

WATER AUTHORITY – CAYMAN

GUIDELINES FOR CONSTRUCTING POTABLE WATER MAINS

1.0 INTRODUCTION

1.1 General

1.1.1 These guidelines shall apply to all potable water pipe lines that are to be incorporated into the Cayman Islands Water Authority public water supply system. Where valve or meter chambers or support walls for multiple meters are required, standard drawings can be obtained from the Water Authority.

1.1.2 The Water Authority is prepared to assume ownership and responsibility for all pipelines that are laid in accordance with these guidelines and reserves the right to refuse to connect its potable water system to any pipeline that fails to meet these standards.

1.2 Site Plans

1.2.1 The Landowner/Developer shall submit to the Water Authority a copy of the relevant Site Plan, stamped as approved by the Planning Dept, showing the approved layout of all roads and subdivision lots, buildings, set-backs etc. The Site Plan shall show the type(s) of final road surface; The Water Authority will not assume responsibility for any pipelines that have been installed beneath concrete roads or roads with concrete or other decorative pavers or surfaces.

The scale drawings shall also indicate the routes of all other (proposed or existing) underground utilities (electricity and communications conduit runs, sewer pipelines, fuel pipelines, transformers, pull boxes etc.) or any other feature (such as road drainage wells) that might affect the construction or maintenance of the pipeline(s) or the installation of service connection pipework to house lots (to be installed by the Water Authority).

The Water Authority will accept the submission of the aforementioned Site Plans by third-parties provided that the submission is accompanied by a letter stating that the third-party is the authorized representative.

1.2.2 The Water Authority will design the water infrastructure layout for the development and provide a stamped approved drawing of the same to the Landowner/Developer or his authorized representative.

1.2.3 Where the scope of the works is changed after initial approval (such as for phased or partial development), or where 5 years or more has elapsed since Water Authority approval of the water supply infrastructure, the Landowner/Developer or his authorized representative shall submit a revised Site Plan to the Water Authority. The Water Authority will then re-design the water supply infrastructure layout for the development taking into account any changes and will provide a revised stamped approved drawing of the same to the Landowner/Developer or his authorized representative. The revised stamped approved drawing will supersede all other earlier drawings.

1.2.4 Where the pipelines will be installed in phases, a washout shall be installed at the end of each phase with a full length (20ft) of pipe beyond the washout valve. No phase (or remnant) shall be less than 400ft in length.

1.2.5 All pipelines shall be installed in strict accordance with the latest stamped approved drawings.

1.3 Inspections

1.3.1 The Water Authority shall supervise the installation of the pipelines according to an inspection schedule. The developer/landowner shall inform the Water Authority's Quality Assurance Inspector prior to the commencement of trenching/pipelaying work and agree on the inspection schedule.

1.3.2 Quality Assurance Inspectors can be contacted weekdays from 7:30 am – 4:00 pm as follows:

Mr. George Forrester 938 7059
Mr. Jermeil Hydes 938 7027

2.0 MATERIALS

2.0.1 All pipes and fittings shall be constructed with materials approved by the Water Authority in advance of construction.

2.0.2 PVC pipe and fittings shall bear identification markings that will remain legible during normal handling, storage and installation. The markings shall be applied in a manner that will not reduce the strength of the product.

Marking shall include the following and shall be applied at intervals of not more than 5 ft.

- a) Nominal size (e.g. 4 in.)
- b) PVC
- c) Standard Dimension Ratio and pressure class (e.g. SDR 26 (160))
- d) ASTM designation number (e.g. ASTM D2241)
- e) Manufacturer's name or trademark and production–record code (to determine date of manufacture)
- f) Seal (or mark) of the testing agency verifying the suitability of the pipe material for potable water service.

2.0.3 PVC pipe and/or fittings manufactured more than 9 months prior to the start of pipelaying (to be determined by examination of the manufacturer's production-record code marking) will be rejected unless it can be proved, to the satisfaction of the Water Authority, that the pipe and/or fittings were stored after manufacture in an approved manner (e.g. shaded from direct sunlight).

2.0.4 When requested, documentation shall be provided to correlate/confirm the pipe manufacturer's production code markings with actual production dates.

2.1 Pipes

2.1.1 PVC pipes used in the potable water pipelines shall meet the requirements of ASTM D2241 SDR 26 (160). These pipes shall have socket/spigot (push-fit) joints with elastomeric gaskets. PVC pipes can be used for all pipe sizes.

