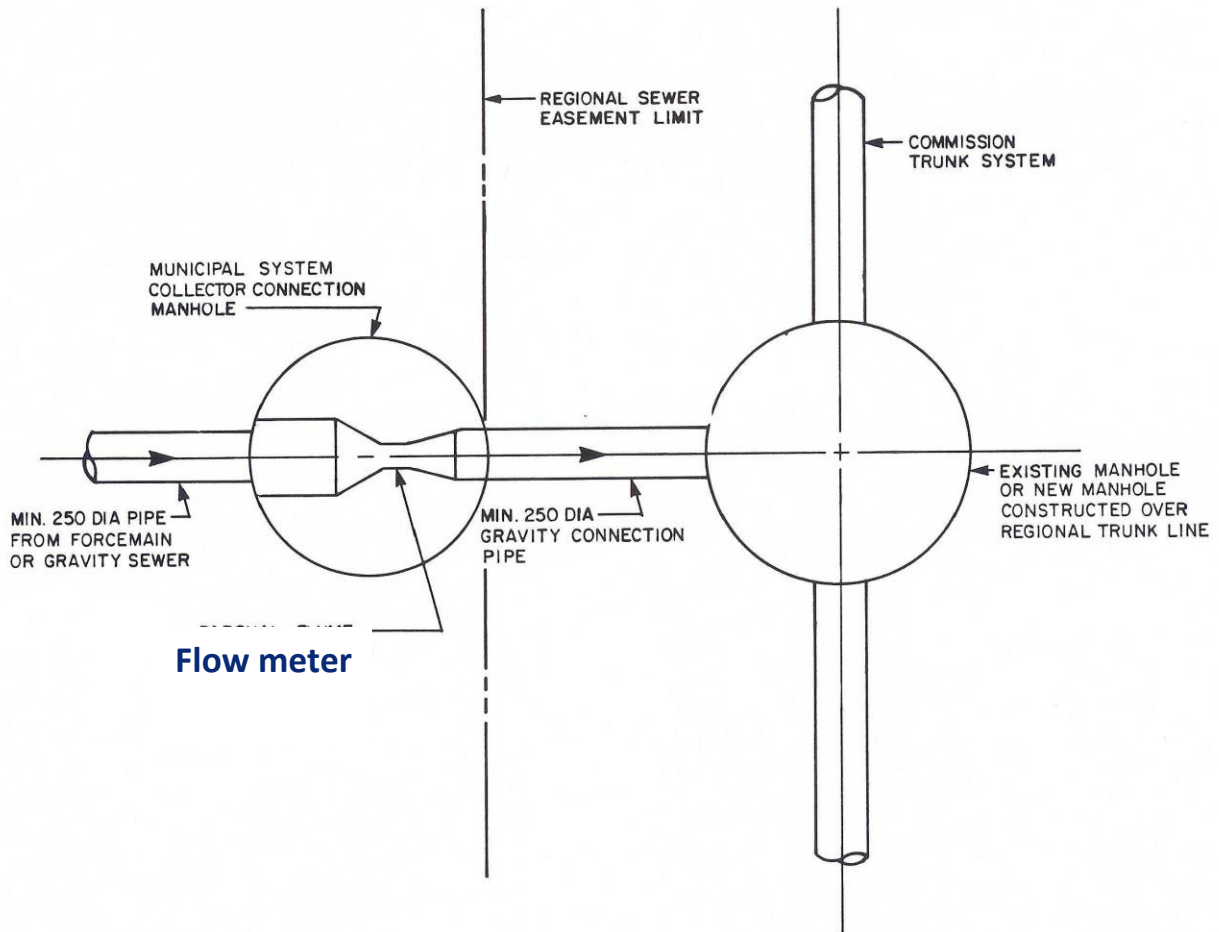
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- c) **Fillcrete**
 - i) Backfill the trench with fillcrete where backfilling with Class I or Class II backfill is not feasible.
 - ii) Uniformly place fillcrete from the top of bedding to the designated or pre-existing subgrade elevation.
 - iii) Protect fillcrete from freezing or other adverse weather conditions for a minimum of 24 hours following placement.
 - iv) Fillcrete that is exposed to significant infiltration of water within 24 hours of placement must be removed and replaced.
 - v) A minimum of 150 mm of granular base course must be placed on the fillcrete surface before allowing any vehicular traffic over the fillcrete. Granular base course may be placed 24 hours following the placement of the fillcrete.

