Assets Planning and Delivery Group
Engineering

DESIGN STANDARD DS 63

Water Reticulation Standard
Design and Construction Requirements for
Water Reticulation Systems up to DN250

VERSION 3
REVISION 16

FEBRUARY 2024

FOREWORD

The intent of Design Standards is to specify requirements that assure effective design and delivery of fit for purpose Water Corporation infrastructure assets for best whole-of-life value with least risk to Corporation service standards and safety. Design standards are also intended to promote uniformity of approach by asset designers, drafters and constructors to the design, construction, commissioning and delivery of water infrastructure and to the compatibility of new infrastructure with existing like infrastructure.

Design Standards draw on the asset design, management and field operational experience gained and documented by the Corporation and by the water industry generally over time. They are intended for application by Corporation staff, designers, constructors and land developers to the planning, design, construction and commissioning of Corporation infrastructure including water services provided by land developers for takeover by the Corporation.

Nothing in this Design Standard diminishes the responsibility of designers and constructors for applying the requirements of WA OSH Regulations 1996 (Division 12, Construction Industry – consultation on hazards and safety management) to the delivery of Corporation assets. Information on these statutory requirements may be viewed at the following web site location:

https://www.legislation.wa.gov.au/legislation/statutes.nsf/law_s4665.html

Enquiries relating to the technical content of a Design Standard or to become a registered Design Standard user should be directed to Engineering.StandardsEnquiries@watercorporation.com.au. Future Design Standard changes, if any, will be advised to registered Design Standard users as and when published.

Head of Engineering

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Users should use and reference the current version of this document.

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REVISION STATUS

The revision status of this standard is shown section by section below:

REVISION STATUS						
SECT.	**VER./ REV.**	**DATE**	**PAGES REVISED**	**REVISION DESCRIPTION (Section, Clause, Sub-Clause)**	**RVWD.**	**APRV.**
1	3/13	02.03.18	Varies	Minor revisions	AA	JD
1	3/14	27.09.18	Varies	Definitions added	AA	JD
2	3/7	6.05.11	16	2.2.1.5 (b) includes hydrant spacing in rural areas to be 400m	CW	PF
2	3/7	6.05.11	17	2.2.1.5 (b) includes hydrant spacing to be away from high voltage transformers etc	CW	PF
2	3/13	02.03.18	Varies	Various minor amendments; Added requirement for redline markup submission; Altered allowable hydrant spacing (2.2.1.5b); Added pit requirement for air valves (2.2.1.5); Amended PE pipe nomination requirements (2.2.3.3);	AA	JD
2	3/14	27.09.18	21	Removed need to submit redline markups (2.2.3.1).	AA	JD
2	3/15	17.12.21	Varies	Added requirement for valving at end of lines (2.2.1.3) Clarified accessibility and hydrant location considerations (2.2.1.5.)		
2	**3/16**	**Feb 2024**	**Varies**	**Updated Fig 2.1; Provided more detail on design submission requirements for trenchless installations; Valves locations updated for difficult to access locations**	**JD**	**AA**
3	3/13	02.03.18	Varies	Multiple Table 1 (previously Table 3-1) products amended; Table 2 (previously Table 3-2) fastener requirements updated	AA	JD
3	3/14	27.09.18	Varies	PE requirements amended.	AA	JD
3	3/15	17.12.21	Table 3.1 and 3.2	Updated PE and PVC and bedding requirements		
3	**3/16**	**Feb 2024**	**Table 3.1**	**Clarified where PE100 is permitted**	**JD**	**AA**
4	3.9	27.10.11	All	Section moved to end of document now section 6	CW	PF
4	3/13	02.03.18	Varies	Vermin ingress requirements updated (4.4.2);	AA	JD

REVISION STATUS						
SECT.	**VER./ REV.**	**DATE**	**PAGES REVISED**	**REVISION DESCRIPTION (Section, Clause, Sub-Clause)**	**RVWD.**	**APRV.**
				Pipe cover requirements added (4.4.3.2); Clearances to services clarified (4.4.3.2) Pipe jointing methods updated (4.4.5); Min distance to buried valve requirements added (4.4.5); Anchor block requirements on PE pipe added (4.4.5.6); Pressure testing requirements updated (4.4.7); New pressure test record sheet added;		
4	3/14	27.09.18	Varies	Pipe alignment and depth requirements updated (4.4.3.2); Joints under roads requirements amended Max HDD reamer sizes added (4.4.5.2); Vertical thrust block requirements amended (4.4.5.6); Need to cable-tie open service connection valves (4.4.7.1); Non-PE pressure test duration changed to 1hr (4.4.7.5); Requirement to leave main charged at 600kPa(g) (4.4.9);	AA	JD
4	3/14	27.09.18	Varies	Test Record Sheets amended	AA	JD
4	3/15	17.12.21	Varies	Lay pipe with marking at crown Detection tape required for pipes in unusual alignments Flange wrapping requirements clarified		
4	**3/16**	**Feb 2024**	**Varies**	**Clarified need to disinfect/pressure test all service connections**	**JD**	**AA**
5	3/9	27.10.11	All	Section number changed from 5 to 4	CW	PF
5	3/13	02.03.18	Varies	All-welded steel connection permitted (5.5.2); Isolation requirements amended (5.6.10)	AA	JD
5	3/14	27.09.18	Varies	Method submission section amended (5.3.2)		
5	3/15	17.12.21	Varies	Section rewritten		

REVISION STATUS						
SECT.	VER./ REV.	DATE	PAGES REVISED	REVISION DESCRIPTION (Section, Clause, Sub-Clause)	RVWD.	APRV.
6	3/9	27.10.11	All	Section numbering changed to 5	CW	PF
6	3/10	18.07.13	All	Drawing List Updated Revised drawings AQ-71-1-1, BD62-2-1, BD62-2-2, BD62-8-8, BD62-8-9, BD62-8-10, BD62-8-15, BD62-8-24, BD64-9-1; Deleted drawing BD62-8-7; New drawings added BD22-5-8, BD62-2-9, BD64-10-1. Note: The following drawings were updated in 2012, BD62-2-4,BD62-2-5, BD62-7-1,BD62-7-3,BD62-10-1,BD62-10-2 ,KA76-1-5	CW	MH
6	3/12	06.02.17	51-52	Drawing List Updated		
6	3/13	02.03.18	Multiple	Drawing List Updated	AA	JD

DESIGN STANDARD DS 63
Water Reticulation Standard

CONTENTS

1 INTRODUCTION

1.1 Purpose

The Water Reticulation Standard sets out the guidelines and technical standards that are complementary to the requirements in the WSAA Water Supply Code WSA03-2011 for the design and construction of water reticulation assets for the Corporation. In the event of conflict between the Code and the Standard, the Standard shall take precedence.

Guidelines for all administrative, commercial, and procedural matters for subdivision services work can be accessed at web site: https://www.watercorporation.com.au

1.2 Intended Audience

The Standard has been prepared to assist Corporation personnel, consulting engineers and water industry contractors, engaged in any or all aspects of planning, design and construction of Corporation's water reticulation assets.

1.3 Scope

This Standard covers the design and construction of water reticulation for pipe sizes up to DN 250 and including service connections on existing live watermains that are installed or prelaid at the time of watermain installation. Pipes larger than DN 250 are considered to be distribution mains and shall be designed and constructed to the requirements of the Corporation's Water Distribution Standard.

1.4 Alternative Proposal

Alternative proposals for the design, specification or construction of water reticulation shall be subject to acceptance by the Corporation.

1.5 Design and Construction Responsibilities

Water Reticulation design and construction shall reflect the requirements of all parts of the Standard.

1.6 Reference Material

- WSAA Water Supply Code of Australia (Water Services Association of Australia) WSA03-2011
- Polyethylene Pipeline Code WSA 01 – 1998 (Water Services Association of Australia)

Water Corporation website - https://www.watercorporation.com.au/home/builders-and-developers

- Utility Providers Code of Practice for Western Australia
- Steel Pipeline System Design Manual (Steel Mains)
- Steel Pipeline System Handling and Installation Reference Manual (Steel Mains)
- Pipe Fittings Standard Drawings (Water Corporation)
- DS80 WCX CAD Standard (Water Corporation)
- Strategic Products Register – Water, Wastewater and Drainage Systems (Water Corporation)

1.7 Glossary of Terms

In this Standard the following words and expressions shall have the following meanings. These meanings do not necessarily comply with the meanings given in the Water Corporation Act and other Water Corporation publications.

The following definitions shall apply:

As Constructed Records – records prepared after construction detailing the infrastructure that has been built, including location, alignment, size, material, pressure rating of the works

Code - the WSAA Water Supply Code of Australia WSA03-2002, as published by the Water Services Association of Australia.

Corporation - the Water Corporation, Western Australia.

Deferred Services - services to be installed to lots at a later date by the Corporation.

Drawings - water reticulation project drawings including drawings selected from Section 6 of the Standard.

Drawing Guidelines – Corporation's WCX CAD Standard.

FTI – Final Takeover Inspection

Lot - a property for which a separate title may be held or issued, and which the water reticulation will service.

Major road – Any road that is not defined as an Access Road or Local Distributor as defined by MRWA

MGA94 – Map Grid of Australia 1994.

PCG94 – Perth Coastal Grid 1994.

Minor Road – Any road that is an Access Road or Local Distributor as defined by MRWA

Prelaid Services - water service connections installed in conjunction with the construction of new reticulation mains.

Shall - a mandatory requirement, which can be varied only under a specific circumstance by written approval of the Corporation.

Should - a requirement to be adopted unless circumstances justify a variation to achieve the intended results.

Standard - the Water Reticulation Standard as published by the Water Corporation.

Water Reticulation - a water service system including watermains (mains), property connections and appurtenant fittings not exceeding DN 250 that provides a water supply to a defined development area

Zoning Valves - valves that are used to divide water reticulation into zones for purposes other than normal maintenance (as distinct from isolating valves).

1.8 Abbreviations

The abbreviations as listed in the Standard shall have the following meanings:

AC	asbestos cement	kPa(g)	kilopascal (gauge)

AHD	Australian Height Datum	L	litre
AS	Australian Standard	mg	milligram
A1	594mm x 841mm	m	metre
A4	210mm x 297mm	GRP	glass reinforced plastic
B/END	blank end	mm	millimetre
BL	building (property) line	MSCL	mild steel cement mortar lined
BV	butterfly valve	NI	not installed
CI	cast iron	OD	outside (external) diameter in mm.
CU	copper	PAW	pedestrian access way
DAV	dual orifice double air valve	PE	polyethylene pipe
DI	cement lined ductile iron	PN	pressure nominal
DN	nominal diameter in mm.	POS	Public Open Space
E&C	expanded & collapsed (slip-in)-steel pipe joint	PVC	polyvinyl chloride
EXIST	existing	RC	reinforced concrete
FP	flushing point	ROW	Right of Way
HDD	Horizontal Directional Drilling	RRJ	rubber ring joint
HYD	hydrant	S	Steel
kg	kilogram	SC	scour
kL	kilolitre	SV	sluice valve
kPa	kilopascal		

2 DESIGN GUIDELINES

2.1 General

2.1.1 Scope

This Section of the Standard sets out the requirements for the design and drafting practices for water reticulation assets of the Corporation. It shall be read in conjunction with Part 1 of the WSA Code. In the event of conflict between the Code and the Standard, the Standard shall take precedence.

2.1.2 Redevelopment of Existing Areas

The condition and adequacy of existing water supply mains in the redevelopment work shall be assessed in consultation with, and must be acceptable to, the Corporation.

2.1.3 Water Reticulation Planning for Subdivisions

Determination of the reticulation layout plan including reticulation main sizes and class, location of distribution main off-takes, zoning valves, and capacities of other elements of the system to ensure the supply to and within the subdivision is integrated with the overall water supply scheme will either be by Water Corporation or, where accepted by Water Corporation, by the designer to the Water Corporation's satisfaction.