2.1.2 Minimum pipe size shall be three (3) inches nominal diameter.

2.1.3 Pipe colour shall be blue or white.

2.2 Fittings

2.2.1 All PVC fittings shall meet the requirements of ASTM D2241 SDR 26 (160). These fittings shall have socket/spigot (push-fit) joints with elastomeric gaskets.

2.3 Valves

2.3.1 All valves shall be flanged Ductile Iron resilient seated gate valves with rubberized gate and cast iron operating cap, manufactured in accordance with BS 1452, type tested to conform to BS EN 5163 and BS EN 1074-1 and 2, Type B (BS 5163). All flanges shall be NP16 to ISO 2531.

2.3.2 Installed valves shall be left exposed (i.e. not backfilled) until they have been examined by the Water Authority's Quality Assurance Inspector. Valves shall be fully operational, with operating nut set screw tightly fastened to the valve operating stem.

2.4 Corrosion Protection of Buried Metal Piping Specialties and Flanges

- 2.4.1 Where their use has been approved by the Water Authority, all buried metal piping specialties (flange adaptors, mechanical couplings, joint restraints etc.) and flanges, fixing bolts, metal straps etc. shall be protected against the corrosive effects of groundwater by wrapping in Denso profiling mastic and/or Densyl tape, or an approved equivalent.
- 2.4.2 Wrapped fittings, flanges, bolts etc shall be left exposed until they have been inspected by a Water Authority's Quality Assurance Inspector.

3.0 TRENCHING

3.1 Setting-out of Pipeline Route

- 3.1.1 Prior to the commencement of trenching operations the Contractor shall ensure that property boundaries along the route of the proposed pipeline are surveyed (by a qualified land surveyor) and flagged or otherwise clearly identified. The proposed pipeline route shall be set-out no closer than five feet (5 ft) from any property line or boundary.
- 3.1.2 The pipeline shall be set-out in such a way that any required changes in direction shall only be accommodated by means of joint deflection (as approved by the pipe manufacturer but not to exceed 2° per joint) or by approved fittings (bends).
- a) **Longitudinal bending of pipe lengths shall NOT be permitted under any circumstance.**

3.2 Trench Depth

- 3.2.1 Roads along which pipelines are to be installed shall be completed to within four inches (4") of the final road elevation (to allow for final grading and the installation of base course and wearing surface) prior to the commencement of pipelaying operations. Clearly marked pegs indicating the final road elevation shall be provided along the pipeline route, at intervals not exceeding 100ft.
- 3.2.2 Pipes shall be laid with a minimum of 28 inches cover (maximum cover not to exceed 32") from the top of the pipe to the existing ground level at the time of pipeline installation (see Figure 1).
- 3.2.3 If any pipeline depth is found to be in excess of the maximum acceptable depth (36" from top of pipe to final, finished road level), either prior to or after acceptance of that pipeline by the Water Authority, that pipeline section shall be deemed to be unacceptable and shall be relaid at the specified depth. Re-use of previously installed pipes will not be permitted.
- 3.2.4 If, arising from the Contractor's method of working, the trench is excavated below the required grade, all parts of the trench excavated below the grade shall, at the Contractor's expense, be filled in with crushed rock or gravel, maximum size 1 inch, over the full width of the trench in compacted layers not exceeding six (6) inches deep to the established grade (with due allowance for the pipe base or special bedding)

3.3 Trench Width

- 3.3.1 The minimum trench width is that width between the faces of the soil required to ensure the correct placing and compaction of bedding and backfill materials equally on either side of the pipe. All sheeting and supports are to be outside this width.
- 3.3.2 The minimum trench width for pipe sizes up to and including six (6) inch nominal diameter is eighteen (18) inches.
- 3.3.3 For pipe sizes over six (6) inch nominal diameter the trench must be wide enough to allow six (6) inches of space on each side of the pipe. (For example, when laying an eight (8) inch diameter pipe, the trench must be at least 6" + 8" + 6" = 20" wide.)

3.4 Trench Bottom

- 3.4.1 The trench bottom shall be at a constant grade and free from high or low spots that could cause the pipe to be supported unevenly. The bottom of the trench shall be raked smooth to remove any large stones or other unacceptable material.

