

APPENDIX REGIONAL STANDARD FOR WATER SERVICES

CONTENTS

Regional Standard for Water Services

Regional Standard for Water Services

November 2012



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1 Introduction

This document was developed to consolidate the existing four codes of practice for water services for Porirua, Hutt, Upper Hutt and Wellington cities in order to provide a consistent method of design and implementation of water services across the Wellington region. The intention is to promote consistency in the local industry for the benefit of developers, designers, suppliers and councils. Whilst the current format still has clauses particular to each city, the intention is that these differences will reduce over time as design philosophies consolidate with more collaboration.

The document is intended to be read in parallel with existing codes of practice, but relates only to infrastructure for stormwater, wastewater and water supply networks within the boundaries of the participating cities. It provides overall objectives and performance criteria that proposed infrastructure projects shall comply with, and a set of standard design methods and general network component specifications.

It is intended that the provisions within this document shall be applied to the design and construction of proposed infrastructure in new subdivisions, and to the maintenance, renewal and upgrades of existing council infrastructure.

1.1 Acknowledgements

This standard was developed by a working group comprising representatives from:

Porirua City Council
Lower Hutt City Council
Upper Hutt City Council
Wellington City Council
Kapiti Coast District Council
Capacity Infrastructure Services Limited

Acknowledgement is made for the time, effort and resources the working group members, and their organisations, provided in the development of this standard.

1.2 Review of Standard

The standard may undergo occasional amendment as policy and technology evolves. A review will be undertaken in approximately two years and approximately every five years thereafter. Any feedback on the standard can be made to:

Capacity Infrastructure Services Limited
Private Bag 39-804
Wellington Mail Centre 5045
Lower Hutt
c/- Asset Development Manager

Alternatively, submissions can be made to any of the participating councils.

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2 Using this Document

This document is subordinate to the council's district plan and is to be used in parallel with any operative subdivision or development codes of practice. Where, within the council's subdivision or development codes of practice, there is any cross-reference to the superseded sections below, or conflict with this document, the provisions within this document shall take precedence.

This standard supersedes the following:

- Lower Hutt City Council
 - Code of Practice for Stormwater
 - Code of Practice for Sanitary Sewer
 - Water Supply Design Code/Subdivision Code of Practice
- Porirua City Council Code of Development and Subdivision Engineering, sections:
 - Stormwater Drainage
 - Wastewater
 - Water Supply
- Upper Hutt City Council Code of Practice for Civil Engineering Works, sections:
 - A10 Stormwater Drainage and Flood Control
 - A11 Reticulated Wastewater
 - A13 Water Supply
 - B6 Stormwater Drainage
 - B7 Wastewater Drainage
 - B8 On Lot Treatment and Disposal of Household Wastes
 - B9 Water Supply
 - C3 Stormwater Drainage – Design
 - C4 Wastewater – Design
 - C5 On Lot Treatment and Disposal of Household Wastes – Design
 - C6 Water Supply
- Wellington City Council Code of Practice for Land Development, sections:
 - D Sanitary and Stormwater Sewer Design and Construction
 - E Water Supply Design and Construction

2.1.1 Document Structure

This document is structured such that each asset class (water supply, wastewater and stormwater) is divided into four sections:

- Objectives: The objectives outline the broad, overarching objective of the network.
- Performance Criteria: The performance criteria outlines the minimum operational and functional levels of service expected from proposed developments and/or upgrades.
- Design Methods: Design methods describe the design methodology that is considered acceptable for the purposes of establishing the effectiveness of proposed solutions.
- General Specifications: General specifications describe acceptable engineering methods that constitute a standard acceptable method of compliance with the objectives and performance criteria. This section should be read in conjunction with each council's technical specifications.

2.1.2 Related Council Specifications

This document should be read in conjunction with the council's technical, construction and materials specifications. These currently include:

WCC Water Technical Specification
 WCC Drainage General Conditions of Specification
 PCC Engineering Specifications
 HCC Specification for Construction of Sanitary Sewer Drains
 HCC Specification for Construction of Stormwater Drains
 HCC Specification for Construction of Water Mains
 UHCC Code of Practice for Civil Engineering Works, Part D

2.2 Definitions

For the purposes of this document, the following definitions and abbreviations shall apply.

2.2.1 Nominal Pipe Diameter

All pipe diameters referred to in this document are in millimetres (mm) and are nominal internal diameters unless specifically noted otherwise. Only polyethylene pipes are denoted with a nominal outside diameter and this should be post-fixed with the letters OD. For example:

63 OD is 63 mm nominal outside diameter; and
 100 mm is 100 mm nominal internal diameter.

2.2.2 Definitions

The following terms are used in this document:

| Term | Description |
|--------------------------------------|--|
| Annual Exceedance Probability | The probability of an event happening in any one year, typically expressed as a percentage (10%) as opposed to a ratio (1 in 10 years). |
| Aquatic Receiving Environment | Waters, including wetlands, which serve as a habitat for interrelated and interacting communities and populations of plants and animals. |
| Asset Class | Either water supply, stormwater or wastewater. |
| Black water | Wastewater that contains toilet waste. |
| Council | The participating territorial authority within which the boundaries of the proposed scheme or renewal is located; or a delegated representative thereof. |
| Culvert | A pipe, typically passing under a road or embankment, which links two open watercourses. |

| | |
|--|---|
| Developer | An individual or organisation having the financial responsibility for the development project and includes the owner. |
| Drainage | Wastewater or stormwater pipework, channel or stream, and 'drain' has a corresponding meaning. |
| Grey Water | The wastewater from sinks, basins, baths, showers and similar appliances but not including any toilet waste. |
| Household Unit or Dwelling Unit | Any building or group of buildings, or part thereof used or intended to be used, principally for residential purposes and occupied or intended to be occupied by not more than one household. |
| Local/Minor Roads | All other roads which are not primary or secondary arterial roads. |
| Network | All pipes, pumping stations, fittings, reservoirs, structures, treatment facilities and any other appurtenant components or facilities directly associated with the asset class. |
| On-site Disposal | The treatment and disposal of wastewater within the boundaries of a private lot, typically residential. |
| Potable water | Drinking water as defined in the Health (Drinking Water Amendment) Act 2007. |
| Primary Flow | The estimated stormwater flow resulting from the event outlined by the primary level of protection. Typically fully contained within the Primary Network. |
| Primary Network | The stormwater network designed to collect and dispose of the primary flow without surcharging/overflowing. |
| Primary Arterial | Roads providing interconnections between major sectors of a large area linked with external areas, and that distribute traffic from major intercity links. Defined by the roading and traffic department, but typically has traffic volumes of 7,000 to 10,000 vehicles per day with a significant number of heavy vehicles. Includes state highways. |
| Principal Main | A type of reticulation main, typically 100 to 200 mm in diameter, that provides the firefighting and majority of supply in a street. Sometimes called a distribution or secondary main. |
| Pumping Station (in water supply) | A facility for mechanically increasing pressures in a pipeline. In water supply; typically used to fill reservoirs or increase pressures in a distribution zone. |
| Pumping Station (in wastewater) | A facility for mechanically increasing pressure in a pipeline, or to lift effluent to a higher elevation in an adjacent manhole (lifting station). Typically used to convey collected effluent to an adjacent catchment or trunk main. |
| Pumping Station (in stormwater) | Similar to pumping station (wastewater) but designed to convey the stormwater to a safe discharge point. |
| Reticulation Main | A water main that distributes water to customer connections. Could be either a principal main or rider main. |

| | |
|-------------------------------------|---|
| Rider Main | A type of reticulation main, typically less than 100 mm in diameter, and secondary to any principal main in a street. Sometimes referred to as a tertiary main. |
| Rising Main | A dedicated pipeline running between a pump's discharge and a nominated discharge point; typically a reservoir in water supply systems, or a manhole on a gravity drain for wastewater systems. |
| SCADA | Supervisory Control And Data Acquisition. The council owned and operated telemetry and control systems used to remotely monitor and control facilities such as pumping stations, reservoirs, large-scale metering installations etc. |
| Secondary Arterial | Roads providing access to primary arterial roads. They have a dominant through vehicular movement and carry the major public transport routes. Defined by the roading and traffic department. |
| Secondary Flow | The excess stormwater flow that cannot be contained by the primary network, typically due to extraordinary design storm or network blockage. |
| Sewer | A pipe that conveys wastewater/sewage, typically using gravity. Could also be called a sewer drain. |
| Sewerage | The collective term for a network of wastewater/sewer pipes. |
| Stormwater | Rain water that does not percolate into the groundwater or evaporate, but flows via overland flow, interflow, channels or pipes into a defined channel, open watercourse or a constructed infiltration facility. |
| Subdivision | The subdivision of land as defined in the Resource Management Act 1991. |
| Subsoil drain | A drain that is designed to control groundwater levels. It achieves this through the infiltration of groundwater into the pipe, typically through perforated walls or porous joints. It does not collect and transport surface runoff. |
| Trunk Main (in water supply) | A large diameter water main designed to transport water between reservoirs, distribution zones, source waters and reticulation mains. Trunk mains do not typically have customer connections. Sometimes called a transmission main or primary main. |
| Trunk main (in wastewater) | A large sewer that collects tributary flow from adjacent catchments and/or pumping stations. |
| Wastewater (sewage) | Water that has been used and contains unwanted dissolved and/or suspended substances from communities, including homes and businesses and industries. |
| Water Supply | Potable water; intended for human consumption. Includes water collected and used onsite for private use. |

2.2.3 Abbreviations

The following abbreviations are used in this document:

| Abbreviation | Description | Unit |
|------------------------|---|--------------------------------|
| ABS | Acrylonitrile Butadiene Styrene | |
| ADWF | Average dry weather flow | L/s |
| AEP | Annual exceedance probability | % |
| ARI | Annual Return Interval | years |
| CLS | Concrete-lined steel | |
| DN | Nominal diameter | mm |
| DICL | Concrete-lined ductile iron | |
| GL | Ground level in metres above datum | m |
| GRP | Glass reinforced plastic | |
| GW | Greater Wellington Regional Council | |
| hr | Hour | hour |
| H | Head (water column measured in metres) | m |
| ha | Hectare | ha |
| HDPE | High density polyethylene (PE80c) | |
| HPPE | High performance polyethylene (PE100) | |
| kPa | Kilopascal | 10 ³ Pa |
| L | Litre | |
| m | Metre | |
| MDPE | Medium density polyethylene (PE80b) | |
| MHWS | Mean high water springs | m |
| mPa | Megapascal | 10 ⁶ Pa |
| MPVC | Modified polyvinyl chloride | |
| m/s | Metres per second | ms ⁻¹ |
| m³/s | Cubic metres per second | m ³ s ⁻¹ |
| mm | Millimetres | mm |
| MSL | Mean Sea Level (1953 Wellington Local Datum)* | m |
| NZBC | New Zealand Building Code | |
| NCD | WCC New City Datum (same datum as MSL) | m |
| NZVD2009 | NZ Vertical Datum (0.44 m above MSL) | m |
| OCD | WCC Old City Datum (-11.57 m NCD); discontinued in 1953 | feet (typ.) |
| OD | Outside diameter | mm |
| OPVC | Molecularly oriented polyvinyl chloride | |
| PDWF | Peak dry weather flow | L/s |
| PE | Polyethylene (generic) | |
| PGWF | Peak ground water flow (infiltration) | L/s |

| Abbreviation | Description | Unit |
|--------------|-------------------------------|------|
| PN | Nominal pressure | bar |
| PP | Polypropylene | |
| PRV | Pressure reducing valve | |
| PSWF | Peak sewerage wastewater flow | L/s |
| PRWF | Peak rainwater flow (inflow) | L/s |
| PVC | Polyvinyl chloride (generic) | |
| PWWF | Peak wet weather flow | L/s |
| RRJ | Rubber ring joint | |
| RTU | Remote telemetry unit | |
| s | second | s |
| SDR | Standard dimension ratio | |
| SN | Stiffness number | |

*Note: Tide levels listed in Tide Tables published by Land Information New Zealand use a Wellington Standard Port zero datum equivalent to -0.915 m MSL or 3.002 m below bench mark K80/1 (LINZ code ABPB). The actual average measured sea level is currently measured at around 1.08 m above Wellington Standard Port datum or 0.17 m MSL (1953 Wellington Local Datum).

2.2.4 Pipe Gradients

This document uses a percentage to represent pipe or channel grades as opposed to a ratio; i.e. 1% instead of 1 in 100 (V:H). The percentage grade can be calculated by dividing the ratio's vertical component by the horizontal component and multiplying by 100. A conversion table is presented below.

| Grade % | Grade Ratio |
|---------|-------------|
| 0.33% | 1 in 300 |
| 0.5% | 1 in 200 |
| 1% | 1 in 100 |
| 2% | 1 in 50 |
| 5% | 1 in 20 |
| 10% | 1 in 10 |

2.3 Referenced Standards

New Zealand and Australian standards have been referenced in this document. Where a standard's year has been nominated, then that specific issue is to be used. Where no year is nominated, the latest version is to be used. Standards referenced in this document are listed in the table below.

| Reference | Title |
|----------------|--|
| SNZ HB 44 | Subdivision for people and the environment |
| AS/NZS 1170.0 | Structural design actions – General principles |
| AS/NZS 1260 | PVC-U pipes and fittings for drain, waste and vent application |
| AS/NZS 1477 | PVC pipes and fittings for pressure applications |
| AS/NZS 1546.1 | On-site domestic wastewater treatment units – Septic tanks |
| AS/NZS 1546.3 | On-site domestic wastewater treatment units – Aerated wastewater treatment systems |
| AS/NZS 1547 | On-site domestic wastewater management |
| AS 1741 | Vitrified clay pipes and fittings |
| AS/NZS 2041 | Buried corrugated metal structures |
| AS/NZS 2280 | Ductile iron pipes and fittings |
| AS/NZS 2566.1 | Buried flexible pipelines – Structural design |
| AS/NZS 2566.2 | Buried flexible pipelines – Installation |
| AS/NZS 2638.2 | Gate valves for waterworks purposes – Part 2: Resilient seated |
| NZS 3101.1 & 2 | Concrete Structures Standard |
| NZS 3106 | Design of concrete structures for the storage of liquids |
| AS/NZS 3500.2 | Plumbing and drainage – Sanitary plumbing and drainage |
| NZS 3501 | Specification for copper tubes for water, gas, and sanitation |
| AS/NZS 3725 | Design for installation of buried concrete pipes |
| AS 3996 | Access covers and grates |
| AS/NZS 4020 | Testing of products for use in contact with drinking water |
| AS/NZS 4058 | Precast concrete pipe (pressure and non-pressure) |
| AS/NZS 4130 | Polyethylene (PE) pipes for pressure applications |
| AS/NZS 4441 | Oriented PVC (PVC-O) pipes for pressure applications |
| NZS 4442 | Welded steel pipes and fittings for water, sewage and medium pressure gas |

| Reference | Title |
|--------------|--|
| SNZ PAS 4509 | New Zealand Fire Service firefighting water supplies code of practice |
| NZS 4517 | Fire sprinkler systems for houses |
| NZS 4522 | Underground fire hydrants |
| NZS 4541 | Automatic fire sprinkler systems |
| AS/NZS 4765 | Modified PVC (PVC-M) pipes for pressure applications |
| AS/NZS 5065 | Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications |

3 General Requirements

This document represents the performance and engineering requirements for the three water networks. Reference shall be made to this document when planning and designing stormwater, wastewater and water supply infrastructure for either new subdivisions, or the renewal or upgrade of existing infrastructure.

This document outlines:

- the networks' mandated levels of service
- how components of the infrastructure are expected to function
- acceptable engineering methods to comply with performance levels.

3.1 Subdivision Requirements

Requirements relating to the overall subdivision process, urban planning, health and safety and other council utilities and services can be found in the council's existing subdivision codes and policy documents. Reference shall also be made to these documents and their requirements when planning works when using this document.

When considering the stormwater, wastewater and water supply infrastructure, this document specifically excludes:

- subdivision application processes
- subdivision approval processes
- development contributions policy
- roading
- roading reinstatement
- applications for connections to public services
- subdivision compliance certification
- as-built requirements.

These requirements are detailed within each council's general subdivision codes or policy documents.

3.2 Legislative Requirements

Any proposed infrastructure project must, as a minimum, comply with the following legislation where applicable, plus any subsequent amendments:

- Building Act 2004
- Civil Defence Emergency Management Act 2002
- Climate Change Response Act 2002
- Local Government Act 2002
- Energy Efficiency and Conservation Act 2000
- Health and Safety in Employment Act 1992
- Resource Management Act 1991
- The Environment Act 1986

- Forest and Rural Fires Act 1977
- Health Act 1956 and amendments
- Soil Conservation and Rivers Control Act 1941
- Land Drainage Act 1908
- Utilities Access Act 2010

3.3 Regulatory Documents

In addition to the legislative requirements, the following regulatory are also to be referenced where applicable:

- Council's operative district plans
- GW Freshwater Plan
- GW Coastal Plan
- Operative council bylaws and charters
- The New Zealand Building Code.

Other documents are also referenced throughout this document at the relevant section.

3.4 Alternative Solutions

Innovative, alternative solutions are encouraged and will be considered where the proposed scheme can demonstrate compliance with both the objectives and performance criteria as set out in this document. It must be proven that the performance, maintenance and long-term economic outcomes are equivalent, if not better than the 'standard' solutions presented in the Design Methods and General Specifications sections within this document, as well as comply with the urban planning objectives set by the council.

Acceptance of alternative solutions will be at the discretion of the council. The form of alternative solutions should be discussed with the council at an early stage of design.

3.5 Application and Approvals

Developers are encouraged to discuss their proposed scheme with the council prior to concept design to ascertain requirements or pertinent considerations relating to their proposal.

This document does not cover the applications and approvals process. Each council has its own subdivision application and approvals process which the applicant must abide by. Compliance with the provisions in this standard does not imply acceptance of the asset for vesting or compliance with the subdivision consent.

4 Stormwater

4.1 Objectives

To safeguard people, property, infrastructure and the environment from the adverse effects of stormwater, contaminated or otherwise, and to meet the performance requirements outlined within this document.

4.2 Performance Criteria

Any scheme must demonstrate consideration and compliance with the criteria listed below.

4.2.1 Functional

All new stormwater systems, or existing systems modified to accommodate new works, shall be designed to protect property and infrastructure from inundation or damage to the Minimum Level of Service specified in sections 4.2.6 and 4.2.7.

The stormwater system shall be designed to allow for all reasonably predictable development within the upstream catchment designed to the level of development allowed for within the council's district plan.

The network shall be a gravity network formed of pipes, formed channels or defined watercourses to approved discharge points within, as far as practicable, the catchment as it exists at the time of development.

The system shall be designed such that there is no direct cross-contamination between the wastewater and stormwater systems or any other source of hazardous substances.

No development or new drain shall cause water to be diverted from one catchment to another, either directly or indirectly.

Detention ponds and/or other measures to reduce peak flows may be considered where the downstream system cannot accommodate peak flows or controls are necessary to protect the receiving environment from the potential adverse effects of unrestricted and untreated discharge.

PCC & Retention or attenuation/detention facilities are required for all UHCC: development connecting to existing infrastructure and shall be designed to limit the design peak discharge from the development (post-construction) to not greater than the existing design peak discharge (pre-development) already entering the public network, for a 1 in 10 year, 20-minute duration storm.

All structures shall be designed with adequate flexibility and special provisions to minimise the risk of damage during an earthquake or from differential settlement. Flexible joints are required at all junctions between rigid structures (wet wells, manholes, drywells, pumping stations, stream and bridge crossings etc.) and natural or engineered ground. Rigid pipelines shall have a flexible connection within the lesser of 650 mm or twice the pipe diameter of the structure wall. Manhole connectors shall be used for PVC pipes.

4.2.2 Access

Any proposed system shall not unduly restrict the location of any potential building or development, or restrict potential development elsewhere in the catchment.

Where practicable, stormwater assets shall be placed in land that is public, or is proposed to be vested. Where this is not practicable, the public stormwater asset shall be protected by an easement. These assets include pipes, open watercourses, and secondary flow paths.

WCC: WCC does not require easements over stormwater drains in private property.

Systems shall be designed such that reasonable access for regular maintenance can be made without significant damage or disruption to other utilities, land use activities and landscape values. Drainage easements may be necessary to provide for the unobstructed flow of design floodwaters and removal of materials that may result in blockages downstream.

Secondary flow paths shall be clearly defined as no-building zones.

4.2.3 Maintenance and Operational

The network shall be designed such that it is compatible with the council's existing systems, materials and maintenance practices.

The network shall be designed such that gravel/debris obstructions, scouring and land instability are minimised.

4.2.4 Durability

The proposed scheme must be designed with an asset life of 100 years, although it is accepted that mechanical components such as pumps and valves, and electrical equipment are likely to have lesser durability.

In addition to longevity requirements, systems shall be designed in a way that minimises the life-cycle costs, inclusive of capital, maintenance and rehabilitation costs. For the purposes of this criterion only, the life cycle shall be taken as 100 years. The council may not necessarily accept the lowest cost option if it has a poor or limited track record for performance.

4.2.5 Health and Safety

The requirements of the Health and Safety in Employment Act are to be accommodated within the design to protect the public and users of the system during construction, and over the life of the asset. This shall include fencing, signage and suitable covering to prevent public access to hazardous areas.

4.2.6 Primary Level of Protection

Each system is to be designed to accommodate the design storm to a set level of protection as defined by an annual exceedance probability (AEP). The required level of protection for primary systems is outlined in Table 4.1. The primary system typically comprises piped drainage systems, formed drainage channels and soakage systems.

Generally, the designer shall design the overall catchment to the General Catchment Level of Protection, and then demonstrate that the roads, sections and other considerations internal to the catchment are not inundated when the general catchment is subjected to the assigned internal event for each consideration.

The general catchment is the entire drainage area above the design point of concentration.

Table 4.1 – Primary Level of Protection (AEP)

| | HCC ⁺ | PCC | UHCC | WCC |
|--|------------------|-------|------|-----|
| General Catchment Level of Protection | | | | |
| Residential | 10% | 10% | 4% | 10% |
| Commercial/Industrial | 5%/10% | 10%* | 4% | 10% |
| Rural/Rural residential | 10% | 10% | 10% | 10% |
| Internal Level of Protection for Roads | | | | |
| Arterial/State highway | 5% | 1% | 1% | 1% |
| Secondary Arterial | 5% | 5% | 5% | 5% |
| Local/Minor | 10% | 10% | 20% | 20% |
| Bridges | 2% | 1% | 2% | 2% |
| Internal Level of Protection for Sections | | | | |
| Open Space/Reserve | 50% | N/A** | 50% | 50% |
| Private Yards | 20% | 10% | 20% | 50% |
| Car Parks | 20% | 10% | 20% | 20% |
| Internal Level of Protection for Others | | | | |
| Where no secondary path is available | 1% | 1% | 1% | 1% |
| Key public facilities, hospitals, substations etc. | 10% | 1%* | 4% | 1% |
| Wastewater disposal fields | 5% | 5% | 20% | 5% |

* The minimum level of protection may be specified differently in the building consent depending on the buildings intended purpose. Consent requirements supersede those listed here.

** Refer to PCC parks and reserves department for required levels of protection.

+ See note below regarding potential reduction in levels of protection for *New Drains in Existing Areas*.

HCC: The *minimum* primary and secondary levels of protection, as well as the freeboard, may be reduced as shown below for new drains in existing areas.

| | Primary | Secondary | Freeboard |
|------------------------------|---------|-----------|-----------|
| Residential | 10% | 2% | 200 mm |
| Commercial/Industrial | 10% | 2% | 50 mm |
| Key Public Facilities | 10% | 2% | 200 mm |
| Arterial Roads | 10% | 5% | - |

4.2.7 Secondary System Level of Protection

The secondary system comprises secondary flow paths typically overland and along carriageway surfaces. The secondary systems shall only be required should the primary

system become blocked or its capacity exceeded. The secondary system level of protection shall be able to be conveyed through a combination of both the primary system and the secondary flow paths.

Table 4.2 – Secondary System Level of Protection (AEP)

| | HCC | PCC | UHCC | WCC |
|---|-----|-----|------|-----|
| Building Floors (also see 4.2.8) | | | | |
| Housing and communal residential and communal non-residential | 1% | 1% | 1% | 1% |
| Commercial | 1% | 1% | 1% | 2% |
| Industrial | 2% | 1% | 1% | 2% |
| Rural residential | 1% | 1% | 1% | 2% |
| Gully traps | 1% | 1% | 1% | 2% |
| Roads | | | | |
| Arterial* | 2% | 1% | 1% | 1% |
| Secondary arterial* | 2% | 1% | 1% | 5% |
| Local/minor* | 5% | 1% | 1% | 20% |
| Bridges | 1% | 1% | 1% | 1% |

* Flooding is allowed at these levels of protection, but the road must be passable by light vehicles. The table below indicates acceptable depths and flow velocities as measured at the road centreline.

Table 4.3 – Maximum Stormwater Flow Depths and Velocities

| | Max depth | Max velocity |
|---------------------------------|-----------|--------------|
| Primary/Secondary arterial road | 0.1 m | 2 m/s |
| Local/minor road | 0.2 m | 2 m/s |
| Steep local/minor roads | 0.1 m | 3 m/s |
| Walkways only | 0.4 m | 1 m/s |

4.2.7.1 Secondary Flow Path

A secondary flow path is the path the stormwater would take if the primary drain was rendered inoperable or is overwhelmed by a flow exceeding the drain’s design capacity.

The secondary flow path shall be shown on the submitted design and subsequent as-built plans. Designers shall demonstrate that existing and proposed dwellings are not affected by the secondary flow during the design secondary storm event.

Where the primary drain’s capacity is large, and the consequence of overflow is great (primary flow is greater than secondary flow path capacity), a secondary inlet may be required by the council.

The secondary flow path is only required to convey the secondary system level of protection event, less the design capacity of the primary system, regardless of secondary intakes.

4.2.8 Freeboard

Habitable building floors shall have a freeboard of 500 mm above the surface water of the secondary level of protection event. All other building freeboards shall be 200 mm.

A freeboard of 500 mm shall also apply to all buildings where the surface water has a depth of 100 mm or more and extends from the building directly to and across a road or car park, other than a single car park for a dwelling. This is to accommodate surface waves from passing vehicles.

The freeboard shall be measured from the underside of floor joists (from beneath the damp proof course) for timber floors, and from the underside of the slab for concrete floors.

For open channels and streams, a minimum freeboard of 300 mm shall be adopted for the *primary* level of protection flow (or minimum 500 mm in HCC).

Vehicle bridges must have a freeboard of 600 mm to the underside of the bridge structure, or 1200 mm where there is a possibility of large trees in the waterway.

4.2.9 Building Floor Levels to be Identified

The building platform and building floor levels that are required to meet the above secondary levels of protection and freeboard shall be identified on the subdivision plans for each lot within the subdivision. The floor levels shall be expressed in terms of MSL (or NCD for WCC) and the local benchmark and level shall also be clearly identified. Datum for MSL and NCD are outlined in section 2.2.3 (page 7).

4.2.10 Environmental

Pre-application advice should be sought from GW if the proposed works involve the discharge of contaminants, including sediments, into an aquatic receiving environment.

For all land development work (including urban and rural subdivisions and land use change), the design shall include an evaluation of the post-development stormwater effects on the upstream and downstream existing and potential properties. Upstream increases shall be negligible or shown to have no detrimental impact. Downstream impacts to be managed and mitigated against shall include, but are not limited to, changes in peak flow and flooding, erosion, sedimentation and contamination. Works will be required to address any adverse effects.

In general, stormwater design should be commensurate with the intended character of the area, and the environmental context. Environmental quality must be taken into account in the location and design of stormwater systems. Where practicable, and unless directed otherwise by the council, sustainable stormwater techniques should be employed to minimise the potential adverse effects of development. Options such as, but not limited to, bio-retention, retention of streams and natural landform, porous paving, rain gardens, rainwater tanks, green road reserves and detention storage should be considered. The following should be taken into account when considering environmental quality:

- The need to avoid adverse effects on cultural and heritage sites.
- The need to preserve or protect areas of ecological significance, areas of significant habitat for indigenous flora and fauna and outstanding natural features.
- The need to avoid, remedy or mitigate adverse effects on freshwater ecosystems, streams and watercourses, esplanade strips, harbours and coastal maritime areas.
- The need to avoid, remedy or mitigate adverse effects on visual amenity.
- The need to provide for on-site silt and sediment management, erosion control and dust control during construction.

Stormwater must not be discharged to the ground in a manner that may cause or contribute to ground instability.

Consideration shall be given to pre-treatment of stormwater discharges to aquatic receiving environments, including harbours and inlets, to minimise potential adverse effects.

4.2.10.1 Water Quality

Stormwater treatment devices may be required to avoid adverse water quality effects on receiving waters. Special consideration may be required where the proposed stormwater discharges directly to an open stream or harbour.

Where appropriate, preference will be given to low impact designs. Auckland Regional Council's 'Low Impact Design Manual for the Auckland Region; Technical Publication 124' and supporting technical reports are good guides for low impact design.

Other devices such as vortex separators may be considered on a case-by-case basis.

With any treatment application to be vested to the council, consideration shall be given to:

- complying with any requirements of the roading department
- providing adequate capacity to accommodate the design storm
- ensuring suitable secondary flow paths or overflows should the facility be overwhelmed
- providing suitable vehicle access and working space to the site to allow maintenance
- providing a suitable maintenance plan to be implemented by the council to maintain the facility in a suitable state of readiness
- fish passage where required
- visual amenity
- siting the facility (and access) on public land or land protected with an easement.

The council will take into account the longevity and cost of maintaining the facility when considering approval of the proposed facility.

4.2.11 Low Impact Design

Notwithstanding the general criteria listed above, recent emphasis has turned to reducing the flow and the contaminants in the stormwater discharged into receiving environments. These objectives can be partly met through on-site stormwater management, which involves retaining the runoff to reduce peak flows and/or to filter out contaminants at source.

Using low impact design concepts and practices enables multiple social, environmental, cultural, and transport outcomes to co-exist through improving the overall design quality, providing amenity, and enhancing environmental quality and attractiveness of the area.

Alternative approaches to stormwater management, including attenuation and/or some disposal on-site, may be encouraged where practical. This is for the primary purpose of controlling the peak stormwater flow and preventing the further degradation of the water quality and ecology in receiving waters. An economic life-cycle assessment shall also be carried out as part of the analysis of the alternative option.

Alternative solutions sometimes rely on open or secondary flow paths to a much greater extent than conventional piped systems, particularly for large, long storms in saturated conditions producing excessive runoff. These flow paths require careful conservative design, and protection into the future.

4.3 Design Methods

The design methods presented here are considered 'acceptable solutions' for the purposes of developing solutions compliant with the objectives and performance criteria of this standard. Deviation from these methods will be considered with suitable evidence that the alternative method is equivalent in performance, cost and application to those presented here.

Stormwater design is presented in two parts in this document: hydrological design and hydraulic design. For the purposes of this document, hydrological design relates to the collection and transportation of rainfall runoff overland to a nominated point in the network. Hydraulic design relates to calculating the behaviour of the flow once inside a network.

Where the council has a catchment management plan, the proposed scheme shall be designed in line with the objectives and philosophies of the catchment management plan, as well as the design methods and specifications outlined in this document. The council should be contacted during the early stages of design to ascertain if an operative catchment management plan applies in the area of interest.

Certified calculations shall be made available to the council as part of any application.

4.3.1 Hydrological Design

The hydrological design outlined here relates to determining the peak flow for a catchment for the critical rainfall event.

For large detention structures, more sophisticated methods may need to be employed for storage routing. This may include historical event modelling and/or synthetic hydrographs. These methods are not covered within this document.

For catchments less than 100 ha, the Rational method may be used to determine peak discharge at the concentration point of a catchment. Urban catchments greater than 100 hectares require specific design to account for the likely complexities of a large urban catchment. The council shall approve the method and the proposed software to be used in these instances.

Rural catchments greater than 100 ha may adopt the Modified Rational method.

Where a suitable period of measured rainfall and stream gauging data is available, these shall be used to determine peak flows for streams as opposed to the methods described below. The suitability of the hydrological data shall be at the discretion of the council.

The following **standard methods of calculation** can be found in Appendix 4 (page 95). Listed here are methods for:

- Rational Method
- Modified Rational Method
- Time for Concentration.

These methods require the determination of rainfall intensity and runoff coefficients particular to each city. These are outlined in sections 4.3.1.1 and 4.3.1.2 respectively.

4.3.1.1 Rainfall Intensity (i)

Rainfall intensity is a function of the level of protection (AEP from Table 4.1, page 15) and time for concentration (T_c). Once these parameters have been established, the critical rainfall intensity can be determined from the appropriate Depth Duration tables in Appendix 5, Appendix 6. Methods for determining the appropriate T_c are shown in Appendix A4.3 (page 96).

The rainfall intensity gained from the Depth Duration tables shall be increased by 16% to accommodate the projected effects of climate change¹.

PCC & HCC: Rainfall intensities for PCC and HCC shall **also** be multiplied by the geographical zone factor shown in Appendix 6 and Appendix 5 respectively, **as well as** the 16 % allowance for climate change.

4.3.1.2 Runoff Coefficients (C)

Table 4.4 – Runoff Coefficients to be used with Hydrological Design

| Area Type | Coefficient C |
|--|---------------|
| Fully paved or roofed areas, CBD areas or urban, industrial or commercial areas with greater than 65% coverage permitted by the district plan. | 0.95 |
| Industrial/commercial areas with paved plus roof area up to 65% coverage permitted by the district plan. | 0.70 |
| Urban areas allowing between 36% and 65% impervious site coverage (inner residential, infill housing, intensive residential development). | 0.65 |
| Urban areas allowing coverage up to 35% (residential or outer areas). | 0.50 |
| Parks, reserves, green spaces, rural areas. | 0.35 |

4.3.2 Hydraulic Design

The designer may use the Manning's formula for hydraulic calculations as outlined in Appendix 7 (page 100). The Colebrook-White method is not suitable for free-surface or open channel flow, but is not specifically excluded from use where a suitable situation is presented. Parts of the hydraulic design presented here are also applicable to wastewater hydraulic design in conjunction with the provisions outlined in section 5.3.2 (page 48).

The hydraulic design must take into account:

- an allowance for air entrainment
- losses at bends and changes in direction
- losses at pipe entries, junctions and exits
- losses through manholes and structures
- changes in grade, invert level or pipe size
- backflow effects from proposed system existing and potential sea levels.

¹ The Ministry for the Environment has published "Preparing for Climate Change – A Guide for Local Government in New Zealand" (July 2008) which suggests that the average annual temperature will increase by around 2.1° by 2090. This translates to an increase in precipitation of up to 16% for most storm events. This document is free online from the MfE website.