2.1.4 Land Requirements

Fee simple ownership is the Corporation's preferred land tenure for installations such as pump stations, water tanks, treatment plants, reservoirs and pipelines not in public land.

2.2 Technical Requirements

2.2.1 Design Basis

The design methodology provided in the Code is generally acceptable. However, the design criteria in the Standard shall take precedence over the criteria in the Code.

The hydraulic design, network layout and pipe sizing shall meet the conditions for all planned stages of development.

In unusual scenarios, the design may be required to include aspects that are atypical of standard water reticulation design. In such cases, the principles of other Design Standards shall apply as applicable.

2.2.1.1 Design Criteria

(a) Reference Ground Level

The reference elevation to meet pressure requirements for an urban property is the ground level found on the front 30 m of the property. Minimum pressures are calculated using the highest contour in the front 30 m of the property. Maximum pressures are calculated using the lowest contour in this same area of the property.

In the case of a "battleaxe" lot, the 30m is considered applicable from the "head" of the lot as shown in Figure 1.1.

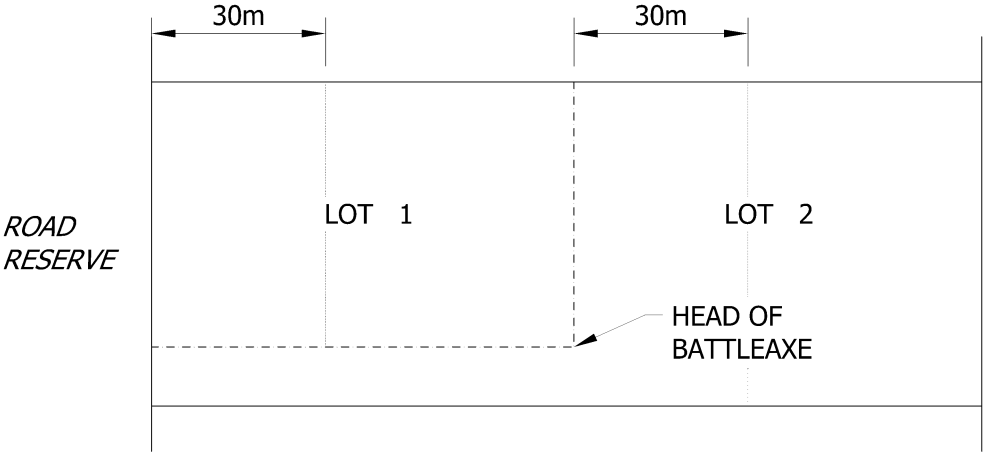

FIGURE 1.1
(NOT TO SCALE)

The reference elevation for a farmland service is the highest point along the property boundary abutting the pipeline.

Where building envelopes are clearly defined on plans for subdivision, the reference elevations for maximum and minimum head calculations may be restricted to the area of the building envelopes, provided adequate planning controls are available to ensure that variations are not permitted. Any anomalies between supply to the front 30m and a defined building envelope shall be submitted to the Corporation for assessment.

(b) Minimum Head

The minimum head **(H_{min})** at the reference ground level of every serviced lot shall be:

- 17 m in the Perth Metropolitan Area.
- 15 m in Country urban areas.
- 15 m in farmland services where flow rate restrictions are employed.
- 5 m in farmland services where flow is discharged into a holding tank or stock trough at the service off-take.

(c) Maximum Head

The maximum head **(H_{max})** at the reference ground level of a serviced lot shall be limited to 100m.

(d) Pressure Fluctuations

To limit pressure fluctuations for a serviced lot, the minimum head shall be no less than that given by the formula:

$$H_{min} = 2.7(H_{max})^{1/2}$$

The maximum pressure shall be that which occurs under static conditions, unless higher pressure occurs in other situations.

2.2.1.2 Sizing of Mains

Water reticulation mains shall be sized so that the velocity of flow in pipes is kept below 2 m/s and with full consideration of the following:

- The impact of adjoining water supply schemes and high-level supply zone boundaries or operational control zones.

- The impact of staging the water supply to a development area in the event that all of the distribution mains defined in the Scheme design are not in place at the time of initial supply.
- The eventuality of a single distribution main connection being closed;
- The eventuality of any one section of the water reticulation being isolated;
- All aspects of the overall long-term supply situation.
- As many services as hydraulically possible are placed on each main to ensure it remains self-cleansing within the limits of minimum supply heads.

(a) Limits on Reticulation Main Size

The largest pipe size to be used for water reticulation shall be DN 250.

In normal circumstances, e.g. suburban and country residential or higher density development, the minimum pipe size shall be DN 100 except in the following situations:

- DN 63 (PE) or DN 50 (CU), may be used as dead end mains in cul-de-sacs serving up to 10 single residential lots if fire hydrant is not located within the main. Hydraulic design check shall be carried out for each cul-de-sac.
- DN 150 shall be the minimum pipe size for areas within industrial and commercial zones.
- DN 200 shall be the minimum pipe size of for the central business districts of Perth, Fremantle, and Joondalup.

The Corporation may specify minimum acceptable pipe sizes in particular locations to meet the needs of distribution planning and future growth areas in regional centres.

(b) Improvements to Existing Mains

Improvements to the hydraulic capacity of existing mains may be necessary as a result of a proposed development. The nature and extent of the improvements will be determined by the Corporation.

2.2.1.3 Reticulation Layout

The water reticulation shall as far as practicable, form a series of closed loops to minimise dead end mains. Every group of 50 or more properties shall be supplied by more than one pipe route.

Within a subdivision agreement area, mains shall be provided across the full frontage of all lots created except where future extension of the main will not be required. Every lot shall be served by a reticulation main along one of the street frontages of the property, i.e. in gazetted road reserves.

Where agreed to by adjacent landowners, water reticulation may proceed up to 12 metres beyond the last lot. This facilitates future connection without disturbance to previous works and shall be in accordance with Water Corporation's land development procedures.

Dead end mains are permitted, but not preferred, in cul-de-sacs. Dead end mains may also be used at the fringe of a system but they shall be sized to cater for future extension where this can occur.

To facilitate future tie-ins to both the water and also the wastewater networks, an isolation valve must be provided on water mains at likely future connection points. The isolation valve/s must be located such that there will be sufficient buried pipe from the likely edge of excavation required for any future extension works, in accordance with Clause 4.4.5.5 and minimise the numbers of service connections affected by the future tie-in. The valving must facilitate the depressurisation (required for safety reasons) of the water main during the future extension of both the water and wastewater mains. Alternative design solutions may be considered at Water Corporation's discretion, provided they feature a safe arrangement to conduct a future connection that can be depressurised and that does not unduly inconvenience other customers with outages, etc.

2.2.1.4 Mains and Services Location

Mains shall align with the existing or proposed connection points from the distribution system and be located:

- within road reserves on an alignment of 2.1m measured from the property boundary in accordance with the Utility Providers Code of Practice for Western Australia, wherever practicable.
- where road reserves are not presently available, within easements negotiated and provided by the Developer over Crown land or Public Open Space.
- where the above routes are not available,

  either: within a lot of 3m minimum width provided by the Developer, transferred in fee simple to the Water Corporation;

  or: for farmland water reticulation, in an easement over private property where it is often more practical to lay the main in cleared farm paddock, (for example, within a fire break) rather than destroy the vegetation along a country road reserve, where agreed with the Water Corporation and Landowner.
- to minimise the number of long services (service pipes laid under the road to properties on the opposite side of the street). For a 30m or wider road reserve a reticulation main shall be placed on both sides of the street and all properties provided with short services.
- on one side of the road reserve. If a road crossing is unavoidable, each main should cross the road perpendicular to the road reserve boundary at 2.1m off the lot boundary and in line with property truncation point as illustrated in Figure 1.2.

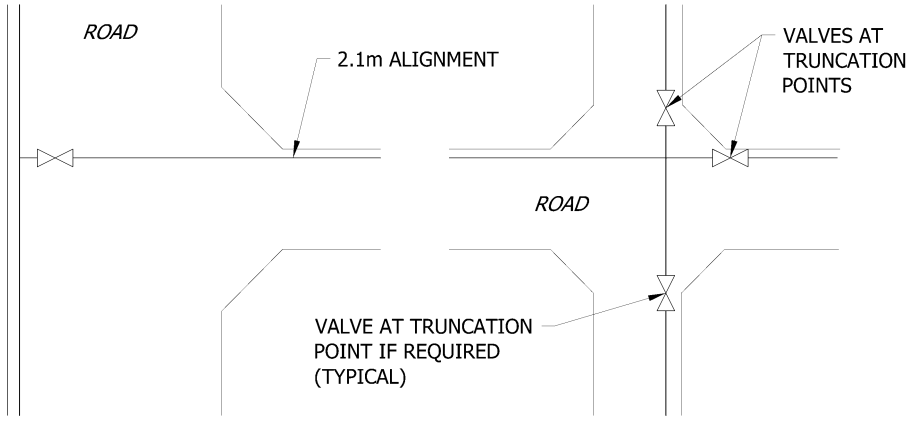

FIGURE 1.2
(NOT TO SCALE)

- where street corners have truncations larger than the standard, such as at an intersection that incorporates a major roundabout with extensive landscaping, the Corporation may require the mains to follow the boundaries on the 2.1m standard alignment.

Where a corner lot is the last lot to be supplied then the reticulation main shall continue across the lot frontage or the intersecting road to connect to an existing main.

Special attention shall be given to crossing a bridge or a river or structures such as tunnels or culverts. In these cases a proposal shall be shown in a Method Statement and submitted to the Corporation for consideration and acceptance. In addition, permission shall be sought from the relevant Authorities (e.g. Local Authority, Main Roads Western Australia, Department of Biodiversity, Conservation and Attractions, Department of Water and Environmental Regulation).

The design must consider on-site constraints, both existing as well as other utilities' designs.

2.2.1.5 Appurtenances

a. General

All appurtenances, including valves, must be located in the safest location practical for access, operation and maintenance. Proximity to moving vehicles and above ground features (e.g. power poles), topography, footing stability, space to conduct operation and maintenance activities and all other safety related aspects must be considered in the locating of all appurtenances.

Any infrastructure that requires access from the surface (e.g. pits, hydrants, valves, etc) must not be located within drains.

b. Valves

In a reticulation network, valves are required to isolate the reticulation mains for operational and maintenance purposes. These guidelines have been written so that where practicable, the network is able to be supplied through alternative mains if the primary main is isolated, without affecting a large number of lots.