3.5 Unsuitable Material at Bottom of Trench

- 3.5.1 When, in the opinion of the Water Authority, the existing material in the bottom of the trench is unsuitable for supporting the pipe, the contractor shall excavate below the invert of the pipe, as directed by the Water Authority.
- 3.5.2 Where the bottom of the trench is above the water table, the trench shall then be backfilled to specified pipe grade over its entire width with 1-inch minus crushed rock. This material shall be well graded from coarse to fine (with no more than 20 percent fines passing the No.200 sieve) and be free from organic materials. The crushed rock shall be compacted in layers not exceeding six (6) inches deep to the required grade (with allowance for the pipe base or special bedding).
- 3.5.3 Where the bottom of the trench is below the water table, the trench shall be backfilled over its entire width to the specified pipe grade (with allowance for the pipe base or special bedding) with clean, washed gravel (maximum size 1") free from organic materials.

4.0 PIPE BEDDING

4.1 General

- 4.1.1 Pipe bedding material (see 4.2 and 4.3 below) shall be placed by hand in the excavation below the invert level of the pipe and shall be tamped and rammed by hand to provide a dense well compacted bed free from soft spots throughout the length of the pipeline. Pockets shall be provided in the surface of the bedding to accommodate pipe joints and all hard spots that would prevent a uniform bearing shall be removed.
- 4.1.2 Stones, bricks or similar materials shall not be used below or against the pipes to locate them in position in the trench or to level the pipes. Sufficient of the infill materials shall be placed around the barrels of pipes to prevent movement.

4.2 Dry Conditions

- 4.2.1 All pipes laid in dry conditions shall be bedded on a minimum of 4 inches of clean, dry crusher run, marl or sand, free from stones, sticks or other unacceptable material.
- 4.2.2 After jointing of the pipe, additional bedding material shall be placed and firmly compacted by hand around the pipe up to half of the pipe diameter. The placing and the tamping of the material shall proceed equally on both sides of the pipe.

4.3 Wet Conditions

- 4.3.1 All pipes laid in wet conditions shall be bedded on a minimum of 4 inches of 3/8 inch washed gravel.
- 4.3.2 After jointing of the pipe, additional 3/8 inch washed gravel shall be placed by hand around the pipe up to half of the pipe diameter. The placing and the tamping of the material shall proceed equally on both sides of the pipe.

5.0 PIPELAYING

5.1 General

- 5.1.1 Pipes shall be stored and handled carefully and shall be protected from the effects of temperature and UV radiation in accordance with the manufacturer's recommendations.
- 5.1.2 Pipe laying shall not commence until the bottom of the trench and the pipe bedding have been approved by suitably qualified Water Authority personnel.
- 5.1.3 Pipes shall be brought to the correct alignment and inclination, concentric with the pipes already laid.
- 5.1.4 Washouts and Temporary Fill/Flush Points shall be installed in accordance with Figure 3.

5.2 Other Underground Utilities

- 5.2.1 A minimum of six inches (6") of vertical clearance is required where pipelines cross other (existing or proposed) utilities/pipes/ducts, whilst still maintaining the cover requirements of para. 3.2.2 above.
- 5.2.2 A minimum of six feet of horizontal separation is required where pipelines run parallel to other (existing or proposed) utilities/pipes/ducts. The parallel utility/pipe/duct must be installed sufficiently deep (min. 24" cover) to allow water supply service lines to cross over with adequate cover and clearance.
- 5.2.3 A minimum of six feet of horizontal separation is required where pipelines run close to other (existing or proposed) features such as road drainage wells, electrical transformers or any other feature that might jeopardize or obstruct the construction or future maintenance of the pipeline.

5.3 Jointing of Pipes

- 5.3.1 Joints shall be made strictly in accordance with the manufacturer's instructions.
- 5.3.2 Before making any joints, all jointing surfaces shall be thoroughly cleaned and maintained in such condition until the joints have been completely made or assembled.
- 5.3.3 All pipes shall be accurately marked prior to laying to ensure that the gap between the end of the spigot and the shoulder of the socket when jointed shall be as recommended by the manufacturer.

6.0 THRUST BLOCKS

- 6.1 Pipelines shall have thrust blocks at all bends, tees, crosses, junctions, end caps and blank end flanges and at all changes in pipe diameter to prevent movement of the pipelines due to the thrust from hydraulic pressure.
- 6.2 Concrete thrust blocks shall be placed in such positions and sized as shown in the attached drawing (Figure 2) and the schedule below:

	90° bend	45° bend	22.5° bend	11.25° bend	Taper, Cross, Tee, End Cap
Pipe size	Dimension A	Dimension A	Dimension A	Dimension A	Dimension A
8"	20"	12"	6"	6"	14"
6"	15"	8"	4"	4"	12"
4"	10"	6"	3"	3"	8"
3"	10"	6"	3"	3"	8"

- 6.3 The concrete used for the thrust blocks shall have a minimum compressive strength of 3,000 psi after 28 days. The use of early strength cement will be required if a hydrostatic test is required within 5 days following the installation of the thrust blocks.