4.16 Surface Restoration and Cleanup

- .1 Restore the surface to a condition equal or greater than what existed prior to construction.
- .2 Fully restore any and all roadways, walkways, curb, gutter, landscaping, and appurtenances impacted by construction to the satisfaction of the applicable owner.
- .3 Cleanup all surplus materials and debris as the work progresses.

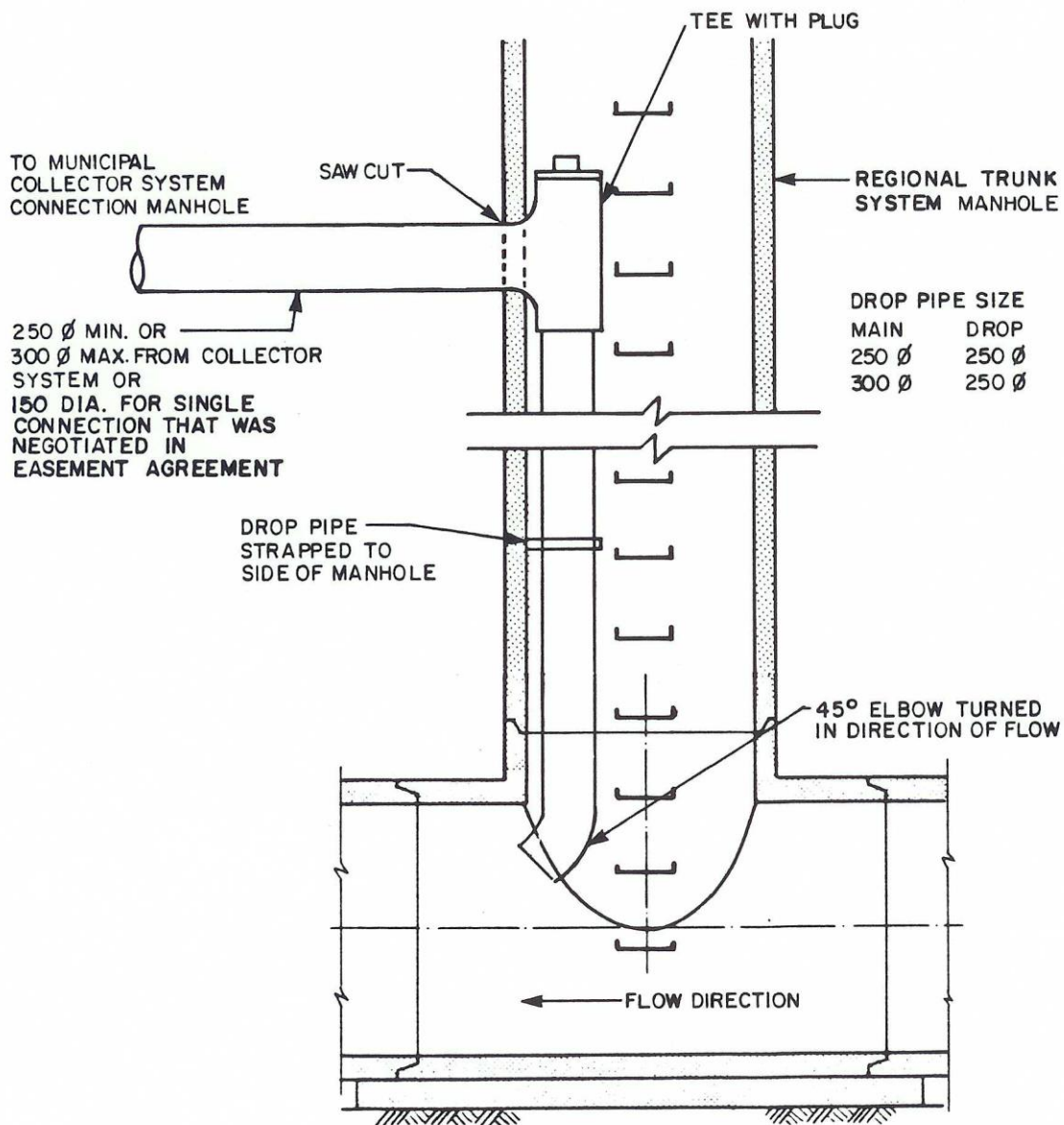
5.0 CONNECTION MANHOLE TYPICAL DETAIL DRAWINGS