For appropriately locating valves in a reticulation network, the concept of primary/secondary reticulation mains is defined (see fig 1.3):

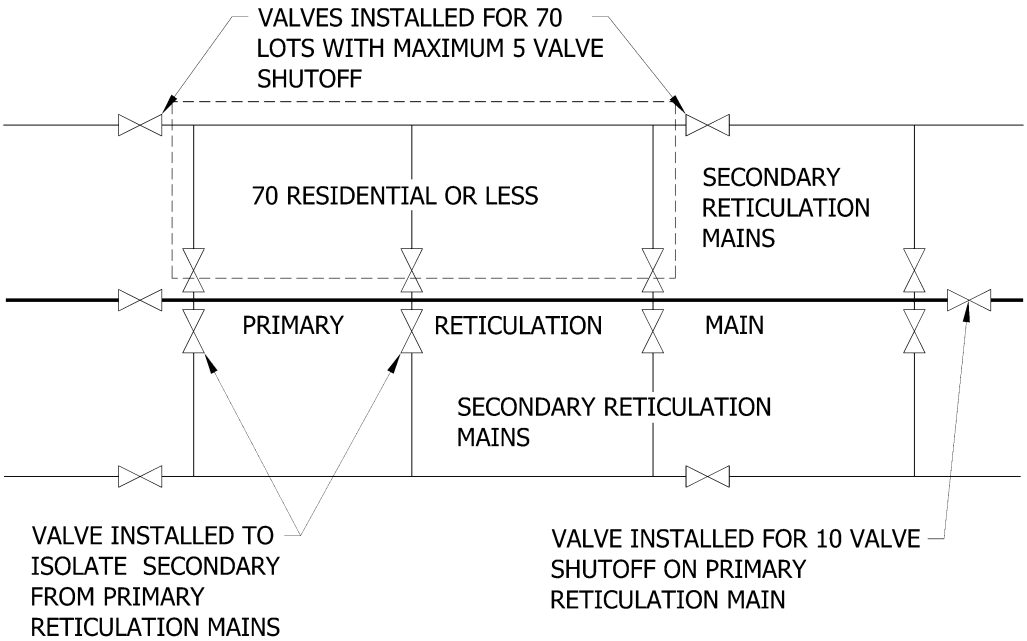

FIGURE 1.3

(NOT TO SCALE)

A primary reticulation main supplies water to a number of secondary reticulation mains. The primary reticulation main is normally a 200mm or 250mm diameter main supplying 150mm and 100mm secondary reticulation mains. Generally the primary reticulation main is:

- the connector to the distribution main, but is not the distribution main
- the spine main on a linear main network configuration
- the ring main on a ring main network configuration

Position isolating valves on reticulation mains so that:

- all secondary reticulation mains supplied from the primary reticulation main have isolation valves at the offtake from the primary main

- it is possible to isolate any section of a primary reticulation main by the closure of no more than 10 isolating valves
- isolating any section of reticulation main interrupts supply to no more than 70 residential lots or 20 non-residential lots
- it is possible to isolate any section of reticulation (but not primary reticulation main) by the closure of no more than five isolating valves
- valves are located at street boundary truncation points. Where there is no truncation, the valve shall be located 6m from the street boundary line as shown in Figure 1.4
- at connections to distribution mains as shown in Figure 1.5

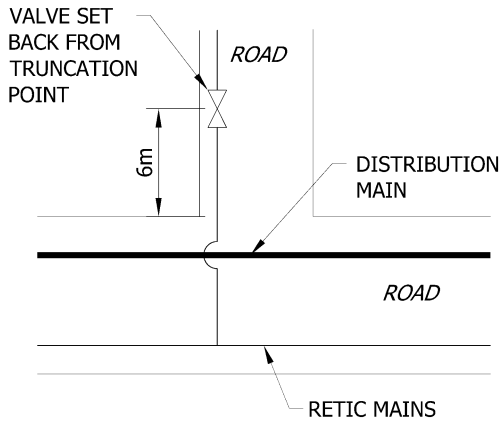

FIGURE 1.4
(NOT TO SCALE)

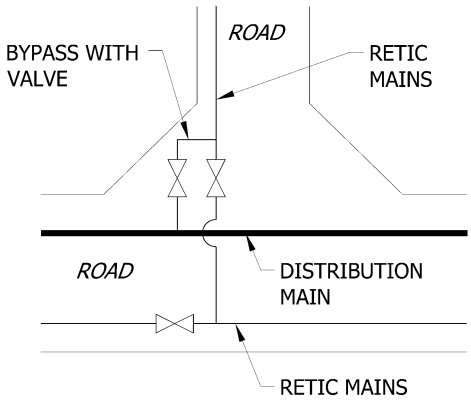

FIGURE 1.5
(NOT TO SCALE)

Intersecting mains shall be arranged in a configuration as typically shown on the drawings of this Standard.

The positioning of valves at truncation points, where circumstances such as main deviation around a non-standard or special truncation arise, shall be governed by the following requirements:

- Maintenance of each segment of a deviating main on a standard alignment relative to normal and truncation boundaries;
- A straight pipe length of at least 800mm between each socketed valve and an adjoining fitting such as a bend;
- The use of readily available standard pipeline fittings.

Compliance with these requirements may result in slight displacement of a valve from a preferred position square off a truncation point but is considered acceptable under these special circumstances.

Valves must be installed at the end of each pipe where future access to the pipe may be difficult, such as road crossings that may require trenchless techniques, in order to facilitate future operation, repair and maintenance.

c. Hydrants

Hydrants shall be screw-down hydrant with built-in isolation valve and installed only on DN100 or larger pipes. Hydrants shall be located:

- so that the maximum distance between a hydrant and the rear of a building envelope, (or in the absence of a building envelope the rear of the lot) shall be 120m;

- so that spacing (as measured by hose-run) between hydrants in non-residential or mixed use areas shall be maximized and no greater than 100m;
- so that spacing (as measured by hose-run)between hydrants in residential areas with lots per dwelling <10,000m^2 shall be maximized and no greater than 200m;
- so that spacing between hydrants (as measured by hose-run) in rural residential areas where minimum lots per dwelling is >10,000 m^2 (1ha) shall be maximized and no greater than 400m;
- centrally along the frontage of a lot to avoid being under driveways, unless the lot features a frontage 6m or less, in which case it shall be placed to the side opposite the driveway;
- at lots that have the widest frontage in the local area;
- where appropriate at the truncation of road junctions or intersections so that they can serve more than one street and can be readily located;
- on both sides of the major roads at staggered intervals where there are mains on both sides of the road;
- at major intersections on dual multi-lane roads, where two hydrants are to be sited on diagonally opposite corners;
- hydrants should be located at least 20m from traffic calming devices i.e. median slow points or chokers, chicanes, mini traffic circles, and intersection 'pop-outs' to ensure traffic is not impeded;
- in a position not less than 10m from any high voltage main electrical distribution equipment such as transformers and distribution boards, liquefied petroleum gas or other combustible storage
- directly on top of the main using a tee unless proved to be impractical

d. Air Valves

Air in water reticulation is normally dissipated through sufficient number of connected services in a typical residential development. However in special situations such as reticulation of rural towns where services are likely to be sparsely located and fed by long reticulation mains, the use of air valves or hydrants in the mains may be required to expel entrapped air in the system.

Air valves, where used in reticulation systems, shall be of DN 50 dual orifice installed:

- with a flanged or threaded isolating valve;
- within a lidded concrete pit rated for Class D loading and as agreed with the Corporation;
- to the requirements of the Corporation.

e. Scour Valves

Scour valves are not normally required in water reticulation for residential areas. In these areas scouring can be carried out through hydrants and flushing points. For long reticulation mains located in undulating terrain, or where installation of flushing points are not practical, scouring assemblies may be required, as required by the Water Corporation.

Where required, scouring assembly shall include a DN 100 flanged sluice valve and installed to the Corporation's requirements.

f. Flushing Points

All temporary blank ends and dead ends of mains shall be provided with flushing points as shown in the relevant DS63 drawings.

g. Pressure Reducing Valves

Pressure reducing valves shall be hydraulically operated and controlled by a Cla-Val CRD pilot control.

Pressure reducing valve installations shall be above ground and housed in a standard lockable vandal-proof metal cabinet. The cabinet shall have lockable doors or removable panels with concealed points of fastenings allowing maintenance access to all valves. The cabinets shall be subject to acceptance by the Corporation. An example of a suitable cabinet is shown on MI06-2-1 Pit type installation is not preferred and should be used in special circumstances agreed to by the Corporation.

2.2.1.6 Services

No services shall be connected directly to any distribution main.

The number of long services shall be minimised wherever practicable.

Prelaid and deferred water services shall be arranged in accordance with the requirements in the relevant drawings of the Standard.

2.2.1.7 Connections of Water Reticulation to Distribution Mains

The location and size of a connection of the water reticulation to a distribution main shall be determined in consultation with, and as accepted by, the Corporation. The following shall be the standard requirements:

- In industrial subdivisions, the smallest connection shall be DN 200.
- If more than 250 services are to be supplied from the connection, then the connection shall not be smaller than DN 300.

2.2.1.8 Trenchless Installations

Any sections of main that are to be installed via trenchless techniques must feature a comprehensive design prior to construction. The design must include:

- A plan of the trenchless section
- A long-section that details at every change in grade and feature :
    - Ground level
    - Pipe invert level
    - Size, type, depth, separation clearance of all crossing services
- Reamer size
- Installation method
- Pipe specification
- Settlement calculations where surface settlement may cause significant future problems (e.g. under rail). Note that HDD installs complying with Table 4.1 do not need further settlement assessment.
- Pipeline thrust mitigation and restraint from all forces including those induced by temperature and pressure
- Launch and receival pits
- Connection details to adjacent pipe/s

2.2.2 Drawings

Drawings shall show sufficient detail to clearly indicate the proposal for construction of the reticulation.

Water reticulation layout drawings shall be drawn to a scale of either 1:1000 or 1:2000 and include the following information:

- A legend indicating the symbols and abbreviations used, and the north direction which should be aligned towards the top and parallel to the side of the plan, wherever practical.

- The boundary of the Agreement Area for water reticulation.
- Street names, lot boundaries, lot numbers and the total number of lots served.
- Special land use other than single residential, e.g. duplex, POS, school, multi- residential
- The land required by the Corporation.
- Details of significant level changes, i.e. the extent and level of any cut or fill, road levels where substantially different from the natural surface, retaining walls
- Existing water mains serving all blocks adjacent to the proposed area of water supply and details of proposed connections to the existing mains.
- A notation indicating the pipe material, class and diameter, and length(s) of the pipelines.
- The location and alignment of the pipe including location of valves, hydrants, flushing points, prelaid services and indication of lots to have deferred services.
- The Corporation file numbers and plan number including plan number of all relevant standard drawings and the Planning reference number.
- lot levels in mAHD (for works involving scheme pressure zoning)A typical proposed water reticulation layout drawing is included in Section 6 of the Standard.

2.2.3 As Constructed Documentation

2.2.3.1 General

As constructed documentation shall be based on:

- Measurement of work prior to backfilling of trenches
- Measurements from installed cadastral survey pegs for the subdivision.
- The MGA94 coordinate system.

2.2.3.2 Format of As Constructed Drawings

As Constructed Drawings shall be prepared in the format provided below:

- A title block and information box as shown on the typical As Constructed Drawing template as in Section 6 of the Standard;
- Data for final pre-calculated plan in digital form (DXF file having a coordinate system based on MGA94 and datum to AHD) in the correct format compatible with the Corporation’s Facilities Mapping System;
- Hard copy (signed) in A4 to A1 sheet according to the extent of subdivision, as directed by the Corporation;
- The digital file layout shall be in accordance with the WCX CAD Standard.

2.2.3.3 As Constructed Drawing Layout

As Constructed drawings shall have the following layout:

- The Local Authority and Suburb name;
- Name of Project;
- Reticulation Plan Reference and Primary Grid reference "Ref plan . . . . . .";
- Plan and Drawing Number (at bottom right hand corner, in large, bold letters and numbers).

  (Corporation to provide this information)
- Corporation Reference Information (at top right hand corner):

  Subdivision file number: "Sub File . . . . . ."

  Planning No: "WAPC. . . . . ."

File Reference No: "Main Ext'n File . . . . . "

- Mains-laying Information Block (at right hand side):

  Actual total lengths of each type laid and size of main.

  Consultant's name, signature and date.

  Licensed Surveyor's signature and date.

  Date commenced . . . . . .

  Date completed . . . . . Date of F.T.I. . . . . .

- Notes:

  Note 2. State brand names of valves, fittings and pipe, and pipe manufacture date.

- Legend for all services shall be shown according to the Drawing as shown Section 6 of the Standard.
- Standard abbreviations as in Section 1 of the Standard except that:

  a) for PVC mains use the format 150P16(1.8), where 150 is the diameter in millimeters, 16 is the nominal pressure rating, and (1.8) is the alignment. The alignment label should only be used for pipes laid parallel to the property boundary with alignment other than 2.1m.

  b) for Polyethylene mains use the format 63PE20(1.8), where 63 is the nominal diameter in millimeters, 20 is the nominal pressure rating, and (1.8) is the alignment. The alignment label should only be used for pipes laid parallel to the property boundary with alignment other than 2.1m.