6.4 Thrust blocks shall always be poured against undisturbed ground. Any loose or disturbed material shall be removed immediately before the concrete is placed.

6.5 Thrust blocks shall be left exposed (i.e. not backfilled) until they have been examined by the Water Authority's Quality Assurance Inspector.

7.0 BACKFILLING (PIPE ZONE)

7.1 Granular backfill in the pipe zone (see Figure 1) shall be clean crushed rock or dry marl, reasonably well graded from coarse to fine. The maximum size shall be 1 inch. Sand may be used in lieu of 1-inch minus material. Soils having more than 20 percent of its weight passing a No.200 sieve shall not be used for backfill. Excavated material may be used if it meets the criteria of granular backfill.

7.2 The backfill shall be compacted taking care to compact the material on both sides as well as on top of the pipe to ensure that firm support is obtained to prevent any lateral movement of the pipe during the final backfill. Backfilling and compacting shall be done by hand until a layer of not less than 12 inches cover is built over the pipe. Backfill shall be placed in horizontal lifts not exceeding six (6) inches in uncompacted thickness on both sides of the pipe. Compaction shall be accomplished by thoroughly tamping and 'walking in' the material. Proper care shall be taken not to place any stones, sticks or other rubbish on or near the pipe.

8.0 MARKER TAPE

8.1 All pipelines shall be marked with magnetically detectable tape. This tape shall be at least 2" wide and shall be blue in colour. It shall be marked "WATER LINE BELOW" (or similar approved wording) continuously along its length.

8.2 The tape shall be buried approximately 12 inches above the top of the pipe and continuously along the length of the line. When the tape has to be joined, the ends shall be tied together in a tight knot.

9.0 GENERAL BACKFILLING

9.1 Upon completion of backfilling in the pipe zone (See Figure 1), the remainder of the trench can be filled and compacted using excavated material and by mechanical means if required. The excavated material shall be free of organic material and shall contain no particles in excess of 2 inches.

10.0 TESTING OF PIPELINES

10.1 Pressure testing shall be carried out to prove the structural soundness of the various components of the pipeline, including pipes, valves and anchorages, and to prove the watertightness of the line.

10.2 The Contractor may, if field conditions permit, partially backfill the trench and leave the joints open for inspection and conduct (at his own expense) an initial leak test. The actual pressure test, however, shall not be conducted until all backfilling has been completed.

10.3 Prior to testing (including the initial leak test if the Contractor wishes to conduct such a test), the pipeline shall be filled with clean, potable water and all air released. Care shall be taken during the filling of the mains to provide free outlets for air to prevent surging and water-hammer.

10.4 The Contractor shall give the Water Authority not less than twenty-four (24) hours' notice of his intention to test a section of or the entire pipeline. A suitably qualified staff member of the Water Authority shall be present at the beginning of the test and shall inspect the test after it has been completed.

- 10.5 All pipes shall be tested to a minimum of 100 psi and shall maintain this pressure for a minimum period of 24 hours. The specific testing procedure shall be approved by the Water Authority prior to beginning an official test.

11.0 TESTING OF LARGE-METER VAULTS AND OTHER CHAMBERS BELOW GROUND

- 11.1 Where the approved design of the Works requires the construction of buried meter vaults, valve chambers or similar where the base of the vault or chamber is below the water table, these shall be tested upon completion to ensure water tightness.
- 11.2 A suitably qualified staff member of the Water Authority shall be present at the beginning of the test and shall inspect the test after it has been completed.
- 11.3 Pipework entering or leaving the chamber shall be sealed-off (where applicable) and the chamber emptied of standing water. After 24 hours the volume of water that has entered the chamber (infiltration) shall be measured or calculated.
- 11.4 The maximum permissible infiltration into the chamber shall not exceed 0.25 US gallon per hour.
- 11.5 If the measured or calculated leakage (i.e. infiltration) exceeds the maximum permissible leakage, the contractor shall investigate the source of the leak and provide details to the Water Authority as to how the defects will be remedied. When approved remedial repairs have been completed the contractor shall inform the Water Authority and the water tightness test shall be repeated.