Table 4.5 – Hydraulic Roughness Factors

| Pipe Material | Manning's n |
|--|-------------|
| Vitreous Clay | 0.013 |
| Precast Concrete Pipe | 0.013 |
| Cast in situ Concrete | 0.015 |
| PVC/PE | 0.011 |
| Corrugated Aluminium, PE or PP | 0.025 |
| <i>Open Channel</i> | |
| Straight uniform channel in earth and gravel in good condition | 0.0225 |
| Unlined channel in earth and gravel with some bends and in fair condition | 0.025 |
| Channel with rough stony bed or with weeds on earth bank and natural streams with clean straight banks | 0.03 |
| Winding natural streams with generally clean bed but with some pools and shoals | 0.035 |
| Winding natural streams with irregular cross sections and some obstruction with vegetation and debris | 0.045 |
| Irregular natural stream with some obstruction with vegetation and debris | 0.060 |
| Very irregular winding stream obstructed with significant overgrown vegetation and debris | 0.100 |

4.3.2.1 Air Entrainment

Where the pipe exceeds grades of 1 in 10, allowances shall be made for bulking of the flow due to air entrainment, and special precautions made to release the air and surplus energy. See Appendix 7 (page 100) for calculation methods.

Special precautions may be required to release air in subsequent tranquil drain sections.

4.3.2.2 Losses Through Structures

Losses through a structure shall be compensated for through a drop in the invert level through the manhole. The drop shall be additional to the entry and exit slopes, and shall be introduced gradually across the manhole.

The losses to be accounted for are:

- h_d head loss due to change in direction
- h_j head loss due to junction (if applicable)
- h_n nominal headloss across structure

Therefore the total drop (h_f) through the manhole to be accommodated shall be:

Equation 1
$$h_f = h_d + h_j + h_n \text{ (in metres)}$$

See Appendix A7.3 (page 101) for acceptable methods for determining components of h_f .

4.3.2.3 Pipe Inlets

Where an open stream or channel transitions to a pipe through a headwall or similar structure, the designer shall take into account the hydraulic head required to ensure full pipe capacity is achieved in the receiving pipe. Many pipe entries will require additional energy, with a subsequent increase in the backwater curve, to transition the flow from a channel cross section to a pipe cross section. The New Zealand Building Code, Clause E1, details appropriate methods for determining the inlet and outlet hydraulics.

4.3.2.4 Culvert Hydraulics

The hydraulic evaluation of stormwater culverts is outlined in the New Zealand Building Code, Clause E1. This method shall be used to evaluate the hydraulic performance of culverts.

Culverts under fills shall be of a suitable capacity to cope with the design storm with no surcharge at the inlet. Where the design storm is less than the 100 year flow, design checks shall be carried out under the 100 year design flow to assess the extent of the surcharge and to show that it will not present a risk to the stability of the adjacent embankments or increase the flooding risk to upstream properties. If either of these situations applies, then the culvert size shall be increased to eliminate the risks.

4.3.2.5 Backflow Effects and Downstream Level Conditions

Backflow effects shall be taken into account in design. Outlet design and water level conditions shall be considered in the design of discharges to existing stormwater systems and waterways and incorporate backflow prevention if necessary.

For discharges to the coast, assumed sea levels shall be the sum of:

- mean high water springs
- projected sea level rise through to 2110
- allowance for barometric rise from storms.

These sums are shown in table below.

Table 4.6 – Design Sea Levels Allowing for Climate Change

| | Wellington Harbour | Porirua Harbour |
|---------------------------------------|--------------------|-----------------|
| <i>Mean high water springs (MSL)</i> | 0.855 | 0.65 |
| <i>+ Projected sea level rise (m)</i> | 1.0 | 1.0 |
| <i>+ Barometric allowance (m)</i> | 0.25 | 0.25 |
| = Design sea level (MSL) | 2.1 | 1.9 |

An additional 1.0 m for sea level rise has been added to the design sea level to account for an increased sea level rise due to climate change² through to 2110.

Where the proposed drain discharges to the public system, the peak flows of both the proposed and public drains are unlikely to coincide due to the difference in times of concentration. The designer is required to determine the receiving waters level during the design event to facilitate backwater curve calculations. A conservative alternative is to assume both systems peak at the same time.

For discharges to the Hutt River, discussions with Greater Wellington shall be held to establish the downstream level of the river during the design event. Greater Wellington has a floodplain management plan and/or flood maps for:

- Hutt River
- Waiwhetu Stream
- Wainuiomata River
- Pinehaven Stream

For wastewater design, the terminal downstream level shall be taken as the pumping station's wet well maximum 'duty pump start' level.

4.3.2.6 Minimum Stormwater Velocity

Pipes shall be laid at a grade that reduces the potential for sediment build-up. Where gradients are < 0.5%, the minimum velocity shall be 0.75 m/s at half the two-year design event flow for trapped drains, where a trapped drain is considered as one where influent passes through a sump or sediment trap before entering the drain. For non-trapped drains, the minimum velocity shall be 0.9 m/s.

Velocities as low as 0.6 m/s may be considered in areas with flat terrain on special application.

² From "Coastal Hazards and Climate Change: A Guidance Manual for Local Government in New Zealand" Ministry for the Environment, July 2008

4.4 General Specifications for Stormwater

The following specifications outline methods that will generally be considered as compliant with the objectives and criteria of this standard. Deviations from these specifications may be tolerated by the council if provided with suitable cause; however, the council reserves the right to decline alternatives if they conflict with the objectives and performance criteria of this standard.

These specifications may change as technology and legislation evolve and changes may be unpublished at the time of design and application. The council reserves the right to vary these specifications to suit the application and contemporary industry practice.

All materials used for stormwater drainage works shall be new, or in as new condition when placed.

4.4.1 Information to be Provided

4.4.1.1 General

In addition to the council's normal subdivision application requirements, the developer shall provide evidence demonstrating compliance with the performance criteria of this document.

Any operations and maintenance guidelines for any water quality and/or control structures shall be submitted to the council for approval along with other required documentation.

4.4.1.2 Calculations

The design details and calculations shall be prepared by a suitably qualified person and demonstrate that required levels of service will be maintained. Calculations presented as part of any application shall include, but not be limited to, those for the rainfall intensity, time for concentration, catchment runoff coefficients, flood routing, peak discharge, consideration of the receiving environment, structure losses, pipe losses and backwater calculations. All assumptions regarding the design shall be clearly listed.

Structural calculations shall be provided to support the proposed pipe class based on min/max cover, traffic/construction loadings, surcharge conditions and bedding and surrounds.

The developer shall provide calculations where scour may occur. Clause E1 of the NZBC can provide guidance on this.

All applications to build within a floodplain must be supported by detailed calculations and plans that outline the floodplain boundaries and levels relative to building floor levels.

Any impact on adjacent areas or catchments that the proposed works may have shall be clearly indicated on the drawings and supported by detailed calculations prepared by a suitably qualified person.

4.4.1.3 Design and Construction Drawings

The following items shall be included in any design and construction drawings:

- A scale plan of the catchment.
- Details of all structures, including culvert entrances and exits, secondary intakes and energy dissipating structures.

- The location of any natural waterways or wetlands within the site, or in close proximity to a boundary. The location in plan, and the level of the water's edge and shoulder of the banks shall be indicated.
- Typical pre-existing and post development cross sections through any natural waterways or wetlands.
- The proposed proximity of buildings to the water's edge and/or shoulder of the banks;
- Clear identification of the extent of any river or coastal floodplains on, or in close proximity to, the site and overland flow paths within the site.
- The level datum.
- A plan showing the proposed location of existing and proposed stormwater drains in terms of datum.
- Long-sections shall be drawn with the chainage starting at the downstream end of the drain and the upstream point of the drain to the right of the drawing. This represents the way the drain would normally be constructed.
- Long-sections shall include details of all proposed and existing depths and levels of manholes, and pipe materials, diameters and grades.

Proposed works shall not begin until construction plans have been approved.

4.4.2 On-site Disposal

On-site disposal shall generally be designed to restrict the post-development rainfall – runoff to pre-development levels. While soakage systems are mostly discussed here, other systems published in NZWERF On-Site Stormwater Management Guideline are acceptable for on-site disposal systems.

PCC & UHCC: Detention or soakage facilities are required for **all** developments connecting to an existing stormwater system and shall be designed to limit the design peak discharge from the development (post-construction) to not greater than the existing design peak discharge (pre-development) already exiting into the public network, for a one in 10 year, 20-minute duration storm.

On-site disposal facilities servicing single lots shall be located completely within the serviced lot and be privately owned and operated.

4.4.2.1 Soakage

The standard acceptable methods of on-site disposal are soak pits and soak trenches³. These may only be used to dispose of runoff generated on the site and are not to accept flows from adjacent lots.

HCC: HCC does not generally accept soak pits as a means of disposing of stormwater.

Suitably designed and constructed soak pits will be considered acceptable for residential applications and will generally be privately owned and maintained. Larger installations for commercial, industrial or communal use will be at the discretion of the council and may require a geotechnical assessment.

³ Note: soak pits and trenches are typically not suitable in the hard ground of the hills in the Wellington region. Careful consideration should be made in the pre-design stages to determine if soakage is a viable option for the application.

Care must be taken to ensure the stability of the adjacent ground is not compromised by the soakage.

The soakage facility must be sited on private property and have adequate clearance from boundaries, dwellings, buildings, retaining walls and sanitary sewers. The following table provides clearance distances for small installations.

Table 4.7 – Clearance Distances Between Soak Pits and Structures

| Proximity to: | Required Clearance |
|---------------------------|------------------------|
| Dwellings | 2.0 m |
| Small outhouses/buildings | 1.5 m |
| Boundaries | 1.5 m |
| Retaining walls | Height of wall + 1.5 m |
| Sewers | 1.0 m |

The top level of the soak pit is to be above the ponding level of a 20% AEP rainfall-runoff event and the base of the soakage facility is to be a minimum of 500 mm above the winter groundwater table level.

The soakage facility will be approved upon submission of results of a suitable soakage test and design. The test, and a suitable design, is outlined in Clause E1 of the NZBC, but with the following modifications:

- Soakage devices that are the sole management device shall be designed to achieve a primary level of protection as defined in section 4.2.6. The design shall consider all storms between 10 minutes and 24 hours in duration.
- All soak holes must completely drain within 24 hours of a rainfall event, to ensure they are ready for the next event.

TP10 and TP124 from the Auckland Regional Council can also be used for guidance as well as the NZWERF On-site Stormwater Management Guideline.

A discharge permit may be required from the regional council for discharge to ground⁴ and this shall be confirmed with GW.

Soakage pit entries or systems should be trapped to limit the amount of debris entering the soakage interface to extend the long-term viability of the system.

4.4.2.2 Discharge Detention and Attenuation

Attenuation, using on-site detention facilities, can be used to limit the discharge from the property to mitigate adverse effects on the downstream system. This may be a requirement of the council depending on the condition of the downstream stormwater system.

These can take the form of an above-ground (rainwater) or buried tank, and may be combined with soakage. The design event duration for a proposed detention structure should be based on the time for concentration of the public stormwater above the point of connection with the proposed detention structure. Storage for larger, multiple lot developments requires special design as outlined in section 4.4.3. For residential

⁴ Discharge into or onto land, including stormwater collected from any road, roof, yard, paved surface, grassed surface or other structure, and discharged into a pipe which discharges into surface water.

detention structures, a 1 in 10 year event with a T_c of 20 minutes shall be used to determine runoff and detention volumes.

Consideration shall be made to providing suitable access for regular maintenance of the outlet and storage volume.

The attenuation facility shall generally be privately owned and maintained and placed on private property. The facility shall be protected by private easement where required.

The secondary flow path due to outlet blockage *shall not* be a buried overflow pipe connection, but be by an appropriate and visible overland flow to an approved outfall or public system. This is to provide a visible indicator to the owner for the requirement for maintenance.

4.4.3 Stormwater Detention Ponds

Detention may take the form of oversized pipes, defined ponds, large channels/swales or ponding areas. Detention ponds or areas require specific design in conjunction with the council. The Unit Hydrograph method⁵ outlined by the NRCS (or in ARC TP 108 “Guidelines for Stormwater Modelling in the Auckland Region”) shall be considered an acceptable method for use in flood routing, although others will be considered upon submission.

Detention areas/ponds must have access for maintenance to at least the standard for intakes.

Where an open detention pond is proposed, detention depths shall not exceed 1.2 m deep unless access to the pond edge is restricted.

The detention structure is to be adequately designed to withstand overtopping or surcharging from an event larger than the design event.

Where detention structures are to be vested to the council as part of the public stormwater network, the structure shall incorporate control, monitoring, alarm and telemetry systems compliant with the current council specification.

4.4.4 Open Watercourses

Open watercourses shall be designed with a minimum freeboard of 300 mm (500 mm for HCC) above the design flow. Consideration shall be given to wave action and heading up at bends in the watercourse.

Major watercourses and their natural character shall be retained wherever possible, and be located in public reserves. Piping more than dry weather flow in large watercourses is often unnecessary and uneconomic.

There shall be no modification of an existing stream system unless it is for flood mitigation purposes, and there are no viable alternative flood management methods available. All development work should be located away from the riparian buffer where possible, and impediments to the natural flow with barriers to fauna should be avoided.

Any work in a stream bed is likely to require resource consent and contact shall be made with Greater Wellington to confirm. Consent may also be required from the territorial authority as well. The extent of any stream improvement work shall be agreed with the council in order to achieve a satisfactory result maintaining the natural topography and vegetation, along with maintenance, hydraulic and safety considerations, including the downstream effects of the work.

Where the stream is ephemeral, and would nominally require a pipe of 600 mm diameter or less in a subdivision, then the stream is to be piped.

⁵ Formerly known as the SCS Unit Hydrograph method. This can be found online in the Hydrology Chapter of the “National Engineering Handbook” (H_210_NE) published by the USDA Natural Resources Conservation Service (formerly Soil Conservation Service).

Any watercourse requiring a pipe over 600 mm diameter for the design event may either be piped if an approved secondary flow path is available, or remain in an open channel.

For watercourses with the equivalent 10% AEP event design capacity as that of a 600 mm pipe, the watercourse is required to be in an easement in favour of the council. The easement is to include sufficient space on at least one side of the stream and flood berm (for mean annual flood) for a 4.5 m wide strip practical for maintenance access to the stream, unless otherwise specified by the council. The cross section of any open watercourse shall be constructed to comply with the council's specific requirements.

4.4.4.1 Bridges

Where bridges cross an open watercourse, the design shall allow for a freeboard of 600 mm between the design peak water level and the underside of the bridge structure. This shall be increased to 1200 mm where there is a possibility of large trees being carried down the waterway (from the Bridge Manual published by New Zealand Transport Authority).

4.4.5 Private Connections to the Public Stormwater System

Private connections may be made to public mains, watercourses and kerbs, and shall be a minimum size of 100 mm nominal diameter. Each proposed dwelling on a lot shall be serviced by a separate connection to the public system at a location approved by the council. Unit titled developments are exempt from this criterion and may be serviced by a single, suitably sized connection. Each connection shall be capable of servicing the entire lot, or the remaining flow not serviced by an on-site stormwater disposal system.

Industrial and commercial lots shall have a minimum nominal diameter of 150 mm and shall connect to a stormwater pipe, swale or, where permitted, open watercourse.

Connections provided to lots must be at sufficient depth that they can be extended to the building platform in a manner compliant with the NZBC.

Where the connection is to an empty lot, the terminal connection shall be:

- laid to the boundary of the property
- end in a method that can accept an approved spigot
- be blanked off or sealed with a removable cap
- be marked with a securely embedded H4 treated timber post, with at least 600 mm protruding above ground, and the top 100 mm painted green.

Connections 150 mm or less can be made directly to a stormwater main, of a larger diameter, using a proprietary factory-made saddle.

Connections larger than 150 mm shall be connected to the public system via a manhole only. Connections shall be made at angles 90 degrees or less to the direction of the flow.

Connections shall not be made to public pipes with 5 m or greater cover. A shallower public drain shall be provided to collect private connections before joining the deeper main.

A private connection cannot cross an adjacent property without the permission of the council and the adjacent property owner. Where permission is obtained, in writing, an easement shall be obtained in favour of the connection's lot.

4.4.5.1 Connections to Kerb and Channel

Connections to the kerb and channel are limited to 100 mm diameter pipes. All other connections must be to a watercourse, swale or a public stormwater pipe.

UHCC: UHCC does not allow connections to a kerb and channel.

For kerb and channel connections, the pipe between the back of the footpath and the boundary may be made from an approved plastic, but beneath the footpath and to the kerb and channel must be galvanised steel or cast iron with approved steel kerb adaptors.

4.4.5.2 Abandoning and Reuse of Existing Private Laterals

Where an existing building has to be demolished or replaced, the end of the lateral is to be capped at the main or re-laid for future use. The council shall be advised of the final treatment.

The reuse of a previously used lateral over 25 years old is not permitted.

4.4.6 Public Stormwater Pipes

The stormwater system shall be designed as a separate system with no cross-connections to the wastewater system.

4.4.6.1 Minimum Size

The minimum nominal diameter for a public stormwater pipe is:

- 300 mm for stormwater mains and double sump leads
- 225 mm for single sump leads.

4.4.6.2 Pipe Materials

The permitted materials for use in the stormwater network are detailed in Appendix 1, page 91. Note that the designer should check with the latest council specification for any amendments.

4.4.6.3 Location

Where practical, pipes shall be located in public land, and where surface access for machinery and maintenance is possible at all times, at reasonable cost and least possible disruption to the public.

Where pipes are laid in private property, they shall be protected by an easement (see section 4.4.13) and subject to the criteria outlined in section 4.2.2 regarding easements and avoidance of existing and potential building sites.

Public drains shall not be laid under permanent buildings or retaining walls and shall be laid at least 1.5 m clear of existing buildings. No building footprint or retaining wall shall impose extra load on the drain and any drain shall be placed outside the 45-degree surcharge line from the centre of the drain, unless by special design solution to the satisfaction of the council (see 4.4.14, page 39).

Drains and manholes shall not be located directly on a boundary line or where a fence is proposed.

4.4.6.4 Minimum Cover to Pipe

(This section applies to wastewater design also.)

Concrete pipe installations shall be designed to comply with AS/NZS 3725 whilst also maintaining a minimum cover of 750 mm.

Flexible pipes (PE, PVC) shall be designed to AS/NZS 2566 whilst maintaining a minimum cover of:

- 600 mm in non-trafficked areas
- 900 mm in trafficked areas where practicable.

Specific design shall be presented to the council for approval where it is proposed to lay pipes at a lesser cover. Solutions may include special protection for a pipe at a shallow depth.

Trench design shall take into consideration loads during construction and design load assumptions shall be identified on the drawings.

Council pipes laid in residential property shall be designed to withstand a 5t wheel load.

Pipes in minor residential roads, private roads and footpaths shall assume HN loadings as per NZTA Bridge Design Manual (also outlined in AS/NZS 3725 Supplement 1).

Pipes in main roads, central business districts, industrial and commercial areas shall be designed using HN-HO-72 loadings as per Bridge Manual published by NZTA.

Special design may be required for areas with special loadings (airports, railroads, industrial applications) and for specific in-situ ground conditions.

4.4.6.5 Pipe Jointing

(This section applies to wastewater design also.)

All pipes shall be jointed with proprietary flexible joints, typically a rubber ring joint.

Alternative jointing methods shall be required to be approved by the council and shall be noted on the drawing and any relevant information produced as requested by the council.

4.4.6.6 Changes in Pipe Diameter

(This section applies to wastewater design also.)

Where the downstream pipe diameter increases, the pipe shall, as a minimum, be designed as soffit-to-soffit such that the hydraulic grade line through the structure is constantly falling (i.e. no heading up).

A downstream reduction in pipe diameter will generally not be accepted. Where a reduction in diameter is justified through a significant increase in grade, the change shall be made in an appropriately smooth transition structure (a manhole as a minimum).

Where a reduction in diameter is approved, specific engineering is required to eliminate heading up in the manhole, and detrimental backwater curves in the approaching pipe.

Reductions to less than a 300 mm diameter pipe will not be considered.

4.4.6.7 Pipes at Steep Grade

(this section applies to wastewater design also)

Pipes laid at a steep grade shall be designed for air entrainment (see 4.3.2.1) and shall have sufficient protection to protect the drain from UV light, erosion and physical damage. The protection shall be visually acceptable within the context of the surrounds.

Appropriate downstream energy dissipation is required where the design velocity exceeds 3 m/s and the flow undergoes a sudden reduction in grade; or where hydraulic design suggests significant turbulence will occur. Energy dissipation shall be designed to protect the receiving structure from erosion and damage.

Pipes at steep grade shall require water stops (see 4.4.6.8).

4.4.6.8 Water Stops

(This section applies to wastewater design also.)

Water stops are required to reduce movement of groundwater along trenches and minimise the potential for trench scour. Manholes can be considered as water stops if constructed in a manner that restricts the passage of water past the structure.

Water stops shall be constructed of 17.5 MPa concrete, be 150 mm thick and keyed 150 mm minimum into the trench walls and base. Water stops shall extend 300 mm above the pipe (see also drawing DR03, Appendix 13).

The spacing of water stops shall be as per Table 4.8.

Subsoil drains may be required where a high water table or excessive infiltration is expected. These drains shall discharge to an appropriate facility, typically a downstream manhole and above nominal design flow levels. Where the subsoil drain passes through a water stop or similar, it shall be sealed so as to restrict bypass flow through the water stop.

Table 4.8 – Water Stop Spacing

| Pipe Grade | Spacing (metres) |
|---------------|------------------|
| > 20% | 5 |
| 20% to 12.5% | 7.5 |
| 12.6% to 6.7% | 15 |
| 6.8% to 1% | 90 |

4.4.6.9 Pipe Junctions

(This section applies to wastewater design also.)

All public pipe junctions shall be made using a manhole. This does not necessarily include laterals, which are subject to provisions in section 4.4.5.

Junctions shall be appropriately benched as outlined in section 4.4.8.6.

4.4.7 Subsoil Drains

Permanent subsoil drains shall be installed in earthfill except where all of the following criteria can be demonstrated:

- There are no natural springs that will discharge at the base of the fill.
- Positive provisions (e.g. cut-off subsoil drain) are made to prevent surface runoff entering the fill at the exposed fill/natural ground contact.
- The natural ground on which the fill is to be placed is contoured and scarified prior to the placement of fill to ensure that, over the whole base of the fill, the fill can be fully compacted to specification and continuity achieved between the fill and natural ground.
- The fill material is uniform, of relatively low permeability and is not erodible.

Private subsoil drains shall be laid to the same standard as if they were public drains and a permit for them shall be obtained. The requirements for a public drain will in general apply, though access requirements may be eased.

Subsoil drains shall be constructed as follows:

- They shall connect to a manhole structure at both ends. The upstream manhole can be a maintenance shaft.
- They should be laid in a narrow trench, though if the loading permits, they may be laid in the cleaned out bed of the old watercourse with gentle horizontal and vertical curves.
- There shall be no abrupt changes in grade.
- The drains in the main gullies shall be established through design and shall be at least one pipe size larger than any connecting branch drain,
- Branch drains shall be laid in all adjacent gullies and adjacent to any wet areas such as a spring.
- Branch drains shall be a minimum of 100 mm diameter and shall be connected to the main by means of Y junctions only. Open butt joints will not be permitted.
- Where the design load allows, perforated concrete, HDPE or ceramic pipes may be used.
- These pipes must all be bedded and surrounded with a minimum of 150 mm of suitable graded filter material. Alternatively a suitable permanent filter fabric may be placed around granular pipe bedding in lieu of the graded filter,
- Where the design load precludes the use of these pipes or where significant localised inflows or ground water are to be intercepted then the drain shall be laid as a sealed drain of adequate strength and may have multiple branches with multiple inlets to collect ground water.
- Where perforated pipes cannot be used, stones larger than the pipe diameter shall be hand placed over the inlets. The larger stones are to be covered with 50 mm of ballast. A suitable graded filter material shall be placed over this ballast.
- Where perforated pipes are used, the ends of the branch drains shall be sealed off and the drain backfilled as normal.
- Subsoil drains shall be clearly identified on as-built plans.
- There shall be no direct stormwater connection or opening to a subsoil drain.

4.4.8 Manholes

(This section applies to wastewater design also; section 5.4.4.)

4.4.8.1 Types

The two types of manholes outlined in this section are:

- manholes; and
- maintenance shafts (also known as cleaning eyes, rodding points or lamp hole cleaning eyes).

Manholes are required to allow physical entry of a person and equipment to the pipe for purposes of maintenance, investigation or connection.

Manholes shall be constructed in pre-cast reinforced concrete with minimum number of risers to minimise risk of infiltration. Other materials may be accepted by the council upon application and with suitable reason.

Manholes shall generally be used on all public drains at:

- junctions of public drains;
- changes in grade; and
- changes in direction.

Branch pipelines 300 mm or smaller may be saddled onto pipes 1200 mm diameter or larger without the requirement for a manhole, provided a manhole is constructed on the branch line within 50 m of the junction.

Maintenance shafts are designed to provide access to rod or jet obstructions clear of the pipe. Maintenance shafts shall not be used unless dispensation has been granted by the council.

Maintenance Shafts may be considered (except for HCC) at the upstream termination of a short section of 150 mm drain section, typically 50 m or less.

In some circumstances, a maintenance shaft may be used at the top of a steep change of grade where a manhole is likely to be in an unsafe or precarious position.

The council may also consider approving maintenance shafts at subdivision terminal staging points or where the developer can justify their use for a special circumstance.

There shall be no customer connections to a maintenance shaft.

4.4.8.2 Design for Floatation

In areas of high water table, manholes shall be designed against floatation using a factor of safety of 1.25. The weight of the manhole risers, lid, slab and base shall be used for calculating the resistance against floatation and the manhole shall be assumed to be empty. The weight and effects of the surrounding soil shall be ignored except where integrated flanged manhole bases are used, whereupon the volume and net density of the soil (density of dry soil minus the density of water) above the flange can be used to calculate additional resisting force.

4.4.8.3 Manhole Size

Manholes shall be a minimum of 1050 mm diameter.

Manholes with a depth to invert between 2 and 4 metres shall be 1200 mm diameter.

Manholes with a depth to invert greater than 4 metres shall be 1500 mm diameter.

The manhole shall be large enough to appropriately admit connecting pipelines and any required change in direction. Manholes shall also be large enough to accommodate landings with room for manoeuvring and equipment if required.

600 mm diameter manholes may be used where the pipe invert is less than 1 m from the finished ground level, and the manhole is not located in the carriageway. 600 mm manholes can accept a maximum of two incoming pipes. Notwithstanding this, manholes less than 1050 mm will generally not be considered unless special circumstances are presented.

WCC: Does not accept 600 mm manholes.

4.4.8.4 Deep Manholes

Deep manholes are considered to be manholes greater than 5 m in depth. Manholes shall be specifically designed to take into consideration access, health and safety, maintenance and rehabilitation. Deep manholes shall typically have:

- landing or landings to reduce potential fall to less than 5 m;
- the level of the lowest landing must be *at least* 2 m above the level of the benching; and

- hinged hatches in the landings above the manhole rungs arranged such that a person can be safely winched to the surface from the manhole base without requiring manoeuvring.

Permanent ladders may be used in lieu of rungs.

4.4.8.5 Manhole Rungs

Manhole rungs are required for all manholes greater than 1 m in depth. They shall be suitably protected from corrosion (typically hot dipped galvanised steel for stormwater or council-specified grade of stainless steel for wastewater) and be 'dropper' or safety type that do not allow the foot to slip sideways off the rung.

The first rung shall be within 675 mm of the lid and the rungs shall be aligned below the manhole entry.

The manhole entry (and rungs) shall be arranged such that the offset entry hole is above the outlet pipe.

WCC: The manhole rungs shall be arranged such that they are parallel to the flow and above the manhole benching. The manhole entry is aligned central to the manhole.

4.4.8.6 Benching and Haunching

Manholes shall be haunched to the top of the pipe soffit.

Pre-fabricated benching and haunching may be permitted at the discretion of the council.

4.4.8.7 Connections to Manholes

A 1050 mm manhole shall have no more than 3 incoming pipes and 1 outgoing pipe. This includes sump leads, private connections and main pipelines.

4.4.8.8 Drops at Manholes

All pipe entries shall be haunched to the manhole invert to avoid cascades, although sump leads, or normally dry stormwater laterals 300 mm in diameter or less, may enter above the benching as a cascade.

Haunched drops are not to exceed 500 mm and consideration shall be given to the hydraulic grade line and surcharging where super-critical flows transition to tranquil sub-critical flows.

For wastewater pipes, drops greater than 500 mm may be made using an internal drop.

4.4.8.9 Internal Drop Structures

External drop structures are not permitted within either the stormwater or wastewater network.

Internal drop structures will not normally be considered for stormwater applications, but are acceptable within wastewater systems.

Drop structures shall be avoided where possible, by laying the approaching drain at a shallow grade, then descending to the manhole invert through a steep section of pipe at the final approach. A manhole is required at either end of the steep approaching inlet drain.

For wastewater systems, internal drop structures are required where the approaching inlet grade is greater than 45 degrees. Internal drop pipework shall be designed to be clear of the design flow and the discharge shall be to a haunched channel. Internal drop

pipes shall not be larger than 225 mm in diameter. The minimum size for a manhole with an internal drop structure is the nominal manhole diameter plus the drop pipe outside diameter.

4.4.8.10 Spacing

Manholes shall be spaced not more than 90 m in road reserve for pipe less than 1050 mm in diameter, or 90 times the pipe diameter for pipes 1050 mm in diameter or greater.

Manhole spacing shall reduce to 60 m in private property.

4.4.8.11 Loadings

Covers, lids, risers and manhole installations shall be designed to withstand HN-HO-72 loadings.

Manhole lids in trafficked areas, or where there is the potential for vehicle loadings, shall be a minimum of 150 mm thick.

Where the manhole is in an area likely to be subjected to high ground water levels, the manholes shall be designed to withstand uplift from at least 1.25 times the expected uplift pressures.

4.4.8.12 Manhole Covers

Manhole covers shall be as specified by each council's approved material list. They shall, as a minimum, be able to withstand HN-HO-72 loadings and comply with Class D loadings of AS 3996.

Bolt-down manhole covers shall generally not be approved for new schemes except in carriageways with posted speed limits of 80 km/hr or greater. They shall not be used as a solution to drains surcharging due to increased stormwater from proposed developments.

Bolt-down covers may be considered in existing networks where the potential for surcharging exists at the discretion of the council. The use of these will also require appropriate sealing of lids, and the tying of manhole risers and lids together using an approved proprietary system.

4.4.8.13 Changes in Grade

Notwithstanding the provisions in 4.4.8.1 (page 32) regarding manholes at the top of steep banks, changes of grade shall be made at a manhole.

4.4.8.14 Changes in Direction

Any change in direction or bend shall be completed contained within the interior of the manhole. The maximum change of direction shall be 90 degrees.

An exception to this may be made where a manufactured mitred bend is required, generally on large pipes, typically 750 mm in diameter or larger, provided:

- there is no compelling reason not to form the bend within a manhole;
- there is a downstream manhole within 5 m of the bend;
- there are no proposed or potential connections to the bend; or
- the location of the bend is shown, accurate to ± 100 mm in the required co-ordinate system, on the drain's as-built plan.

Maintenance structures shall not be used for changes in direction.

4.4.9 Pipe Intakes

Intakes shall be designed to accept the design flow without scour or erosion of the pipe surrounds. Wing walls are a minimum requirement for stormwater intakes directly into a pipe.

Suitable barriers/fences shall be required above an intake where a fall of 1 m or greater is possible from above the intake headwall, and where public access is possible.

An all-weather access track must be provided to the entrance of all intakes. The access shall be at least 4 m wide and no steeper than 1:5 (v:h) and suitable for use by trucks. There must also be room for machinery to work at the intake. The access shall be in public land or protected by an easement.

Provision shall be made so that no water can bypass the inlet structure and flow into compacted fill or areas where damage may occur.

See also section 4.3.2.3 (Page 22) for hydraulic design requirements.

Grills are not typically required for culvert entries unless specifically requested by the council. Culverts are required to have access provisions for clearing similar to those of pipe intakes, and debris arrestors may be required. Provisions to protect the structure against scour and erosion at the inlet and outlet shall be provided and supported by calculations where requested.

4.4.9.1 Intake Grills

Grills shall be placed on intake pipes 675 mm in diameter or smaller, and shall have vertical bars spaced no greater than 115 mm apart. Pipes greater than 675 mm in diameter shall have bar spacing either smaller than 115 mm or greater than 450 mm. In addition to this, the grills shall:

- be bolted to the wall with either hot dipped galvanised or stainless steel bolts in a fashion that will allow the grill to be readily replaced;
- consist of a vertical front face of a height at least equal to the pipe diameter, and a sloping top. The angle of the top shall be greater than 1 in 4 (v to h);
- be sufficiently strong to resist the impact of any debris that may come down the watercourse;
- be sufficiently designed to withstand cleaning with an excavator bucket (where appropriate);
- not allow the top grill to protrude beyond the vertical grill (to avoid excavator buckets from catching on the top grill).

4.4.9.2 Debris Traps

Debris arrestors may be required upstream of the intake at the request of the council. The debris arrestor shall be a coarse screen designed to restrict the entry of large objects into the intake structure. These are typically constructed from vertically set steel railway sections or similar. The screen's bar spacing shall be approximately 0.75 times the diameter of the intake pipe.

A catch-pit may also be required immediately upstream of the debris arrestor to arrest sediments and heavier debris. The dimensions of this trench or pit shall be based on catchment characteristics, approaching flow velocity and maintenance restrictions.

4.4.9.3 Secondary Intakes/Paths

Secondary intakes shall be considered in all cases where there is serious consequence of damage should the intake be overtopped. The preferred form of a secondary intake in a confined ponding area is a mushroom intake where entry of floating debris into the intake is minimised.

The design of the secondary intake should be based around the assumption that the primary intake is blocked.

Provision shall be made for flows greater than the design capacity of the intake and pipe to overflow to an overland flow path that meets the minimum AEP as outlined in section 4.2.6 (page 14).

4.4.10 Outlets

The outlet or outfall from a public or private drain shall be to the public stormwater network or an approved alternative.

Discharging to land sloping down to receiving waters is to be avoided where possible. Discharging to land may be considered where the designer can demonstrate that the flows can be controlled, there are no adverse environmental effects and overland flow is contained to within the developer's property before reaching a receiving body of water. Discharging to land will not be considered where the slope is large and scouring is likely.