- .1 The following Connection Manhole typical detail drawings are provided for information purposed only, and are intended to supplement these Guidelines. In all cases, the Municipality and Consultant shall remain fully responsible for the Design.
- .2 All of the typical detail drawings are for 250 to 300 mm diameter pipe sizes. Where the connection pipe exceeds 300 mm diameter, the Connection Manhole details shall be designed and presented to the ARROW for review and acceptance.



TYPICAL CONNECTION ARRANGEMENT

Figure 1

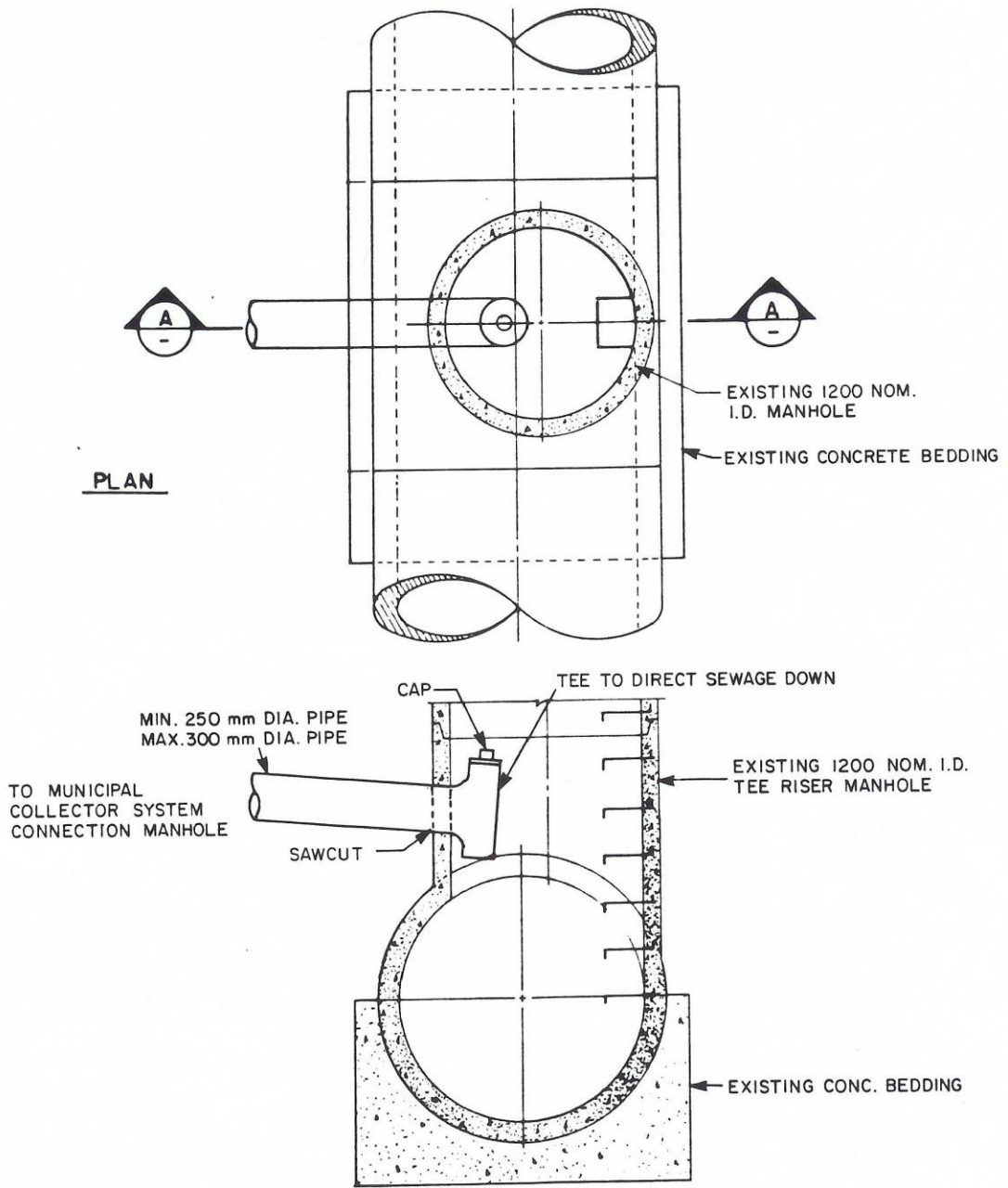


INTERNAL DROP MANHOLE DETAIL

NOTE:

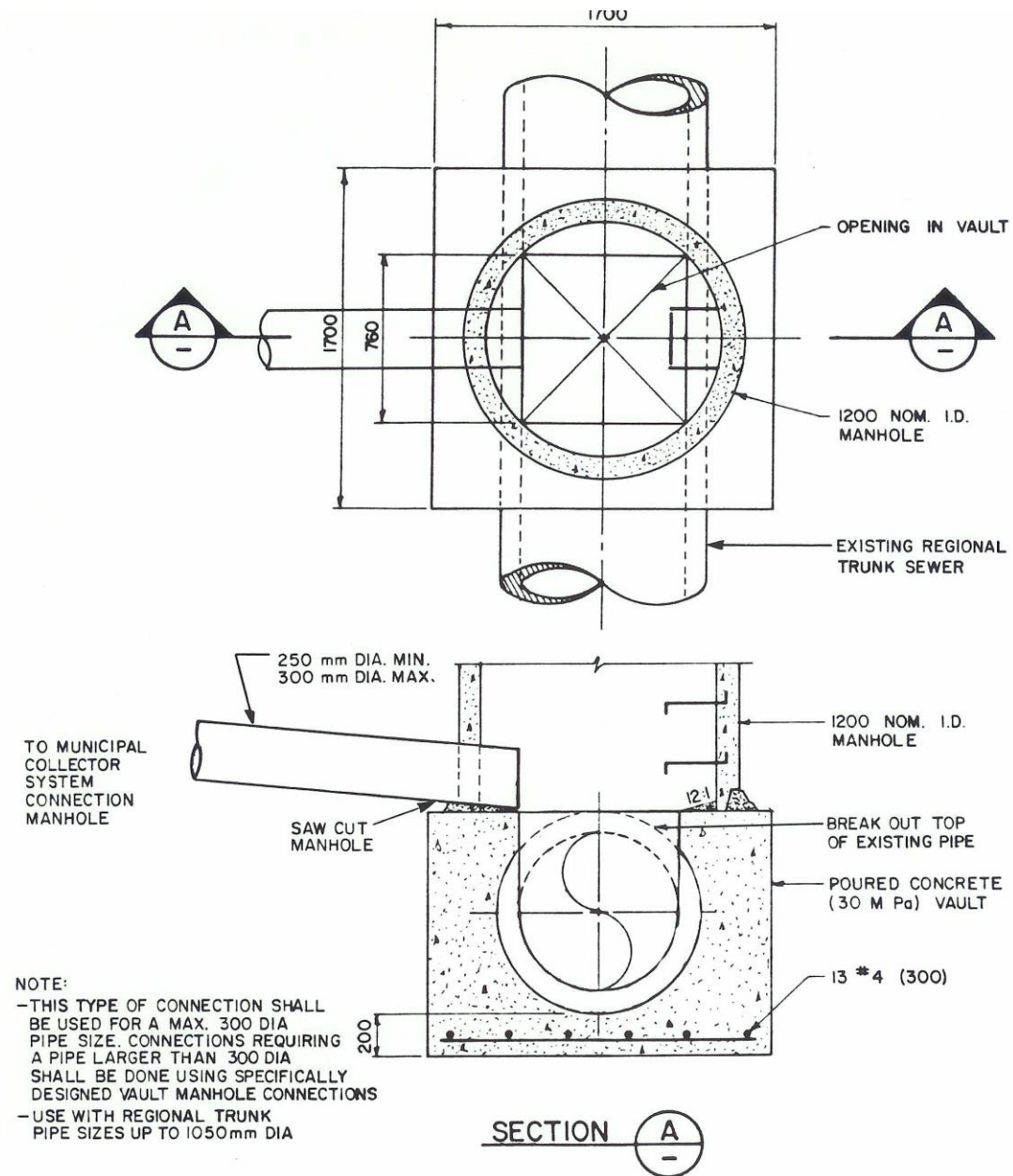
THE INTERNAL DROP MANHOLE SHALL BE USED WHEN THE REGIONAL TRUNK SEWER LINE INVERT IS DEEPER THAN 6m AND THE INCOMING PIPE SIZE DOES NOT EXCEED 300 DIA.