2.2.3.4 Details on As Constructed Drawings

As Constructed Drawings shall be drawn to a scale of either 1:1000 or 1:2000 as appropriate and shall include the following:

- Information on the correct position of all mains and appurtenances accurate to within 0.1m including size, class and types;
- Street names, Reserves, Public Access Ways, Right of Ways, Public Open Spaces, lot numbers and boundaries;
- Running chainages for each continuous length of main relating the positions of all valves, hydrants and fittings to the nearest lot boundary or road reserve boundary;
- Depth to the top of the pipe from the final verge level and the gutter level at intervals of 30 metres (maximum). The depths shall be recorded on the drawing, e.g., V:0.7m, or G:0.5m for gutter;
- The start of each connection to the existing network, or change in either pipe material or pipe size shall be marked as "START 00m". "START 00m" shall have a measurement relating its position to the nearest lot boundary or building line, along the alignment of the main;
- All sluice valves marked with size and chainage (e.g. 150 SV 10.2m);
- All tees marked with chainage (e.g. TEE 10.2m);
- All bends marked by angle and chainage (e.g. 45º BEND 10.2m);
- All bronze gate valves marked with chainage (e.g. SV 10.2m;
- All hydrants marked with chainage (e.g. HYD. 10.2m)
- Flushing points installed on the end of mains shall be marked as "END" with chainage (e.g. END FP 110.2m);
- Intermediate flushing points shall be marked with chainages (e.g. FP. 109.2m);
- All blank ends shall be marked as "END" with chainage. (e.g. END 110.2m);
- The chainage of the lot boundary nearest to each appurtenance listed above shall be marked.

A typical Reticulation As Constructed Drawing is included in Section 6 of the Standard.

3 PRODUCTS AND MATERIALS

3.1 General

3.1.1 Definitions

The term "product" shall, for the purposes of this standard, have the same meaning as the term "products and materials" and shall be taken to include manufactured products, discrete product components and component materials. The term "supplier" shall be taken to include the product manufacturer, owner, producer, distributor, retailer, vendor and any agent, contractor or provider of a service related to the product.

3.1.2 Product Quality Requirements

Water reticulation product shall be new and shall have mechanical, corrosion resistant and operational characteristics that render it fit-for purpose in live service. Product shall be packaged, handled and installed so that, when installed in accordance with the recommended installation guidelines, it will operate in pressurized water services within the specified operating parameters for at least 50 years before its major rehabilitation or replacement is required.

3.1.3 Product Suitability for Contact with Drinking Water

All elements of water reticulation product in contact with drinking water shall comply with the requirements of AS/NZS 4020. All water reticulation systems shall be handed over to the Corporation in a hygienic and disinfected condition in accordance with Section 4.4.8 of the Standard.

3.1.4 Nominated Product

Where a specific proprietary product is nominated, an alternative product that is demonstrated to be equal in quality and function may be substituted, subject to authorization by the Corporation in accordance with **Table 3.1:** Standard Water Reticulation System Requirements, and subject to its listing in the "Strategic Products Register – Water, Wastewater and Drainage Systems" as a conforming product.

3.2 Product Compliance

3.2.1 Performance Compliance Requirements

Water reticulation product shall comply with the requirements of **Table 3.1**. All products used must be listed in the "Strategic Products Register – Water, Wastewater and Drainage Systems" (SPR), unless there is no viable alternative.

3.2.2 Ancillary Materials Compliance

Materials ancillary to the construction of water reticulation shall comply with requirements of Table 3-2.

Table 3.1 - Standard Water Reticulation System Requirements

No.	PIPELINE FEATURE		POLYVINYLCHLORIDE (PVC)	POLYETHYLENE (PE)	MILD STEEL (MS)	COPPER (CU)
			PIPES			
1	Pipe standard & materials		PVC-U: SPS 115 PVC-M: SPS 116 (Note 4)	AS/NZS 4130 PE100, fabricated from a resin that is both designated HSCR in PIPA POP 004, as well as classed as Disinfection Resistant in accordance with Water Corporation SPS 125 and listed as such in the Water Corporation's Strategic Product Register	SPS 100 Steel grade K1016 to AS1594	AS 1432 Type A Cu-DHP (UNS C12200) to AS/NZS1279
2	Pipe diameter series		Series 2 (Cast Iron Outside Diameter)	Series 1 (ISO outside diameter series)	SPS 100	N/A
3	Identifying colour		SPS 115/116 Clause 2.3	Black striped blue to WSA-01. Pipes must also be indelibly marked with the resin manufacturer and also resin grade.	N/A	AS 1432 Clause 14.3
4	Nominal diameters: (Note 2)	Standard	DN100, 150, 200, 250	None	DN100, 150, 200, 250	DN20, 40, 50
		Conditional (Note 18)		OD25, 32, 63, 125, 180, 250, 315 (Note 21)		DN100, 150
5	Pressure ratings: (Notes 3, 5, 19)	Standard	PN, 16	PN20 (refer Note 21)	PN40 approx. (governed by steel plate thickness)	PN24 ,15, 13 (DN50, 100, 150 respectively)
		Conditional (Notes 18)	PN20			
6	Product age		<12 months; < 6 months if exposed (Note 15)	< 12 months	< 12 months	< 12 months
			PIPE FITTINGS			
7	Pipe fittings :	Standard & materials	SPS 106	For OD25mm-OD63mm:AS/NZS 4129 compression jointed; For OD125mm-OD315: Ductile Iron fittings as per SPS106 (Note 8)	Fabricated to Pipe Fittings Standard Drawings (Note 13)	Silver-soldered capillary short fittings to AS 3688 (Note 12) Compression fitting: Viega Propress (Note 20)
		Pressure rating (Note 3)	Rated ≥ PN16	Rated ≥ PN16	Rated ≥ PN16 (governed by steel thickness)	Compression: PN12; Capillary: as retic. pipe
8	Flanged pipe fittings: (Note 3); (Flange requirements :	General requirements	SPS 106	AS/NZS 4129 PE stub flange with steel backing ring to AS 4087, galvanized to AS/NZS 4680, wrapped to DS95 (refer Note 8)	AS 4087 Figures B7& B8	AS 4087 Figure B1
		Pressure rating: applications ≤ PN12	Rated ≥ PN16	Rated ≥ PN16 (Note22)	AS 4087 PN16	AS 4087 PN14
		applications > PN12 & ≤ PN16	Rated ≥ PN16	Not permissible	AS 4087 PN16	Not permitted for pipelines above PN12
		applications > PN16 & ≤ PN20	Rated ≥ PN20	Not permissible	AS 4087 PN21	Not permitted for pipelines above PN12
9	Tapping bands c/w DN20, 25 or 40 RP thread tapping (Notes 6, 12)		WSA 107: DN 100, 150, 200, 250	WSA 107 & AS/NZS 4129: OD 63, 125, 180, 250	Pipe Fittings Standard Drawings	WSA 107: DN40, 50
10	Self-cutting tapping bands (Notes 7, 12)		DN 100, 150, 200	OD 63, 125, 180, 250	Not applicable	Not applicable
			VALVES AND HYDRANTS			
11	In-line isolating valves DN20-50		Copper alloy gate valves to SPS 255 or ball valves to SPS 252. Ball valves for mains tapping isolation to SPS 251 (Notes 1, 12)			
12	Meter isolating valve DN 20		Copper alloy right angle ball valve to SPS 254 (Notes 1, 12)			
13	Isolating gate or butterfly valves DN80-250		Butterfly valves to (DN100-250) to SPS 261. PN16 rated resilient seated gate valves to SPS 272 up to PN16 and PN35 metal seated to SPS 271 for applications > PN16. (Note 1)			
14	Screw-down hydrants		SPS 292 (Note 1)			
15	Extension Valve Spindles		Drawing AQ71-3-1.			
			PIPE COUPLING AND REPAIR FITTINGS			
16	Pipe couplings without axial restraint (Note 9)	Axially bolted (Gibault)	WSA 105 long series, rated ≥ PN16 (Note 1)	Not permissible	WSA 105 long series, rated ≥ PN16 (Note 1)	WSA 105 long series, rated ≥ PN16 (Note 1)
		Circumferentially bolted	316L/316Ti SS body; 316 SS fasteners ≥ PN16	Not permissible	316L or 316Ti SS body; 316 SS fasteners	316L or 316Ti SS body; 316 SS fasteners
17	Pipe couplings with axial restraint (Note 10)		Conditional (Note 18)	Conditional (Note 18)	Not applicable	Not applicable
18	Slip-on pipe repair couplings (Note 9)		DN100 moulded GRP coupling	Not applicable	Not applicable	Not applicable
19	Wrap-around pipe repair clamps (Note 11)		SPS 152	Not permissible	SPS 152	SPS 152
			INSPECTION COVERS, FRAMES AND SERVICE CHAMBERS FOR VALVES, HYDRANTS AND METERS (Note 14)			
20	Stop tap cover, frame and service chamber		Drawings AQ71-1-3 and BD64-3-1			
21	Sluice valve cover, frame and surround		Drawings AQ71-1-4 and BD64-2-1 (trafficable); BD62-2-1 (non-trafficable)			
22	Section valve cover and frame		Drawings AQ71-1-5			
23	Hydrant inspection cover, frame and service chamber		Drawings AQ71-1-2 and BD64-10-2			
24	Meter inspection cover, frame and service chamber		Drawings AQ71-1-1, BD64-10-1 (GRP) and BD64-4-1 (Timber or Plastics)			
25	Standup Service Protector		Drawing BD64-9-1			
			LIMITATION ON PIPELINE INSTALLATION APPLICATIONS			
26	Above ground or exposed		Not permissible	Not permissible	Acceptable	Acceptable
27	Buried		Acceptable	Acceptable (Note 21)	Acceptable	Acceptable
28	In unstable ground conditions		Not permissible	Not permissible	Acceptable if welded (Note 13)	Conditional (Note 18)

29	In bridge crossings	Not permissible	Conditional (Note 18, 21)	Acceptable if welded (Note 13)	Conditional (Note 18)
30	Below creek or waterway beds	Not permissible	Conditional (Note 18, 21)	Acceptable if welded (Note 13)	Not permissible
31	In Perth or Fremantle CBD	Not permissible	Conditional (Note 18)	Acceptable if welded (Note 13)	Conditional (Note 18)
32	In pumping main applications	Conditional (Note 18)	Conditional (Note 18)	Acceptable	Conditional (Note 18)