Where significant turbulence is likely, such as at a large change in cross-sectional area, specific measures shall be taken to eliminate scour and erosion of the receiving drain and surrounds. This may take the form of protective aprons and linings of the receiving channel or flow calming or energy dissipating structures. As a general rule, exit velocities in drains of up to 1.8 m/s may be tolerated without specific energy dissipation structures. Short duration flows up to 3 m/s may be tolerated if it can be shown that the channel is in stable and strong ground, potential maintenance has been considered and addressed, and the consequences of erosion are small.

Where the outlet discharges to a natural stream or channel, the outlet shall, as a minimum, be protected by a proprietary wing wall structure, concrete apron and concrete embedded downstream riprap with the intention of reducing scouring velocities.

Any structure should be designed to minimise the collection of debris. Where collection of debris is likely, access considerations equivalent to those of an intake (see section 4.4.9, page 36) shall be incorporated into the design to allow for removal of the debris.

Direct outfall to specific rivers, streams or the sea may require permission from Greater Wellington. Consideration towards the Freshwater Plan and Coastal Plan should be made when proposing direct discharges to streams, rivers and coastal areas.

4.4.11 Sumps

PCC & Sump requirements and detailing is covered under the Roadway sections of **WCC**: WCC and PCC codes of practice. Section 4.4.11 applies to UHCC and HCC only.

The intake capacity of a road sump with grating and rear entry, and acceptable ponding at inlet is approximately 28 L/s.

High capacity sumps may be required in some instances. The intake capacity of these sumps shall be determined in consultation with the manufacturer.

Sumps shall:

- connect to a manhole, or to an open watercourse where no stormwater reticulation is available;
- utilise a rear entry and cycle friendly grate;
- be double sumps at the end of cul-de-sacs, at low points in the road or where slopes are steeper than 1 in 20;
- be clear of vehicle crossings and access ways;

- be placed where there is the potential for water to leave the road and enter a private property, typically upstream from vehicle crossings, or sudden changes in grade or direction;
- be placed in areas where ponding of water is possible; and
- be spaced no greater than 90 m apart, but close enough to adequately accept the contributing flows.

Sump leads shall have a flexible connection within 300 mm of the sump. Standard single sumps shall be serviced by a 225 mm nominal diameter lead, and double sumps shall be serviced by a single 300 mm nominal diameter lead.

Special design shall be required where a lead is proposed to discharge to a pipe running full to ensure the sump lead is of a suitable size.

4.4.12 Stormwater Pumping Stations

4.4.12.1 General

Publicly owned stormwater pumping stations will be considered only at the sole discretion of the council and only where, in the opinion of the council, there are no practicable alternatives.

The council shall be contacted prior to design to establish any materials or design conventions that have been established.

Pumping systems shall be designed using a multi-pump system to best balance the need for regular pump operation against the relative infrequency of major storm events. The peak storm frequency (AEP) shall be set to match the upstream and downstream stormwater system, but shall be not less than:

- the AEP specified in the Performance Criteria (see section 4.2.6, page 14) when an overland secondary flow path can be identified that will ensure the minimum level of protection is not exceeded; or
- 1% AEP when no overland secondary flow path is available.

4.4.12.2 Site and Structure

A metered water supply and tap outlet shall be provided to the immediate vicinity of the station. The supply shall be fitted with an approved RPZ backflow preventer.

The station site shall be on a separately titled lot on the subdivision with a sealed vehicle access to a formed road. The lot shall be vested to the council. The site shall be fenced and provided with a lockable gate as outlined by the council.

Architectural featuring of any visible structures shall be within the context of the proposed subdivision and shall be subject to the approval of the engineer.

Chamber lids shall provide access openings centrally over each pump and shall be designed to withstand HN-HO-72 loadings when in roads (including paths and berms).

Access openings shall be provided with protective screens to prevent people from falling into the chamber while maintenance is being carried out.

The wet well shall be designed such that the wet well can be isolated from the reticulation and drained without compromising minor stormwater flows. Isolation can be via a penstock gate or stop-logs specifically stored on-site.

4.4.12.3 Electrical

On all pump stations the control switchboard shall be provided with a plug and wiring capable of allowing an emergency generator of a size suitable for coping with the wet weather flow, to be used to drive the pumps.

Stormwater pumping stations shall incorporate valving control, monitoring, alarm and telemetry systems to council standards at the time of the design.

4.4.12.4 Pumps

All pumps in a station shall be of the same size and the number used shall be such that at peak flows one pump remains unused as a standby.

Valves shall isolate all pumps and incorporate an easily dismantled pipe joint near the pump, which enables easy removal of the pump. Pumps shall be designed for not more than 8 starts per hour, but shall use starters capable of 15 starts per hour. For pumps of over 2 kW, soft start systems shall be provided.

Pumps shall be of a suitable submersible type and shall have non-clogging impellers.

Each duty pump shall be capable of passing all required flows up to and including the design flow without exceeding the restriction on the number of starts.

Where practical, the pumps shall be installed in a duty-standby arrangement with each pump capable of accommodating the full flow. The duty shall be interchangeable between pumps. Where multiple pumps are used, only one pump is required to be on standby while the others are on duty or assist; for example, in a three-pump arrangement, the full flow can be carried by only two pumps with one pump on standby.

4.4.13 Easements

(This section applies to wastewater design also.)

WCC: WCC does not require easements for stormwater or wastewater drains in private property.

Where an easement is required, the easement shall be a minimum 3 m wide. For drains larger than 300 mm nominal diameter, the easement width shall be 2.7 m plus the outside diameter of the drain. The drain shall be laid along the centreline of the easement.

Where more than one public main is laid in an easement, the easement shall extend 1.35 m from the outside edge of each outside drain.

The cross section of the drainage easement shall, wherever possible, be designed and constructed as an access for maintenance (including mowing if appropriate). The easement may also be used for secondary overland stormwater flow if required.

Unless otherwise approved, easements shall be within one lot and shall not straddle a boundary line. The pipe centreline shall not be laid less than 1.0 m from the boundary,

The council will at all times retain a 24-hour access right to all services contained within the easement without impediment, and without prior notice to the property owner. Under no circumstances shall any building be constructed or obstruction placed in a drainage easement or underground service easement. The easement shall be secured over all public services crossing private property at development stage whether services are existing or new.

4.4.14 Pipes near Buildings

(This section applies to wastewater design also.)

Where a building or retaining wall already exists, public drains shall not be laid within 1.5 m of the building or retaining wall (see Location, section 4.4.6.3, page 29).

Where a pipe is laid deeper than 1.5 m, a building line restriction shall be defined by a 45-degree line between the base of the trench to the closest underside of the foundation (see Figure 4.1). The building line restriction illustrated can be described as a 45-degree

line, starting from a point 300 mm below the pipe invert and 0.5 times the pipe's outside diameter towards the foundation.

A consent notice shall be issued requiring specific engineering design by a chartered professional engineer for the foundations of any building proposed within the building line restriction area. The design shall ensure no additional surcharge load is imposed on the pipe and an excavation could be made to maintain or replace the pipe without undermining the foundations of any building.

When laying a drain alongside an existing structure, and the trench is likely to be open for more than 48 hours, the pipeline design shall assume the building restriction line begins at the **trench** invert plus half the trench width (see Figure 4.1).

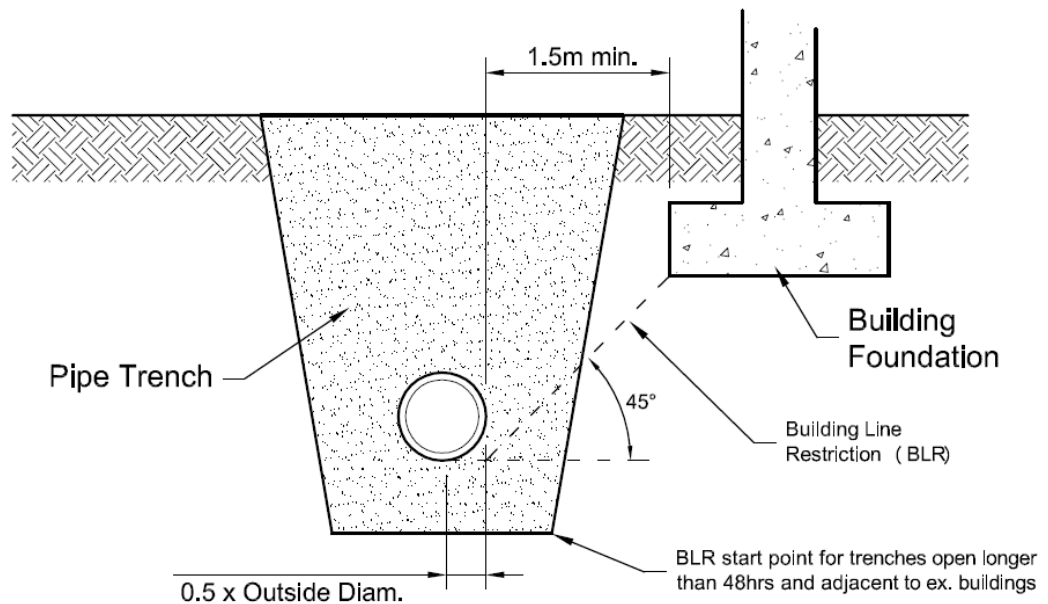


Figure 4.1 – Building Line Restriction

Notwithstanding the building line restriction, the foundation shall not be closer than 1.5 m to the outside edge of the pipe barrel. Dispensation may be considered for foundations closer than 1.5 m in special circumstances. Distances less than 1 m will require the foundation to be 300 mm below the pipe invert.

4.4.15 Testing

(This section relevant to wastewater design also.)

For subdivisions, and depending on the council's specific requirements, all sewers and stormwater will be tested upon completion of construction at the applicant's expense and as part of part of the council's approval process. The council's representative shall be present during the test, and will sign the appropriate documentation provided by the council to verify the test if successful. A minimum of 24 hours of notice is required to be given to the council prior to the test being carried out. The developer shall provide all fittings and materials to carry out the test.

For subdivisions, the developer is required to have met the following requirements prior to pipe testing and council arriving on site:

- Trenched and pipes laid.
- Bedding and surround material, top and bottom shall have been laid over the pipe. Minimum 100mm top and bottom of pipe.
- All pipe junctions exposed including laterals and inspection eyes.

- Lines flushed and all residual debris cleaned out.
- All fittings and connection to have been installed prior to pressure test.
- Lines to have been pressurised overnight to the required pressure prior to the test commencing.

All mains and branch pipelines, including manholes and connections shall be tested after backfilling. The test shall be either the Water Test or Low Pressure Air Test as outlined below (based on tests described in AS/NZS 3500.2).

4.4.15.1 Water Test

The upstream end of the section under test shall have a minimum head of 1.5 m above the pipe soffit. The maximum head at the lower end of the pipeline shall be 6 m.

Concrete and earthenware pipes shall be soaked for 24 hours prior to the test. Care shall be taken to ensure that all air is expelled when filling the pipe with water.

For concrete and ceramic pipes, the amount of leakage shall not exceed 2 millilitres per millimetre diameter per metre length per hour measured over a minimum period of 10 minutes. This is equivalent to 1.5 litres of leakage in ten minutes for a 30 m long 150 mm diameter pipeline.

For uPVC and HDPE pipes there shall be no leakage after 5 minutes.

4.4.15.2 Low Pressure Air Test

The Low Pressure Air Test is applicable to pipelines only and should not be used where new manholes are required to be tested also.

Air is to be introduced into the pipeline until a pressure of 30 kPa is reached.

Time is to be allowed for the air temperature to become uniform and pressure to stabilise, typically at least 3 minutes.

The air supply is to be disconnected and the pressure drop measured after 5 minutes.

The pipeline is acceptable if the pressure drop does not exceed 5 kPa (510 mm water gauge pressure).

4.4.15.3 CCTV Inspection

The council may require the drain to also be inspected with a colour CCTV camera. This inspection shall be additional to the water or air test. Any defects detected by the camera inspection shall be made good and the relevant section of pipeline tested again. Contractors are advised to carry out their own test before backfilling the trench.

Acceptance of the drain will not be given until it has passed the water or air test and any CCTV inspection required.

4.4.16 Benchmarks (WCC Only)

(This section applies to wastewater also.)

All as-built levels are to be taken from an approved permanent benchmark such as a WCC benchmark or LINZ survey marks with the required accuracy.

All new developments shall require a new council benchmark or benchmarks to be established if:

- there is no existing benchmark within 1 km of the development; and/or
- the total area of the development is greater than 1 km².

The council shall determine the requirement and placement of new benchmarks.

New benchmarks shall be:

- levelled and certified, in writing, by a licensed cadastral or registered professional surveyor. The certificate shall be accompanied by a finder diagram and shall list the survey method;
- established in NZTM coordinates;
- Levelled to MSL;
- documented with a finder diagram showing at least three measurements from known permanent features to the new benchmark.

The council has the sole discretion to grant dispensation, in the form of cost sharing, upon consideration of:

- total development size (not just individual stages);
- location;
- ongoing development in the area;
- distance from existing bench marks; and
- benefit to WCC.

4.4.16.1 Installation

The council shall take the following factors into account when siting a new benchmark;

- Likelihood of future disturbance, permanence.
- Ground stability.
- Services.
- Survey visibility, line of sight.
- Accessibility (clear of traffic, road reserve, council easement).
- Ongoing development.

A standard WCC benchmark plaque will be issued by the Council on application.

There are two types of installation depending on the ground conditions. The two types are:

- **good ground:** typically consists of weathered greywacke parent material and soils less than 300 mm thick
- **adverse ground:** typically consists of soft colluviums, deep soils and/or sands.

Benchmarks established in **good ground** shall be set in a 350 x 350 mm square concrete block poured to a minimum depth of 500 mm. The plaque base shall be recessed into the concrete block and the block surface shall be flush with the finished ground level to the tolerances set out by the roading department's reinstatement requirements.

For benchmarks established in **adverse ground**, the concrete block's base shall be increased to a minimum of 550 x 550 mm square. The block may be stabilised with steel stakes (waratahs) or reinforcing rods set into the block and angling out into the surrounding ground below the block's base.

These installation types are detailed in Appendix 13, Engineering Drawings.

5 Wastewater

5.1 Objectives

To provide a system for the safe treatment and disposal of wastewater that safeguards people and communities from injury or illness caused by infection or contamination resulting from exposure to wastewater, while at all times avoiding, remedying or mitigating adverse effects on the environment.

5.2 Performance Criteria

5.2.1 Durability

The wastewater network shall:

- minimise adverse environmental effects and comply with all consent conditions set under the Resource Management Act;
- be designed and constructed with materials suitable for the intended use, with a proven performance record, and commensurate with a nominal structural and operational life of 100 years; notwithstanding the nominal operational network life, items with a lesser expected operational life, such as mechanical and electrical equipment, shall be selected and installed with consideration to maximising longevity, compatibility with existing systems, and economic replacement; and
- be designed in a way that minimises the overall renewal and maintenance life-cycle costs. For the purposes of calculation, the lifecycle costs shall be determined using a life of no less than 100 years.

5.2.2 Maintenance and Operational

The wastewater network shall:

- minimise the risk of flood water ingress without unduly restricting maintenance access;
- be compatible with the existing wastewater drainage network;
- be laid out in such a way as to minimise the potential for blockage and facilitate on-going maintenance or development;
- minimise the likelihood of leakage and infiltration and the penetration of roots;
- minimise the likelihood of blockage; and
- withstand all anticipated superimposed loads.

5.2.3 Functional

The wastewater network shall:

- adequately service the catchment including all current and future lots ultimately possible under the operative district plan; this includes potential expansion of the network beyond the developer's initial development;
- consist of an underground piped reticulation system where an adjacent public reticulation is available;

- be of capacity suitable for carrying peak flows anticipated during the lifetime, without surcharge, and with due allowance for ground and surface water infiltration and inflow;
- be designed to minimise blockage and sediment deposition;
- maintain adequate self-cleansing velocities to ensure a daily flush at dry weather flow at both existing and fully developed stages. Where inadequate flows are expected, such as within some industrial areas, or during initial stages of development, special flushing facilities shall be required at the discretion of the council;
- adequately convey wastewater to an approved discharge point;
- utilise gravity drainage wherever practicable;
- where utilising mechanical or electrical equipment, have adequate emergency provisions and alarm systems to minimise the possibility of discharge to land or water;
- be adequately vented to reduce the build-up of hazardous gases and prevent siphoning of private drainage or gully traps. Ventilation should be provided in such a manner that it does not cause a hazard to property owners or members of the public;
- provide alarm and telemetry systems that are compatible with those being used by the council at the time of project implementation;
- not be connected to the stormwater network. Wastewater systems shall be designed and constructed to minimise the risk and extent of stormwater inflow and infiltration. Where the wastewater network is within a flood plain, or overland flow path, it shall be designed to prevent floodwaters entering the network;
- ensure all gully traps are above the 100 year event surface level and at least 150 mm above the nearest opening (e.g. manhole or cleaning eye) in the wastewater network; and
- ensure overflow protection is provided at pumping stations to allow for pumping failure. This shall take the form of 4 hours' dry weather storage or suitable approved alternative. Notwithstanding this, emergency relief overflows and venting shall be provided for extreme events in addition to any storage provisions.

PCC: For PCC, the overflow storage shall be 6 hours average dry weather flow.
UHCC: For UHCC, the overflow storage shall be 8 hours average dry weather flow.

5.2.4 Access

The wastewater network shall:

- be located within the road reserve except where special difficulties preclude this;
- be protected by easement where special difficulties necessitate the placing of reticulation pipes on private property;
- not unduly restrict the location of any future buildings or development; and
- be located and designed to provide reasonable access for maintenance without significant damage or disruption to other network utility services, land use activities and landscape values. Covers, barricades, fences and sign-posting shall be provided as appropriate to provide for public safety and prevent public access to hazardous areas.

5.2.5 Environmental Quality

Ensure that environmental quality is taken into account in the location, design and construction of all components of wastewater systems.

In considering environmental quality, the following should be taken into account:

- The need to avoid adverse effects on cultural and heritage sites and to respect cultural values, particularly the cultural values of tangata whenua relating to wastewater treatment and disposal.
- The need to preserve or protect areas of ecological significance, areas of significant habitat for indigenous flora and fauna and outstanding natural features.
- The need to avoid, remedy or mitigate adverse effects on freshwater ecosystems, watercourse margins, esplanade strips, harbours and the coastal marine area.
- The need to avoid, remedy or mitigate adverse effects on visual amenity.
- The need to provide for on-site silt and sediment management, erosion control and dust control during construction.

5.2.6 On-site Disposal

On-site disposal shall be designed to enable the safe hygienic disposal of all household wastewater by surface or subsurface land disposal without creating any adverse environmental impact outside the bounds of the lot. Such systems may only be used in rural or rural residential developments where a connection to the existing reticulation is not considered reasonable by the council.

Grey-water reuse schemes in urban areas are considered an alternative solution and will be considered under special application (refer to section 3.4).

On-site wastewater treatment and disposal systems shall:

- provide an appropriate and safe treatment and disposal facilities in accordance with any regional plans developed pursuant to the Resource Management Act;
- have a life expectancy in line with the best available systems of the time;
- satisfy all consents granted under the Resource Management Act;
- be adequately separated from private water supplies, watercourses and boundaries such that there are no adverse effects within or outside the lot served;
- have minimum maintenance needs and be as fail safe as practicable;
- demonstrate that there are suitable management systems in place for their long-term operation, maintenance, replacement, upgrading and funding;
- be unobtrusive; and
- not be permitted where water supply is on demand/unrestricted.

HCC: On-site disposal will be considered where water supply is on demand/unrestricted

Design shall be based on field testing and any other site investigations necessary to demonstrate that these requirements can be met.

Reference can be made to:

- GWRC “Guideline for on-site sewage systems in the Wellington Region” (Dec 2000);
- AS/NZS 1546.1 “On-site domestic wastewater treatment units - Septic tanks”;
- AS/NZS 1546.3 “On-site domestic wastewater treatment units - Aerated wastewater treatment systems”; and
- AS/NZS 1547 “On-site domestic wastewater management”.

See also section 5.4.9 (page 56) for general specifications for on-site disposal.

5.3 Design Methods

The design methods presented here are considered to be acceptable for the purposes of developing solutions compliant with the objectives and performance criteria of this standard. Deviation from these methods will be considered with suitable evidence that the method is equivalent in function and outcome to the standard solutions presented in this document.

Wastewater design is presented in two parts in this document; wastewater design flows and hydraulic design. For the purposes of this document, wastewater design flow relates to determining the hypothetical design parameters for the collection system. Hydraulic design relates to calculating the behaviour of the flow within the system.

Certified calculations shall be made available to the council as part of any application.

5.3.1 Wastewater Design Flow

The design flows determined in this section are to be used in the hydraulic design of the wastewater collection network. Reference to the council's current district plan will be required to ensure all potential development upstream, downstream and within the development is accommodated in any proposed works.

5.3.1.1 Wastewater Catchment

The catchment used for all wastewater design calculations shall be all the area that drains/discharges wastewater or could physically and legally drain/discharge wastewater to the point under consideration. When determining the design flow, the catchment shall be, as a minimum, considered to be developed to the full extent permitted by the district plan.

Where future development is possible (i.e. if a district plan change is pending, or flows are possible from an adjacent development), the potential for additional wastewater flow shall be accommodated.

Sewer catchment areas will usually need to be calculated manhole to manhole so the network pipelines are not unnecessarily oversized.

5.3.1.2 Population

The population to be used for wastewater design in typical residential developments shall be based on a people per dwelling basis.

Table 5.1 – Residential Development Population Density

| Council | Population per Dwelling | Min. Density People per Ha* |
|---------|-------------------------|---|
| HCC | 3.5 | 60 |
| PCC | 3.5 | 50 |
| UHCC | 3.5 | 45 |
| WCC | 3.1 | Residential – 140 Inner city – 400 Suburban centre - 1200 |
| WCC CBD | 3.1 | 400 ha of floor area** |

* gross area including streets, but excluding reserves.

** assuming 3 m between floor levels and maximum building height and coverage as per district plan. Ninth floors and above can assume 50% occupancy.

Alternative means of estimating occupation and/or flows will be considered and may be discussed with the council.

5.3.1.3 Residential Design Flows

Design flows are determined by multiplying the area's/development's estimated population by the figures in **Error! Reference source not found.**

Table 5.2 – Residential Design Flows (L/person/day)

| Council | ADWF | PDWF | PWWF |
|---------|-----------|------|------|
| HCC | 270 | 540 | 1080 |
| PCC | 270 | 540 | 1080 |
| UHCC | 275 | 550 | 1100 |
| WCC | see below | | |

For WCC design only:

ADWF = 0.0023 L/s/person (L/s)

PDWF = ADWF / 86400 * PF * population (L/s); where PF is the peaking factor from Appendix 11.

PWWF = PDWF + PGWF + PRWF (L/s); where PGWF and PRWF is peak ground and rainwater flow respectively.

PGWF = $A_{wet} \times 0.347 + A_{dry} \times 0.044$ (L/s); where A_{wet} is the area (ha) with a high water table including (but not limited to) those areas with a surface level less than 3 m NCD. A_{dry} is all other areas.

PRWF = $A_{res} \times 0.440 + A_{other} \times 0.232$ (L/s); where A_{res} is the residential area (ha) and A_{other} is the remaining area.

5.3.1.4 Industrial/Commercial Design Flows

Flow from large industrial or institutional complexes, wet industries, large residential buildings or commercial developments shall be by specific design and pertinent to the activity. The basis of design for this shall be submitted for approval to the council and prior to final design.

Consultation with the council is required when designing flows for the following areas:

- Hospitals and nursing homes.
- Massey University.
- National Art Gallery and Museum.
- Te Papa.
- Abattoirs.
- Lambton Harbour Waterfront facilities.
- Commercial port area.
- Oriental Parade residential high rises, Wellington.
- Foreshore area seaward of Evans Bay Parade, Wellington.
- Wellington CBD.

Where specific activities are *not* known, the following factors from Table 5.3 may be used:

Table 5.3 – Industrial and Commercial Design flows (L/ha/sec)

| Council | | ADWF | PDWF | PWWF |
|---------|--|------|------|------|
| HCC | Indust/Comm. | 0.52 | 1.56 | 1.56 |
| PCC | Heavy | | | 1.3 |
| | Medium | | | 0.7 |
| | Light | | | 0.4 |
| UHCC | Industrial | 1.0 | | 3.0 |
| | Light industrial | 0.08 | | 0.23 |
| | Commercial | 0.25 | | 1.0 |
| WCC | Apply WCC residential method as outlined in section 5.3.1.2 (page 45) to obtain PDWF and PWWF. | | | |

5.3.2 Hydraulic Design

Manning's formula shall be used in the hydraulic design of sanitary sewers. The method outlined in section A7.1 (page 100) shall be used with the following amendments:

- Section 4.3.2.5: Backflow effects for wastewater pipes should assume downstream pumping station wet well levels are at normal operational maximum (duty pump start level).

In addition to this, gravity wastewater pipelines shall not be designed to operate at pipe full capacity and pipes shall allow for a 15% air space in the design, i.e.

$$\frac{\text{Area of sewage}}{\text{Area of pipe}} = 0.85$$

For circular pipes, this is equivalent to a pipe flowing at a depth of 80% of the pipe diameter. This air gap is required to maintain airflow through the sewers and eliminate the discharge of odours at manholes.

5.3.2.1 Self-cleansing Velocities

Notice should be taken of the requirement for new sewers to maintain self-cleansing velocities during subdivision staging. The design shall allow for interim measures for self-cleansing where these cannot be achieved during the initial stages of the development.

Self-cleansing velocities can be demonstrated by:

- calculating the expected PDWF for the proposed pipe section and ensuring flow velocity exceeds the minimum requirement of 0.75 m/s; **or**
- adopting the minimum pipe grades in Table 5.4 (except for WCC designs which will typically require steeper grades).

Table 5.4 – Minimum grades for wastewater pipes

| Pipe DN | Minimum Grade | |
|---------|---------------|-------|
| 150 | 1.11 % | 1/90 |
| 225 | 0.69 % | 1/145 |
| 300 | 0.44 % | 1/230 |

These values are based on pipes flowing at 52% depth (PDWF) and assuming a peaking factor of 2. Steeper grades may be required for areas with greater peaking factors; e.g., areas using the WCC method of PWWF calculation.

Shallower grades may be permitted at the discretion of the council provided the applicant can demonstrate cleansing velocities can be achieved or the effects mitigated.

5.3.2.2 Maximum Velocity

Velocities during PWWF should not exceed 3 m/s. Where velocities exceed 3 m/s, special provisions shall be made such as drop manholes (see Internal Drop Structures; section 4.4.8.9, page 34) to flatten the approaching grade, or by increasing pipe diameter.

5.4 General Specifications for Wastewater

5.4.1 Information to be Provided

5.4.1.1 General

In addition to the council's normal requirements for subdivision application, the developer shall, as a minimum, provide the following information with any wastewater design:

- drawings and calculations as outlined below;
- operations and maintenance guidelines for any pumping station, odour treatment or effluent treatment facility to be vested to the council.

5.4.1.2 Calculations

The design details and calculations shall be prepared by a person qualified in wastewater design and demonstrate that required levels of service will be maintained. Calculations presented as part of any application shall include, but not be limited to, those for the peak and daily flows, structure losses, pipe losses and backwater calculations. All assumptions regarding the design shall be clearly listed. Any deviation should be documented and the written council approval for the deviation attached.

Analyses, results and reports calculations prepared by a suitably qualified person shall be submitted for pumping stations and on-site disposal fields proposed.

Structural calculations shall be provided to support the proposed pipe class based on min/max cover, traffic/construction loadings, surcharge conditions and bedding and surrounds.

5.4.1.3 Design and Construction Drawings

Design and construction drawings shall show details of all structures, including energy dissipating structures, internal/external drops and typical trench cross sections. The following shall be included within the submitted drawings:

- Long-sections shall be drawn with the chainage starting at the downstream end of the drain and the upstream point of the drain to the right of the drawing; this represents the way the drain would normally be constructed.
- The level datum.
- The long-sections shall show levels, grades and material of proposed pipelines in terms of datum as well as material, depth and diameter of manholes and maintenance structures.
- The long-sections and plan drawings shall show proximity to any other existing or proposed services.
- Where on-site treatment is proposed, drawings are required outlining the effluent treatment areas proposed, flood levels in design event, the proximity of any natural body of water and the method and layout of irrigation.

Proposed works shall not begin until construction drawings have been approved.

5.4.2 Private Connections to the Wastewater Network

The minimum nominal diameter for a private connection shall be 100 mm. Each proposed dwelling on a lot shall be serviced by a separate connection to the public main and at a location approved by the council. Unit titled developments are exempt from this criterion and may be serviced by a single, suitably sized connection.

Connections provided to lots must be at sufficient depth that they can be extended to the building platform in a manner compliant with the NZBC.

All 100 mm connections to the public main shall be via a proprietary 'Y' junction. Connections 150 mm or greater shall be made at a manhole except in Wellington CBD where laterals larger than 150 mm shall be made at a manhole. The minimum length of a connection shall be 1 m.

Y junctions, and connections in general, shall not be made to a sewer deeper than 3.5 m to the crown. Each lot's 'Y' connection shall be made to a shallower branch sewer which will join with the deeper main at a manhole.

Where the connection is to an empty lot, the terminal connection shall be:

- laid to the boundary of the serviced property;
- end in a method that can accept an approved spigot;
- be blanked off or sealed with a proprietary removable cap painted red; and
- be marked with a securely embedded H4 treated timber post, with at least 600 mm protruding above ground, and the top 100 mm painted red.

A private connection cannot cross an adjacent property without the permission of the council and the adjacent property owner. Where permission is obtained, in writing, an easement shall be obtained in favour of the connection's lot.

Minimum grades for private connections up to the property boundary shall be as outlined in Clause G13 of the NZBC, but with a minimum grade of 1:60 unless otherwise justified.

Connection to the public network shall be carried out by a contractor approved by the council.

5.4.2.1 Abandoning and Reuse of Existing Private Laterals

Where an existing building has been demolished or replaced the end of the lateral is to be capped at the main or re-laid for future use. The council shall be advised of the final treatment.

The reuse of a used lateral over 25 years old is not permitted.

5.4.3 Public Wastewater Pipes

The wastewater system shall be designed as a separate system with no cross-connections to the stormwater system.

5.4.3.1 Minimum Size

The minimum nominal diameter for a public wastewater gravity pipe is:

- 150 mm.

5.4.3.2 Location

Where practical, pipes shall be located in public land, preferably carriageways, footpaths and berms, and where surface access for machinery and maintenance is possible at all times, at reasonable cost and with the least possible disruption to the public.

Where public drains are laid in private property, they shall be subject to easements as outlined in section 4.4.13 (page 39) and shall not impinge on potential building sites within the development unless a clear policy allowing such is published by the council (WCC has a policy titled “Standards and Guidelines for Building Over or near Public Drains”).

Public drains shall not be laid under permanent buildings or retaining walls and shall be laid at least 1.5 m clear of existing buildings (see also 4.4.14, page 39). No building footprint or retaining wall shall impose extra load on the drain. Drains shall be placed above the 45 degree surcharge line projected downwards from the nearest bottom edge of the adjacent foundation or footing, unless by special design solution to the satisfaction of the council.

Drains and manholes shall not be located directly on a boundary line or on the alignment of a proposed fence or retaining wall.

5.4.3.3 Pipe Materials

The permitted materials for use in the wastewater network are detailed in Appendix 2, page 92. Note that the designer should check with the latest council specification for any amendments.

Materials for stream crossings, elevated pipelines and pumping station pipework shall be discussed and approved by the council prior to detail design.

5.4.3.4 Pipeline Design

The following sections are to be applied to both wastewater and stormwater designs:

| | |
|--------------------------|---------------------|
| Minimum Cover to Pipe | - 4.4.6.4 (page 29) |
| Pipe Jointing | - 4.4.6.5 (page 30) |
| Changes in Pipe Diameter | - 4.4.6.6 (page 30) |
| Pipes at Steep Grade | - 4.4.6.7 (page 30) |
| Water Stops | - 4.4.6.8 (page 31) |
| Pipe Junctions | - 4.4.6.9 (page 31) |

5.4.4 Manholes

Refer section 4.4.8 (page 32).

5.4.5 Venting

Venting of structures is required to eliminate the collection of noxious gases and corrosive conditions within the structure’s air space. Venting shall be required at all:

- pumping station wet wells;
- manholes that receive a rising main discharge;
- manholes where inverted siphons enter or discharge; and
- terminal upstream manholes on any branch line (this is deemed satisfied for pipes in subdivisions if at least one property is connected to the most upstream manhole in the branch).

Odour treatment will be required where vents discharge to urban areas. Odour treatment can be in the form of activated carbon filters or odour beds. Solutions for odour treatment shall be discussed with, and approved by, the council prior to detail design.

5.4.6 Easements

Refer section 4.4.13 (page 39).

WCC: WCC does not require easements for wastewater drains in private property.

5.4.7 Wastewater Pumping Stations

Pumping stations will only be considered for approval by the council where gravity drainage is not feasible. Pumping stations serving more than 10 urban lots may be vested to the council.

The design is required to be approved by the council before construction begins. The designer shall liaise with the council pumping station engineer prior to detail design to establish acceptable methods and materials.

The developer shall bear all costs of design, construction and commissioning of pumping station including SCADA, controls, power supply and integration of the station into the wastewater network.

Pumping stations that are to be vested to the council shall comply with the following minimum requirements:

5.4.7.1 Pumps

- The station shall be designed to convey the peak wet weather wastewater flow under normal duty.
- Stations shall be designed in a duty-standby arrangement with each individual pump capable of conveying the design peak wet weather wastewater flow, i.e. 100% standby pumping capacity.
- A three-pump duty-assist-standby arrangement may be considered for large stations where a single pump cannot provide the full design flow. All three pumps shall be of identical hydraulic performance and the standby pumping capacity shall be at least 50% of design flow.
- The duty shall be interchangeable between pumps.
- Pumps shall have non-clogging impellers with a throughlet of between 75 mm and 100 mm where possible.
- The council's preferred pump make shall be used. The council should be contacted prior to design to determine the appropriate manufacturer.
- Pumps shall be selected based on a system curve developed for the proposed station pipework and rising main.
- Pumps shall be capable of a minimum 12 starts per hour.
- Pump rates shall be set taking into consideration any capacity limitations of the downstream gravity network.

5.4.7.2 Station

- The station shall be placed completely within a separately titled lot or within road reserve. A sealed access of not less than 3.5 m width shall be provided to the nearest public street. The immediate area around the station shall be fenced and provided with a locked gate.
- Water supply, with an appropriate backflow preventer, shall be supplied to the station.