12.0 FLUSHING AND DISINFECTION

- 12.1 After the pipeline has successfully passed the pressure test, the pipeline will be disinfected and flushed and connected to the Grand Cayman water distribution system, prior to placing it into service.
- 12.2 Disinfection, flushing and connection will be carried out by the Water Authority at no cost to the developer or his Contractor.

13.0 WATER SERVICE LINES

- 13.1 Upon successful completion of the pressure test and prior to the subdivision roads being paved, the developer shall confirm that all of the requirements (as set out below) for the installation of service lines (i.e., the pipework between the water main and the individual properties) have been met.
- 13.1.1 If any underground utilities have been installed subsequent to the pressure test described at Sect. 10 above, the pressure test shall be repeated.
- 13.1.2 Where the property has not been sub-divided into lots with individual block & parcel numbers, a layout of the lots in electronic (AutoCad) format shall be provided showing individually numbered lots.
- 13.1.3 The Developer (and not the pipelaying contractor) shall be responsible for ensuring that property boundaries have been surveyed (by a qualified land surveyor) and flagged or otherwise clearly identified in preparation for the installation of water service lines.
- 13.1.4 If service lines are installed based on wrongly-flagged property boundaries or if the layout of lots changes subsequent to the installation of the service lines, the Developer shall pay the Water Authority the cost of providing new service lines and for any other abortive work resulting from the re-installation of the service lines.