Table 3-1 Notes

1	Relevant Strategic Product Specifications (**SPS *****) and Design Standards (**DS****) may be obtained at Water Corporation's website https://www.watercorporation.com.au/home/suppliers/resources/design-standards. WSAA Standards (**WSA *****) may be downloaded from the WSAA web site at www.wsaa.asn.au. WSAA National Codes (**WSA ****) may also via the WSAA website at www.wsaa.asn.au or by telephoning WSAA on 03 9606 0678.
2	CIOD (Cast Iron Outside Diameter) pipes means the range of pressure pipes of the same DN and same OD e.g. grey/cast Iron (CI), ductile iron (DI), asbestos cement (AC) with some exceptions, PVC pipe series 2 and GRP. ISO pipe outside diameters most commonly mean PVC pipe (metric) series 1. Series 1 PVC, PE and steel pipe ODs conform to ISO diameter series that are not diameter compatible across all reticulation sizes.
3	Unbalanced hydrostatic forces at axially unrestrained pipeline joints (e.g. socketed bends, tees, tapers, blank ends) shall be counterbalanced by permanent thrust or anchor supports in accordance with the drawings (e.g. BD62-2-3). All components connected to and downstream of a reticulation system having an operating pressure up to PN20 shall, in the absence of an intervening PRV, be rated $\geq$ PN20. Otherwise pipeline fittings and components shall be rated $\geq$ PN16.
4	The general use of MPVC pipe shall be limited to reticulation (not pumped) watermain applications.
5	PVC pipeline systems shall be re-rated for exposure to temperature variations and, where used in pumping applications, for exposure to cyclic fatigue effects. Re-rating shall be in accordance with WSAA Technical Note TN4 (available on WSAA web site) or shall be supported by appropriate pipeline temperature, water hammer and cyclic fatigue design analysis
6	Tapping bands shall be designed for the selected watermain and service pipe materials and shall be tapped to the AS1722.1 RP thread series. A tapping band for use on plastics pipelines shall have an E-lip type seal. Each plastics tapping outlet boss shall be provided with a Type 316 stainless steel reinforcing ring to prevent leakage in long term service due to creep of the plastics material. Wherever there is a requirement for a DN 50 service pipe, threaded service fittings shall be DN 40 as DN 50 fittings are not supported by the Corporation materials catalogue or stock. Connection to existing (legacy) DN 50 threaded tapping bands and fittings may be by means of DN 50 to DN 40 adaptor fittings. The use of tapping bands for pipe repair in lieu of authorized repair fittings is not permissible. Threads to comply with Clause 4.4.5.2
7	The use of tapping ferrule stop taps (e.g. Drawing BD22-11-1) or tapping bands incorporating self-tapping cutters for under-pressure installation shall be conditional (i.e. permissible only by express written authorization of the Corporation). For acceptance, a nominal DN20 service self-tapping assembly shall have a compression off-take to suit DN25 PE pipe.
8	PE fittings are not permitted other than stub flanges and reducers. PE stubs and reducers must be fabricated from the same resin as the main pipeline. For example, if the pipeline is fabricated from an HSCR grade resin, then the stub flange fitting must be made from the same HSCR grade resin.
9	The use of slip-on or bolted pipe couplings shall not be generally permissible in lieu of integral (or factory) pipe sockets and purpose made pipe fittings in new reticulation pipeline work. Where permitted, axially bolted pipe couplings shall be long series complying with WSA 105. Where permitted, the use of short length (e.g. < 150 mm) circumferentially bolted pipe couplings shall be limited to straight (un-deflected) pipeline joints in order to minimize the risks to joint integrity in long term service.
10	The use of pipe couplings that provide axial restraint shall be conditional. Where permitted, the use of couplings with axial restraint on PE pipe shall require each PE pipe end to be coupled and to be internally supported by means of a 316L stainless steel ring stiffening insert that is designed for the particular PE pipe ID.
11	Selection and use of pipe repair couplings/fittings and wrap-around repair clamps shall comply with DS 52 and SPS 152 respectively. Mechanically bolted pipe repair clamps shall not be permissible for permanent repair of PE pipelines.
12	Copper alloy pipe fittings shall be dezincification resistant to AS2345. Copper alloy compression fittings shall not be permissible in buried or concealed pressure applications and shall be in accordance with Drawing BD62-8-31. Silver brazing alloy for capillary joint work shall be in accordance with AS1167.1. Wherever pressure-tight joints are made on threads, threaded fitting ends shall be R (external) and RP (internal) in accordance with AS ISO 7.1.
13	Uncoated, welded, and bolted pipeline joints that feature metallic components shall be wrapped for corrosion protection in accordance with DS95.
14	Tap, valve and hydrant cover and frame assemblies shall be lightweight (no individual component >12 kg weight) with an AS 3996 Class B load classification in urban road verge applications. They shall be heavy duty (usually metallic) with an AS 3996 Class D load classification in trafficable applications. The frame footprint shall be designed to withstand a vertical point load > 20 KN and shall be sized to distribute this load together with the assembly self-weight without exerting any force in excess of 100 kN/m2 on the foundation soil.
15	PVC pipe shall be permissible only if less than 12 months old and less than 6 months exposed to direct sunlight. Exceptions will be determined by the Corporation on a project-by-project basis, subject to the quality of supporting documentary evidence provided.
16	All pipeline and service components in contact with drinking water shall comply with AS/NZS4020 for a minimum component surface to water volume ratio (or scaling factor) to be agreed by the Corporation.
17	Any reticulation or service component that is second-hand or has been previously used in live service shall not be acceptable for new reticulation assets
18	"Conditional" shall mean a requirement to submit justified materials selection, design and installation methodology proposal to the Corporation (Engineering Branch) for determination of acceptability
19	Where used as a service connection north of Latitude 26°S, must be installed within a continuous DN50 PN16 PVC sleeve, from mains connection to meter.
20	Viega compression fittings must be installed using a calibrated Viega compression tool by installed that has satisfactorily completed the associated training course (currently administered by Reece). Compression fittings are not permitted under roads, driveways or other similar surfaces that are difficult to access in the future.
21	PE pipes are only acceptable for: • Single and dual service connections; • cul-de-sac installations (refer BD62-7 drawings); • horizontally directional drilled installations (refer limitations on HDD installation in Clause 4.4.5.3). The use of PE pipes for any other application is not acceptable. Where pipes are installed using methods, including HDD, that have potential to scratch or damage the exterior of the pipe, the wall thickness must be increased by a minimum 10% beyond what would otherwise be required for open-trench installation methodologies.
22	The metallic backing ring and raised lip of PE stub flanges must be rated to at least PN16 to AS4087, however all other PE components of stub flange fittings must be rated at least PN20.

Table 3.2 - Ancillary Materials Standards and Requirements

No.	ANCILLARY MATERIAL	STANDARD SPECIFICATION	OTHER REQUIREMENTS
1	Concrete thrust supports, inspection pits and chambers	To AS 1379 grade N25	Cement Type GP AS 3972. Work to AS 3600 and AS 3610
2	Precast concrete components	To AS 1379 grade N40	
3	Reinforcing steel bars; fabric	To AS/NZS 4671 grade 400Y; grade 450F	
4	Timber/Plastics components	F8 unseasoned jarrah to Table 2.4 of AS 1720.1. Plastics product of proven equivalent strength.	
5	Steel bars/sections/flats	To AS/NZS 3679.1 grade 350	Galvanizing to AS/NZS 4680. Work to AS 4100.
6	Steel plate/floorplate/slabs	To AS/NZS 3678 grade 400	
7	Fasteners for flange, pressure-containing and general applications (steel/steel connection)	**Carbon steel**: Fasteners AS 1252 & AS 4291 property class 8.8. Washers must have Vickers Hardness between 320 and 390	Galvanizing: Bolts & nuts to AS 1214. Washers to AS/NZS 4680.
		Stainless steel: Bolts to AS 1111.1 & ISO 3506.1 property class 70; nuts to AS 1112.3 & ISO 3506.2 property class 70; washers to AS 1237.1 & ISO 7089.	
8	Fasteners for structural connection work (steel/steel & steel/concrete connection)	**Carbon steel**: Fasteners AS 1252 & AS 4291 property class 8.8. Washers must have Vickers Hardness between 320 and 390	Galvanizing as for flange fasteners.
		Stainless steel: Type 316 (A4), mechanical property class 80 - bolts to AS 1111.1 & ISO 3506.1, nuts to AS 1112.1/ISO 3506.2 and washers to AS 1237.1/ISO 7089.	
9	General fastener installation	Washers required under bolt heads and nuts. Stainless steel structures to comply with AS/NZS 4673. Stainless steel fastener threads to be coated with molybdenum based or other anti-galling lubricant of approved formulation. Fastener anchorage into concrete to be by means of approved non-expansive adhesive resins.	Spring washers required wherever fastened connections subject to dynamic loads, vibration or relative movement.
10	Flange gasket material	Single ply EPDM or NBR, 3mm thick; mechanical properties to Table 3.1 of AS 1646.2 for IRHD 55 to 75.	Gaskets < DN150 full faced. Otherwise narrow faced.
11	Steel nails	To AS 2334	
12	Pipeline bedding and side support material	Natural or imported embedment zone material as defined in AS/NZS 2566.2 and graded in accordance with Table G1 of AS/NZS 2566.2 (Appendix G), with additional requirement that 100% of material must pass a 13.2mm sieve.	10mm crushed rock graded in accordance with Table G3 (Conditional)
13	Trench & embankment fill material	**Trafficable areas –** Well graded cohesionless material with 100% passing a 75mm sieve but with no more than 10% passing a 0.075mm sieve, free of organic matter as determined in accordance with AS 1289.4.1.1.	Subject to road owner and local authority requirements.
		Non-trafficable areas - Natural or imported cohesionless material with 100% passing a 150mm sieve but with no more than 15% passing a 0.075mm sieve.	
14	Bedding & fill testing	Material particle size distribution/grading to be tested in accordance with AS 1289.3.6.1 for soil or AS 1411.11 for aggregate.	

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4 CONSTRUCTION REQUIREMENTS

4.1 General

4.1.1 Construction Responsibilities

Water reticulation shall be constructed to the requirements of the Corporation as required by Section 1.6 of the Standard. Where expressly stated in the Standard the requirements of the Code shall apply.

4.1.2 Impact on Existing Infrastructure

Construction activities that may interfere with, or impact directly or indirectly on existing Corporation infrastructure including existing water reticulation are not permissible except with the agreement of the Corporation.

4.1.3 Accreditation Requirements

Water reticulation construction personnel shall be accredited in accordance with the following accreditation programs, appropriate to the pipeline materials of each project:

- Steel pipeline construction - Construct and Install Water Distribution Assets (Sintakote Quality Pipeline Installation Program) by Steel Mains.
- PVC pipeline construction - PVC Pipelaying course conducted by South Metropolitan TAFE and/or Civil Contractors Federation (WA)
- PE pipeline welding work - Water Corporation Plastic Welding Panel Member.

4.2 Prevention of Contamination

During the construction of water reticulation, all materials, components and installation shall be configured so as to prevent any contamination of system water. A high standard of hygiene shall be maintained with respect to the personnel engaged and all materials, tools and equipment used in the construction of the work. In particular materials, tools or equipment used previously on live sewerage work shall not be permissible on water reticulation work.

All pipelines and all PE pipes must be capped at both ends to prevent ingress of dust, vermin and other contaminants.

4.3 Materials

The specification of materials for construction of water reticulation shall be in accordance with Sections 3and 4 of the Standard and as defined in the Drawings.

4.4 Construction

4.4.1 Survey and Setting Out

4.4.1.1 General

Water reticulation shall be set out in accordance with the Drawings. Any deviation from the accepted drawings shall be subject to acceptance by the Corporation.

4.4.1.2 Survey Pegs

When finished levels are achieved on lot boundaries after the completion of road reserve clearing and road earthworks:

- sufficient cadastral survey pegs and temporary pegs along curved lot boundaries shall be installed to enable the proper construction of the water reticulation. All pegs shall be uniquely marked so as to be clearly identifiable in relation to individual lots.

- cadastral survey pegs installed for the water reticulation work shall remain uncovered and undisturbed and shall be available for the Joint Final Inspection. Any disturbed cadastral survey pegs shall be re-established by a Licensed Surveyor.

4.4.2 Handling of Pipes and Fittings

All pipes and fittings shall be handled and installed in accordance with the Standard and manufacturer's recommendations in a manner that will prevent physical or structural damage to pipes, coatings, linings and elastomeric seals. The matter shall be referred to the Corporation for direction where these requirements conflict.

Pipeline components including coatings and linings that are damaged, including scored pipe surfaces, and cement lining cracks larger than 0.1mm shall be rejected.

Pipes and fittings that have coatings or linings of polymeric or plastic materials shall not be exposed to the external environment for more than 12 months prior to use.

4.4.3 Pipe Alignment and Depth

4.4.3.1 Alignment

Pipelaying shall not commence until the cadastral survey pegs required to determine the pipe alignment are in position. The following requirements shall apply unless otherwise shown on Drawings:

- Pipe alignments shall generally be in accordance with the Utility Providers Code of Practice, being 2.1m for pipe in a single pipe trench (1.8m is acceptable for a pipe in a common trench with other utility services), measured at the pipe joints from the pipe centre line to the road reserve boundary.
- In a common trench, the water reticulation main shall be laid with other services in accordance with the alignments and depths shown on the Drawings.
- In Public Access Ways, Public Open Space and other reserves, the main shall be laid parallel to and on an alignment of 2.1m from the nearer side boundary.