- Chains of high tensile quality stainless steel for lifting are to be provided for the maintenance and servicing of all pumps.
- The wet well volume shall be designed based on a maximum 12 starts per hour plus adequate standby storage.
- Wet wells shall be vented.
- Pipework shall be arranged such that each pump can be isolated whilst others are in operation. Similarly, all non-return valves should be able to be isolated and maintained while the standby pump is operating. All valves and non-return valves are to be in a chamber external to the wet well.
- A valve is to be provided to allow the wet well to be fully isolated from the reticulation.
- All iron and steel shall be suitably internally and externally protected against corrosion. Flanged or welded fittings shall be provided throughout, with a proprietary dismantling joint or similar in the system to facilitate dismantling.
- All pipework within the wet well shall be ABS or stainless steel.
- Chambers shall be designed against flotation when empty.
- Emergency storage, capable of storing the required volume outlined in section 5.2.3 (page 43), shall be provided either in the wet well or offline. This storage shall be in addition to the operational wet well storage.
- The control of odours shall be included in the design.
- Any dry wells shall be adequately force-ventilated using ducted mechanical exhaust and drawing air from near the base of the dry well. Exceptions may be made for shallow chambers at the discretion of the council.
- Provision for an emergency overflow and overflow monitoring, notwithstanding the overflow storage, shall be made. The overflow level shall be determined such that manhole surcharge upstream of the station is avoided. A discharge permit must be obtained from Greater Wellington for the overflow.
- Chamber lids shall be placed centrally over the pump sets and shall be suitable of withstanding HN-HO-72 loads when in the carriageway, berm or footpath.
- The equipment in the wet well shall be designed so that all maintenance to the equipment can be carried out without the need to enter the wet well. All valves should be operable from the surface to enable the wet well to be emptied in an emergency without the need for man entry.
- The lining of the wet well below the 'standby pump on' level shall be sulphate resistant.

5.4.7.3 Electrical and Controls

- Pumping stations shall incorporate all necessary control, monitoring, alarm and telemetry systems to council standards at the time of design. Liaison with the council's pumping station engineer shall be made, prior to design, to determine the necessary electrical and control specifications.
- All electrical equipment is to be flame resistant, installed above the 1% AEP (100 year) flood level and in a stainless steel weather-proof cabinet.
- All equipment shall be designed to Hazard Safety Rating Zone 1 Class 1 in NZS/AS 3000.
- Cables shall be sealed to prevent sewer gases entering the electrical cabinet.
- For pumps over 2 kW, soft starter systems, capable of not less than 15 starts per hour, shall be provided to mitigate starting currents.

- Terminals are to be provided to allow the connection of a suitable generator. Both a single-phase and a 3-phase plug shall be provided on the board to allow for equipment connections.

5.4.7.4 Rising Mains

- Rising mains shall generally be designed to withstand the dynamic head expected in the pipeline including allowances for surge, water-hammer and fatigue.
- The pipes shall generally be minimum OD110 PE100 SDR11 but the design presented shall be that which achieves the best operational and efficient result for the council.
- Rising mains shall be sized to ensure a minimum velocity of 0.9 m/s is achieved with the design flow, whilst at the same time avoiding excessive discharge pressures and associated power consumption.

5.4.8 Private Wastewater Pumping Stations

Where connection to the council network is not possible, and where the council has given written permission, private wastewater pumping stations may be considered provided they comply with the following minimum criteria:

- Design of the station is to be carried out by a suitable professional and be submitted to the council for approval.
- Pumps shall have an open multi-channelled impellor with a macerator/grinder on the intake (allowing maximum 8 mm free passing). Pumps shall also have thermal overload protection and a liquid temperature rating of 40°C.
- Materials and design shall have minimum 50 years durability.
- The rising main shall be a minimum of 63 OD PE100 SDR11.
- Wet well design and pumps shall be based on 12 starts per hour and peak wet weather flow.
- Chambers shall be designed against floatation and chamber hatches shall be designed to be impervious to inflow and infiltration.
- All controls, electrical equipment and cables are to be provided with suitable weatherproof enclosures and sited above 1% AEP flood level.
- The station shall be fitted with an audible and visual alarm system indicating pump failure and overflow.
- Non-return valves *shall not* be installed on the private discharge main in a way that prevents the un-discharged effluent to return to the wet well when pumping stops. This avoids septic conditions in the rising main. Notwithstanding this, the rising main discharge shall be placed and designed to eliminate the potential for sewage from the main pipeline to surcharge and backflow down the rising main and overflow the wet well.
- The rising main shall discharge to a private or public manhole.
- The wet well shall be of a size to hold 24 hours of ADWF (section 5.3.1, page 46), plus the volume of the rising main, above the pump start level.

The resource consent may require additional emergency storage or an emergency disposal field depending on the surrounding environs and scope of the development.

The Developer shall take the responsibility to alert any future owners of the site and the station that:

- the site is serviced by a private pumping station;
- the owners are fully responsible for the maintenance and operation of the station;

- the owners are responsible for any fines or consequences from a failure adequately to maintain the station;
- a 24-hour message service and on-going maintenance contract must be acquired for the station; and
- the station must be kept to a standard acceptable to the council and does not cause a nuisance to other property owners, adverse effects to the surrounding environment, or discharge material that may damage or cause negative effects to the council's sewer network and the environment.

Notices shall be placed on the resource consent outlining the maintenance obligations of the private owner, and equivalent notices shall be placed on the certificate of title for the serviced properties.

5.4.9 On-site Disposal

On-site disposal for residential waste may be approved in rural and rural residential areas where there is no available potential for a connection to the public wastewater network, and the provision of a community system for vesting to the council is not considered appropriate by the council. There are three levels of treatment discussed:

Primary treatment may typically consist of:

- improved multi-chamber septic tank; or
- home treatment plant such as aerated tanks or rotating disc systems.

Secondary treatment may typically incorporate discharge to land and consist of:

- soakage trenches, commonly dose loaded; or
- evapo-transpiration and seepage beds or trenches; or
- mounded evapo-transpiration and seepage beds; or
- land irrigation by low pressure spray or drip system.

Tertiary treatment includes options such as chemical or ultra-violet treatment where discharge to waterways is proposed. All discharges to waterways will require a resource consent.

5.4.9.1 Application

For any subdivision for which on-site disposal is proposed, proof of the ability to provide a suitable system for each lot shall be submitted with the resource consent application.

The preliminary design and supporting report shall be based on field testing carried out on each lot.

Any design shall comply with the council's wastewater bylaw, and shall provide for, but not be limited to, the following points:

- site assessment carried out by a suitably qualified person;
- design and installation undertaken by a suitable professional;
- effluent to have primary and secondary treatment as a minimum;
- a test on the system is carried out by the installer or manufacturer within a 4-month period of its installation to demonstrate its compliance with AS/NZS 1547; a copy of the compliance results shall be sent to the council;
- on-site system capacity designed for occupancy based on the number of bedrooms in the dwelling – as per Table 4.3A1 AS/NZS 1547, but shall be not less than 4500 litres;
- an outlet filter to a standard prescribed in AS/NZS 1547;

- even distribution of effluent to the entire disposal field by either pump or dosing siphon; and
- a minimum 3-year service/maintenance contract with the supplier or its agent post-installation.

The minimum features of any design shall include:

- manufactured to contemporary New Zealand standards;
- minimum 24-hour emergency capacity;
- audible and visual alarm;
- full-height primary wall (to prevent solids washing through to the high performance chambers during surge flows);
- groundwater entry prevention lids;
- irrigation filter (regular blockage would indicate tank is not performing well);
- flush valves (to clean lines);
- 24-hour call or message service;
- service contract; and
- routine servicing.

Effluent disposal fields shall comply with the following location requirements:

- Have at least 20 m separation distance between neighbouring disposal fields.
- Located not closer than 50 m from valley floors, ephemeral streams, storm drains, any type of open waterbody, or down-slope land boundaries, and 20 m down-gradient (i.e. with respect to groundwater flow) from drinking water bores.
- Located in an area where the ground surface is free of inundation in a 5% AEP flood event,
- Have the underside of the disposal bed be not less than 600mm above the highest water table,
- Located no closer than 1.5 m from any boundary.
- disposal into the top soil, preferably.
- Located in a designated area free from slopes over 18 degrees (3 horizontal: 1 vertical).

Effluent disposal fields shall comply with the following site requirements:

- A primary effluent disposal field of not less than 250 m² (average 3 bedroom home).
- A 'reserve area' of equivalent size to the designed effluent disposal area shall be set aside on the same lot for future expansion or replacement of disposal area.
- Maximum discharge to land not to exceed 1500 litres/day per primary disposal field.
- With suitable soils and groundwater conditions, for lot sizes under 5,000 m², the aerial effluent-loading rate shall not exceed 3.5 litres/m²/day.

With suitable soils and groundwater conditions, for lot sizes 5,000 m² and above, the aerial effluent-loading rate shall not exceed 5 litres/m²/day.

Other requirements for effluent disposal fields include:

- suitable plants and shrubs shall be planted and maintained in the disposal field; and
- fencing of the disposal field from children and animals as a protection for public health.

If, at subdivision stage, an existing effluent disposal system on any lot within the proposed development is found to be more than 10 years old, it must then be proven to comply with the current minimum requirements for on-site effluent disposal.

5.4.9.2 Soil Considerations

In situations of high permeability soils and/or high water table, where potential for environmental contamination is high, further treatment by filtration and/or disinfection will be required.

In special circumstances the use of other than water-based sewage systems may be proposed. Such systems shall be designed according to current guidelines and supported by relevant design data. In such cases grey water shall be disposed of to land and adequate soil testing and design shall be provided to support the proposal for grey water disposal. The council will consider grey water disposal to land where adequate soakage can be shown from soil testing and any potential adverse public health effects/nuisance conditions can be minimised.

5.4.9.3 Design

Design inputs shall include:

- testing of site soils;
- obtaining winter groundwater surface levels; and
- topographical survey of the relevant part of the lot to enable the system to be accurately located in terms of ground contours and features.

Reference shall be made to the current versions of the following standards:

- NZS 1546.1 On-site domestic wastewater treatment units - Septic Tanks;
- NZS 1546.3 On-site domestic wastewater treatment units – Aerated wastewater treatment systems;
- NZS 1547 On-site domestic wastewater management.

5.4.10 Testing

Testing and acceptance of sewer systems is covered within the provisions of section 4.4.15 (page 40).

6 Water Supply

6.1 Objectives

To safely and reliably collect and adequately distribute water for domestic, commercial, industrial and firefighting purposes in a manner that protects public health, promotes sustainability, and complies with the performance criteria outlined in this document.

6.2 Performance Criteria

Any scheme must demonstrate consideration and compliance with the criteria listed below.

6.2.1 Durability

The water supply network shall be designed and constructed with materials suitable for the intended use, with a proven performance record, and commensurate with a nominal structural and operational life of 100 years.

Notwithstanding the nominal operational network life, items with a lesser expected operational life, such as mechanical components, pumps, control valves and electrical equipment, shall be selected and installed with consideration to longevity, compatibility with existing systems and economic replacement.

The water supply network and its components shall be designed in a way that minimises the overall life-cycle costs. For the purposes of calculation, the life-cycle costs shall be determined using a life of no less than 100 years.

Designs shall accommodate anticipated demand growth and network expansion ultimately possible under the council's current district plan. This includes potential expansion of the network beyond the developer's initial development.

Network components shall be designed to be resilient to the appropriate level outlined in the relevant standard. Pumping stations, reservoirs and supporting structures for trunk mains should be designed to Importance Level 4 as defined in AS/NZS 1170.0.

6.2.2 Maintenance and Operational

The network shall be designed to be water tight to the specified required test pressures which includes allowances for surge and fatigue.

Components shall be compatible with the existing network.

Pipework shall be laid underground.

The network shall be designed to minimise the extent of water supply outage required for any planned or unplanned maintenance activities.

Pumping facilities shall have adequate standby pumping and emergency provisions to mitigate the consequences of pump or power failure. All pumps in a pumping station shall be of equivalent duty and there shall be at least one standby pump.

Drinking water systems shall be designed and equipped to prevent back-siphoning. The location and operation of hydrants, overflow pipes, air valves, scours and other fittings shall ensure no external water enters the system.

6.2.3 Functional

The system shall at all times comply with the provisions of the Health (Drinking Water) Amendment Act 2007 and the Drinking Water Standards for New Zealand.

The council will not provide an on demand supply from the reticulated water supply system in urban areas unless a reticulated wastewater system is available in a new development.

HCC: Reticulated water supply connections to non-wastewater reticulated sections will be considered by HCC on application.

In any development, the reticulated supply shall be capable of providing uninterrupted, suitable flow and pressure to the designated point of supply and to all existing and potential lots allowed for within the council's current district plan.

Any shared, private, reticulated water supply system shall comply with the objectives and performance criteria of this standard.

The network shall provide firefighting flows and pressures in compliance with SNZ PAS 4509 "Code of practice for firefighting water supplies". Suitable positive pressures shall be maintained in the remainder of the distribution zone during firefighting scenarios. Any private firefighting mains shall be constructed to the performance requirements of this standard.

Trunk mains shall *not* have customer connections direct from them. All customer connections shall be from reticulation mains, which may in turn be connected to trunk mains.

Pressure to all customer points of supply, in a reticulated network, shall be provided by gravity and from a council storage reservoir. Alternatives such as pressure boosting stations will not typically be considered.

Pressure surges from demand or mechanical facilities shall be minimised through suitable design and provision.

The network shall be designed so that no more than 50 lots will be isolated when isolating any reticulation pipe section for the purposes of maintenance.

6.2.4 Access

Provisions shall be made to allow suitable access for firefighting appliances and equipment to the firefighting water supply.

Public pipelines shall be placed in road reserve wherever possible, with suitable access for maintenance and operation. Where this is not possible, the pipe shall be placed on publicly owned land or land that is protected by an easement in favour of the council.

Provisions shall be made such that all facilities, such as reservoirs, flow/pressure monitoring stations, treatment facilities or pumping stations, are on publicly owned land, and accessible by vehicle during all weather conditions.

The access performance criteria in this document applies to any existing, private water main that is proposed to be vested to council.

6.2.5 Environmental

The network shall be designed and operated in a way that eliminates or minimises adverse effects on the environment and complies with the requirements of the Resource Management Act. This includes the need to avoid, remedy or mitigate:

- adverse effects from mechanical plant;
- adverse visual effects, particularly from reservoirs;
- adverse effects on cultural and heritage sites; and

- adverse effects on stream and watercourse margins and the coastal marine area.

Areas of ecological significance, significant habitats for indigenous flora or fauna, and outstanding natural features shall also be protected or preserved.

6.2.6 Health and Safety

The network and its components shall be designed to eliminate or minimise, as far as practicable, any risks of contamination of the water supply as required by the Health (Drinking Water) Amendment Act.

Barricades, fences, signage, covers, access restrictions and other provisions shall be made to protect both the public and operational staff from hazards presented by the network components, or operation thereof.

6.2.7 Levels of Service

Table 6.1 – Mandated Levels of Services for Flow and Pressure

| Council | Max.* Pressure | Min. Flow (L/min) | Min.** Pressure | Comment on Pressures |
|---------|----------------|-------------------|-----------------|--|
| HCC | 90 m | 15 | 30 m | 10 m min. pressure may be accepted for highest properties adjacent to reservoir. |
| PCC | 90 m | 15 | 35 m | Target min. pressure as measured at the boundary. Pressures down to 20 m may be considered in special circumstances. |
| UHCC | 107 m | 25 | 40 m | A min. pressure of 25 m <i>may</i> be considered in existing areas or on rider mains. |
| WCC | 90 m | 25 | 25 m | |

* As measured from top water level of reservoir or downstream setting on network PRV.

** As measured during peak demand flow assuming reservoir level is at the reservoir floor (bottom water level).

The developer shall also ensure a minimum pressure of 10 m is achievable at the proposed building platform. Private pump facilities may be permitted to achieve the pressure at the building platform, but it is not permitted to connect the pump suction such that it has a direct demand on the point of supply.

Note that both commercial and residential fire suppression sprinkler systems may have an increased flow and pressure requirement that may not be possible with the council's minimum standards. Consideration should be made towards these requirements in areas where sprinkler systems are likely.

Table 6.2 – Mandated Levels of Services for Storage Volumes

| Council | Storage (L/person) | Comments |
|------------|---|---|
| HCC | 700 / 650 / 600 | for populations < 1000 / 1000 to 2000 / > 2000 respectively |
| PCC | 450 | |
| UHCC | 550 | |
| WCC | 700 / 650 / 600 | for populations < 1000 / 1000 to 2000 / > 2000 respectively |
| All | Add firefighting storage requirements to all above figures as outlined in SNZ PAS 4509 | |

6.2.8 Point of Supply

The customer point of supply for a potable connection is the boundary where the council responsibility ceases and private ownership begins. This point varies between cities and installation types.

The point of supply, or the boundary between public and private responsibility, is typically the customer side of the service valve (to by) unless otherwise specified. The council shall own and maintain all pipework and fittings up to and including the service valve.

The point of supply, where practicable and where road frontage is available, shall be:

- 400 to 600 mm on the public side of the property boundary for properties in Porirua and Upper Hutt cities;
- 400 mm on the public side of the property boundary for properties in Hutt City;
- 450 mm on the public side of the property boundary for properties in Wellington City.

Service valves (or meters) shall not be placed in driveways or areas where vehicle traffic is likely.

Where these dimensions are not practicable for reasons of maintenance, access or boundary anomalies, alternative locations shall be discussed with the council.

See also Customer Connection and Service Valve (section 6.4.7, page 73).

6.3 Design Methods

The design methods presented here are considered to be acceptable for the purposes of developing solutions compliant with the objectives and performance criteria of this standard. Deviation from these methods will be considered with suitable evidence that the method is equivalent in function, and outcome to the standard solutions presented in this document.

Certified calculations shall be made available to the council as part of any application.

For larger subdivisions, or those that may have a significant impact on the existing network, the council may insist that numerical network modelling is used to determine the scheme's compliance with the performance criteria of this document.

6.3.1 Hydraulic Design

6.3.1.1 Peak flow

The peak flow is based on the *ultimate* population or number of dwellings expected in the development/area. The ultimate population for a development can be determined from section 5.3.1.2 (page 46).

The peak instantaneous residential demand Q_{peak} shall be determined using the equations in Table 6.3 where Pop is the ultimate population.

Table 6.3 – Peak Residential Flow Calculations

| Council | Peak Flow (Q_{peak}) L/s | Comments |
|---------|--|--|
| HCC | = 0.0162 x Pop = 0.285 x Pop ^{0.594} | for Pop > 2000 for Pop ≤ 2000 |
| PCC | = 0.012 x Pop | |
| UHCC | = 0.273 x Pop ^{0.63} | |
| WCC | = 0.0162 x Pop = 0.306 x Pop ^{0.594} | for principal mains for rider mains |

Peak day demand volume per person shall be assumed to be the litres per head figures presented in Table 6.2 (page 62) and excluding firefighting volumes.

Where an area has predominantly industrial demand, and the demand is unknown, the designer may use the average dry-weather wastewater flow calculated in section 5.3.1.4 (page 48) multiplied by a factor of 8, as the design demand for the water supply analysis.

6.3.1.2 Operating Pressure

All fittings and pipes shall be rated greater than both the design operating pressure of the main and the council's nominated minimum allowable pressure class in Table 6.6 (page 71). An allowance for surge shall be made where the main is subjected to automated closing valves or the influence of pumps. The design operating pressure for any point in the system shall be calculated as:

- maximum possible static pressure + allowance for surge (see section 6.3.2, page 65).

6.3.1.3 Firefighting Flows

Firefighting flows shall be as outlined in SNZ PAS 4509 and shall be assumed to be in addition to two-thirds of the ultimate design peak flow as calculated in section 6.3.1.1 (page 63). In networks where industrial and commercial properties represent the greatest demand, the design firefighting flow shall be based on the peak industrial/commercial demand in addition to the required firefighting flows required under SNZ PAS 4509.

Domestic sprinklers may be proposed where the existing reticulation cannot meet the requirements of the FW2 water supply classification of SNZ PAS 4509. The requirement for domestic sprinklers shall be noted on a consent notice provided the reticulation can meet the FW1 requirements of SNZ PAS 4509. The developer shall conduct tests on the council main to ensure the proposed scheme will comply with the requirements of both SNZ PAS 4509 and the requirements of the proposed sprinkler system. The test results shall be provided by the applicant to the council. All domestic sprinkler systems are to be privately owned, operated and maintained.

6.3.1.4 Allowable Pipeline Losses

The allowable head losses for a pipeline due to friction and turbulence, including fittings, at design peak flow shall be:

- ≤ 50 m/km for rider mains; or
- ≤ 5 m/km for principal mains; or
- ≤ 3 m/km for trunk mains.

Amendments to these allowable pipeline losses may be considered at the discretion of the council where it can be demonstrated that there are no detrimental pressure or surge effects. Pipeline losses are permitted to exceed the above during firefighting scenarios.

Pipeline losses shall be calculated using the Darcy-Weisbach method outlined in Appendix A7.4 (page 102), and the pipe roughness in Table 6.4 below.

Table 6.4 – Pipe Roughness

| Formula | PVC / PE | | DACL / CLS | |
|-------------------------------|----------|--------------|------------|--------------|
| | Trunk | Reticulation | Trunk | Reticulation |
| Manning's roughness | 0.011 | 0.013 | 0.013 | 0.014 |
| Colebrook-White / Swamme-Jain | 0.06 | 0.15 | 0.15 | 0.6 |

For the purposes of this clause, trunk mains shall be assumed to be mains 250 mm nominal bore or greater.

6.3.1.5 Minimum Velocity

As well as staying below the allowable pipeline losses listed above, effort shall be made to keep the design peak flow velocities above 0.8 m/s where practicable.

6.3.1.6 Maximum Branch Main Length

The maximum length of a branch, single-end fed main terminating in a hydrant is 135 m long for a 100 mm pipeline, or 450 m long for a 150 mm pipeline. Dispensation for this clause may be applied for on a case-by-case taking into consideration minimum

firefighting pressures, allowable pipeline losses and minimum peak pressures. Coastal roads where network loops are not practicable are an example where dispensation may be considered.

6.3.2 Surge and Fatigue

Surges within the distribution network, due to normal operational activities, shall not exceed those due to head-losses from peak demand, or those allowable under Allowable Pipeline Losses, section 6.3.1.4 (page 64).

A surge analysis shall be carried out for any areas where a surge within the network is possible due to an automated valve, pump or other proposed facility capable of inducing surge. Where a surge is identified, the effect of the surge shall be mitigated.

For metallic pipes, surge analysis shall be carried out as described in the rising main section 6.4.18 (page 81).

Where plastic pipes are proposed in a cyclic environment, such as rising mains or direct-on-line pumping into the reticulation, provisions for a potential increase in pipe class shall be made due to fatigue and/or surge. Appendix 9 (page 107) outlines an acceptable method for determining the effects of surge and fatigue on plastic pipes.

6.3.3 Network Modelling

Network modelling shall typically use the values in Table 6.4 for pipe roughness except where modifications are made for other pipe types such as unlined cast iron or asbestos cement. The council may also request the modelling to be carried out using particular software or format. The council may be able to provide modelling services to the developer, or wish to conduct the modelling in-house. The developer is to discuss council requirements with the council prior to carrying out any modelling to confirm process and requirements.

Where the model incorporates existing infrastructure, the model shall be calibrated against recent data. The council may be able to provide some network data for this purpose. The WaterNZ Modelling Special Interest Group has published the National Modelling Guidelines for Water Distribution Network Modelling. Models shall be developed and calibrated in accordance with these guidelines.

The developer shall submit a modelling report outlining the scenarios, assumptions, verification and results from the modelling activities. The council may require a peer review of the model to be carried out at the developer's expense.

6.3.4 Hydraulic Report

All scheme designs shall be accompanied by a hydraulic report. The hydraulic report shall demonstrate how the proposed scheme complies with the performance criteria of this document and shall include, but not be limited to:

- demonstration of compliance with minimum pressures at points of supply (or at building platform in the case of PCC) during peak demand;
- demonstration of compliance with minimum pressures during firefighting scenarios (multiple firefighting scenarios may be required to demonstrate suitable coverage of all proposed lots); minimum pressures in the network shall not fall below 10 m during firefighting scenarios and shall be compliant with the requirements of SNZ PAS 4509;
- the maximum pressures achieved in the network (including any allowances for surge where relevant);
- life-cycle costs analyses (especially for pump selection and rising main sizing etc.);
- headlosses per kilometre for each pipe during peak demand flow;
- hydraulic calculations;

- fatigue and pipe de-rating calculations;
- the modelling report where numerical network modelling has been carried out; and
- results of any surge/transient analyses.

The report shall include all assumptions made regarding the scheme.

6.4 General Specifications for Water Supply

6.4.1 Information to Be Provided

6.4.1.1 General

In addition to the council's normal requirements for subdivision application, the developer shall, as a minimum, provide with any water supply design:

- evidence that the performance criteria outlined in this document can be met with the proposed design;
- calculations and drawings as outlined below; and
- operations and maintenance guidelines for any reservoir, pumping station or any other mechanical facility to be vested to the council shall be submitted to the council for approval along with any other required document.

Any developer considering an extension or modification to the existing network should arrange a meeting with the council prior to concept design to determine the schemes water supply needs.

6.4.1.2 Calculations

The design details and calculations shall be prepared by a professional, qualified to a tertiary level and experienced in water supply design, and demonstrate that required levels of service will be maintained. Calculations presented as part of any application shall include, but not be limited to:

- demand calculations (both staged and projected ultimate);
- hydraulic calculations;
- network modelling reports;
- structural calculations for reservoirs and pumping stations;
- pump curves and duty points;
- economic evaluations; and
- structural trench design.

All assumptions regarding the design shall be clearly listed.

6.4.1.3 Design and Construction Drawings

Drawings shall show:

- the layout of the proposed reticulation including service connections, valves, hydrants, air valves, scour points, easements, stage termination points and any pertinent topographical features that may impact on the operation or future expansion of the network;
- proposed materials, sizes and pressure class of all pipes;
- typical and specifically engineered trench and installation details;
- typical and specifically engineered thrust block details;
- junction and jointing details; and
- where any anchor blocks, bulk heads, water stops, above ground pipelines, steep pipelines, or where any non-standard installation is required.

Specific construction drawings for specific facilities such as reservoirs, PRVs or pumping stations will also be required although any building consents shall be sought under the council's building compliance regulatory role. Proposed works shall not begin until construction plans have been approved.

6.4.2 Network Layout

Public mains shall, as far as practicable, be laid in the road reserve and be arranged to:

- avoid dead ends and minimise friction losses, tendencies for surge and zones of stagnant water;
- allow easy access for repairs and maintenance;
- typically be parallel with property boundaries;
- maintain adequate clearance from buildings, structures and other infrastructure to avoid collateral damage from failures;
- take into consideration flexibility of distribution zone boundary changes and potential outage areas;
- where practicable, limit the number of affected residents from any valve closures to 50 lots;
- minimise the length of household connections and ensure that they do not cross carriageways, except for areas where the carriageway is less than 6 m in width; and
- provide dual or alternative feeds to minimise disruption when any section is cut off for maintenance.

Principal mains shall be provided on both sides of the road in:

- major roads and dual carriageway roads;
- split level roads;
- state highways and motorways;
- roads with railway lines;
- CBD and suburban centres;
- roads with a central dividing island; and
- industrial/commercial areas.

Where practicable, for ease of maintenance, reticulation mains with service connections shall be laid in the berm as opposed to the footpath or carriageway. Mains shall not be laid under commercial verandas.

WCC: Principal and trunk mains shall be laid in the carriageway 1.4 m from the kerb.

New mains shall not be placed near mature trees, or proposed tree planting locations.

Where a hydrant on a principal main is required in a private right-of-way in order to comply with SNZ PAS 4509, the main shall be a public main. The main shall be placed in an easement in favour of the council, clear of wheel tracks and constructed to the same standard as if laid in the public carriageway.

Where a main is required to be laid in private land, the main shall be protected by an easement.

6.4.2.1 Loops

The network layout shall be designed to avoid dead ends as far as practicable to minimise water age and prevent the deterioration of water quality. Where a road or cul-de-sac terminates at a dead-end, and an access way or road reserve carries through to

an adjacent street, the principal main shall be carried through to connect to the main in the adjacent street. The through-main shall be a minimum nominal diameter of 100 mm. Alternatively, the council may accept a looped rider main at the end of a short cul-de-sac.

6.4.2.2 Rail / Motorway / Stream Crossings

A water main, as far as is practical and where necessary, shall cross streets, railway lines, streams and underground services at right angles. Mains shall be installed within steel ducting when crossing beneath railway lines or motorways in such a way that the main can be drawn out and replaced without excavation of the carriageway or railway. The steel ducting shall be suitably protected against corrosion both internally and externally.

Special design, in consultation with the council, is required where a pipeline crosses above or beneath a stream. See also section 6.4.17 (page 81).

6.4.3 Easements

Easements in favour of the council shall be required for any public water supply assets proposed to be laid in private land, right-of-way or private road. This includes any mains, service valves, service connections, chambers or facilities. The pipe shall be laid along the centre of the easement such that it can be practically accessed, serviced and replaced at any time in the future.

Easements for council owned **service pipes** in private property shall be 1 m wide.

Easements for **rider mains** shall be a minimum of 1.8 m wide.

Easements for **principal** pipelines shall be the greater of:

- 3 metres; or
- The pipe's outside diameter plus 2 x the depth to invert.

WCC: Easements for all reticulation mains shall be at least 4 m wide.

Easements for **trunk** mains shall be assessed on a case-by-case basis to ensure provisions for future access, maintenance and renewal are accommodated.

6.4.4 Seismic Resilience

Specific considerations shall be given to design for seismic resilience. The council may have guidelines relating to seismic design that should be used in selecting materials and methods. These are typically:

- pipelines in areas with potential for liquefaction, lateral spreading, tsunami inundation or slope failure shall be designed and constructed with materials with suitable end restraint, redundancy or with suitable mitigation;
- pipelines laid across known fault lines should be designed to mitigate pipe fracture (valve either side of fault line, or practical means of redundancy), or minimise risk of failure with suitable flexibility;
- trunk pipelines, reservoirs and pumping stations shall be designed with a high resilience to seismic activity; and
- buried structures should have suitably flexible couplings at the structure/fill interface to allow for differential movement. However, consideration needs to be made towards the end restraint also depending on the consequence of failure.

The council will approve specific details relating to structures and their design against seismic failure.

Greater Wellington publishes seismic hazard maps highlighting the areas at risk.

6.4.5 Distribution Zones

Distribution zones are discrete areas, typically supplied from a common source, that separate areas with different operating heads. The distribution zones have a discrete boundary that is generally denoted by closed valves, and/or PRVs. Moving a distribution zone boundary is not permitted without written dispensation as it affects existing customers or increases the risk of failure of existing pipes.

Creation of a distribution zone supplied solely through a PRV is at the sole discretion of the council.

6.4.6 Pipes

6.4.6.1 Pipe Sizes

Regardless of the minimum hydraulic requirements for providing adequate firefighting and peak demand flows and pressures, the **minimum** nominal internal diameter of pipes shall be:

- 20 mm for customer connections
- 50 mm for rider mains
- 100 mm for principal mains in residential areas
- 150 mm for principal mains in industrial/commercial and CBD areas

In addition to the minimum diameters above, the allowable nominal pipe sizes permitted for use in the network are detailed in Table 6.5.

Table 6.5 – Allowable Nominal Pipe Diameters

| Type | Permitted Nominal Diameters* (mm) |
|--|-----------------------------------|
| Customer services | 20, 32, 40, 50, 80, 100, 150 |
| Rider mains | 50 |
| Principal mains (with customer connections) | 100, 150, 200 |
| Trunk mains (no customer connections) | 250, 300, 375, 450, 500, 600 |

*Pipes other than these diameters shall be considered by specific request.

6.4.6.2 Minimum Pressure Class

Notwithstanding allowances for surge, fatigue and anticipated working pressure, the minimum pressure rating of public pipelines shall be outlined in Table 6.6.

In special circumstances, pressure classes greater than those listed in Table 6.6 may be required by the council to allow for operational flexibility. Pressure classes less than that listed will not be considered.

Table 6.6 – Allowable Pressure Classes (bar)

| Council | Reticulation Mains | Customer Connections |
|------------|--------------------|----------------------|
| Porirua | 12 | 12 |
| Lower Hutt | | |
| Upper Hutt | | |
| Wellington | 16 | 16 |

6.4.6.3 Materials

The permitted pipe materials for use in the water supply network are detailed in Appendix 3, page 93. Note that the designer should check with the latest council specification for any amendments.

Other items to note when considering pipe materials are:

- pipe bridges, exposed pipes shall be CLS or flanged DICL;
- pipes on banks with a slope greater than 1:5 (v:h) shall be laid in CLS or axially restrained DICL; these pipes shall also be anchored using anchor blocks (see Anchor Blocks, section 6.4.9.2, page 75).
- PE or PVC pipes shall not be used in areas that are contaminated, or may be potentially contaminated with hydrocarbons.
- all fire services shall be of a metallic material.
- all PVC variant pipes shall be rubber ring jointed; solvent jointed pipe will not be accepted.
- principal and trunk mains constructed with polyethylene pipe shall be either electro-fusion or butt welded; rider mains and services may be joined using suitably approved compression fittings.

WCC: All PE100 rider mains and customer connections shall be electro-fusion welded. Compression fittings are not to be used on PE100 pipe. All reticulation pipes in WCC's CBD and suburban centres, and pipes with a nominal diameter 200 mm or larger, shall be concrete-lined steel or ductile iron. Rider mains may be PE100 or copper.

6.4.6.4 Minimum Cover

Pipes shall not be laid at depths greater than 300 mm below the listed minimum without suitable justification such as avoiding existing services or accommodating tall fittings and/or chambers (PRVs, etc.).

The council may increase cover requirements where the pipeline is expected to be subjected to extraordinary loads; for example, airports, state highways and industrial/commercial areas where high frequency heavy loads are expected.

Minimum cover to pipework shall be:

Table 6.7 – Minimum Cover to Pipes

| | Carriageway | Footpath/berm |
|-----------------|-------------|---------------|
| Principal mains | 750 mm* | 750 mm |
| Rider mains | 750 mm | 600 mm |
| Service pipes | 600 mm | 400 mm |

* 900 mm for UHCC

6.4.6.5 Separation from Other Services

Water supply pipes shall not be laid in the same trench as a wastewater pipe.

Water supply pipelines shall be designed to achieve the following minimum separations from other services.