- 13.2 All water service lines shall be installed by the Water Authority and the developer shall reimburse the Water Authority the estimated cost of this work prior to the commencement of the installation.

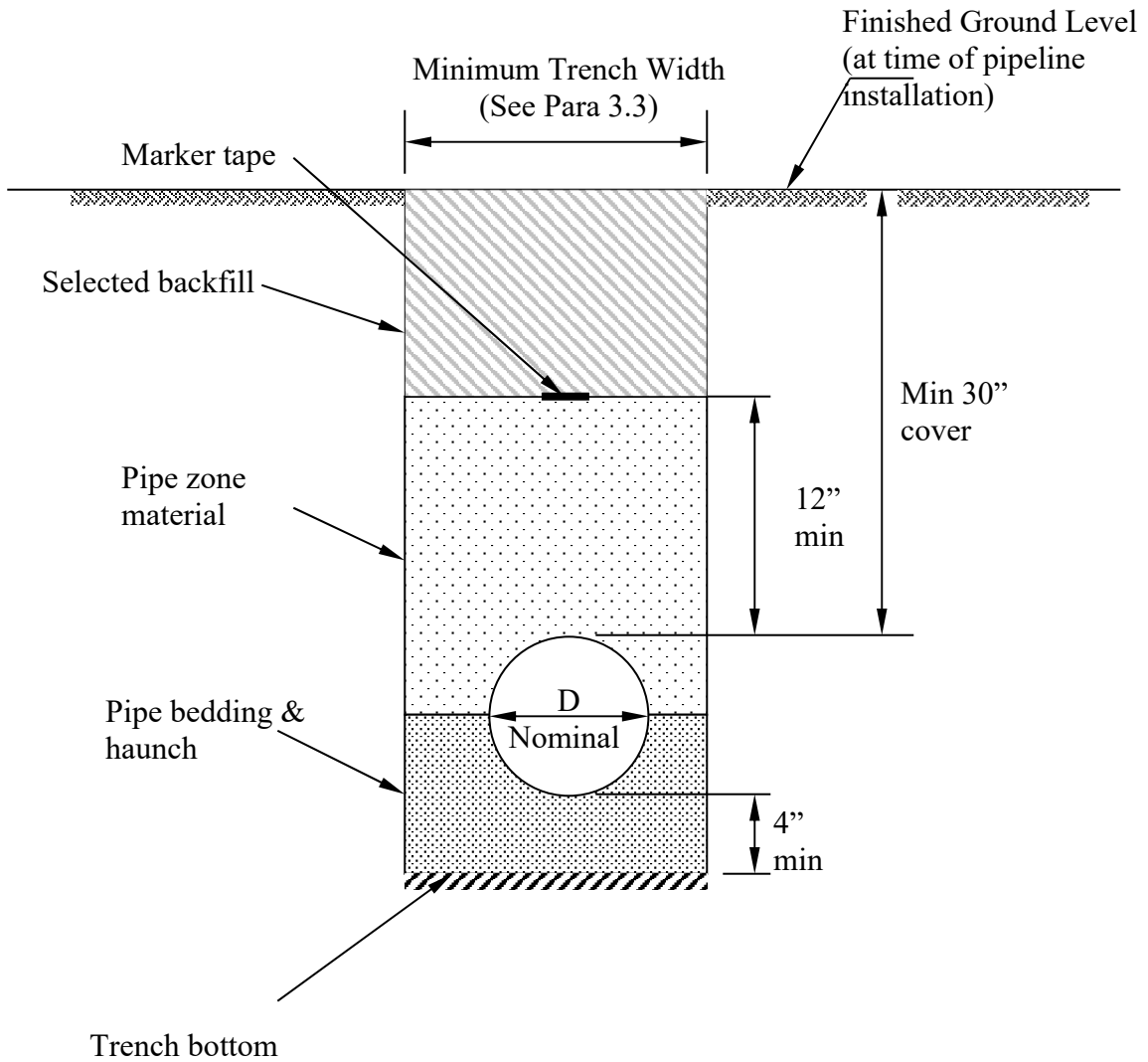
- 13.2.1 Where other buried utilities (e.g. electrical, gas, telecom etc) will be crossed by water service lines, those buried utilities that have been installed less than 24" below the current road level shall be exposed by the Developer before any water service lines are installed.
- 13.2.2 The locations of all other buried utilities shall be clearly marked by the Developer before any water service lines are installed.
- 13.2.3 Water Authority will not be responsible for damage to buried utilities that were installed less than 24" below the current road level and not exposed by the Developer prior to the installation of the service lines.
- 13.3 The water infrastructure shall not be approved until all the water service lines have been installed in accordance with this section.
- 13.4 Water service lines will not be installed where the depth of the pipeline (final finished road level to top of pipe) will exceed 36" after paving (see also para 3.2.3)
- 13.5 In order to facilitate future maintenance of the water service lines, there must be at least six feet of horizontal separation between any water service line and any other underground utilities/pipes/ducts (see also section 5.2), e.g., electricity and telecommunication conduits. Water service lines are typically installed in close vicinity to a site boundary (to allow one service line to accommodate two adjacent properties) and therefore no other underground utilities/pipes/ducts (or trees) can be installed at or near this site boundary.