Mains shall be laid true to line within 100mm from their correct alignment, except where obstacles prevent access to the alignment. In such instances, a proposal that is acceptable to all utilities shall be submitted to the Corporation for acceptance. All agreed alignment variations shall be documented on the As Constructed Drawings.

Pipelines laid alignments other than 2.1m must be installed with a pipe identification/detection tape 300mm above the pipe crown. Tape must comply with AS2648, include a metallic tracer wire (with corrosion resistance equal to or better than 316 stainless steel) in a sinusoidal wave pattern fully encapsulated within the tape.

4.4.3.2 Pipeline Depth (Cover)

Pipes shall be laid at the depths stated in Table 4.1 and to the details shown on the Drawings except as agreed by the Corporation.

Table 4.1 – Allowable Pipeline Cover

Installation Method	Pipe location	Pipe Size (mm)	Allowable Cover (mm)	
			min	max
Open Cut	Verge	All	600	900
	Minor Road	All		
HDD	Verge	≤125	750	
		180		
		250	900	1100
	Minor Road	≤125	750	900
		180	1000	1200
		250	1200	1500
All	Major Road*	All	1500	1700

** Pipes under Major Roads have additional requirements beyond those stated in this Design Standard and must be reviewed in each case by Water Corporation Engineering Branch for acceptance. They must also comply with the road owner's cover requirements*

The following additional requirements shall be complied with:

- Generally pipes shall be laid as straight as practicable and in compliance with manufacturer's recommendations while maintaining the appropriate minimum cover. Change of grade shall be effected by means of a smooth transition over a number of pipes to avoid exceeding the maximum allowable deflection and possible entrapment of air;
- Concrete encasement or protective cover slabs are not permissible as alternatives to maintaining minimum pipe cover.

4.4.3.3 Crossing of Other Services

A minimum vertical clearance of 150mm and minimum horizontal clearance of 250mm (both measured wall-to-wall) must be maintained at all times with other services unless the other service owner has greater clearance requirements (for example, 300mm is the minimum required clearance with electrical services in accordance with AS 3000), in which case the greater of the two clearance requirements shall be met. Flanges and other appurtenances of greater diameter than the pipe shall not be located at pipe crossings.

4.4.4 Excavation and Bedding

4.4.4.1 General

Prior to excavation:

- mains, pipes, cables, other services and equipment belonging to the Corporation and other Utilities that are adjacent to a proposed water reticulation system shall be located and potholed;
- all temporary work required to support and protect exposed or buried mains, pipes and cables, to the requirements of the relevant Public Utilities shall be carried out to ensure that the operation of the services is not interrupted in any way.

4.4.4.2 Excavation Work

(a) Open Trench Excavation

Where open trench excavation is proposed, pipe trenches shall be excavated to alignments, depths and widths required by the Drawings to provide the required pipe cover and clearances. The following requirements shall also apply:

- Trenches shall be dewatered where necessary until each section of main has been completed and tested. Groundwater shall not be allowed to enter pipes;
- Over excavation shall be filled with compacted bedding material.

(b) Trenchless Excavation

Where open trench excavation is not practicable, such as across major roads, freeways and railways, under major obstructions, and wherever shown on the Drawings, the pipeline shall be installed by trenchless technology methods. The methods shall be to the requirements of the controlling authority and acceptable to the Corporation. The Drawings shall detail all such requirements.

4.4.4.3 Bedding

Trench bedding shall be constructed in accordance with the Drawings and to meet the following requirements:

- For trenches in sand or gravel the natural soil at the trench bottom shall be compacted;
- For trenches in other soil types the trench shall be over-excavated by at least 150mm in depth, refilled with imported bedding material and compacted as for trenches in granular soils;
- In all cases the trench bottom shall be hand trimmed immediately before placing the pipe to provide even support to the whole pipe barrel, with additional trimming required to accommodate components with greater diameter than the pipe, such as pipe sockets.

4.4.5 Pipe Laying and Jointing

4.4.5.1 Preparation of Pipes

Immediately prior to laying of the pipes:

- the pipes, particularly the pipe ends shall be examined for cracks, scoring, gouges or other defects that may affect the pipeline integrity. Defective pipes shall be rejected;
- all sand and other foreign materials shall be removed from the pipe bore before lowering each pipe into the trench.
- the mating pipe spigots, socket surfaces and joint elastomeric rings shall be cleaned immediately before jointing to prevent damage to joint seals or leakage of jointed pipes.

4.4.5.2 Jointing

a. General

As joints are more likely future leak points than plain pipe, joints in pipe shall be limited to the fewest as reasonably practical.

All buried bolted joints must be wrapped and protected with a 4-step (priming, profiling mastic, tape and overwrap) petrolatum system in accordance with DS95.

b. PVC to PVC Pipes and Fittings

Joints between PVC pipes and fittings shall be made with elastomeric seals in accordance with the manufacturer's instruction, ensuring that:

- the pipes are in a straight line prior to making the joint;
- only jointing lubricant specified by the pipe manufacturer is used;
- joint sockets are adequately restrained to prevent movement during the jointing process;
- joint spigots are “pushed home” in a manner recommended by the pipe manufacturer until the witness mark is just visible;
- the pipes are not damaged during the process.

Where a PVC pipe is cut on site, the cut end shall be chamfered and witness marked in accordance with the manufacturer’s instructions without damaging the pipe.

c. PVC to DI Pipes and Fittings

PVC socket ends shall be jointed with only matching PVC spigot ends in order to achieve a watertight joint. No metallic pipe or pipe fitting spigots shall be jointed to PVC socket ends, however it is permissible for PVC spigots to be jointed to DI sockets.;

Where a PVC pipe is cut on site, the cut end shall be chamfered and witness marked in accordance with the manufacturer's instructions without damaging the pipe.

d. DI Fittings

- Ductile iron fittings shall be jointed with elastomeric joint seals in accordance with the manufacturer's instructions, ensuring that:
- each seal is retained in the socket groove of the previously laid pipe without any twist or buckle;
- the spigot end of the joining pipe to be laid is centred within the elastomeric seal and supported until the jointing process is completed;
- the pipe is "pushed home" firmly and straight in the socket and is restrained from springing back.

e. Jointing of Steel Pipes and Fittings

Elastomeric seal jointed steel pipes shall be installed in compliance with the manufacturer's instructions. Fittings shall be welded as for weld-jointed steel pipes.

Where steel pipes are weld-jointed, installation shall be in accordance with the Steel Pipeline System Handling and Installation Manual and the following requirements:

- All pipe welding shall be in accordance with AS 4041 Pipework Class 2P, Corporation Welding Specification WS-1 and the Drawings;
- Pipe flanges for valve connections shall be welded to pipes in accordance with the Drawing AY58-15-1 of the Pipe Fittings Standard Drawings;
- Welding procedures and qualification of each welder and welding operator shall be in accordance with AS4041 and the requirements of Corporation Welding Specification WS-1;
- Where the cement mortar lining of a pipe or fitting cannot be readily reinstated at the welded joint, a convex band shall be welded over the joint in accordance with Drawing AY58-13-2 and AY58-19-1. When the band has cooled, it shall be fully injected with cement grout through a hole in the top after making due allowance for air release, which is then sealed with a welded cap once the grout has set;
- All cut ends and welded areas shall be protected as required by sub-clause "Protection of Steel Pipes from Corrosion" under in Section 4.4.5.2.

Welded joints are subject to visual examination by the Corporation for acceptance of welding work.

f. PE to PE Pipes and Fittings

PE pipes and pipe fittings and their jointing shall comply with the requirements of, and including limitations in Table 3.1.

Pipes shall be prepared for welding in accordance with pipe manufacturer's recommendation.

g. PE to RRJ Pipes and Fittings

PE pipes connecting to RRJ components must feature an anchor block in accordance with Clause 4.4.5.6 and feature provision means for isolation to allow for the pressure test to be conducted.

h. Protection of Steel Pipes from Corrosion

Damaged pipe coating shall be repaired using Canusa heat shrink repair patches in accordance with the manufacturer's recommendations.

Unless fully Sintakoted, all welded joints, bands, bends, tees, flanges, flange and valve body assembly bolts shall be primed and wrapped with a butyl mastic tape and PVC overwrap system (Denso or approved equivalent) in accordance with the manufacturer's application specification and Water Corporation DS95.

For pipes emerging from below ground, the tape wrapping shall extend to 100mm above the finished ground level.

Where a protective coating system is used, pipeline and valve surfaces shall be prepared so that rust and any other deleterious materials are removed in accordance with the coating manufacturer's requirements

In all circumstances, the minimum surface preparation requirements shall be degreasing and mechanical wire brushing to obtain a Class 2 cleanliness in accordance with AS 1627 Part 2.

i. Threaded Couplings

Pipe and fitting connections using threaded couplings must comply with the following:

Male threads to be AS ISO 7.1, type R. Parallel male threaded fittings are not permitted

Female threads to be to AS ISO 7.1, type RC (tapered); or AS 1722.2 Type G (parallel)

No more than 3 wraps of thread tape are permitted

Parallel thread connection c/w sealing gasket is accepted for water meter connections

4.4.5.3 Laying of Pipes

(a) General

Pipes shall be laid to the following general requirements. At the end of each day's work or at any time when pipe laying is suspended, every open end of each incomplete pipeline shall be plugged with a tapered stopper or an acceptable end cap matching the pipe. No tools or any construction materials shall remain in the pipes.

Pipes shall be laid so the pipe identifying text is located at the crown of the pipe.

b) PVC pipeline system

- PVC pipelines shall be laid in accordance with manufacturer's instructions and in accordance with the practices recommended in the PVC pipelaying accreditation course.

c) PE pipeline system

- PE pipelines shall be laid in accordance with manufacturer's instructions and practices recommended in the PE butt welding accreditation course.
- Allowance shall be made for the likely pipe movement due to temperature changes during installation and commissioning. A final service temperature of 20º±5ºC may be assumed unless otherwise specified in the Drawings. Pipe lengths and bend locations shall be adjusted for changes in length that will occur when the temperature stabilises at the final service temperature.
- The trenches shall not be backfilled unless the ambient temperature is within ±5ºC of the final service temperature.
- PE pipes within the trench may "snake" if the final "snaked" alignment at the final stabilised service temperature is within 100mm of the correct alignment.

d) Road crossings

Pipelines under the road pavement shall not contain:

- an electrofusion or mechanical joint;
- an elastomeric seal (in the case of major roads only);

- a butt-welded joint in the case of an OD125 PE pipe.

Elastomeric seal joints shall be minimized under minor roads.

Mild steel weld-jointed pipes shall have external fusion bonded polyethylene coating and internal cement lining and shall be in the longest practicable lengths, to minimise the number of welded joints under the road pavement.

e) Freeway and railway crossing

- The pipe crossing shall not have elastomeric seal, electrofusion or mechanical joints and shall be in conduit or sleeve only if required by the relevant authorities.
- Minimum clearance between pipe and pipe sleeve shall be 100 mm. Larger clearances may be required by the Corporation in certain circumstances.
- The pipeline shall be supported within the pipe sleeve on non-corrosive saddles or supports acceptable to the Corporation.

f) Bridge, tunnel and river crossings

Each crossing proposal shall detail the construction methodology together with the approval of relevant authorities and shall be submitted to the Corporation for consideration and acceptance.

g) Horizontal Directional Drilling

Horizontal Directional Drilling (HDD) has a number of drawbacks for pipe networks. As such, HDD is not permitted unless it can be demonstrated to the satisfaction of the Water Corporation that conventional open-cut installation is not feasible.

HDD installations shall limit the installation reamer size to the following sizes.

Pipe OD (mm)	Maximum Allowable Reamer Diameter (mm)
125	170
180	255
250	310

Minor obstacles such as trees, sign-posts, power-poles, etc are not considered to be sufficient justification for trenchless construction methods.