Table 6.8 – Separation Distances between Services

| | Horizontal separation | Vertical separation |
|--|-----------------------|---------------------|
| Other water pipes ≤ 375 mm | 300 | 300 |
| Other water pipes > 375 mm* | 600 | 450 |
| Gas mains | 300 | 150** |
| Communications cables/ducts | 300 | 150 |
| Electricity cables/ducts ≤ 11kV | 500 | 500 |
| Wastewater pipes [†] ; can be | 1000 | 500 |
| or | 600 | 750 |

* Where the new pipe is > 375 mm, the separations used shall be the greater of the > 375 water pipe, or the adjacent utility; i.e., a new 450 mm pipe laid beside electricity cables shall have a horizontal separation of 600 mm and vertical separation of 500 mm.

** Subject to adequate separation. To be discussed with gas utility.

[†] The dual separation criteria allows a shallow but wide separation, or a deep but close separation.

6.4.6.6 Terminal Mains

Terminal mains, those terminating at the end of a cul-de-sac or similar, shall end at a hydrant, preferably situated in the carriageway. Any customer or rider main connections shall be positioned upstream of the terminal hydrant so the entire length of the principal main can be flushed through the hydrant.

6.4.6.7 Bends and Curves

Pipes shall generally be laid parallel to the kerb or carriageway centreline. Where curves are required, pipes may be laid in a curve made using deflections at the joint up to the manufacturer's recommended safe deflection. Curvature using the pipe barrel will not be tolerated except with polyethylene pipes. Curves made with polyethylene pipes are not to exceed the manufacturers' recommended bending radius.

Factory fabricated bends, of no greater than 45 degrees, shall be used where appropriate curves cannot be achieved using recommended joint deflections.

All cast bends shall be ductile iron and manufactured and coated to AS/NZS 2280.

All bends shall be suitably anchored using thrust blocks as outlined in section 6.4.9 (page 75) regardless of whether the bend utilises restrained joints or not, unless the council has specifically approved otherwise.

6.4.7 Customer Connection and Service Valve

(See also section 6.2.8 Point of Supply page 62)

6.4.7.1 General

Each residential dwelling on a lot, proposed, anticipated or otherwise, shall require a separate, single potable service connection from the public main up to and including the agreed point of supply. Unit titled developments are exempt from this requirement and may be serviced by a single suitably sized service connection.

A meter may be required to be installed as part of the connection. (See 6.4.16, page 80)

Service pipes shall be laid perpendicular to the main and terminate in a service valve (sometimes referred to as a toby) or meter. A minimum 1 m length of PE80b (or PE100 in WCC) pipe shall be laid on the private side of the point of supply. This length of service shall be suitably plugged to allow the service to be extended to the building platform at a later date. The location of the plugged end shall be clearly pegged.

Front sections (or dwelling units with individual street frontage) shall have the point of supply located adjacent to the street boundary as outlined in section 6.2.8, page 62.

For properties supplied from a public main in a right-of-way or private land, the service valves shall be located in shared property.

The location of all service valves and service pipes shall be shown on the construction drawings for approval. Service valves shall not be placed in driveways.

Service connection pipe material shall be as outlined in Appendix 3, page 93.

Service valves and meters shall be of an approved type and shall be housed in an approved surface box. The service valve shall be, unless otherwise approved:

- a 20 mm approved manifold; or
- a 25 to 50 mm approved gate valve (see 6.4.12.1, page 77); or
- an 80 mm or greater approved resilient seated gate valve (see 6.4.12.2, page 77).

Private supply pipes, between the service valve and the serviced dwelling, shall be laid completely within the same lot as the serviced dwelling, or land which the serviced dwelling has legal access rights to.

6.4.7.2 Back-flow Prevention

The council's policy on back-flow prevention shall be complied with. Typically, all commercial and industrial services greater than 20 mm shall require a back-flow preventer installed downstream of the service valve and meter and close to the point of supply.

An approved back-flow preventer may be required to comply with the New Zealand Building Code. The council, at its discretion, may also request back-flow prevention to meet their obligations under the Health (Drinking Water) Amendment Act.

6.4.7.3 Service Valve Markings

Service valve locations shall be marked, on the point of the adjacent kerb closest to the valve, as follows:

| | |
|-------------------------|--|
| Porirua City Council | A white arrow painted on the top surface of the kerb: minimum 100 mm long. |
| Hutt City Council | A 50 mm wide white stripe painted on the top and vertical faces of the kerb. |
| Upper Hutt City Council | A 50 mm white stripe painted on the vertical face of the kerb only. |
| Wellington City Council | An arrow is to be saw-cut into the kerb (min 5 mm deep) pointing at the location: minimum 100 mm long. |

6.4.7.4 Minimum Size

The minimum nominal diameter for a customer service connection is 20 mm. Connections greater than 20 mm shall require specific approval.

The size of service pipes to industrial and commercial lots are subject to specific design and council approval.

6.4.7.5 Minimum Cover

See section 6.4.6.4, page 71 for minimum cover for service pipes.

6.4.7.6 Terminal Mains

Rider main and customer connections made to the end of terminal mains shall be made *before* the terminal hydrant to allow for scouring of the full length of main.

6.4.7.7 Fire Services

Fire services for both private firefighting networks and automatic fire suppression sprinkler systems require specific consideration and approval and shall be applied for, and designed, outside the provisions of this document.

Notwithstanding this, if a standard 20 mm nominal diameter domestic customer connection is inadequate to provide both the demand requirements of this standard, and those of NZS 4517:2010 "Sprinkler Systems for Houses", a separate metered connection to the public main shall be designed and applied for to supply the sprinkler system and a single water closet. The size of the connection shall be sufficient to meet the requirements of NZS 4517:2010.

6.4.7.8 Secure Connections

A customer, such as a hospital or commercial development, may require a secure supply which will reduce the potential for water outages due to maintenance activities. This may be in the form of:

- a dual connection from the same main, separated by a line valve and a minimum horizontal separation of 2 m; or
- connections to two separate individual principal mains, both with backflow preventers on them to avoid cross-connection.

The form of the secure connection shall be discussed and approved at the discretion of council.

It is up to the designer to ascertain the design's compliance with NZS 4541 *Automatic Fire Sprinkler Systems* if the connection is provided for the purpose of firefighting.

6.4.8 Rider Mains

Rider mains are required to service properties that do not have road frontage adjacent to a principal main. Individual services that cross the carriageway centreline are not permitted.

Rider mains shall:

- be 50 mm nominal diameter;
- be supplied from a principal main at both ends, except for private roads or right-of-ways;
- have intermediate connections for rider mains longer than 100 m;
- have at least one flushing point; and
- have a valve installed at all connections to principal mains.

6.4.9 Thrust and Anchor Blocks

All concrete for thrust or anchor blocks shall be minimum strength 20 MPa at 28 days.

6.4.9.1 Thrust Blocks

Thrust blocks shall be designed to resist the total unbalanced thrust and transmit all load to the adjacent ground. Calculation of the unbalanced thrust shall be based on the design pressure for the main with an allowance for pressures experienced during testing.

Thrust blocks shall be designed assuming a maximum soil bearing strength of 75 kPa or the strength as measured on site.

Thrust blocks are required regardless of any joint restraints employed in the pipework.

Special engineering design is required for thrust blocks on nominal pipe sizes greater than 300 mm. The design shall consider in-situ soil properties when designing the thrust blocks.

6.4.9.2 Anchor Blocks

Anchor blocks are designed to prevent the movement of pipe bends in a vertical direction. These are typically installed on vertical bends on banks and employ the weight of mass concrete to restrain the pipework.

6.4.10 Water Stops (Bulkheads)

Water stops, also known as bulkheads, are required where the potential for trench scour is high, or where the surrounding natural ground prevents sufficient natural drainage of the trench (if the trench is susceptible to water infiltration).

The bulkheads shall be keyed into the adjacent, natural ground by a minimum of 150 mm and shall be spaced as per the requirements of section 4.4.6.8 (page 31).

6.4.11 Fire Hydrants

Only hydrants listed on the council's list of acceptable materials or technical specifications shall be used.

Hydrants shall only be placed on mains 100 mm nominal diameter or greater and may be used for:

- providing water for firefighting;
- flushing water from terminal mains;
- allowing air to enter, and discharge from, the main during mains filling or draining;
- scouring; and
- introducing water to the mains from adjacent zones or for disinfection.

6.4.11.1 Placement

Maximum spacing shall be as per SNZ PAS 4509:2008 – *Firefighting Water Supplies Code of Practice* suitable for the highest risk fire hazard class in the vicinity. Special note shall be made of SNZ PAS 4509 requirements for hydrant spacing with regards to distance lines and access to buildings set back from the carriageway.

Notwithstanding the requirements of SNZ PAS 4509, hydrants shall be:

- spaced at intervals not exceeding 90 m in commercial and industrial areas, and 135 m in residential areas;
- placed at intersections and adjacent to special fire risks;
- in front of long right-of-ways;
- at high points in the reticulation where air valves would present an undue maintenance burden;
- placed with due consideration to the safe operation of the hydrant;
- placed at the end of terminal mains and at reticulation low points to allow for scouring; and
- placed either side of a distribution zone boundary valve (see 6.4.12.4, page 78).

Terminal hydrants shall be placed in the carriageway unless discharge can be made to a suitable sump or drain without flowing over unsealed public land and without nuisance. The terminal hydrant shall be mounted on a hydrant bend.

Hydrants shall not typically be placed on rising mains or trunk mains where these mains are without services and there are adequate parallel principal mains available. For the purposes of this clause, a trunk main is any main with a nominal diameter of 250 mm or greater.

6.4.11.2 Surface Markings

Surface markings shall be as outlined in SNZ PAS 4509. Blue reflective pavement markers shall be required for all hydrants.

Circles shall be placed around any hydrant that attracts a high risk of being obstructed by a parked vehicle. This typically includes hydrants within 2.5 m of a kerb where parallel parking is allowed, where the centre of the hydrant is within 600 mm of a marked parking bay, or any other area where the council considers the hydrant to be at risk of being obstructed.

6.4.12 Network Valves

Only valves listed on the council's list of acceptable materials or technical specifications shall be used.

Network valves are used to isolate sections of the network for operational or maintenance purposes. They shall be located:

- in a manner that minimises the number of properties affected by a mains closure;
- at the beginning of any branch or rider main;
- in locations that enable safe operation, taking into account traffic and access considerations;
- in a manner that minimises the number of valves or hydrants required at intersections, whilst still achieving operational objectives; and
- at distribution zone boundaries.

All buried valves shall be housed in a surface box approved by the council.

At intersections, valves shall be placed on all branch pipelines and at least one placed on the through pipeline to maintain operational flexibility and limit potential customer disruption.

6.4.12.1 Gate Valves DN 50 mm or Less

Small diameter gate valves approved by the council shall be used:

- to isolate rider mains from the principal main;
- as a scour valve at any terminal end of a rider main; and
- as a scour valve at any low point in a rider main.

Gate valves DN 50 mm or less used in the network shall be of a type approved by council. They shall be clockwise closing with a hand-wheel that will admit a key for operating the valve, and be the same nominal diameter as the main it services.

6.4.12.2 Gate Valves DN 80 mm or Greater (Sluice Valves)

Gate valves 80 mm or greater (commonly referred to as sluice valves) shall be resilient seated and flange/flange pattern of a make and model approved by the council.

Gate valves shall be the same nominal diameter as the main it services.

Resilient seated gate valves shall be used on all principal and trunk mains unless otherwise specified by the council. They shall be anti-clockwise closing with a non-rising spindle and manufactured to AS/NZS 2638.2. The minimum rating for a resilient seated gate valve is 16 bar or greater to suit design pressures.

Valves shall not be spaced greater than 450 m on reticulation mains with customer connections (principal mains), and valves shall not be spaced greater than 900 m on pipes without customer connections (typically trunk mains).

Buried valves shall be operated by a standard key and bar. Valves in pits and chambers may be required to have a hand-wheel at the discretion of the council. Spindle caps shall be a maximum of 350 mm below the finished ground level. Where unavoidable, extension spindles may be used to meet this requirement where mains are necessarily at depth, but the means of positively fixing the extension to the spindle shall be approved by the council to ensure a non-friction based fixing system is adopted that is not susceptible to failure due to corrosion or wear.

Where socketed valves have been allowed, cast in-situ bearing blocks shall be poured to resist turning torques and valve movement from differential pressures.

Valves DN 375 mm and greater shall incorporate a bypass valve of no less than DN 100 mm. The council may require valve chambers for large diameter valves, especially those with a gear-box or actuator.

Resilient seated gate valves shall also be used as service valves for customer connections DN 80 or greater.

6.4.12.3 Butterfly Valves

Butterfly valves shall not be used in the general reticulation unless specifically approved by the council. Butterfly valves hinder swabbing operations and can create undesirable surges due to their rapid closing potential.

Butterfly valves may be considered in motorised applications such as reservoir auto-closing valves or in pumping stations.

6.4.12.4 Zone Boundary Valves

Where a closed valve (DN 100 or greater) is used as a boundary between two distribution zones, a hydrant shall be installed either side of the valve to permit the use of a mobile PRV installation if required.

The surface box of the boundary valve shall be painted red.

6.4.13 Air Valves

Air valves may be air release, air/vacuum or combination air valves. The air valves shall be specifically selected to admit or expel air at a rate that does not induce negative pressures in the main or produce excessive air speeds at the air vent. Generally, combination air valves are preferred on mains.

Air valves shall:

- be automatically operated and of a make approved by the council;
- be provided at high points on the mains where air may become trapped and create an obstruction to normal flow; these mains may be rising or trunk mains, and potentially reticulation mains where required by the council;
- be placed off the carriageway where practicable; this may necessitate the construction of a branch main from the top of the main, laid at a constantly rising grade, to the air valve location;
- be installed with a gate valve on the mains branch so the air valve can be removed whilst the main is in service; and
- be placed in an approved chamber that allows the gate valve to be operated and air valve to be removed without excavation; the chamber shall be vented to avoid differential air pressures between the chamber and the surrounds, and drained to a suitable point such that the air valve cannot become submerged; the chamber's entry and vents shall be placed above the level of potential ponding areas that may result from a surcharging stormwater system.

The system should be designed such that adequate back pressure is maintained on the valve to prevent leakage. Typically 1 bar is the minimum back pressure or as recommended by the manufacturer.

6.4.13.1 Locations

Air valves should be considered at:

- increased downslopes (combination air valve);
- decreased upslopes (air/vacuum or combination air valve);
- long ascents, every 400 m to 800 m (air/vacuum or combination air valve);
- long descents, every 400 m to 800 m (air release or combination air valve);
- horizontal runs (combination air valve at the beginning and end of run plus an air release or combination air valve every 400 to 800 m depending on velocity); and
- high points, (combination air valve).

These installations are illustrated in Figure 6.1 which shows air valve installations on a hypothetical rising main. The minimum type of valve is shown, although many could be replaced with a combination air valve.

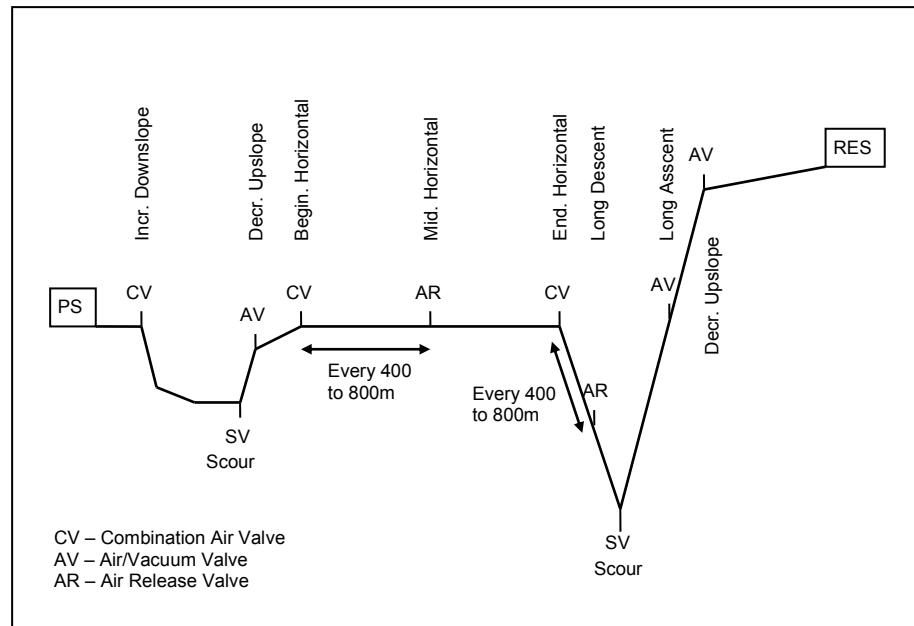


Figure 6.1 – Typical Air Valve Locations on a Rising Main

Generally, the location and type of air valves shall be discussed and approved with the council prior to submission of detail design.

6.4.14 Pressure Reducing Valves

The use of pressure reducing valves (PRVs) shall be avoided if at all practicable, and shall only be used with the approval of the council. Reduced capital costs shall not be the sole justification for their use.

Where PRVs are approved, they shall be placed outside traffic lanes and shall include:

- an approved water meter connected to the council's SCADA system;
- an upstream top entry strainer;
- a low flow by-pass PRV;
- upstream and downstream isolation valves;
- upstream and downstream pressure tappings and gauges within the chamber; and
- upstream and downstream hydrants that can be used to connect a bypass while PRV is being maintained.

The installation shall be constructed in a suitably drained chamber, outside vehicle traffic lanes and with suitable operator access for maintenance.

The PRV shall be of a make approved by the council and shall be sized to accommodate ultimate consumption and fire flows without excessive noise (minimum district plan requirements) and/or cavitation. The PRV shall be sized to last a minimum of 10 years, without requiring overhaul, at the ultimate design flow.

6.4.15 Scour Valves

Scour valves are generally required to drain the pipe for maintenance purposes, scour air from pipes or to flush potentially stagnant water from 'dead end' mains. Scour valves are required at:

- the end of all public and private rider mains;
- the end of all terminal reticulation mains (hydrants are acceptable); and
- the low point between line valves of all mains with a nominal diameter greater than 200 mm.

Hydrants on pipelines \leq 200 mm may be used to scour the main instead of a dedicated scour branch and valve.

Scour pipes shall discharge to a visible location such as a stream, kerb, open channel or pump-out, to reduce the risk of the valve being inadvertently left open. Scour pipes must not discharge to a closed stormwater structure.

Facility shall be provided to prevent damage, channel scour or flooding due to operation of the scour valve. If discharge is to a perennial stream or other water body, then potential impacts on water quality must be addressed.

Valves shall be sized to drain the main by gravity over a period not greater than 1 hour. Minimum scour sizes are:

| <u>Main size</u> | <u>Scour size</u> |
|------------------|-------------------|
| \leq 200 mm | 80 mm |
| 250 to 300 mm | 100 mm |
| 350 to 375 mm | 150 mm |

Backflow prevention shall be provided where there is the potential for water to flow back into the main under gravity. This includes pump-outs.

6.4.16 Water Meters

6.4.16.1 Customer Meters

All non-residential properties, or mixed residential and non-residential properties, extraordinary users as defined in the council's bylaws or charter, may be required to be metered at the point of supply.

Developers should check the current metering policy with the council before submitting designs.

Meters shall be installed to council specifications. The meter and meter box shall be of a type approved by the council.

6.4.16.2 District and Area Meters

District and area meters are large non-revenue meters designed to measure community consumption in gross.

These are typically designed and installed by the council, but the council may require the developer to install an area meter as part of any large multiple lot development.

The area meter shall be an approved magnetic flow meter which shall be connected to the council's SCADA system. The arrangement of the meter installation shall be discussed with the council prior to detail design, but it shall typically include:

- a pressure tapping with ball valve and, potentially, a pressure transducer;

- a suitably large chamber, preferably outside traffic lanes;
- suitable operator access provisions;
- suitable chamber drainage;
- upstream and downstream valves within a suitable vicinity; and
- suitable roadside control cabinet.

The developer shall arrange the power supply for the meter operation.

6.4.17 Above Ground Mains

Reticulation mains shall not typically be laid above ground, except where:

- the main crosses over a stream,
- the main crosses over a railway or vehicle lane via a pipe bridge or attached to the deck of another bridge;
- the main is built within a tunnel; or
- the main is attached to the face of a retaining wall or steep bank.

Mains laid above ground shall be suitably protected from the elements and be either concrete-lined steel or ductile iron. The pipes shall be flange jointed, and be suitably restrained to walls or structures to withstand seismic loading plus normal service loads.

Where the pipes cross a bridge abutment, provisions shall be provided to allow for movement both longitudinally and in shear. This may be in the form of a suitably rated flanged rubber bellow which must be easily accessible for replacement, as well as protected from UV damage, weathering and debris accumulation.

Where the pipe crosses an expansion joint interface, suitable means shall be provided to allow for longitudinal movement. This may be a sliding expansion joint or bellows. Provision must again be made to allow for protection, maintenance and replacement.

Generally, any exposed pipeline must be approved by the council in principle and design.

6.4.18 Pumping Stations

Pumping stations shall be provided by the developer to supply water to a reservoir at a higher hydraulic elevation than the sourced distribution zone.

The designer shall discuss standard pumping station requirements with the council prior to preliminary design and shall comply with any council technical specifications.

Typically, pumping station design shall, as a minimum, include:

- consideration of rising main design (section 6.4.189, page 81) and surge potential and mitigation;
- consideration of available peak suction pressures and the detrimental effects the station may have on suction pressures;
- electrical supply and pump controls including protection measures and terminals for emergency generator connection;
- pumpset selection and installation;
- magnetic flow metering;
- manual and electronic pressure monitoring;
- seismic restraint systems for all equipment;
- consideration of practical maintenance of all equipment and pipe work;
- SCADA (using council-specified equipment and I/O conventions) with viable radio link; and

- permanent station building with suitable security, access, ventilation, acoustic dampening, lifting provisions (overhead gantry), drainage, parking and external visual mitigation.

The design specifications shall be approved by the council along with acceptable pump makes. The developer shall provide all electrical connections and electricity accounts for the station. Switchboards will require terminals to allow the station to be powered by a mobile stand-by generator.

Pipework within the station shall generally be flange jointed, of either ductile iron or concrete lined steel.

The station shall be placed completely within a separately titled lot or within road reserve. A sealed access of not less than 3.5 m width shall be provided to the nearest public street. The immediate area around the station's titled lot (if applicable) shall be fenced and provided with a locked gate. The station shall be designed such that it complements the surroundings through the use of architectural featurings and/or landscaping and planting. The final design shall be approved by the council.

Operation and maintenance manuals will be required for all pumping stations as part of the completion documentation.

Liaison with GW is required if the station is to be connected to part of the wholesale water supply network.

6.4.18.1 Pumping Station Serving a Reservoir

Pumping stations shall be designed with a minimum of two pumps in a duty/standby arrangement (100% standby capacity). Three pumps may be allowed in larger stations with council approval. Where three pumps are installed, they shall be in a duty/assist/standby arrangement (with 50% standby capacity). All pumps, whether in a two or three pump arrangement, shall be of the same make, model and duty size.

Small stations shall be designed to allow both pumps to run simultaneously.

The pumps shall be sized to pump the full reservoir storage amount, without using the standby unit, over an 18-hour period. Smaller stations (daily pumping volume less than 2500 m³/day) shall pump the receiving reservoir volume over 15 hours.

6.4.18.2 Booster Pumping Stations

Booster pumping stations will not typically be permitted for developments. Special permission is required from the council before booster pumping stations will be considered.

If permitted, they shall be designed to provide, as a minimum, firefighting and peak consumer demands using variable frequency drives and compatible pumpsets. Booster pumping stations used for firefighting shall only be provided in areas where an underground electricity reticulation is available.

6.4.19 Rising Mains

Rising mains shall be designed in consideration with the design duty of existing or proposed pump sets. The length, material and diameter of the rising main have a significant influence on the dynamic head on the pumps.

The pumps and/or rising main shall be selected to enable the pumps to operate as close as possible to the best efficiency point.

Rising mains and materials shall be designed to accommodate anticipated surges and test pressures. A transient analysis may be required by the council for rising mains longer than 300 m; or with a flow greater than 30 L/s and a dynamic head greater than 14 m; or a high lift (~50 m or greater) system with a check valve. Surge scenarios shall include sudden loss of electricity (sudden stop) and direct-on-line starting (sudden start). Surge protection devices will be considered to mitigate the effects of surge. Variable

frequency drives may be considered to mitigate the surge effects of sudden start, but not for sudden stop surges as power failure is still a credible risk.

Due to the cyclical loading nature of rising mains, the main shall generally be of externally and internally protected CLS or DICL. PE mains less than 100 mm nominal diameter may be considered at the discretion of the council provided specific and suitable non-economic reasons are presented and they are re-rated to allow for fatigue (see 6.3.2, page 65).

The proposed rising main option shall be shown to be the most economical through a net present value analysis (NPV) comparing capital and operating costs over a 50-year period. A sensitivity analysis on the interest rate used shall also be shown. This may simply be varying the rate by 1% to 2% either side of the interest rate to demonstrate the effect this has on the preferred economic option. The interest rate used should be the average long-term lending rates published by the Reserve Bank of New Zealand unless otherwise specified by the council.

Rising mains shall be designed as normal buried water supply pipelines allowing for anchor and thrust blocks, trench stops, bulkheads and suitable jointing.

6.4.20 Suction Mains

Suction mains shall be designed to the same standard as rising mains. An analysis of the upstream network is required to ensure the pumping station's operation does not create detrimental or nuisance surges within the upstream network, and that required suction pressures can be maintained under all design scenarios.

6.4.21 Reservoirs

Reservoirs shall, as a minimum, retain the volume outlined in Table 6.2 (page 62) including firefighting volume and in conjunction with the ultimate development population outlined in section 5.3.1.2 (page 46). The council reserves the right to refuse developments that shall be served by a small reservoir, typically those serving less than 100 sections and/or smaller than 250 m³ in size.

The designer shall approach the council prior to preliminary design to ascertain current council specifications for reservoirs which will supersede any requirements outlined here. Notwithstanding this, reservoirs shall:

- be designed for an anticipated lifespan of 100 years;
- typically have walls, floor and roof constructed of reinforced concrete, unless otherwise approved;
- be above-ground installations unless consent conditions require otherwise;
- be designed to withstand hydraulic loading from water levels 450 mm higher than the overflow level, along with the requirements of AS/NZS 1170, NZS 3106 and NZS 3101;
- be supplied with water by a dedicated rising main;
- have a separate inlet, outlet, scour and overflow pipe;
- not typically exceed 6 m depth, or 7.5 m in special cases;
- have full operational redundancy in the form of a second tank, internal dividing wall 0.4 times the height of the tank, adjacent zone with suitable sized storage or other method of supplying the zone if the reservoir or outlet main is out of service;
- have an automatic-closing (auto-shut) valve compatible with the council's closing algorithms. This may require the need for a seismic trigger as specified by the council;

- have a suitable permanent chamber or structure to house SCADA, electrical and monitoring equipment;
- be designed to withstand surge and surcharge;
- have under-floor drainage suitably designed for the identification and location of floor leakage;
- have an overflow suitable to discharge flows 1.5 times the anticipated inflow;
- have a top entry inlet with a dropper to the floor and designed to avoid back-siphoning in the event of an inlet mains break;
- have drainage suitable to discharge overflows and scour flows to suitable receiving waters without surcharging or in breach of any required resource consents;
- have a valve chamber immediately adjacent to the reservoir housing the isolation valves. The chamber shall be an integral part of the reservoir foundation; and
- have suitable safe operator access to the reservoir, valve chambers and control equipment to council specifications. There shall be a minimum of two reservoir hatches with each located on the opposite side of the roof to the other.

Reservoirs shall be funded and constructed by the developer to the above specifications. The council reserves the right to construct the reservoir at the council's expense, with a contribution from the developer if there is an additional purpose for the reservoir. Inversely, the council may contribute to any reservoir being constructed by a developer if that reservoir is suitably sized to supply an area outside the proposed development.

Reservoirs shall be sited on a separately titled and fenced lot with a minimum 3.5 m wide gated and sealed vehicle access. Security to the site and structures shall be to current council standards. The reservoir shall be suitably screened and visually mitigated to complement the surrounding environment.

Liaison with GW is required if the reservoir is supplied directly from the wholesale water supply network. GW may have requirements in addition, or in place of those listed here.

Operational and maintenance manuals are required as part of the completion documentation.

6.4.22 Testing

For subdivisions, all water supply pipes, pumping stations reservoirs and any relevant appurtenant structures and fittings will be pressure tested upon completion of construction at the applicant's expense, and as part of the council's approval process, prior to the issue of any S.224c certificate. The council's representative shall be present during the tests, and will sign the appropriate documentation provided by the council to verify the test if successful. A minimum of 24 hours of notice is required to be given to the council prior to the test being carried out. The developer shall provide all labour, fittings and materials to carry out the test.

6.4.22.1 Pipes

For subdivisions, the developer is required to have met the following requirements prior to pipe testing and the council arriving on site:

- all pipes trenched and laid;
- all lines thoroughly flushed and all residual debris cleaned out;
- all fittings and connections to have been installed prior to pressure test; and
- any required pre-test soaking completed.

All equipment and materials required to affect the test shall be supplied by the developer.

Steel, ductile iron and PVC pipes shall be filled with water ensuring care is taken that all air is flushed from the system. The main shall be raised to test pressure and allowed to stabilise over a period at least 1 hour (24 hours for DICL and STCL pipes). For reticulation mains, the test pressure will be 1.25 times the lowest rated component of the pipe at the lowest point of the test main. No point of the test main shall be less than 1200 kPa or more than 1800 kPa. The council may request higher test pressures for trunk, rising or high pressure mains.

After the stabilisation period, the mains shall be re-established at test pressure and left, without topping up, for a period of one hour. All joints and fittings shall be inspected for visible leakage during this time.

At the end of one hour, the mains shall be pumped back up to test pressure with careful note made of the amount of make-up water that is required to reinstate test pressure. The amount of make-up water shall not exceed 1 litre per 10 mm of diameter per kilometre of pipe tested per hour of test. The pipe shall be deemed to have passed if the make-up water is less than that permitted by this test and if there are no visible leaks and weeps during the test (or if they were remedied during the test).

Polyethylene pipes shall be tested in one of two ways: Test 1 is for rider mains or short runs of reticulation mains (< 400 m), and Test 2 is for larger, long run mains.

The test pressure for both tests shall be 1.25 times the rated pressure of the lowest rated component.

Test 1 comprises the following sequence:

1. The main shall be pumped up to the test pressure and have this pressure maintained for at least 30 minutes. This may require occasional intermediate pumping to maintain the test pressure.
2. The pressure is then released through the purge valve until the pressure in the main drops to between 200 and 400 kPa.
3. The purge valve shall be closed and the mains pressure recorded and plotted during the rising stage until the pressure rise plateaus. Recording shall be made for at least another 60 minutes after the pressure rise plateaus.
4. The plotted pressure in the main shall initially increase then plateau over the 60 minutes. If the pressure begins to fall at any time during the rising/plateau stage, the mains shall be deemed to have failed.

If the main fails, a minimum period of 4 hours is required before a retest is permitted to allow the pipe to fully relax, and pending council availability.

Test 2 comprises the following sequence:

1. The main shall be fully charged and care taken to ensure all air is purged from the pipe.
2. The test pressure shall be applied at a constant rate. The time T_L shall be noted as the time between start of pumping (zero seconds) and time to reach the test pressure (T_L).
3. Once test pressure is achieved, the mains shall be isolated and the pressure decay recorded (in minutes).
4. The first decay reading P_1 will be read at decay time t_1 which is equal to or greater than T_L .
5. The second decay reading P_2 will be read at decay time t_2 which is equal to or greater than $5 \times T_L$.
6. Calculate
$$N_1 = \frac{\log_e P_1 - \log_e P_2}{\log_e t_2 - \log_e t_1}$$
7. N_1 should be between 0.04 and 0.12. If $N_1 > 0.25$, an unacceptable leak is present.

8. The third decay reading P_3 will be read at decay time t_3 which is equal to or greater than $15 \times T_L$.
9. Calculate
$$N_2 = \frac{\log_e P_2 - \log_e P_3}{\log_e t_3 - \log_e t_2}$$
10. If $N_2 > 0.25$, an unacceptable leak is present.
11. If $N_1/N_2 < 0.8$, then an unacceptable leak is present.

6.4.22.2 Disinfection and Commissioning of Mains

Mains shall not be commissioned until all compliance criteria have been met, construction has been certified and commissioning is approved by the council.

Mains shall first be thoroughly flushed prior to disinfection by inducing water velocities in the pipe of at least 0.75 m/s. The main shall then be drained and a solution of clean water and 50 mg/L of free available chlorine introduced into the main until full. All hydrants and valves shall be operated post-filling to ensure all contact surfaces are disinfected. Additional solution may need to be introduced into the main after valve operation to ensure all surfaces are again in contact with the solution.

The main shall remain full for 24 hours. At the end of 24 hours, the water in the main shall be tested and shall have a chlorine residual of no less than 10 mg/L. The disinfection procedure shall be repeated if the chlorine residual is less than 10 mg/L.

The chlorine solution shall be flushed from the main until chlorine levels reduce to between 0.2 and 0.5 mg/L. The main shall be left isolated with the reduced chlorinated water within. A successful bacteriological test (*E.coli* and total coliforms) shall be carried out prior to commission by a testing laboratory approved by the council.

Any make-up pieces of pipe required for commissioning, but not included in the disinfected pipeline, shall washed and be swabbed with 100 mg/L solution.

Commissioning, sometimes referred to as cutting-in, shall be carried out by a contractor approved by the council. The developer is not permitted to operate any council network valves without approval.

If the pipe is contaminated, or suspected to be contaminated after the disinfection procedure has been carried out, the disinfection process shall be repeated until a satisfactory result is achieved.

6.4.22.3 Pumping Stations

A commissioning plan for pumping stations shall be submitted to, and approved by, the council prior to completion. The plan shall include pump performance testing, external acoustic measurements and pressure testing of the pipework as well as a test of safety overrides, control algorithms and switchboard functionality.

All building and electrical work shall be tested and provided with a code of compliance certificate to the satisfaction of the council in its building regulatory role.

The council will accept the station once the station has satisfactorily met all the requirements of the commissioning plan and any relevant building and resource consents. Submission, in hard and electronic form, of operational and maintenance manuals comprise part of the commissioning requirements.

6.4.22.4 Reservoirs

At no stage shall a reservoir enter service without suitable disinfection, bacteriological monitoring and council permission. An approved commissioning plan is required prior to placing a reservoir into service that also requires liaison with the regional health protection officer.