Figure 2



TIE-IN TYPE I
TEE-RISER MANHOLE

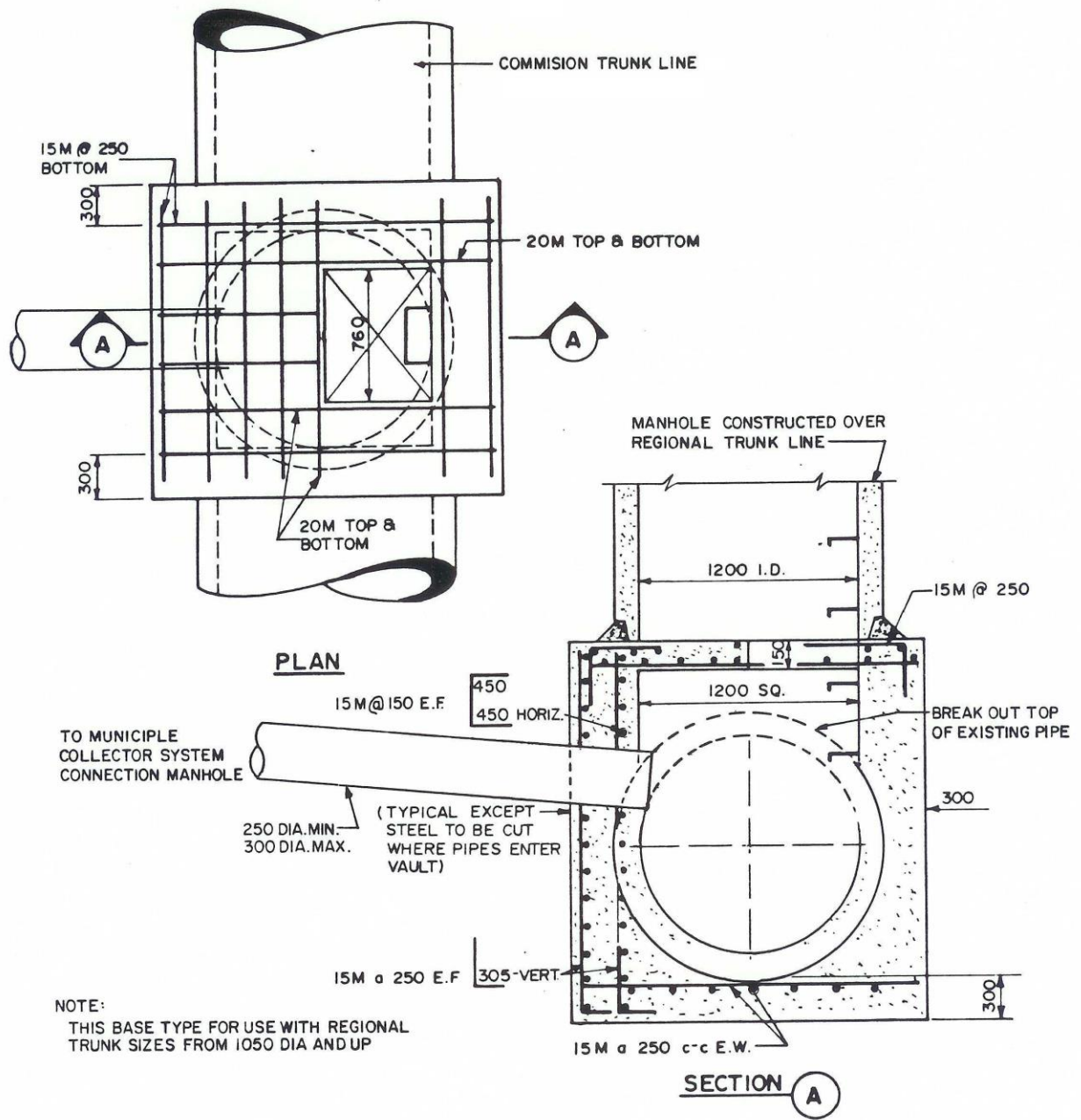
Figure 3



TIE-IN TYPE II SEWER MANHOLE BASE DETAIL

NOTE:
FOR REGIONAL TRUNK PIPE SIZE UP TO
1050 mm DIA.