(b) Pipeline Bends and Curves

a) Deflecting Pipes on a Curve

A pipeline required to follow a long curve may be laid and jointed with deflections at the joints. The maximum angular deflection at a pipe joint shall not exceed the pipe manufacturer's recommendations. Bending of pipes to achieve a curve or for any other purpose is prohibited, except for PE and CU pipes.

PE pipes may be laid in a curve of radius that is not less than the manufacturer's recommendations.

An acceptable pipe-bending tool shall be used to bend CU pipe. Crimped or distorted pipes shall be rejected.

b) Bends

- Where the required angle change exceeds the permissible joint deflection, standard bend fittings shall be used.
- Bends shall be installed opposite cadastral survey pegs unless otherwise shown on the Drawings or accepted by the Corporation.

- Where a bend is required on a truncation at which a valve is also required, the bend and the valve shall be separated by an 800mm minimum length of straight pipe, with the bend located on the truncation point.

4.4.5.4 Installation of Fittings and Valves

(a) General

Flanges must be installed in accordance with DS38-02. All below ground bolted connections must be wrapped using a petrolatum 4-step system, including profiling mastic, in accordance with DS95.

The mating flanges of all flanged joints where dissimilar metal contact may occur shall be electrically isolated by means of acceptable flange insulation kits.

The inside of all valves, hydrants and fittings and the mating surfaces of the spigot ends, collars, flanges and rubber rings shall be cleaned immediately prior to installation and before jointing.

Pipes shall be cut to ensure installation of fittings in the correct location. The minimum pipe length between adjacent elastomeric seal jointed fittings shall be 1000mm without anchorage and 800mm with anchorage.

(b) Hydrants

A double flanged hydrant riser pipe of the appropriate length shall be installed on a hydrant tee to suit the final verge level above the tee. The hydrant installation shall then be completed in accordance with the Drawings.

Hydrant lids must be installed with the lug on the opposite side to the hydrant spindle.

(c) Flushing Points

Flushing points on all permanent and temporary blank ends shall be installed in accordance with and in the locations designated on the Drawings.

(d) Valves

If a sluice valve and a bend are both required at a truncation, the valve may, subject to agreement, be displaced from the truncation point by 800mm. The valve shall be positioned in the location least likely to be paved.

All gate valves, including those used to isolate private fire services from the main, must be installed such that they close in an anti-clockwise direction.

Pipelines installed via HDD under roads or in other difficult to access areas shall have valves installed on either side of the crossing.

(e) Covers, Frames and Surrounds

Covers, frames and service chamber assemblies for sluice valves, gate valves, stop valves, hydrants and flushing points shall be installed so that the cover level is flush with the final surface level and to the requirements shown on the Drawings.

(f) Temporary Blank Ends

Temporary blank end caps shall be installed on new pipelines to be connected to existing water mains. The end caps shall be installed approximately 4m from the existing water main and shall be clear of any pavement.

Temporary blank ends shall be adequately anchored to withstand test pressure.

4.4.5.5 Connection to Existing Water Mains

Work on or connection of new pipelines to existing water mains is not permissible unless:

- written acceptance has been obtained from the Corporation;
- all required pressure testing of the new water reticulation has been successfully conducted and accepted;
- the new water reticulation has been disinfected in accordance with Clause 4.4.8 of this Part of the Standard.
- A drawing outlining the connection detail has been submitted and accepted by the Corporation, and demonstrates the ability to isolate the new connection as well as sufficient thrust restraint to mitigate the risk of failure of either the new or existing main.
- The potential for exposure to asbestos containing material has been evaluated, noting that in addition to old asbestos cement pipes, asbestos has also historically been a component of old steel pipe wrappings. If asbestos is assessed to be potentially present, a risk assessment must be prepared addressing handling and disposal issues and submitted to the Corporation for acceptance.

New mains shall be laid at the specified depths and alignments after ascertaining by manual excavation methods the positions of other existing services in the vicinity.

Interference with, or operation of any existing main or valve or fitting is not permitted unless accepted by the Corporation in each case.

Connections to existing water mains must be located sufficiently offset from any valves that are under pressure (from either side) in order to avoid the risk of the valve blow-off, in accordance with table 4.2.

Table 4.2 – Min Distance to Existing Water Main

Pipe Diameter (mm)	100	150	200	250
Length of buried pipe required to nearest valve for systems at 50m head (m)*	5	5	5	5
Length of buried pipe required to nearest valve for systems at 100m head (m)*	5	6	8	10

**Assumes unsaturated soils and flat topography, length needs to be increased accordingly in the case of waterlogged soil conditions or steep slopes.*

4.4.5.6 Thrust Supports and Anchors

(a) Thrust Supports

Thrust blocks are required on all bends, tee and ends of pipelines with unrestrained jointing (e.g. RRJ).

Thrust supports for permanent installation shall be of concrete. For temporary installation, repairs and where concreting work is impracticable, backing boards may be used in accordance with the relevant Standard Drawings. Thrust supports for multiple or compound bend arrangements shall be of concrete only.

Flange bolts shall be installed with the washers and nuts furthest from any concrete thrust support. Bolt heads must not be encased by the concrete. Corrosion protection of the flange bolts shall be carried out prior to construction of concrete thrust supports.

Thrust supports shall not extend more than 300mm from the nominated alignments except where otherwise accepted by the Corporation. Thrust supports shall be installed and the trench backfilled and compacted prior to commencement of pressure testing.

Thrust blocks on shall be designed and installed such that any future excavation of any thrust block, appurtenance or bend can be safely achieved, using conventional open trenching methods,

without compromising the soil support of any other thrust block or causing other thrust blocks to fall. This applies to all thrust blocks, including vertical thrust block pairs.

(b) Steel Pipe Anchorage

- Buried Steel Pipeline

  Where buried steel pipes are used, thrust supports may be replaced by welded pipeline sections installed on both sides of the fittings as indicated in Table 4.3:

Table 4.3 - Minimum Length of Welded Pipe (m) Each Side of Bend

Size DN (mm)	Minimum Length of Welded Pipe (m) Each Side of Bend		
	45° Bend	60° Bend	90° Bend & Tee Branch
100	6	10	30
150	6	10	30
200	6	15	40
250	6	15	40

Note: The lengths are valid for a maximum hydraulic pressure of 1200 kPa in pipe, and a minimum 600mm of well compacted soil cover over pipes.

- Above Ground Steel Pipeline

  Anchorage for above ground steel pipeline shall be constructed to the Drawing details which shall provide for the maximum combined effects of thermal (including linking-in temperature), hydraulic, pipe jointing and pipeline support conditions.

(c) Polyethylene (PE) Pipe Anchorage

When connecting a PE main into an unrestrained component (e.g. rubber ring joint), an anchor block shall be provided to mitigate thermal expansion and Poisson contraction effects. The anchor block must be cast on a rigid metallic puddle flange arrangement. PE puddle flanges are not permitted.

4.4.6 Backfill

4.4.6.1 Initial Backfill

Initial backfill shall be selected fill material placed and compacted to provide continuous support to the pipe as shown in the Drawings.

Initial backfill at the sides and up to 150mm above the pipe shall be well compacted so that no joints or pipes are disturbed or damaged. All joints other than pipe spigot-socket joints shall be left exposed until the pressure tests have been successfully completed.

4.4.6.2 Final Backfill

Final backfill of pipe trenches shall be carried out to the requirements of the Drawings. Where the excavated soil is not suitable for final backfill, granular material complying with the requirements shall be imported for backfill.

Except where thrust support by backfill is required for pressure testing, final backfill shall not be carried out until:

- the As Constructed measurements have been taken for pipes and fittings in pipe trenches;
- the Official Pressure Test is accepted, and height and position have been complied with for service risers.

Where backfill is required to provide thrust support, for pressure testing, it shall be carried out only after the As Constructed measurements have been taken.

Any backfilling carried out prior to complying with the above requirements will be rejected. The reticulation may be required to undergo a further pressure test.

Compacted final backfill shall be finished as follows:

- In a road verge - levelled to the final verge level;
- Within a pavement area - to the levels meeting the road owner's requirements for the pavement construction;
- At service tapping points and around service risers – to the agreed final ground level.

Sections of water reticulation damaged and repaired during backfilling will require the pipeline to pass another official pressure test after reinstatement.

4.4.6.3 Backfill around Valves, Hydrants, Flushing Points and Service Connections

Granular material shall be used for backfill around all valves, hydrants, flushing points and service connections.

4.4.6.4 Restoration of Road Reserves and Access Ways

After backfill pavements in road reserves or access ways shall be temporarily reinstated and maintained in a safe condition for vehicles and pedestrian traffic. The final surface treatment, including restoration of road pavements, footpaths, landscaping and vegetation shall be to the requirements of the road owner.

4.4.7 Testing of Mains and Service Connections

4.4.7.1 General

Each pipeline and service connection shall be subjected to a successful preliminary pressure test before carrying out the Official Pressure Test. The preliminary pressure test is completed by the installer to satisfy themselves that the pipeline components to be Pressure Tested do not have major leaks or have any open valves. Following the successful completion of the preliminary pressure test, the Official Pressure Tests shall be witnessed by the Construction Engineer and the Corporation's representative. Details of each Official Pressure Test shall be recorded on a Pressure Test Record Sheet, and example of which is included in this part of the Standard. Each record sheet shall be submitted as part of the FTI.

Water service connections must be pressure tested in combination with reticulation mains. The tappings and all riser joints and fittings shall remain exposed to view during the pressure test. Water service connections isolation valves must be cable-tied in the open position, in order to identify that the valve is open.

The use of sealant or similar products to plug any detected leakage is not permitted.

4.4.7.2 Preparation

Mains shall not be tested until at least 24 hours after concrete thrust supports have been constructed.

The following requirements shall be met prior to testing:

- The difference in elevation between any two points on the section of the main under test shall be not greater than 30 metres;
- At least 300mm of suitable fill material shall be placed over the initial backfill for the section of pipeline to be tested, leaving all meter risers, stop tap, water service tappings and hydrant tee flanges exposed to view;
- The pressure test gauges shall be located as close as practicable to the lowest point of the test section;
- All water service tapping points and riser joints included for the pressure test shall be exposed for inspection. All property service stop taps shall be in the open position and have their outlets plugged at the time of testing;
- Where a valve is shut to form one end of a test section, suitable temporary supports shall be installed to prevent the valve moving due to unbalanced hydraulic thrust.

- No pressure testing against valves on live mains shall be conducted prior to approval from the Corporation.

4.4.7.3 Filling Mains For Testing

The section of the main to be tested shall be filled gradually with potable water acceptable to the Corporation. Filling of the main shall be completed at least 24 hours prior to the commencement of the Official Pressure Test. For cement mortar lined pipelines this period shall be 48 hours prior to testing to allow for absorption.

Water for testing purposes may be obtained from the Corporation live mains provided prior approval has been given by, and detail arrangements for the draining of test water have been made with the Corporation at least 15 working days prior to filling.

Air from the test section should be expelled. If necessary, temporary air vents may be provided by the use of appropriate tapping band. Temporary air vents shall be removed upon completion of the test and the tapping point sealed with a threaded brass plug in accordance withTable 3.1.

4.4.7.4 Test Equipment

A main or isolated section of the main shall be pressure tested by means of a pump capable of raising and maintaining the hydraulic pressure for the duration of the test.

Calibrated pressure gauges of minimum diameter 100mm, and maximum 50kPa pressure graduation intervals shall be connected to the pipeline to be tested.

4.4.7.5 Official Pressure Test

Each pipeline and service connection shall be subjected to a hydraulic pressure test of 1200 kPa (120m head of water), as measured at the lowest point of the test section, unless otherwise requested by the Corporation.

(a) Test Procedures – All pipelines other than PE

For all water reticulation systems the test shall be carried out with the test pressure maintained for a minimum of 1 hr.

Mains shall be tested in accordance with the constant pressure method detailed in Section 6 and Appendix M, paragraph M4 of AS/NZS 2566.2.

(b) Test Procedures – PE pipelines

For all water reticulation systems the test shall be carried out with the test pressure maintained for a minimum of 5 hrs.