The watertightness of a reservoir shall be determined as outlined in NZS 3106 Appendix C.

This involves filling the reservoir to overflow level and holding the level there for 7 days to allow for absorption. The tank is then isolated, and the water level monitored for another 7 days with the level drop measured at 24 hour intervals.

The reservoir shall be deemed watertight if the water level has dropped the lesser of 0.2% of the reservoir depth or 10 mm.

If the rate of drop is decreasing over the 7 day period, the test may be extended an additional 7 days. If the level drop over the additional 7 days is less than the acceptable limit, the reservoir shall be deemed watertight.

Notwithstanding the above, all visible areas of leakage, such as wet patches on the outside walls or increased flows in the floor drainage, shall be remedied.

If the reservoir fails the test, remedial works shall be carried out and the reservoir re-tested.

The roof shall be tested as water tight by flooding the roof to a depth of 25 mm for a minimum of 24 hours, or if not practical, running sheet flow over the entire roof for a period of 6 hours. There shall be no leaks or damp patches evident on the underside of the roof after the test period.

SCADA and electrical equipment shall also be tested and certified (with code of compliance certificate) to the satisfaction of the council.

The reservoir shall be disinfected prior to vesting to the council.

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7 APPENDICES

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Appendix 1 Acceptable Pipe Materials – Stormwater

The following table outlines acceptable materials to be used for pipes in the stormwater network. This list is current at the time of publishing (November 2012). Any specifications issued by the council after this date shall supersede this list. It is the designer's responsibility to ensure they are referencing the most up-to-date information.

The use of unreinforced pipes will not be considered.

Table 7.1 – Acceptable Pipe Materials for Stormwater Pipes

| Pipe Material | Standard Compliance | Porirua | Lower Hutt | Upper Hutt | Wellington |
|---|---------------------|----------------|------------|------------|------------|
| Mains | | | | | |
| RRJ Reinforced Concrete min. class 2 | AS/NZS 4058 | ✓ | ✓ | ✓ | ✓ |
| Profiled Polyethylene* | AS/NZS 5065 | ✓ | ✓ | ✓ | X |
| Profiled Polypropylene (e.g. Bosspipe)* | AS/NZS 5065 | ✓ | ✓ | ✓ | X |
| Polyethylene PE80c (HDPE min. SDR 17.6) | AS/NZS 5065 | X ⁺ | ✓ | ✓ | X |
| Polyethylene PE100 (HPPE min. SDR 17.6) | AS/NZS 4130 | X ⁺ | ✓ | ✓ | ✓ |
| | | | | | |
| On special application where the above cannot be used or for the repair of existing same | | | | | |
| Vitreous Clay (Earthenware) min Class Y | AS 1741 | ✓ | ✓ | ✓ | ✓ |
| uPVC (Rubber Ring Joint only) | AS/NZS 1260 | ✓ | ✓ | ✓ | ✓ |
| Corrugated Aluminium (for Large Culverts) | AS/NZS 2041 | ✓ | ✓ | ✓ | ✓ |
| Flush Jointed Reinforced Concrete Pipes 1200 mm or greater | AS/NZS 4058 | ✓ | ✓ | ✓ | ✓ |

* Minimum SN16 in carriageway/road reserve or greater as determined by calculations to AS/NZS 2566.1

⁺ PCC will only allow the use of polyethylene in areas with a steep slope.

Appendix 2 Acceptable Pipe Materials – Wastewater

The following table outlines acceptable materials to be used for pipes in the wastewater network. This list is current at the time of publishing (November 2012). Any specifications issued by the council after this date shall supersede this list. It is the designer's responsibility to ensure they are referencing the most up to date information.

The use of unreinforced pipes will not be considered.

Materials for stream crossings, elevated pipelines and pumping station pipework shall be discussed and approved by the council prior to detail design.

Table 7.2 – Acceptable Pipe Materials for Wastewater Pipes

| Pipe Material | Standard Compliance | Porirua | Lower Hutt | Upper Hutt | Wellington |
|---|---------------------|----------------|------------|------------|------------|
| Mains | | | | | |
| Polyethylene PE100 (HPPE min. SDR 17.6) | AS/NZS 4130 | X ⁺ | X | ✓ | ✓ |
| uPVC (Rubber Ring Joint only)* | AS/NZS 1260 | ✓ | ✓ | ✓ | X |
| | | | | | |
| On special application where the above cannot be used or for the repair of existing same | | | | | |
| RRJ Reinforced Concrete min. class 2** | AS/NZS 4058 | ✓ | ✓ | ✓ | ✓ |
| Vitreous Clay (Earthenware) min Class Y | AS 1741 | ✓ | ✓ | ✓ | ✓ |

* Minimum SN16 in carriageway/road reserve, or greater as determined by calculations to AS/NZS 2566.1.

** Consideration towards corrosion-resistant linings and additives shall be made when selecting concrete pipes. Concrete pipes should generally only be considered for sewers of nominal diameter 375 mm or greater (or 525 mm or greater in WCC).

⁺ PCC will only allow the use of polyethylene in areas with a steep slope.

Appendix 3 Acceptable Pipe Materials – Water Supply

The following table outlines acceptable materials to be used for pipes in the water supply network. This list is current at the time of publishing (November 2012). Any specifications issued by the council after this date shall supersede this list. It is the designer's responsibility to ensure they are referencing the most up to date information.

Table 7.3 – Acceptable Pipe Materials for Water Supply Pipes

| Pipe Material | Standard Compliance | Porirua | Lower Hutt | Upper Hutt | Wellington |
|-------------------------------------|---------------------|---------|------------|------------|------------|
| Trunk Mains | | | | | |
| Polyethylene (PE100) SDR11 | AS/NZS 4130 | ✓ | ✓ | ✓ | X |
| UPVC Series 2 | AS/NZS 1477 | ✓ | ✓ | ✓ | X |
| MPVC Series 2 | AS/NZS 4765 | ✓ | ✓ | ✓ | X |
| OPVC Series 2 | AS/NZS 4441 | X | X | X | X |
| Concrete-Lined Mild Steel (CLS) | NZS 4442 | ✓ | ✓ | ✓ | ✓ |
| Concrete-Lined Ductile Iron (DACL) | AS/NZS 2280 | ✓ | ✓ | ✓ | ✓ |
| Principal Reticulation Mains | | | | | |
| Polyethylene (PE100) SDR11 | AS/NZS 4130 | ✓ | ✓ | X | ✓ |
| UPVC Series 2 | AS/NZS 1477 | ✓ | ✓ | ✓ | ✓ |
| MPVC Series 2 | AS/NZS 4765 | ✓ | ✓ | ✓ | ✓ |
| OPVC Series 2 | AS/NZS 4441 | X | X | X | X |
| Concrete Lined Mild Steel (CLS) | NZS 4442 | ✓ | ✓ | ✓ | ✓ |
| Concrete Lined Ductile Iron (DACL) | AS/NZS 2280 | ✓ | ✓ | ✓ | ✓ |
| Rider Mains | | | | | |
| Polyethylene (PE100) SDR11 | AS/NZS 4130 | X | X | X | ✓ |
| Polyethylene (PE80b) SDR11 | AS/NZS 4130 | ✓ | ✓ | ✓ | X |
| Copper | NZS 3501 | ✓ | ✓ | X | ✓ |
| Service Pipes | | | | | |
| Polyethylene (PE100) SDR11 | AS/NZS 4130 | X | X | X | ✓ |
| Polyethylene (PE80b) SDR11 | AS/NZS 4130 | ✓ | ✓ | ✓ | X |
| Copper | NZS 3501 | ✓ | ✓ | X | ✓ |

See following notes for considerations and exceptions.

Additional Notes relating to water supply pipes

Pipe bridges or exposed pipes shall be constructed from CLS or flanged DICL.

Pipes on banks with a slope greater than 1:5 (v:h) shall be laid in CLS or axially restrained DICL. These pipes shall also be anchored using anchor blocks (see Anchor Blocks, section 6.4.9.2, page 75).

PE or PVC pipes shall not be used in areas that are contaminated, or be potentially contaminated with hydrocarbons.

All fire services shall be of a metallic material.

All PVC variant pipes shall be rubber ring jointed. Solvent jointed pipe will not be accepted.

Principal and trunk mains constructed with polyethylene pipe shall be either electro-fusion or butt welded. Rider mains and services may be joined using suitably approved compression fittings.

WCC: All PE100 rider mains and customer connections shall be electro-fusion welded. Compression fittings are not to be used on PE100 pipe.
All reticulation pipes in WCC's CBD and suburban centres, and pipes with a nominal diameter 200 mm or larger, shall be concrete lined steel or ductile iron. Rider mains may be PE100 or copper.

Appendix 4 Hydrological Design

The following provides technical accompaniment to section 4.3.1. These pages relate specifically to stormwater design.

A4.1 Rational Method

The Rational Method is described by Equation 2 below.

$$\text{Equation 2} \quad Q = \frac{CiA}{360}$$

Where:

Q = Peak discharge (m³/s)

C = Runoff coefficient (see section 4.3.1.2)

i = Rainfall intensity (mm/hour)

A = Area of catchment (hectares)

Determination of rainfall intensity (i) requires analysis of the time for concentration (T_c) which is covered further in section A4.3.

A4.2 Peak Flow Determination: Modified Rational Method

The Modified Rational Method is described by Equation 3 below.

$$\text{Equation 3} \quad Q = \frac{CiASF}{360}$$

Where:

Q = Peak discharge

C = Runoff coefficient (dimensionless)

i = Rainfall intensity (mm/hour)

A = area of catchment (hectares)

S = Shape factor

F = Area Factor

S and F can be determined using the formula below.

$$\text{Equation 4} \quad S = 0.4253 + 1.266k - 0.3952k^2$$

$$\text{Equation 5} \quad k = \frac{A}{100L^2}$$

$$\text{Equation 6} \quad F = 0.6 + 0.4e^{\left(\frac{-A}{7700}\right)}$$

Where L (kilometres) is the straight line length to the catchment head

A4.3 Time for Concentration (T_c)

The time for concentration (T_c) is required to ascertain a catchment's critical rainfall event for a chosen level of protection. Every catchment has an intrinsic T_c which can be described by:

$$\text{Equation 7} \quad T_c = T_e + T_f$$

Where

T_c = Time for concentration (minutes)

$T_e = T_o + T_g$ and is a minimum of 5 minutes

T_o = Time of overland flow (minutes)

T_g = Time of gutter flow (minutes)

T_f = Time of pipe and channel flow to design point (minutes)

T_c shall be no less than 10 minutes.

For lengths less than 1 km, T_o (in mins) can be determined using Friend's Equation and Equation 9:

$$\text{Equation 8} \quad T_o = \frac{107nL^{0.333}}{S^{0.2}} \quad (\text{Friend's Equation})$$

Where n is Manning's 'n', L is length in meters, and S is slope in % (i.e. 3.0 for 3% slope)

Gutter flow T_g (in mins) can be estimated using the Manning's derived equation

$$\text{Equation 9} \quad T_g = 0.025 \frac{L}{S^{0.5}}$$

Where L is length in metres and slope is calculated as a % integer (i.e. $S = 3.0$ for 3% slope)

Time for pipe flow T_f can be based on the following velocities:

3 m/s for low gradients (less than 5%)

5 m/s for moderate to steep gradients

For rural catchments, the Bransby-Williams formula (Equation 10) can be used to calculate T_c (in mins).

$$\text{Equation 10} \quad T_c = \left(\frac{FL}{A^{0.1}S^{0.2}} \right) \quad (\text{Bransby-Williams formula})$$

Where L is length in kilometres, and F is 92.7, area A is in hectares, and S is the decimal slope (m/m).

Alternatively, Clause E1/VM1 of the NZ Building Code can be used to determine T_c for small catchments.

Appendix 5 Depth Duration Tables

Depths are in mm per duration; for example;

A 2-year ARI with a duration of 10 minutes in Camborne, Porirua, has a nominal peak intensity of 42.6 mm/hour or an intensity (i) of:

$$42.6 \text{ mm/hr} \times 1.16 \times 1.1 = \boxed{54.4 \text{ mm/hour}}$$

Climate change factor \nearrow \nwarrow Zone factor

Note: The current factors must also be applied to the following tables:

- Zone factors for PCC and HCC tables (See Appendix 6 & Appendix 5)
- Climate change multiplier of 16% (See 4.3.1.1, page 19)

Porirua City (rainfall intensity in mm/hour)

NZTM Coordinates 1754392E 5444631N (Cobham Court)

| ARI (y) | AEP | Duration | | | | | | | | | |
|---------|------|----------|------|------|------|------|------|-----|-----|-----|-----|
| | | 10m | 20m | 30m | 60m | 2h | 6h | 12h | 24h | 48h | 72h |
| 1.58 | 63% | 39.0 | 27.3 | 22.2 | 15.5 | 10.5 | 5.6 | 3.8 | 2.5 | 1.5 | 1.1 |
| 2 | 50% | 42.6 | 29.7 | 24.0 | 16.8 | 11.3 | 6.0 | 4.0 | 2.7 | 1.6 | 1.2 |
| 5 | 20% | 54.0 | 37.5 | 30.6 | 21.3 | 14.2 | 7.5 | 5.0 | 3.3 | 1.9 | 1.4 |
| 10 | 10% | 63.0 | 44.1 | 35.8 | 24.9 | 16.6 | 8.7 | 5.8 | 3.8 | 2.2 | 1.6 |
| 20 | 5% | 73.8 | 51.3 | 41.6 | 29.1 | 19.3 | 10.0 | 6.6 | 4.4 | 2.6 | 1.9 |
| 30 | 3.3% | 80.4 | 56.1 | 45.4 | 31.7 | 21.0 | 10.9 | 7.2 | 4.7 | 2.8 | 2.0 |
| 40 | 2.5% | 85.2 | 59.7 | 48.4 | 33.7 | 22.3 | 11.5 | 7.6 | 5.0 | 2.9 | 2.1 |
| 50 | 2% | 89.4 | 62.4 | 50.6 | 35.4 | 23.3 | 12.0 | 7.9 | 5.2 | 3.0 | 2.2 |
| 60 | 1.7% | 93.0 | 65.1 | 52.6 | 36.8 | 24.2 | 12.5 | 8.2 | 5.4 | 3.1 | 2.3 |
| 80 | 1.2% | 99.0 | 69.0 | 56.0 | 39.1 | 25.7 | 13.2 | 8.7 | 5.7 | 3.3 | 2.4 |
| 100 | 1% | 103.8 | 72.6 | 58.8 | 41.0 | 26.9 | 13.8 | 9.0 | 5.9 | 3.4 | 2.5 |

Wellington City (rainfall intensity in mm/hour)

NZTM Coordinates 1748125E 5428277N (Kelburn Weather Centre)

| ARI (y) | AEP | Duration | | | | | | | | | |
|---------|------|----------|------|------|------|------|------|------|-----|-----|-----|
| | | 10m | 20m | 30m | 60m | 2h | 6h | 12h | 24h | 48h | 72h |
| 1.58 | 63% | 36.6 | 27.0 | 22.4 | 16.5 | 11.4 | 6.3 | 4.3 | 3.0 | 1.8 | 1.3 |
| 2 | 50% | 39.6 | 29.1 | 24.4 | 17.9 | 12.3 | 6.8 | 4.6 | 3.2 | 1.9 | 1.4 |
| 5 | 20% | 50.4 | 37.2 | 31.0 | 22.8 | 15.6 | 8.5 | 5.8 | 3.9 | 2.4 | 1.8 |
| 10 | 10% | 59.4 | 43.8 | 36.4 | 26.8 | 18.2 | 9.8 | 6.7 | 4.5 | 2.7 | 2.0 |
| 20 | 5% | 69.6 | 51.0 | 42.6 | 31.2 | 21.1 | 11.4 | 7.7 | 5.2 | 3.1 | 2.3 |
| 30 | 3.3% | 75.6 | 55.8 | 46.4 | 34.1 | 23.0 | 12.3 | 8.3 | 5.6 | 3.4 | 2.5 |
| 40 | 2.5% | 81.0 | 59.4 | 49.4 | 36.3 | 24.5 | 13.1 | 8.8 | 5.9 | 3.6 | 2.7 |
| 50 | 2% | 84.6 | 62.1 | 52.0 | 38.1 | 25.7 | 13.7 | 9.2 | 6.2 | 3.7 | 2.8 |
| 60 | 1.7% | 88.2 | 64.8 | 54.0 | 39.7 | 26.7 | 14.2 | 9.5 | 6.4 | 3.9 | 2.9 |
| 80 | 1.2% | 93.6 | 69.0 | 57.6 | 42.2 | 28.3 | 15.1 | 10.1 | 6.8 | 4.1 | 3.0 |
| 100 | 1% | 98.4 | 72.3 | 60.4 | 44.3 | 29.7 | 15.7 | 10.5 | 7.1 | 4.3 | 3.2 |

Hutt City (rainfall intensity in mm/hour)

From historical HCC depth duration curves (does not include 16% climate change)

| ARI (y) | AEP | Duration | | | | | |
|---------|-----|----------|------|------|------|------|------|
| | | 10m | 20m | 30m | 60m | 2h | 6h |
| 2 | 50% | 46.1 | 32.8 | 26.7 | 18.1 | 12.1 | 6.9 |
| 5 | 20% | 62.1 | 44.0 | 36.2 | 25.0 | 17.2 | 10.3 |
| 10 | 10% | 72.4 | 51.7 | 42.2 | 29.3 | 20.7 | 12.1 |
| 20 | 5% | 82.8 | 58.6 | 48.3 | 34.5 | 23.3 | 13.8 |
| 50 | 2% | 105.2 | 69.0 | 56.0 | 40.5 | 28.4 | 17.2 |
| 100 | 1% | 112.9 | 76.7 | 62.9 | 44.8 | 31.9 | 19.8 |

Wainuiomata: Multiply depths by 1.07 to allow for geographical influence.

Upper Hutt City (rainfall intensity in mm/hour)

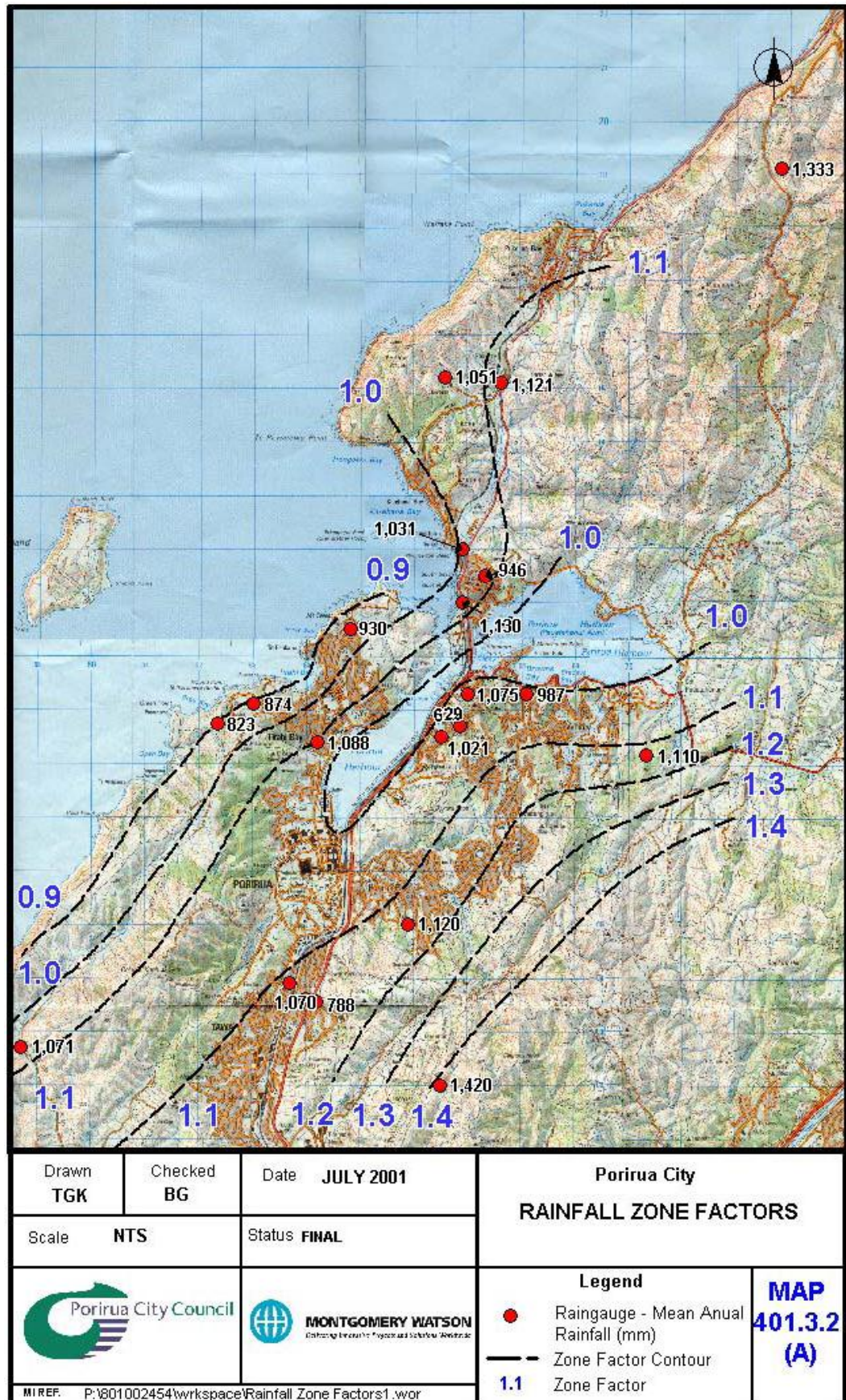
From historical UHCC depth duration curves (does not include 16% climate change)

Use the closest of either KAITOKE or WALLACEVILLE charts depending on location.

| KAITOKE | | Duration | | | | | | |
|---------|-----|----------|-----|-----|-----|----|----|-----|
| ARI (y) | AEP | 10m | 20m | 30m | 60m | 2h | 3h | 6h |
| 2 | 50% | 54 | 39 | 32 | 24 | 17 | 14 | 9.5 |
| 5 | 20% | 72 | 54 | 46 | 33 | 22 | 18 | 13 |
| 10 | 10% | 84 | 63 | 54 | 39 | 27 | 21 | 15 |
| 20 | 5% | 96 | 72 | 62 | 45 | 30 | 24 | 16 |
| 25 | 4% | 102 | 76 | 65 | 47 | 32 | 26 | 18 |
| 50 | 2% | 114 | 84 | 72 | 52 | 35 | 28 | 19 |
| 100 | 1% | 126 | 93 | 80 | 58 | 38 | 31 | 21 |

| WALLACEVILLE | | Duration | | | | | | |
|--------------|-----|----------|-----|-----|-----|----|----|------|
| ARI (y) | AEP | 10m | 20m | 30m | 60m | 2h | 3h | 6h |
| 2 | 50% | 42 | 30 | 24 | 18 | 13 | 10 | 7 |
| 5 | 20% | 54 | 39 | 34 | 25 | 17 | 14 | 9 |
| 10 | 10% | 66 | 48 | 40 | 29 | 20 | 16 | 11 |
| 20 | 5% | 72 | 54 | 46 | 33 | 23 | 18 | 13 |
| 25 | 4% | 77 | 57 | 49 | 35 | 24 | 19 | 13.5 |
| 50 | 2% | 84 | 63 | 54 | 39 | 26 | 21 | 15 |
| 100 | 1% | 96 | 69 | 60 | 43 | 29 | 23 | 17 |

Appendix 6 PCC Rainfall Intensities Zone Factors



Appendix 7 Hydraulic Design

The following provides technical accompaniment to sections 4.3.2 and 5.3.2. These pages relate specifically to stormwater and wastewater design.

A7.1 Manning's Formula

Manning's formula can be used to estimate the capacity of the drain being designed.

$$\text{Equation 11} \quad Q = \frac{1}{n} AR^{\frac{2}{3}} \sqrt{S}$$

Where Q = flow m³/s

n = roughness coefficient (see Table 4.5.)

A = wetted area (m²)

R = Hydraulic radius (wetted area / wetted perimeter) m

S = decimal slope (m/m)

Head losses due to pipe friction and joints can be estimated using the roughness factors presented in Table 4.5 (page 21).

For circular pipes running partially full, the roughness coefficient Manning's n should be modified for pipes using Equation 12.

$$\text{Equation 12} \quad n' = n \left[\frac{\left(1 - \frac{d}{D}\right) - \left(1 - \frac{d}{D}\right)^7}{2} + 1 \right]$$

Where n' = modified Manning's n

n = Manning's n (from Table 4.5)

d = depth of water in pipe

D = diameter of pipe

See Appendix 8 for graphical representations of pipe capacities for pipes running 80% and 100% full including an allowance for air entrainment.

A7.2 Air Entrainment

Where the pipe exceeds grades of 1 in 10, allowances shall be made for bulking of the flow due to air entrainment, and special precautions made to release the air and surplus energy.

The air to water ratio may be calculated from:

$$\text{Equation 13} \quad \frac{\text{air}}{\text{water}} = \frac{kV^2}{gR}$$

Where k = coefficient of air entrainment:

0.004 for smooth concrete pipes

0.008 for cast insitu concrete pipes

g = gravity (9.81 m/s²)

R = hydraulic radius

V = velocity

A7.3 Losses Through Structures

Losses through a structure shall be compensated for through a drop in the invert level through the manhole. The drop shall be additional to the entry and exit slopes, and shall be introduced gradually across the manhole.

The losses to be accounted for are:

- h_d Head loss due to change in direction
- h_j Head loss due to junction (if applicable)
- h_n Nominal headloss across structure

Therefore the total drop (h_f) through the manhole to be accommodated shall be:

$$\text{Equation 14} \quad h_f = h_d + h_j + h_n \quad (\text{in metres})$$

Head losses due to a change in direction (h_d) shall be determined using Equation 15 where the loss coefficient (K_d) shall be determined from the figure presented in Appendix 10.

$$\text{Equation 15} \quad h_d = K_d \frac{V_i^2}{2g}$$

Alternatively, the loss coefficients in the table below can be used.

Bend Loss Coefficient (conservative)

| Angle | K_d |
|-------|-------|
| 22.5° | 0.25 |
| 45° | 0.60 |
| 90° | 0.90 |

Pipe junctions and laterals joining the main flow increase turbulence in the manhole and the change in flow volume changes the flow momentum. Losses due to a junction shall be described by the equation below:

$$\text{Equation 16} \quad h_j = \left(\frac{D_L}{D_i} \right)^2 \frac{V_i^2}{2g}$$

Where D_i and V_i is the incoming pipe diameter and velocity and D_L is joining lateral diameter. **Alternatively**, the momentum equation, shown by Equation 17 and Figure 7.1, may be used to determine h_j .

$$\text{Equation 17} \quad h_j = \frac{Q_1 V_1 - Q_2 V_2 - Q_3 V_3 \cos \theta_3 - Q_4 V_4 \cos \theta_4}{0.5(A_1 + A_2)g}$$

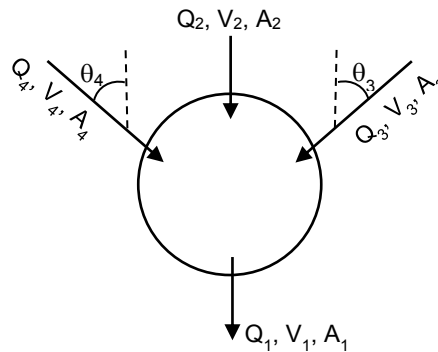


Figure 7.1 – Variables for use with Equation 17

The nominal loss h_n across the structure accounts for the changes in cross-section area as the pipe transitions from circular to open channel and back again as well as discontinuities and increased roughness of the haunching.

Equation 18
$$h_n = 0.1 \frac{V_i^2}{2g}$$

A7.4 Darcy-Weisbach Calculation (pressure pipes)

Pipeline losses shall be calculated using the Darcy-Weisbach equation where the Moody friction factor f can be determined using the Moody diagram or calculated using the Colebrook-White or Swamee-Jain method. The Swamee-Jain method is non-iterative and simpler to solve and differs from the iterative Colebrook-White method by less than 1% for turbulent flow.

Appendix 12 provides head loss charts for standard PVC pipes using the Swamee-Jain method and the roughness coefficients in Table 6.4 (page 64).

Equation 19
$$h_f = f \frac{L V^2}{D 2g} \quad (\text{Darcy-Weisbach Equation})$$

| | | |
|--------|-------|--|
| where: | h_f | = headloss |
| | f | = friction factor determined by Equation 20 or Equation 21 |
| | L | = length of pipe (m) |
| | D | = internal diameter of pipe (m) |
| | V | = fluid velocity (m/s) |
| | g | = gravity (9.81 m/s ²) |

The friction factor f can be determined using either the Colebrook-White method (Equation 20) or the Swamee-Jain equation (Equation 21). Table 6.4 (page 64) provides the roughness factors ϵ to be used in either the Manning's, Colebrook-White or Swamee-Jain equations. The roughness factors allow for fittings and ageing of a typical reticulation or trunk pipeline. Calculations for pump stations or areas with a large number of fittings may require special consideration.

Equation 20
$$\frac{1}{\sqrt{f}} = -2 \log_{10} \left(\frac{\varepsilon / D}{3.7} + \frac{2.51}{R \sqrt{f}} \right)$$
 (Colebrook-White method)

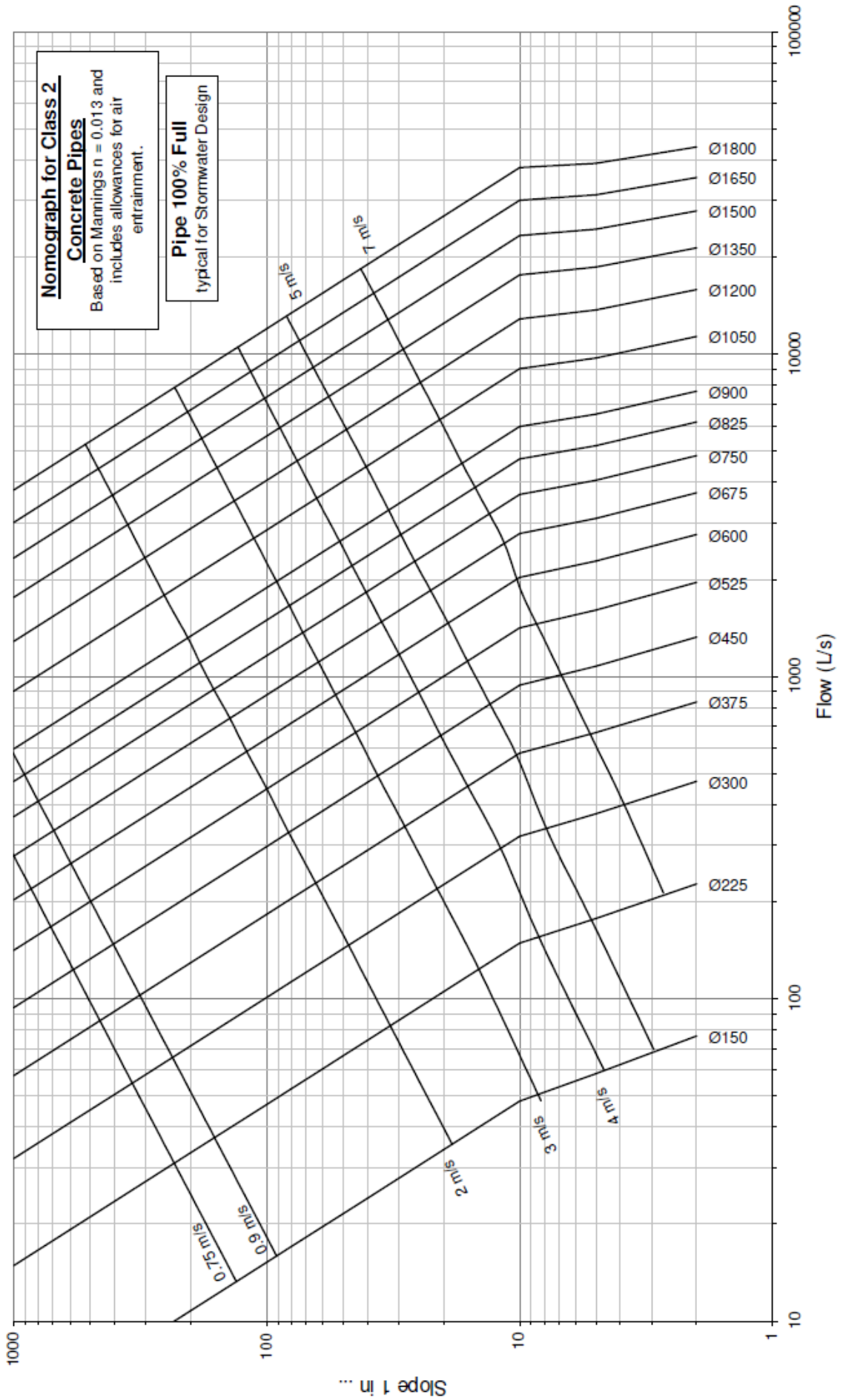
Equation 21
$$f = \frac{0.25}{\left[\log_{10} \left(\frac{\varepsilon / D}{3.7} + \frac{5.74}{R^{0.9}} \right) \right]^2}$$
 (Swamee-Jain method)

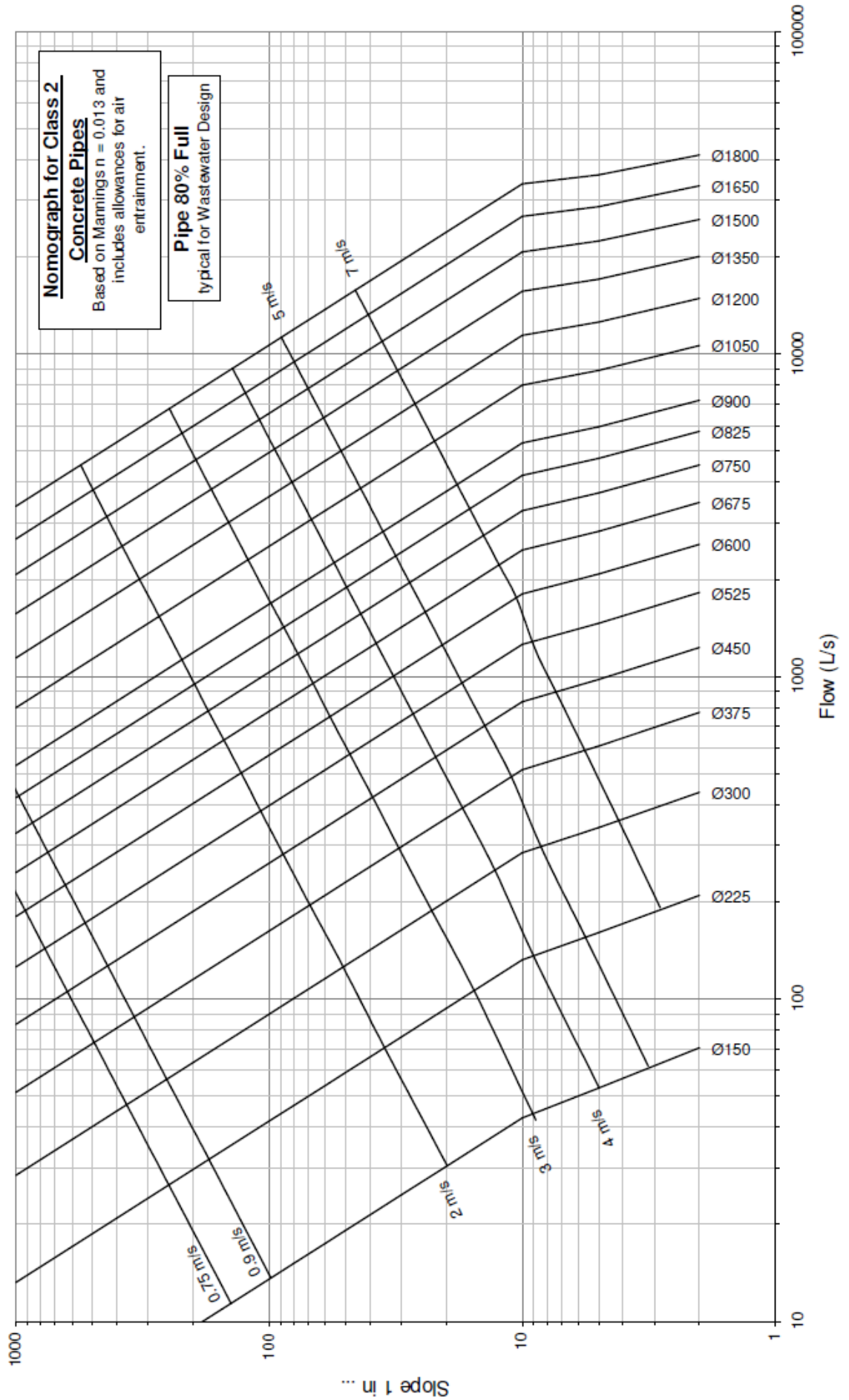
where

- ε = pipe roughness (mm) from Table 6.4
- D = internal pipe diameter (mm)
- R = Reynolds number = $(V \times D) / 10^{-6}$ for water

Appendix 8 Nomographs for Drainage Pipes

The following charts are a graphical representation of the calculations from A7.1 and A7.2 in Appendix 7 for Manning's formula and air entrainment for Class 2 pre-cast concrete pipes.