If it is subsequently found that any other underground utilities/pipes/ducts (or trees) have been installed less than six feet from the water service line, the Water Authority will disconnect the water service line until the offending underground utilities/pipes/ducts (or trees) have been removed.

14.0 METER VAULTS & WALL-MOUNTED METER MANIFOLDS

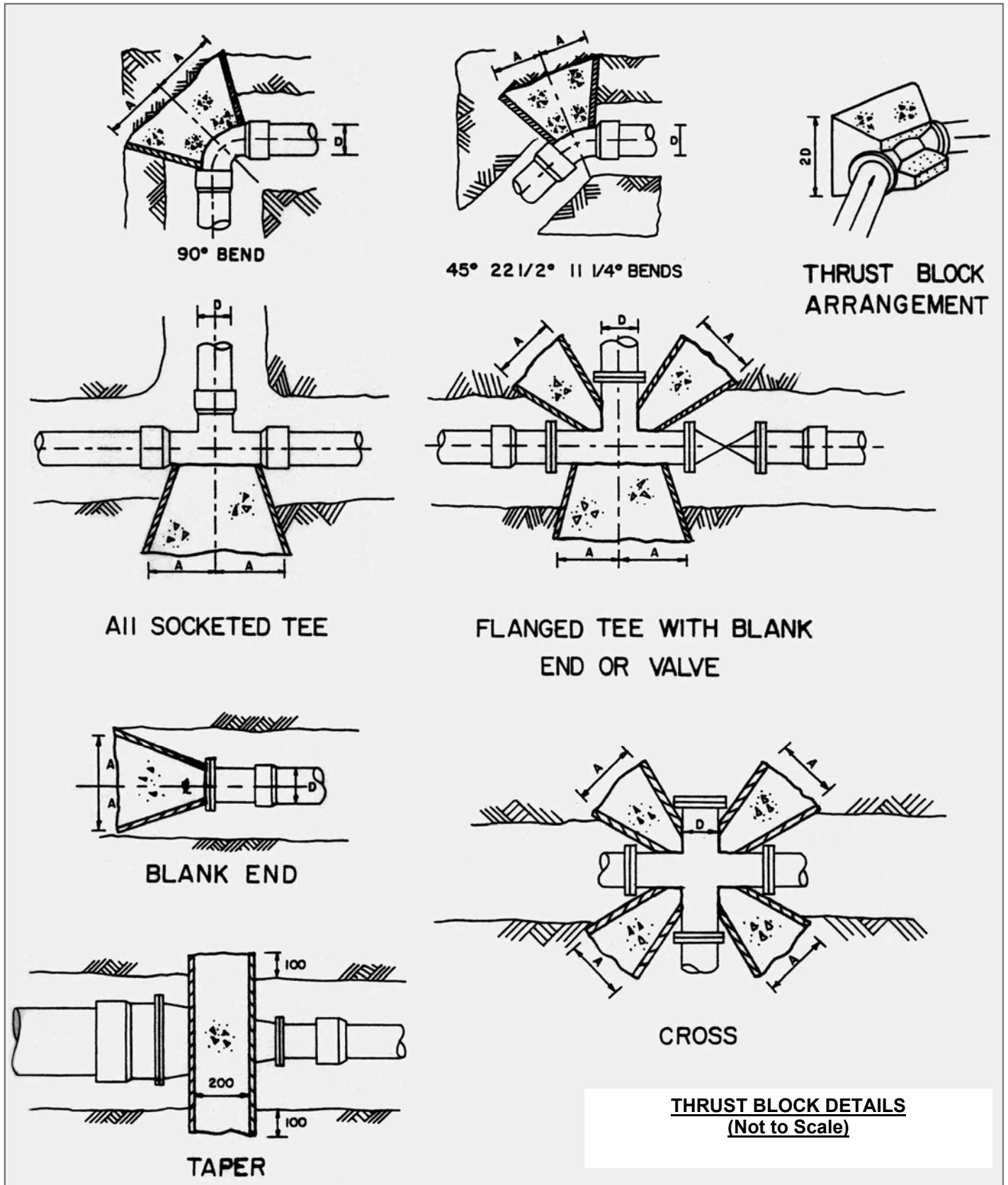
- 14.1 At properties where five or more water meters are to be installed, the developer shall provide a below-ground meter vault(s) or an above-ground, wall-mounted manifold(s), each constructed in accordance with Water Authority specifications and the relevant standard drawings for multiple meter installations.
- 14.2 On completion of wall-mounted manifolds, the supply-side pipework (up to the customers' lock-off ball valve) shall be pressure tested as per para. 10.5 above.
- 14.3 On completion of below-ground vaults the vaults, Water Authority shall be notified and the vault inspected for compliance with Water Authority specifications.
- 14.4 Upon acceptance of the wall-mounted manifold or below-ground vault the developer may apply for the installation of water meters. Only applications for all of the meters that can be accommodated on the wall-mounted manifold or in a below-ground vault will be considered.
- 14.5 The developer shall ensure that the area around any wall-mounted manifold or below-ground vault shall at all times be kept clear of any objects that might impede access for the reading of meters, maintenance or repairs.