Mains shall be tested in accordance with the constant pressure method detailed in Section 6 and Appendix M, paragraph M5 of AS/NZS 2566.2. In pipeline systems that comprise of both PE and non-PE sections, separate pressure tests must be conducted on each type of pipe, or alternatively the test procedure for non-PE pipelines outlined in 4.4.7.5(a) can be used.

(d) Test Acceptance Criteria

Subject to all test preparation and procedures being adhered to, a pressure test shall be acceptable if the following are met:

- For all pipelines other than PE, no makeup water was required to maintain the pressure for the specified duration;
- For PE pipelines, the quantity of make-up water does not exceed the maximum allowable quantity as defined in AS/NZS 2566.2
- There is no visible leak or evidence of leakage detected from the sections/mains being tested;
- There is no failure of any pipeline component or appurtenance; and
- There is no visible leak or evidence of leakage from all water service tapping point or riser joint during testing.

Service connections not connected to the new main (e.g. newly laid to connect a new subdivision lot to an existing Water Corporation main) must be pressure tested.

(e) Re-Testing

If a test section fails the pressure test, the cause of failure shall be determined and rectified. The section shall be re-tested until an acceptable test result has been achieved.

(f) After-Test Requirements

After successful pressure test and before backfilling of a pipe trench, the stop tap in the service connection shall be turned off. The stop tap shall then be fitted with a fabricated "stand-up service protector" in accordance with drawing BD64-9-1, and the stop tap outlet fitted with a security plug in accordance with drawing BD64-9-2.

4.4.8 Disinfection of Water Reticulation

4.4.8.1 General

a) The water reticulation including all service connections shall be disinfected and shall not proceed until a Disinfection Plan has been submitted to and accepted by the Corporation. Each Disinfection Plan shall provide the following details:

- Disinfectant and dilution water quantities proposed for each disinfection batch or operation;
- The progressive stages of disinfection operations as defined by the valving sequence proposed;
- The disinfection dilution and injection equipment proposed;
- The timing of each disinfection operation;
- The methodology proposed for flushing of disinfectant waste and the disposal arrangements acceptable to the local and environmental authorities.

b) At any stage during the filling and testing of mains, the Corporation may request that all mains to be tested be flushed until the water is clear of all foreign material.

c) During filling, disinfectant shall be added to the main in accordance with the requirements in Clause 4.4.8.2, ensuring that the disinfectant is thoroughly mixed with the filling water and evenly distributed.

d) The disinfectant shall be progressively introduced until the reticulation has been fully disinfected.

e) The diluted disinfectant shall be retained in the water reticulation for as long as practicable which shall not be less than 24 hours. The main shall then be drained and flushed with potable water. All waste and flushed disinfectant shall be disposed of in an environmentally acceptable manner in accordance with the requirements of the local and the environmental authorities.

4.4.8.2 Disinfectant

f) Disinfectant shall be calcium hypochlorite powder rated to yield 65% available chlorine, or sodium hypochlorite liquid rated to yield 12% available chlorine. The disinfectant shall be diluted with water for injection into the water reticulation to be disinfected so that the effective strength of the diluted product provides a dosing rate of 20mg/L measured as free chlorine.

g) The disinfectant dilution guidelines in Table 4.4 may be used to calculate the appropriate disinfectant and dilution water quantities in each case.

4.4.8.3 Table 4.4 – Disinfectant Dilution Guidelines

Nominal Pipe Diameter (mm)	Nominal Volume in Pipe	Calcium Hypchlorite Powder (65% $C1_2$)	Sodium Hypochlorite Liquid (12% $C1_2$)
	kL of Water per 1000m of Pipe	kg used for 1000m of Pipe	Litres used for 1000m of Pipe
50	2	0.06	0.4
100	7	0.20	1.2
150	17	0.50	2.8
200	33	1.00	5.5
250	49	1.51	8.2
300	68	2.10	11.3

Note: For a dose rate of 20 mg/L : (a)10 kg of calcium hypochlorite will treat 325 kL of water; (b) 20 litres of sodium hypochlorite liquid will treat 120kL of water.

4.4.9 Water Main Status after Pressure Test and Disinfection

After satisfactory completion of the pressure test and disinfection process, the test section shall be left charged with potable water to 600kPa(g). All sluice valves and section gate valves shall be left fully opened and all hydrants, flushing points and tapping at temporary dead ends shall remain closed.

4.5 Prelaid Water Service Connections

4.5.1 General

Prelaid water service connections in new subdivisions shall be installed in accordance with the Drawings with no additional joints or fittings.

Only a qualified trades person shall carry out silver soldering or brazing.

4.5.2 Alignment and Depth

Water services shall be installed where shown on the Drawings in accordance with the typical arrangements shown.

Where it may prove impracticable to comply with the requirements due to concealed obstructions, alternative proposals will need prior acceptance by the Corporation.

A minimum of 100mm clearance all round shall be provided for all water service pipes relative to other services.

4.5.3 Road Crossings

Road crossings for service connections shall be installed complying with the Drawings before the final road pavement is constructed.

Immediately after installation the ends of the service pipes shall be temporarily sealed with a securely fastened plug and adhesive tape to prevent ingress of unwanted materials.

4.5.4 Tapping Reticulation Mains

Service tapping locations on water reticulation mains shall be located within 100mm of the standard service alignment unless further constrained by the following requirements:

- a minimum of 300mm from a pipe or pipe fitting socket.
- a minimum of 300mm from an adjoining tapping.

When tapping PVC and PE mains, the swarf and coupon shall not be permitted to fall into the main.

The tapping band shall be installed so that the off-take is centrally positioned over the tapping hole in the main and in accordance with the Drawings.

Fittings shall be assembled and jointed in accordance with the manufacturer's recommendations.

Each threaded joint shall be sealed with PTFE thread tape (no more than 3 wraps) or Teflon jointing compound applied in accordance with the manufacturer's recommendations.

Tapping or service pipework which is positioned more than 200mm from the standard or agreed service location in the road reserve or 100mm within a property will be deemed defective and will be rejected by the Corporation.

4.6 Incidental Works

4.6.1 Kerb Marking

Kerb marking shall be provided to the detail shown on the Drawings to indicate the position of valves, permanent flushing points and hydrants. The kerb marking, shall be placed adjacent to the fittings.

4.6.2 Marker Posts

Where there is no kerbing, marker posts shall be provided and installed to the detail shown on the Drawings to indicate the position of valves, flushing points and hydrants.

PVC AND STEEL PIPELINE PRESSURE TEST RECORD SHEET
PRESSURE TEST RECORD SHEET -

Project: _____

_____ Suburb: _____

Main Extension File No.: _____ WAPC: _____

WCFB : _____Sheet No.: _____ WC Plan No.: _____

Project Manager: _____

Contractor: _____

1. Pipeline Tested

Diameter	Material	Horizontal Distance	Remarks
		From To	
		From To	
		From To	
		From To	

NOTE: There are no allowable leakage rates for any type of pipe. Cement mortar lined pipes shall be filled 48 hours before testing to allow for take up.

2. Date Tested: _____

3. Pressure at start of test: _____ **kPa(gauge)**

4. Pressure at test completion: _____ **kPa(gauge)**

5. Duration of Test: _____ MINUTES

❑ PASSED ❑ FAILED

6. Signed By: Date:____/____/____

Contractor: _____

Project Manager (Optional): _____

Witnessed by *Water Corporation representative*: _____

PE PIPELINE PRESSURE TEST RECORD SHEET

REFERENCE INFORMATION	
INSPECTION DATA	**ASSET DATA**
PROJECT NAME:	CHAINAGE FROM:
LOCATION:	CHAINAGE TO:
INSPECTION DATE:	
INSPECTOR NAME:	
PROJECT / CONTRACT NO:	WC DRAWING / P&ID NO.:
PROCESS FLUID:	
TEST FLUID:	

Calculation Table				
Complete the following calculations prior to attending site				
Parameter	**Symbol**	**Formula**	**Result**	**Unit**
Design pressure	P_{design}			kPa
Pipeline pressure rating	P_{pipe}			kPa
Test pressure at lowest point	P_{test}			kPa
Pipe diameter	D			m
Length of pipe being tested	L			km
Volume of pipe being tested (should not exceed 4000m^3)	V	$V=\pi \times D^2/4 \times L \times 1000$		m^3
Fill rate	Q_{fmax}	Recommended $Q_{fmax} = 39.27D^2$		L/s
Design temperature	T_{design}			°C
1st Volume Added	V1	*measured		L
2nd Volume Added	V2	*measured		L
Maximum allowable make-up water *NOTE: this calculation must be performed on site once V1 is determined*	$V2_{max}$	$V2_{max} = 0.55V_1 + 0.14LDH$		L

Is $V2_{max}$ larger than V2? If the answer is “yes”, test has passed. If the answer is “no”, test has failed.

❑ PASSED ❑ FAILED

5 GUIDELINES FOR UNDER PRESSURE CUT-IN (HOT-TAPPING) WORK

5.1 Scope

This section outlines the technical requirements for the permanent physical infrastructure related to under-pressure cut-ins. It is not intended to address other elements, such as the construction process or other procedurally related aspects.

5.2 General

Under-pressure cut-ins (also known as hot-tapping) is a term used to describe cutting into the pipe whilst it is still operational and under pressure, normally to facilitate a new connection to an existing pipe.

The benefits of under-pressure cut-ins are immediately apparent – the elimination of the need to take the main offline – there are a number of other considerations that must be made when evaluating the merits of hot-tapping. These are outlined in

5.2.1 Benefits of under-pressure cut-ins

Reduces (or eliminates) interruptions to customers in the short-term

5.2.2 Drawbacks of under-pressure cut-ins

Compromises the integrity of the pipeline

May reduce asset life

May require use of less durable components

Increases potential for future premature failure (and unplanned customer interruptions)

Often requires specialist contractors

Reduction in hydraulic capacity (as offtake cut is often smaller than the adjoining pipe bore)

5.3 Acceptable Under-pressure Cut-in Types

5.3.1 Steel mains

The only type of acceptable under-pressure cut-ins on steel mains is a fully-welded steel spigot welded to the main prior to cut-in.

The arrangement must maximise the mortar lining coating on all wetted surfaces of the final arrangement, and significant additional steel thickness must also be incorporated in the spigot and reinforcing collar to allow for increased corrosion risks.

Hot tapping of MSCL will reduce the life of the pipeline and shall not proceed unless approved by Water Corporation.

Drawing AY58-3-3 contains details of the minimum requirements to provide additional reinforcement and additional welds to achieve a sacrificial thickness of steel as a corrosion allowance. Drawing AY58-3-3 is not provided in the list of standard drawings.

5.3.2 Mains other than steel

Ductile iron, axially split flanged offtake clamps must be used to clamp around the main prior to cutting wherever practicable. The use of thin-walled stainless steel wrap around clamps is only permitted where ductile iron products are not feasible.

All fittings must be wrapped in accordance with DS95.

All products used must be listed in the Strategic Product Register.

5.4 Other requirements

5.4.1 Thrust

Thrust blocks and anchor blocks must be installed to resist all hydraulic and thermal thrusts unless all pipelines are fully thrust restrained.

5.4.2 Coupon

The pipe coupon (the section of pipe cut out to facilitate the hot-tap) must be retained, tagged with date, time location and operator, and provided to the Water Corporation

5.4.3 Disinfection

Normal disinfection procedures require the pipeline undergoing disinfection to be isolated from the drinking water supply to prevent potential contamination. However, the very nature of under-pressure cut-ins means there will always be at least a very short length that cannot be disinfected via the standard method. This length of pipe and fittings not disinfected in accordance with this standard must be minimised. Any components for which it is not disinfected in the normal manner must be instead disinfected by spraying and swabbing with hyper-chlorinated solution in accordance with Water Corporation procedures.

6 STANDARD DRAWINGS

Refer to the Water Corporation website for the current list of DS 63 Drawings.

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