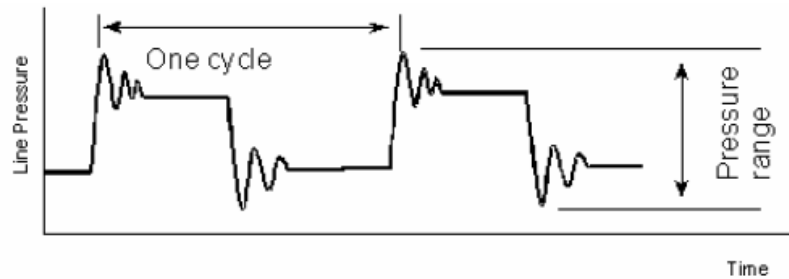
Appendix 9 Surge and Fatigue Calculations

Where plastic pipes are proposed in a cyclic environment, such as rising mains or direct-on-line pumping into the reticulation, provisions for a potential increase in pipe class shall be made due to fatigue and/or surge.

Surge is the sudden change in pressure caused by sudden changes in fluid velocity; for example, an unanticipated power failure resulting in the pumps shutting down and uncontrolled pressure transients (water hammer) in the pipeline. A transient analysis shall be carried out on all rising mains to ensure transients do not exceed the working pressure of the pipeline and fittings. Where transients are excessive, measures such as soft-starters or variable frequency drives on the pumps, surge control valves or increased pipe classes shall be considered.

Fatigue is a result of a large number of repetitive surge events. Generally, a larger number of smaller events can be tolerated than a lesser number of large surges.

Gradual diurnal changes in pressure due to normal consumer demand, as typically experienced by most reticulations, generally do not require specific fatigue design.



**Definition of a pressure cycle and surge range
(from PIPA publication POP101)**

Where plastic pipes are used, and fatigue is expected, the following formula should be used to determine equivalent operating pressures. Note that these can be used for water or wastewater pumping applications.

Equation 22
$$Cycles_{100} = Cycles_{day} \times CF \times 36500 \text{ (kPa)}$$

- Where $Cycles_{100}$ = equivalent cycles over 100 years
- $Cycles_{day}$ = expected number of cycles per day
- CF = 2 for pumped systems,
= 1 for non-pumped systems

$Cycles_{100}$ is to be used to determine the Fatigue Cycle Factor (F) from the following table.

Equation 23
$$OP_{equiv} = \frac{\Delta P}{F}$$

- Where OP_{equiv} = equivalent Operating Pressure (kPa)
- ΔP = Max surge pressure – Min surge pressure (kPa)
- F = Fatigue Cycle Factor from the following table

The pipe class shall be based on the greater of the nominal working pressure or the OP_{equiv} .

Fatigue Cycle Factors⁶

| Total Cycles over 100 year pipe life (Cycles ₁₀₀) | PE80b PE100 | UPVC | MPVC | OPVC |
|---|-------------|------|------|------|
| 26,400 | 1 | 1 | 1 | 1 |
| 100,000 | 1 | 1 | 0.67 | 0.75 |
| 200,000 | 1 | 0.81 | 0.54 | 0.66 |
| 500,000 | 0.95 | 0.62 | 0.41 | 0.56 |
| 1,000,000 | 0.88 | 0.50 | 0.33 | 0.49 |
| 2,500,000 | 0.80 | 0.38 | 0.25 | 0.41 |
| 5,000,000 | 0.74 | 0.38 | 0.25 | 0.41 |

Alternative specific design is required for more complex situations, such as common rising mains or temperatures greater than 20 degrees.

A9.1 Example Fatigue Calculation

The pressure in a pumped rising main surges to 950 kPa when started, to gradually stabilise at 400 kPa. When the pumps stop, the pressure in the pipe drops to a minimum of 100 kPa. The nominal working pressure in the pipe is 950 kPa and theoretically requires a minimum OPVC pipe class of PN10.

The pump is expected to start 8 times a day (Cycles_{day}) which is equivalent to 292,000 over 100 years. As it is a pumped system, Cycles_{day} is multiplied by 2 which provides a Cycles₁₀₀ of 584,000. This translates into a Fatigue Cycle Factor of around 0.54 from the table above.

The surge pressure $\Delta P = 950 \text{ kPa} - 100 \text{ kPa} = 850 \text{ kPa}$. This means the equivalent operating pressure is:

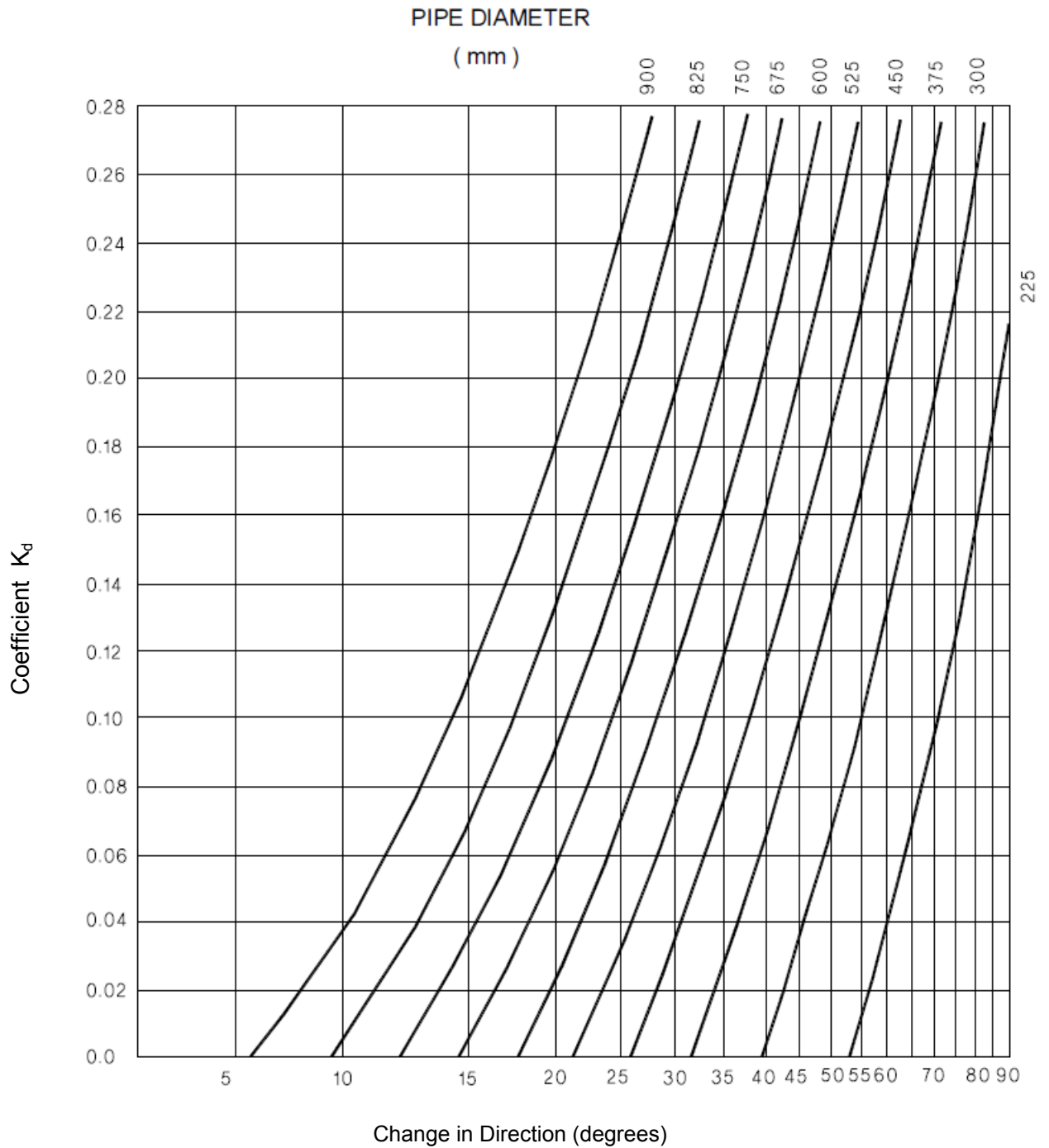
$$OP_{equiv} = \frac{850}{0.54} \quad \text{which} = 1,570 \text{ kPa}$$

This suggests a minimum PN16 pipe is more appropriate as the OP_{equiv} of 1,570 kPa is greater than the original PN10 working pressure.

⁶ From Plastic Pipe Industry of Australia Ltd (PIPA) Guidelines POP010A and POP101 available from www.pipa.com.au

Appendix 10 Losses Through 1050 Manhole

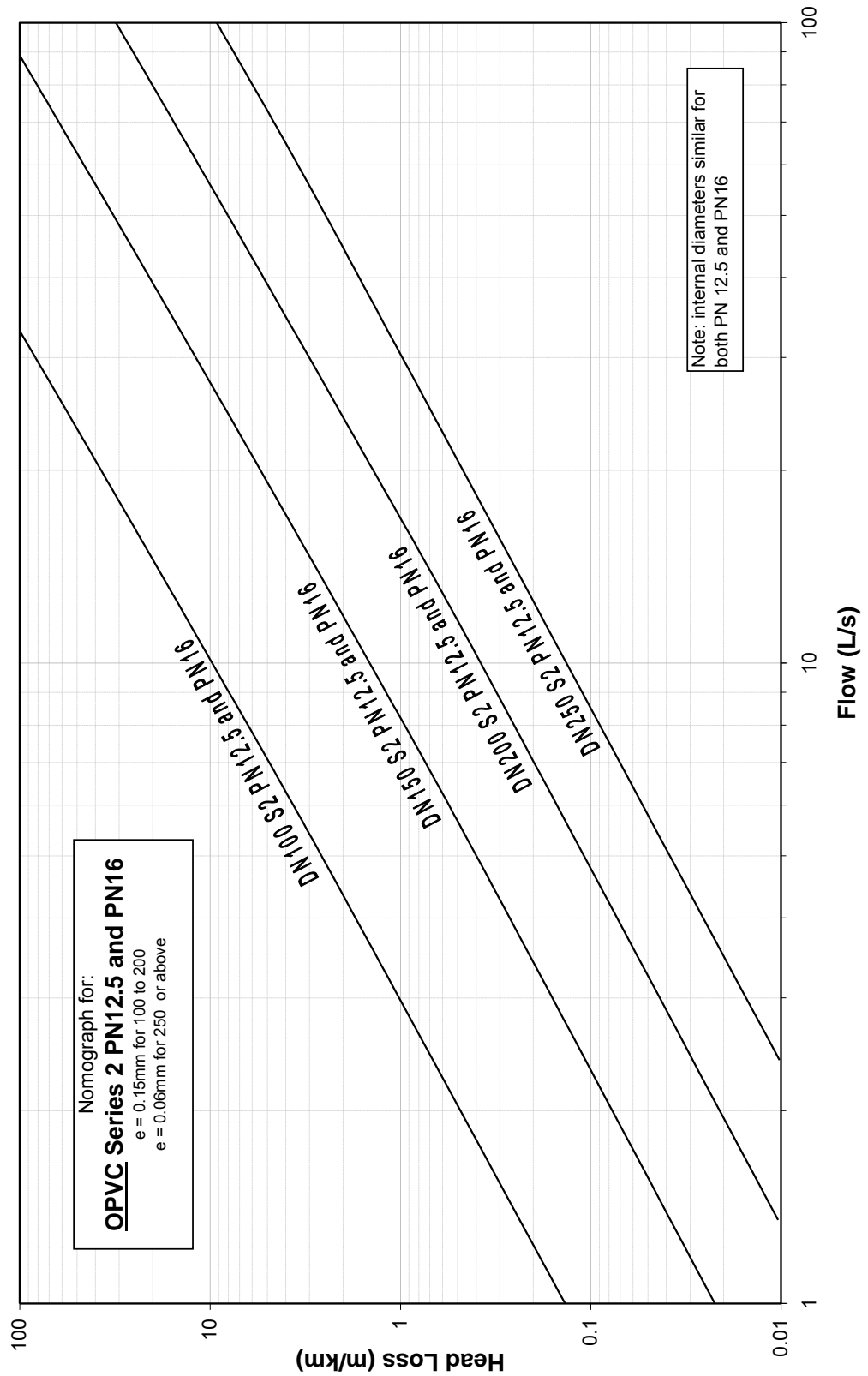
(Chart adopted from NZBC)

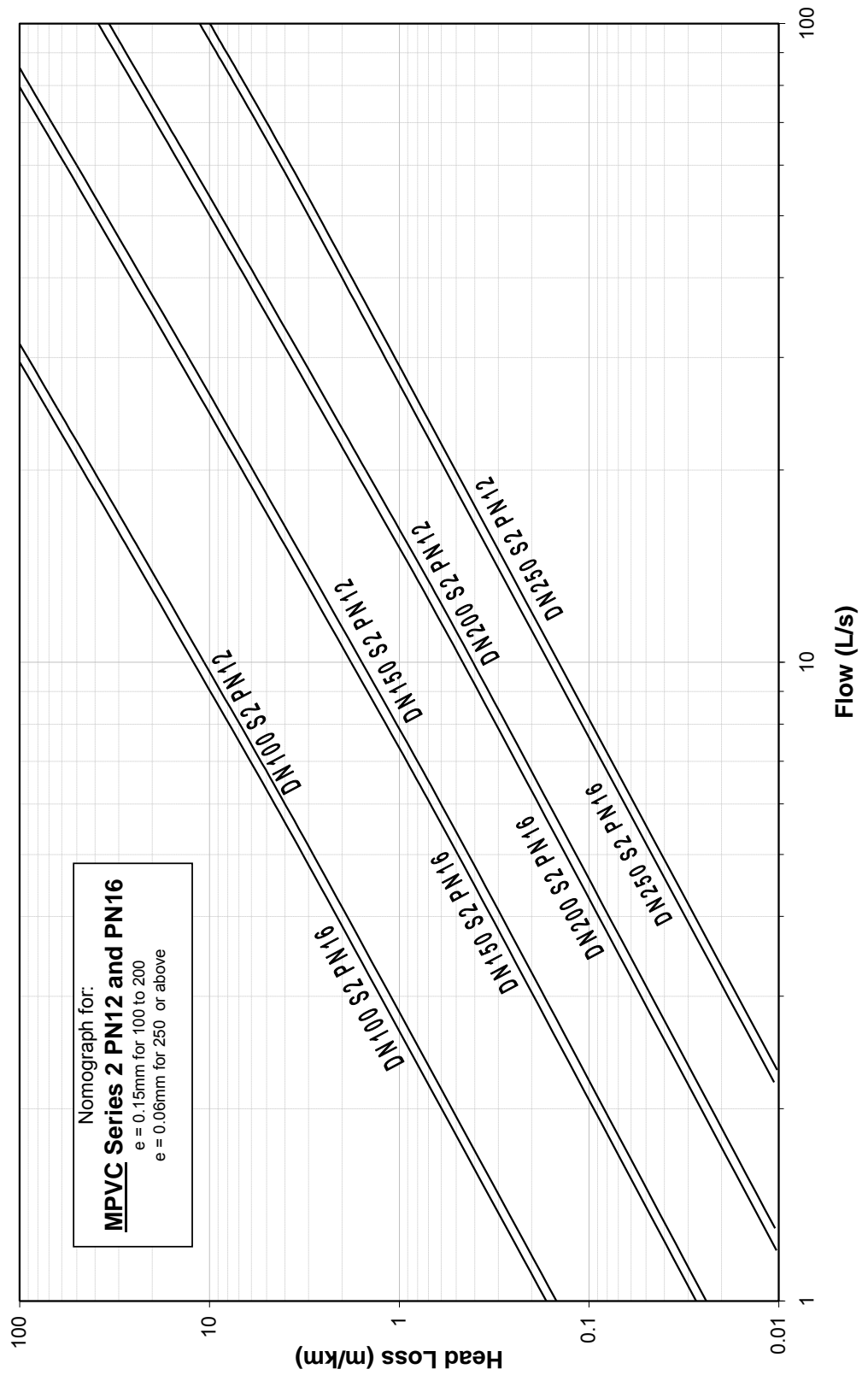


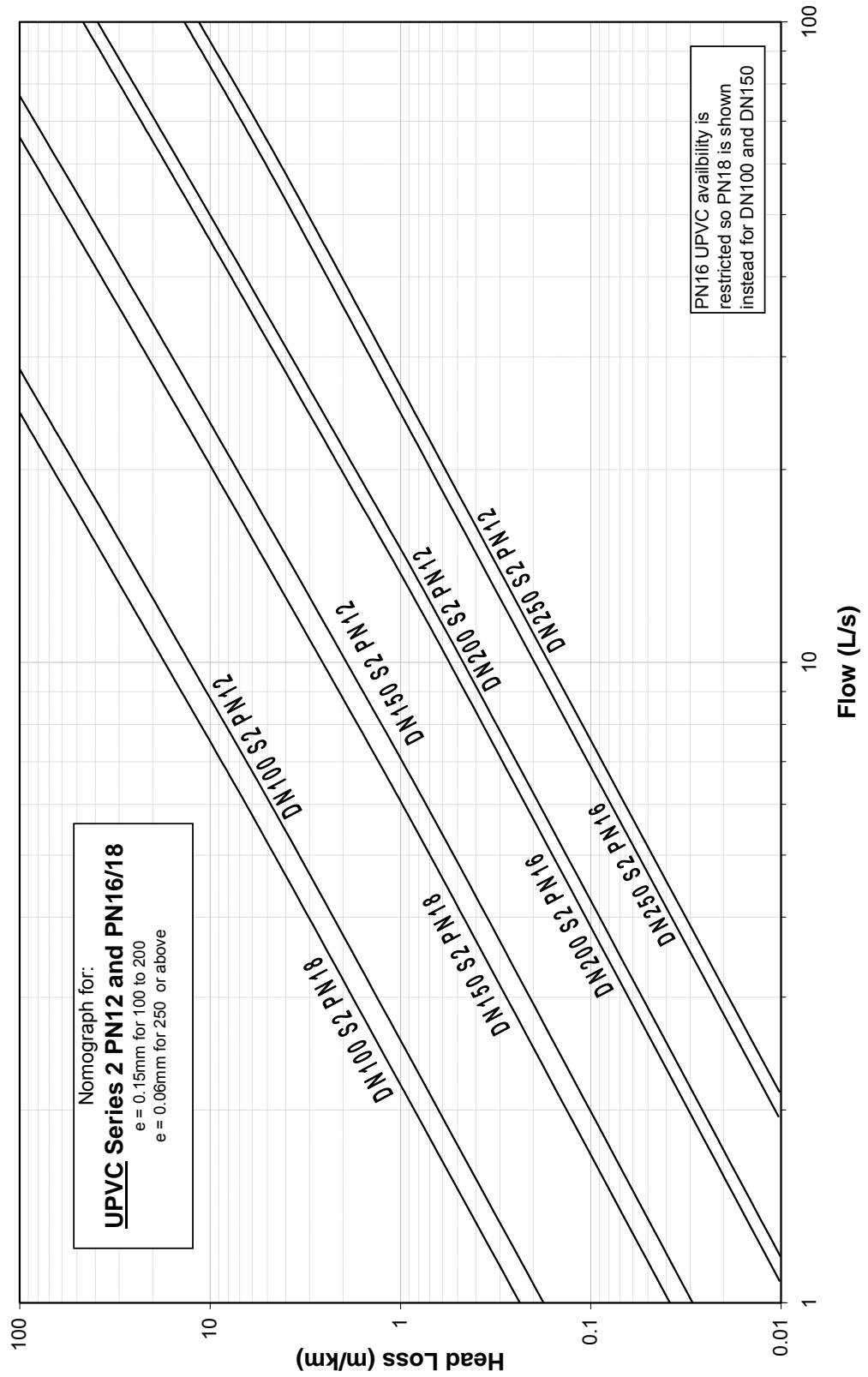
Appendix 11 WCC Wastewater Peaking Factors

| Area (ha) | Population | | | | | | | | | | |
|--------------|------------|-----|-----|-----|-----|------|------|------|-------|-------|-------|
| | 20 | 50 | 100 | 200 | 500 | 1000 | 2000 | 5000 | 10000 | 20000 | 50000 |
| 1 | 13.6 | 9.8 | 8.3 | 7.3 | 6.6 | 6.3 | | | | | |
| 2 | 12.3 | 8.8 | 7.4 | 6.6 | 6 | 5.7 | 5.4 | | | | |
| 3 | | 8.3 | 7 | 6.2 | 5.6 | 5.3 | 5.1 | | | | |
| 4 | | 7.9 | 6.7 | 6 | 5.4 | 5.1 | 4.9 | 4.7 | | | |
| 5 | | 7.7 | 6.5 | 5.8 | 5.2 | 4.9 | 4.7 | 4.6 | | | |
| 6 | | | 6.3 | 5.6 | 5.1 | 4.8 | 4.6 | 4.5 | | | |
| 7 | | | 6.2 | 5.5 | 4.9 | 4.7 | 4.5 | 4.4 | 4.3 | | |
| 8 | | | 6 | 5.4 | 4.8 | 4.6 | 4.4 | 4.3 | 4.2 | | |
| 9 | | | 5.9 | 5.3 | 4.8 | 4.5 | 4.3 | 4.2 | 4.1 | | |
| 10 | | | 5.8 | 5.2 | 4.7 | 4.4 | 4.3 | 4.1 | 4.1 | | |
| 20 | | | | 4.7 | 4.2 | 4 | 3.9 | 3.7 | 3.7 | 3.6 | |
| 30 | | | | | 4 | 3.8 | 3.6 | 3.5 | 3.5 | 3.4 | |
| 40 | | | | | 3.8 | 3.6 | 3.5 | 3.4 | 3.3 | 3.3 | 3.2 |
| 50 | | | | | 3.7 | 3.5 | 3.4 | 3.2 | 3.2 | 3.2 | 3.1 |
| 60 | | | | | | 3.4 | 3.3 | 3.2 | 3.1 | 3.1 | 3 |
| 70 | | | | | | 3.3 | 3.2 | 3.1 | 3 | 3 | 3 |
| 80 | | | | | | 3.2 | 3.1 | 3 | 3 | 2.9 | 2.9 |
| 90 | | | | | | 3.2 | 3.1 | 3 | 2.9 | 2.9 | 2.9 |
| 100 | | | | | | 3.1 | 3 | 2.9 | 2.9 | 2.8 | 2.8 |
| 200 | | | | | | | 2.7 | 2.6 | 2.6 | 2.6 | 2.5 |
| 300 | | | | | | | | 2.5 | 2.4 | 2.4 | 2.4 |
| 400 | | | | | | | | 2.4 | 2.3 | 2.3 | 2.3 |
| 500 | | | | | | | | 2.3 | 2.3 | 2.2 | 2.2 |
| 600 | | | | | | | | | 2.2 | 2.2 | 2.2 |
| 700 | | | | | | | | | 2.2 | 2.1 | 2.1 |
| 800 | | | | | | | | | 2.1 | 2.1 | 2.1 |
| 900 | | | | | | | | | 2.1 | 2 | 2 |
| 1000 | | | | | | | | | 2 | 2 | 2 |
| 2000 | | | | | | | | | | 1.8 | 1.8 |
| 3000 | | | | | | | | | | | 1.7 |
| 4000 | | | | | | | | | | | 1.6 |
| 5000 | | | | | | | | | | | 1.6 |

Appendix 12 Standard PVC Water Pipe Head Losses





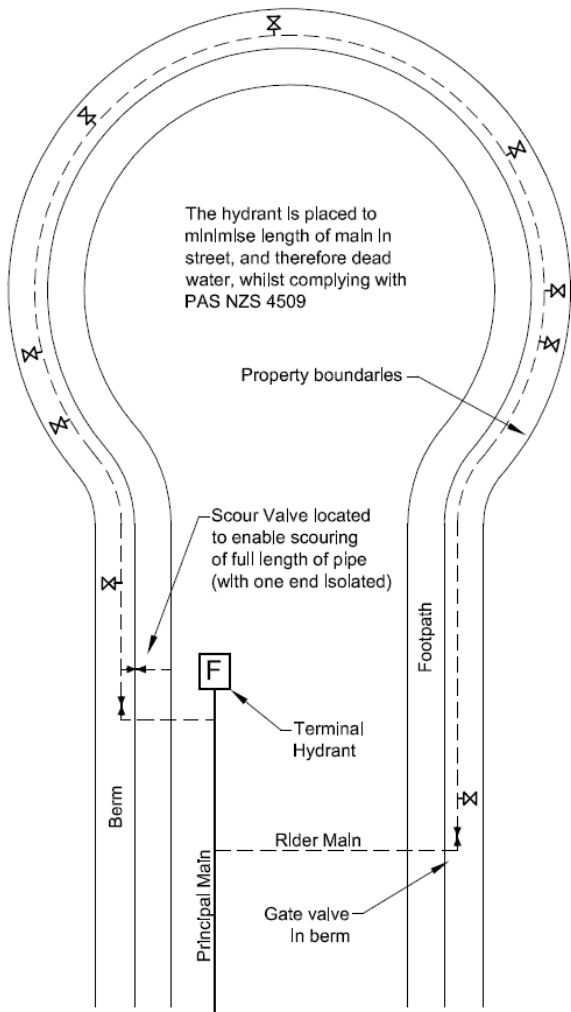


Appendix 13 Engineering Drawings

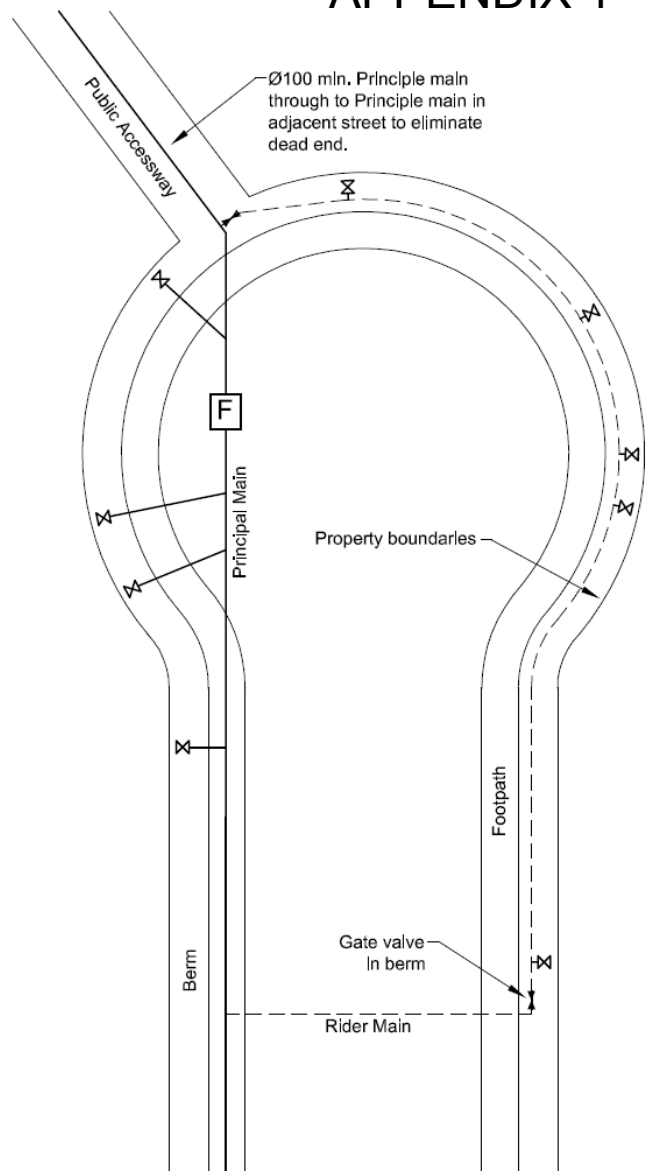
PLEASE NOTE:

The drawings presented here are representative of typical standard installations. Whilst these were current at the time of writing, they will be superseded by any specification subsequently issued by councils. These drawings shall be considered in conjunction with the relevant general specification presented in this document, and any other documents as directed by councils.

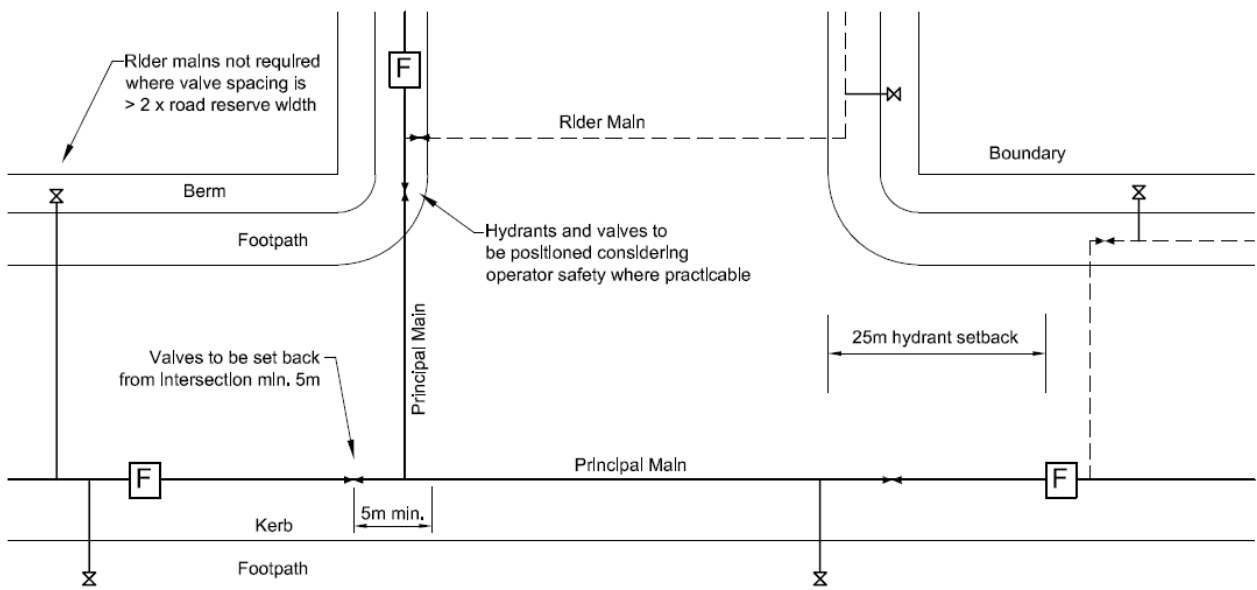
Note: The examples shown here are typical and may vary due to in-situ circumstance or change in Council policy.



Terminal Principal Main



Linked Principal Main



Intersection

This drawing illustrates a means of technical compliance with the standard. Deviation from these may be considered by Council on specific application. It is the designer's responsibility to ensure they are referencing the most-up-to-date drawing version.