Figure 4

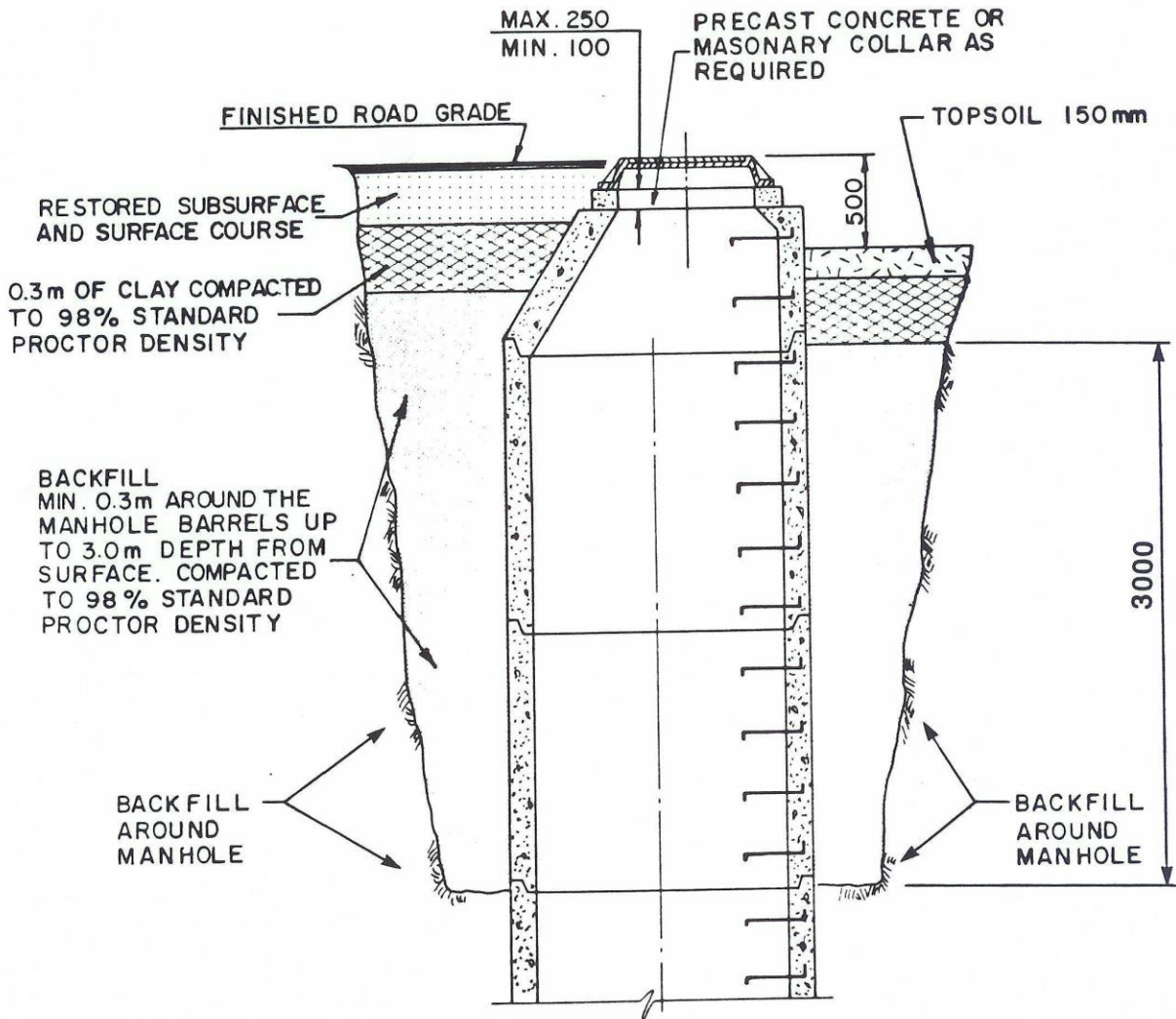


NOTE:
THIS BASE TYPE FOR USE WITH REGIONAL TRUNK SIZES FROM 1050 DIA AND UP

TIE-IN TYPE III MANHOLE BASE DETAIL-VAULT