FIGURE 1



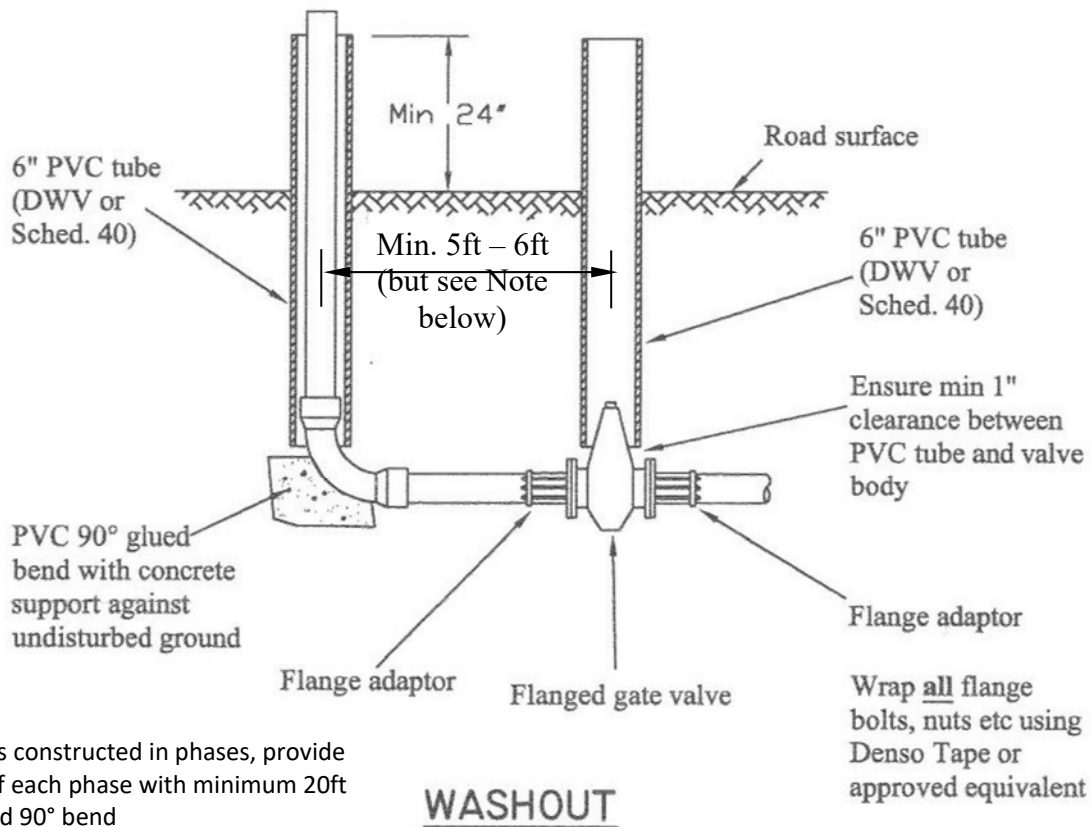
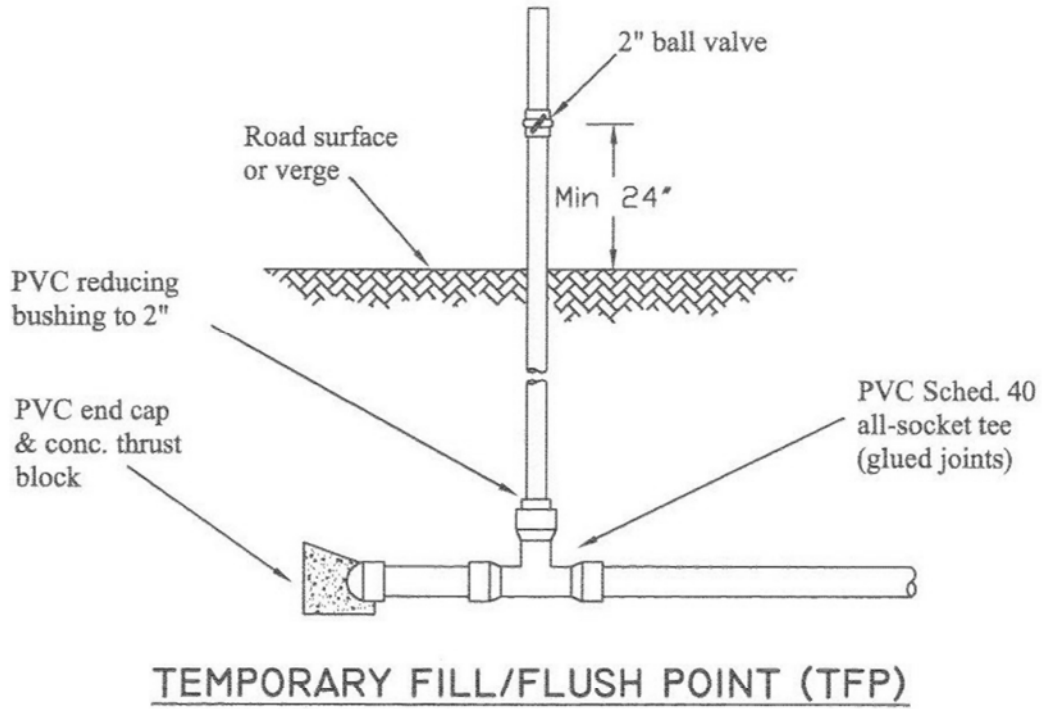
TYPICAL PIPE TRENCH DETAILS
(Not to Scale)

FIGURE 2



THRUST BLOCK DETAILS
(Not to Scale)

FIGURE 3



NOTE

For Developments constructed in phases, provide washout at end of each phase with minimum 20ft between valve and 90° bend