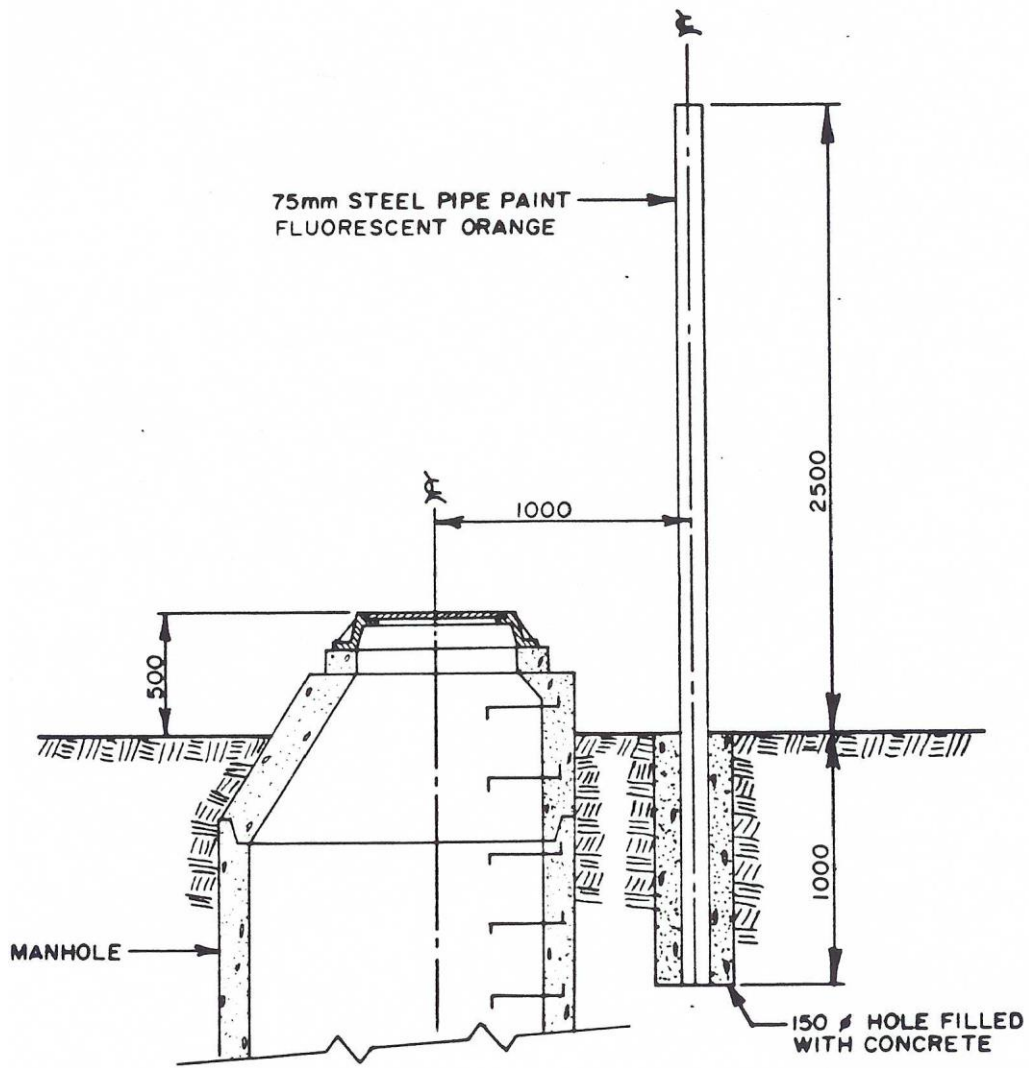
NOTE:
FOR REGIONAL TRUNK PIPE SIZE
1050 mm DIA. AND GREATER.

Figure 5



MANHOLE BACKFILL DETAIL

Figure 6



MANHOLE MARKER

Figure 7