Typical Water Reticulation Layout

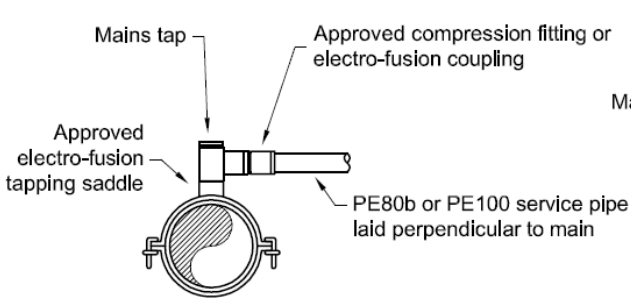
Regional Standards for Water Services Drawing

Dwg No:

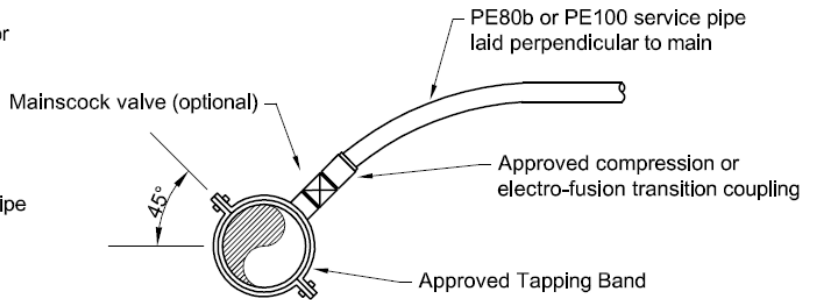
WS01

Rev Date:

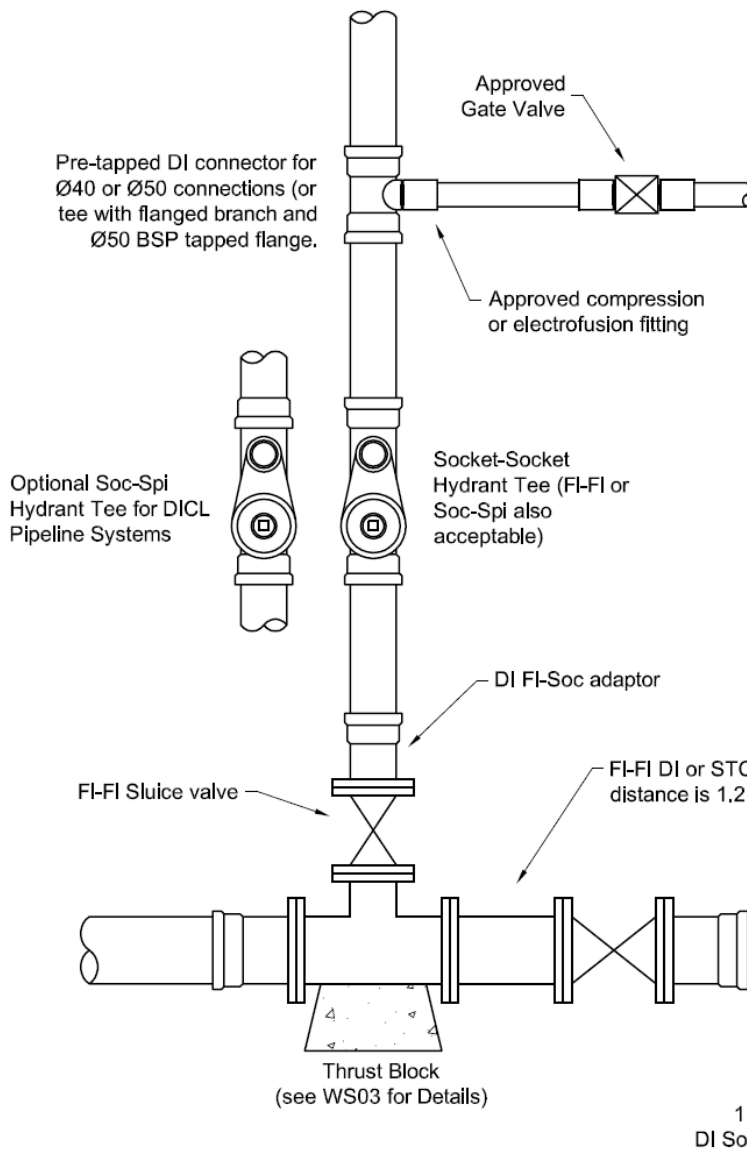
Feb 2011



Typical Tapping to PE Pipe



Typical Tapping to PVC/DICL Pipe



Notes:

- All fittings used to be listed on Council approved materials list or compliant with technical specifications
- PE80b service pipes may use push-type or screw-type compression fittings
- PE100 service pipes shall only use screw-type compression fittings where permitted, or electro-fusion fittings
- Tappings through main pipe wall to be same diameter as service connections nominal bore
- Thrust blocks are required regardless of joint type unless approved by Council

Typical PVC or DICL Pipe Connections

This drawing illustrates a means of technical compliance with the standard. Deviation from these may be considered by Council on specific application. It is the designer's responsibility to ensure they are referencing the most-up-to-date drawing version.

Typical Water Distribution Pipe Junctions and Connections

Regional Standards for Water Services Drawing

Dwg No:

WS02

Rev Date:

Feb 2011

APPENDIX 1

Minimum Bearing Area (sq.m) for 1200 kPa Test Pressure
for AS2280 DICL or Series 2 PVC at 75kPa SBP

| Pipe DN | 11.25° | 22.5° | 45° | 90° | end cap/tee |
|---------|--------|-------|------|------|-------------|
| Ø100 | | | 0.14 | 0.26 | 0.19 |
| Ø150 | | 0.15 | 0.30 | 0.56 | 0.39 |
| Ø200 | 0.13 | 0.26 | 0.52 | 0.96 | 0.68 |
| Ø250 | 0.20 | 0.40 | 0.79 | 1.45 | 1.03 |
| Ø300 | 0.29 | 0.58 | 1.14 | 2.12 | 1.50 |
| Ø375 | 0.45 | 0.89 | 1.75 | 3.23 | 2.28 |

Notes:

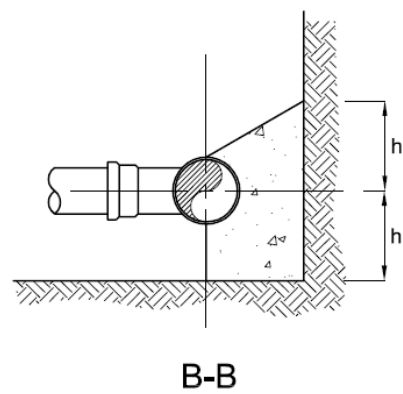
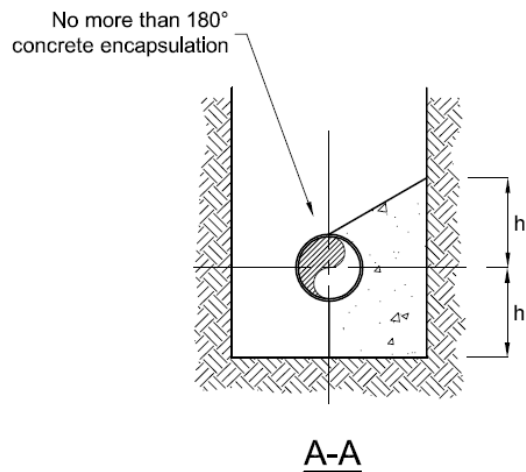
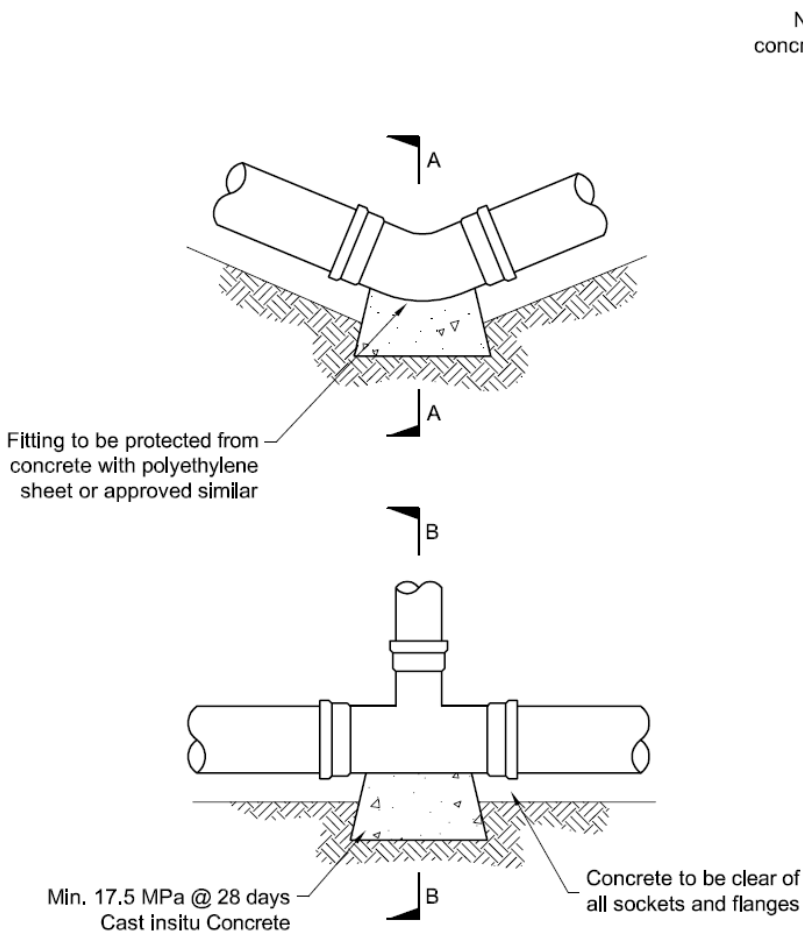
1. Thrust blocks to be poured against firm, clear and undisturbed native ground.
2. Thrust blocks for larger mains to be specifically designed by a chartered professional engineer.
3. Minimum bearing areas may be increased pro-rata for increased test pressures.

Alternatively, the following formulae can be used to calculate min. bearing areas:

$$\text{for bends} = \frac{AP^2 \sin\left(\frac{\theta}{2}\right)}{SBP} \text{ m}^2$$

Where: A = area of pipe (m²: using outside dia. of pipe)
P = test pressure of pipe (kPa)
θ = angle of bend
SBP = safe bearing area of in situ soil (kPa)

$$\text{for end caps/tees} = \frac{AP}{SBP} \text{ m}^2$$



Typical Thrust Block Details

This drawing illustrates a means of technical compliance with the standard. Deviation from these may be considered by Council on specific application. It is the designer's responsibility to ensure they are referencing the most-up-to date drawing version.

Typical Thrust Block Details

Regional Standards for Water Services Drawing

Dwg No:

WS03

Rev Date:

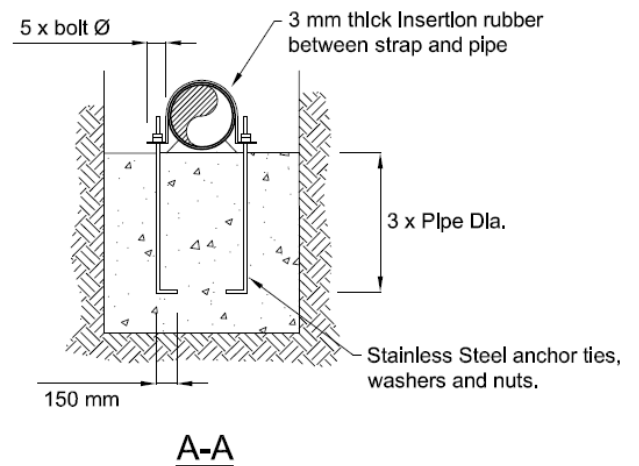
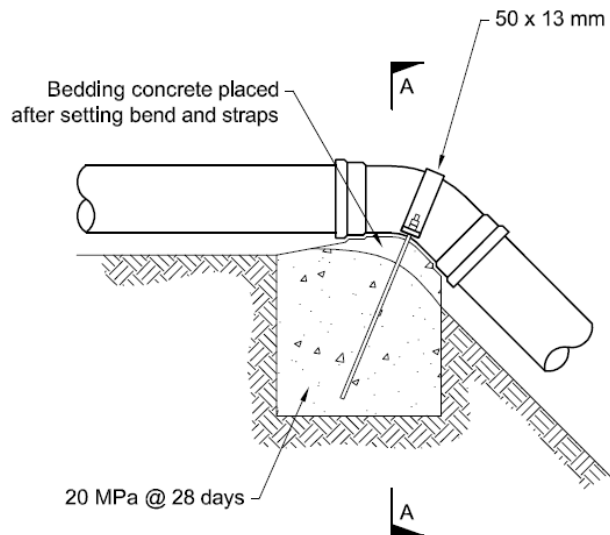
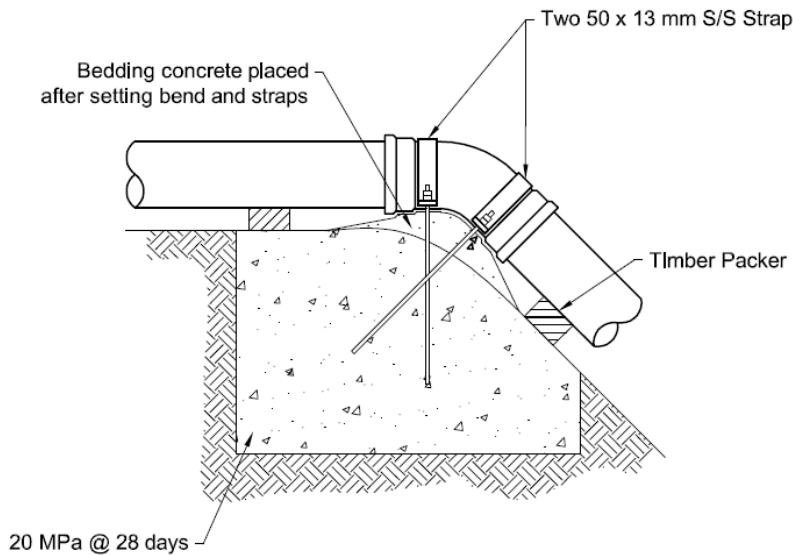
Feb 2011

APPENDIX 1

| Minimum Anchor Volume (cu.m) for 1200 kPa Test Pressure | | | | No. of Straps | Ø of Anchor Ties (mm) |
|---|--------|-------|------|---------------|-----------------------|
| Pipe DN | 11,25° | 22,5° | 45° | | |
| Ø100 | | | 0,14 | 1 | 13 |
| Ø150 | | 0,15 | 0,30 | 1 | 13 |
| Ø200 | 0,13 | 0,26 | 0,52 | 2 | 13 |
| Ø250 | 0,20 | 0,40 | 0,79 | 2 | 20 |
| Ø300 | 0,29 | 0,58 | 1,14 | 2 | 20 |
| Ø375 | 0,45 | 0,89 | 1,75 | 2 | 25 |

Notes:

1. Thrust blocks to be poured against firm, clean and undisturbed native ground.
2. Thrust blocks for larger mains to be specifically designed by a chartered professional engineer
3. All concrete to be clear of sockets
4. All dimensions in millimetres unless specified otherwise
5. Alternative methods are acceptable when designed by a chartered professional engineer and approved by Council



Typical Anchor Block Details

This drawing illustrates a means of technical compliance with the standard. Deviation from these may be considered by Council on specific application. It is the designer's responsibility to ensure they are referencing the most-up-to-date drawing version.

Typical Anchor Block Details

Regional Standards for Water Services Drawing

Dwg No:

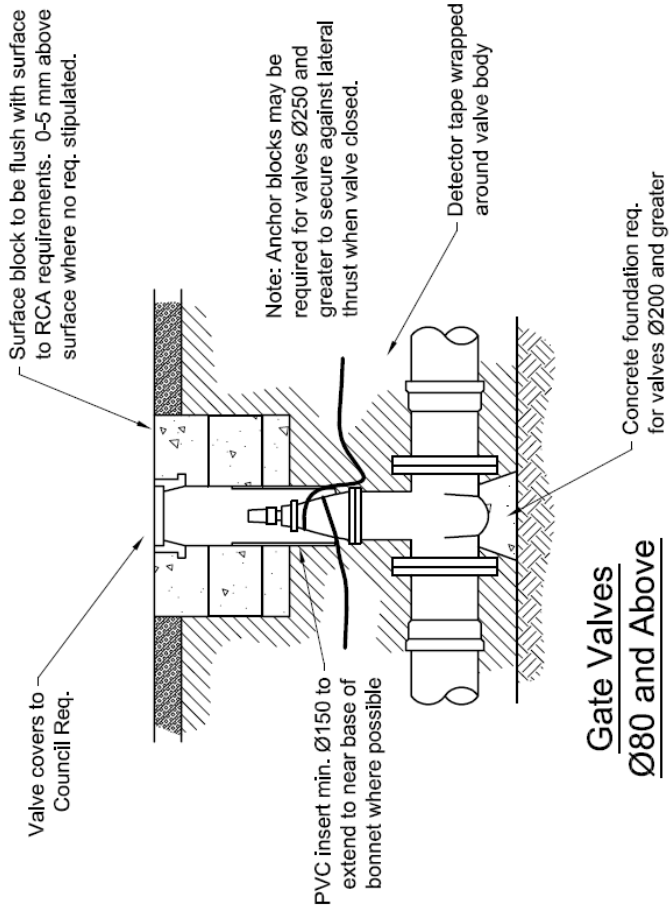
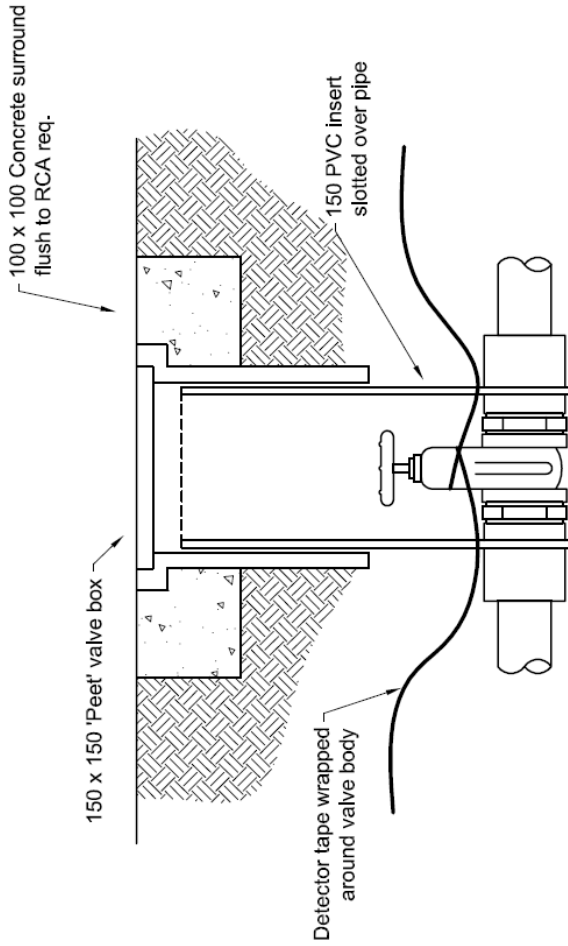
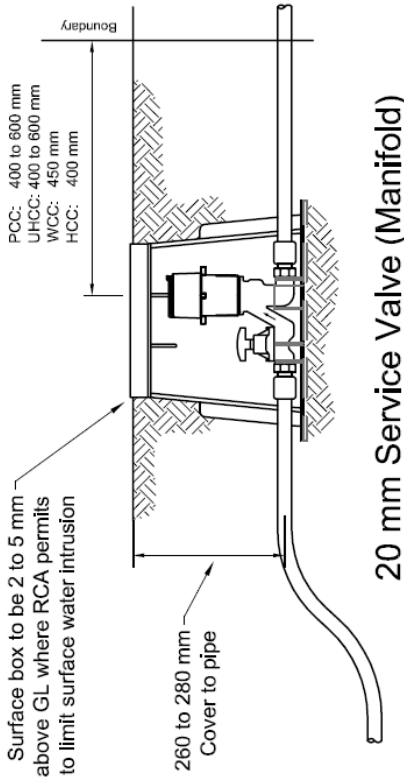
WS04

Rev Date:

Feb 2011

Notes:

1. Nominal depth of between 100 and 380 mm from ground level to top of gate valve.
2. Metallic detector/warning tape to be laid 200 to 300 mm above pipe and continue through valve enclosure whilst maintaining tape conductivity.
3. Plastic manifold bases to be used with manifold installations.
4. A minimum of 1 m PE80b service pipe is to be provided on the customer side of the manifold in new developments. The service shall be secure plugged.



This drawing illustrates a means of technical compliance with the standard. Deviation from these may be considered by Council on specific application. It is the designer's responsibility to ensure they are referencing the most-up-to-date drawing version.

Typical Valve Details

Dwg No:

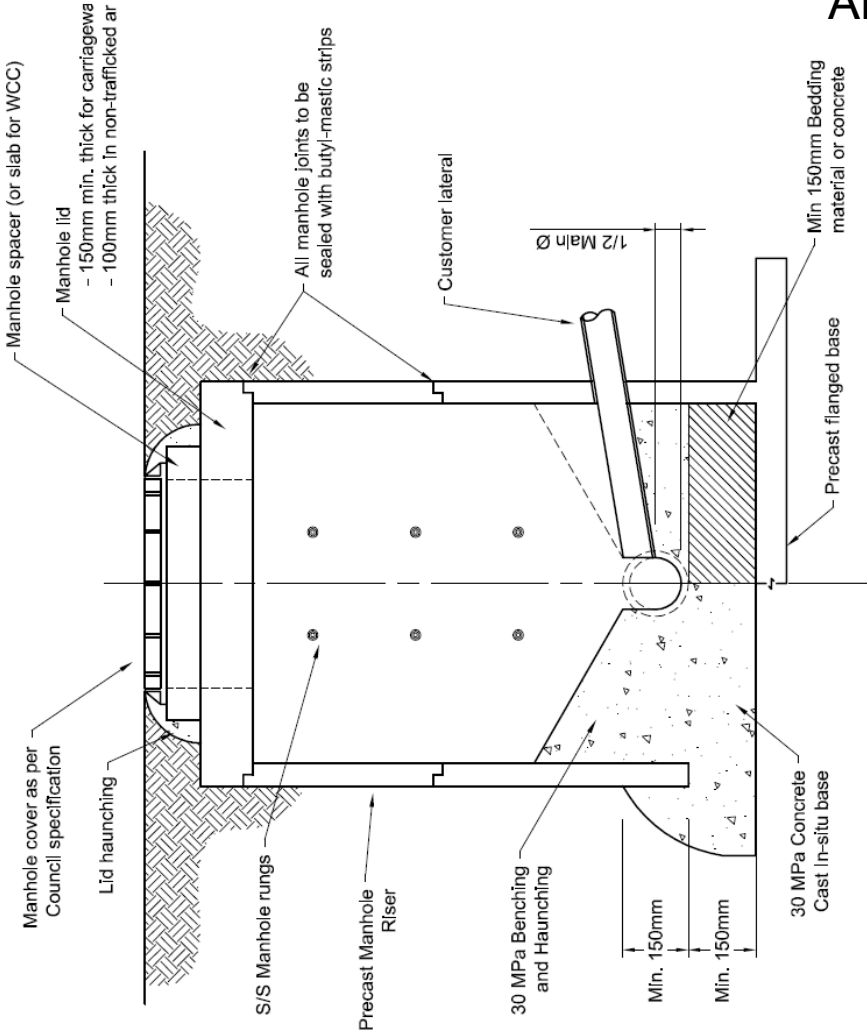
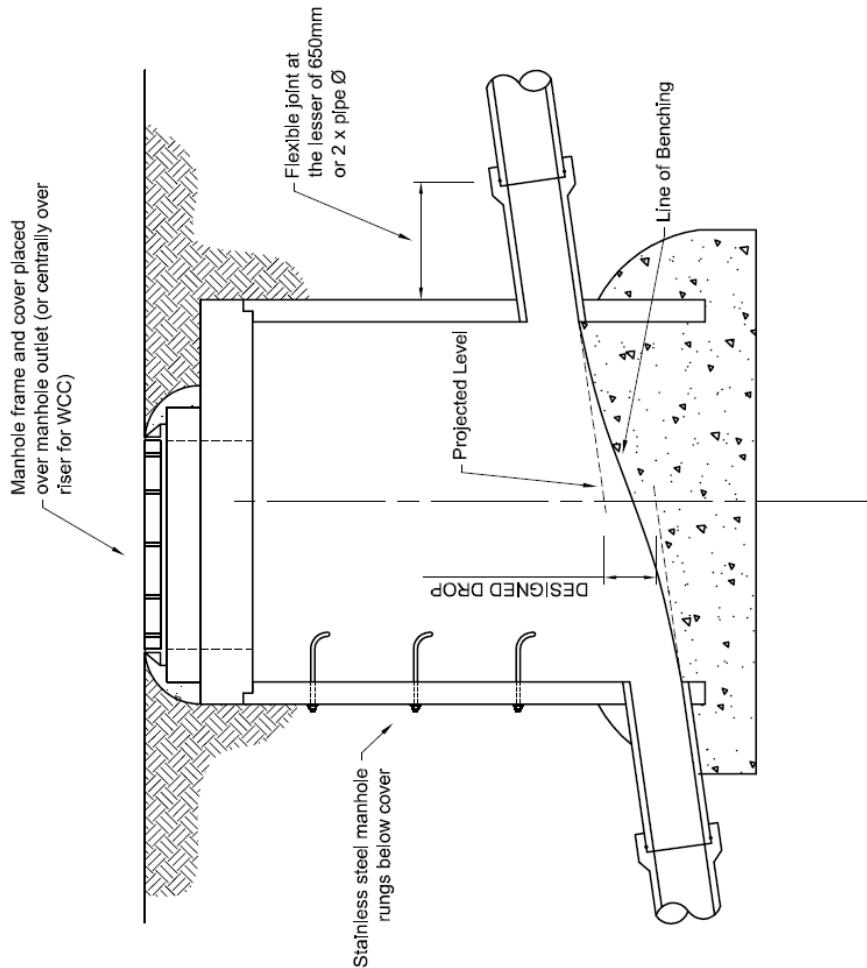
WS05

Rev Date:

Feb 2011

Notes:

1. Manholes and bases to be designed against floatation with a safety factor of 1.25 in areas of high water table or liquefaction potential.
2. Manhole benching and base to be poured to a minimum 150 mm below lowest pipe invert. This includes minimum depth between lowest pipe invert and precast flanged base.



Cross Section through Standard Manhole

Typical Manhole Benching and Haunching Details

This drawing illustrates a means of technical compliance with the standard. Deviation from these may be considered by Council on specific application. It is the designer's responsibility to ensure they are referencing the most-up-to-date drawing version.

Manhole Details

Dwg No:

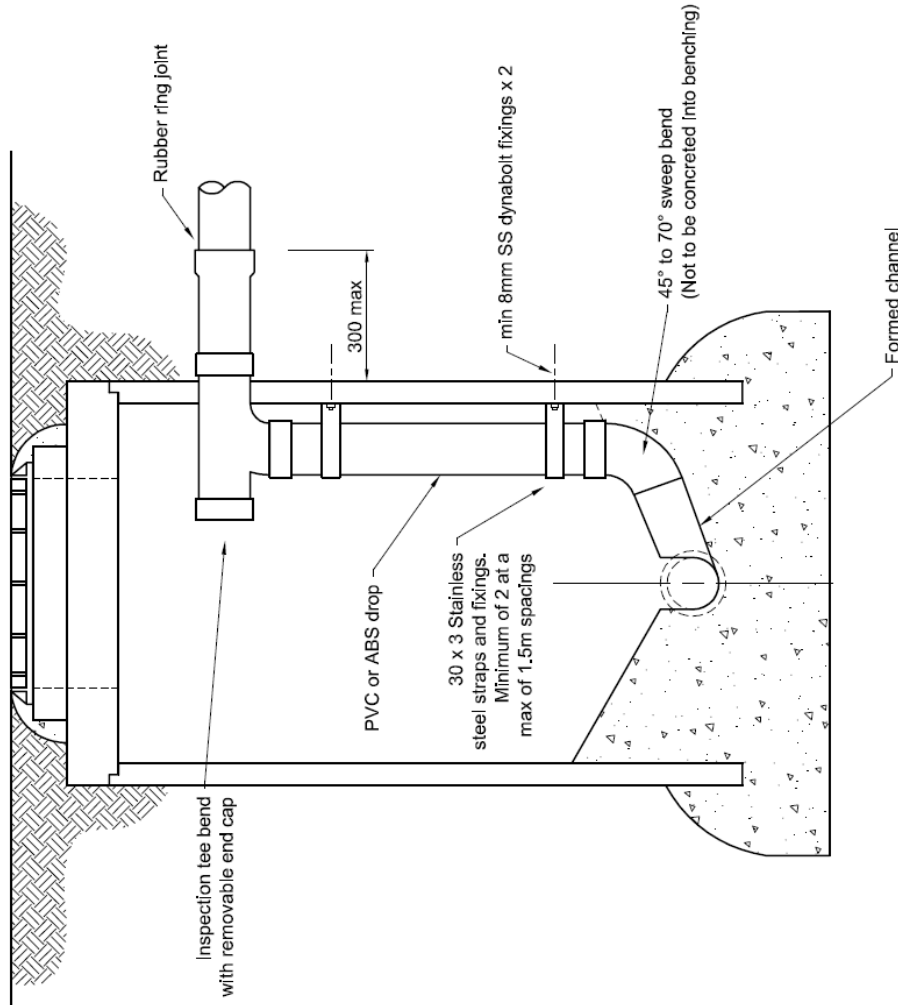
DR01

Rev Date:

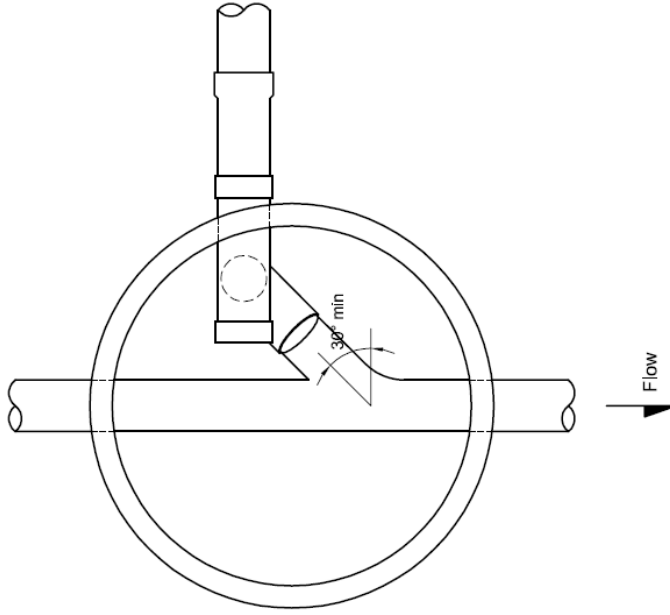
Feb 2011

Notes:

1. Minimum internal clearance between drop structure and opposite manhole wall shall be 1000 mm.
2. All metallic fixings shall be stainless steel.
3. Internal drop shall be for a maximum NB of 225mm (or 150 for UHCC)



Typical Internal Drop Details



Plan View

This drawing illustrates a means of technical compliance with the standard. Deviation from these may be considered by Council on specific application. It is the designer's responsibility to ensure they are referencing the most-up-to-date drawing version.

Internal Drop Details

Dwg No:

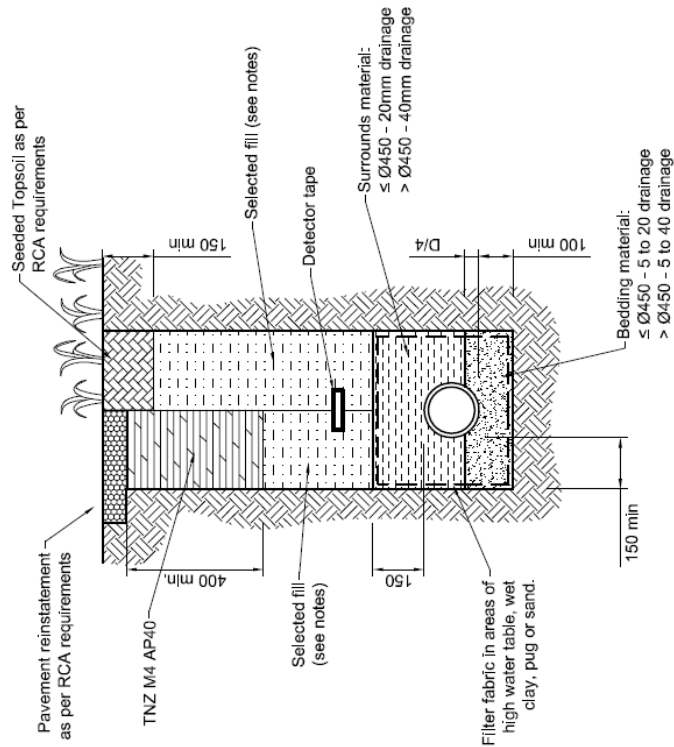
DR02

Rev Date:

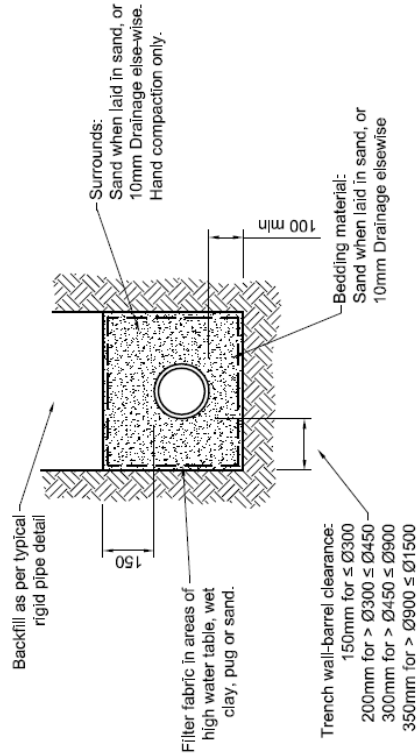
Feb 2011

Notes:

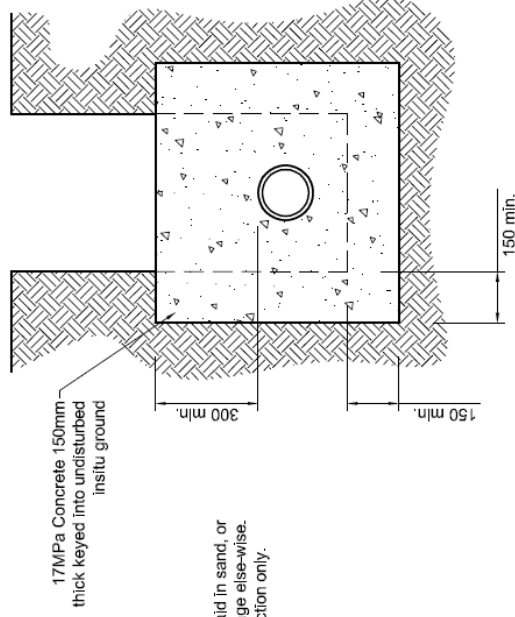
1. Selected fill for WCC is general AP40. Other Councils may allow other materials.
2. All material to be compacted in 150mm layers.
3. Rigid pipes include: Concrete Pipes, Earthenware Pipes, Corrugated Steel and Aluminium Pipes, Steel and Ductile Iron Pipes.
4. Flexible Pipes include all PVC pipes, all polyethylene pipes, Copper, Polybutylene.



Typical Rigid Pipe Trench Detail



Typical Flexible Pipe Bedding and Surrounds Detail



Typical Waterstop Detail

This drawing illustrates a means of technical compliance with the standard. Deviation from these may be considered by Council on specific application. It is the designer's responsibility to ensure they are referencing the most-up-to-date drawing version.

Typical Trench and Waterstop Details

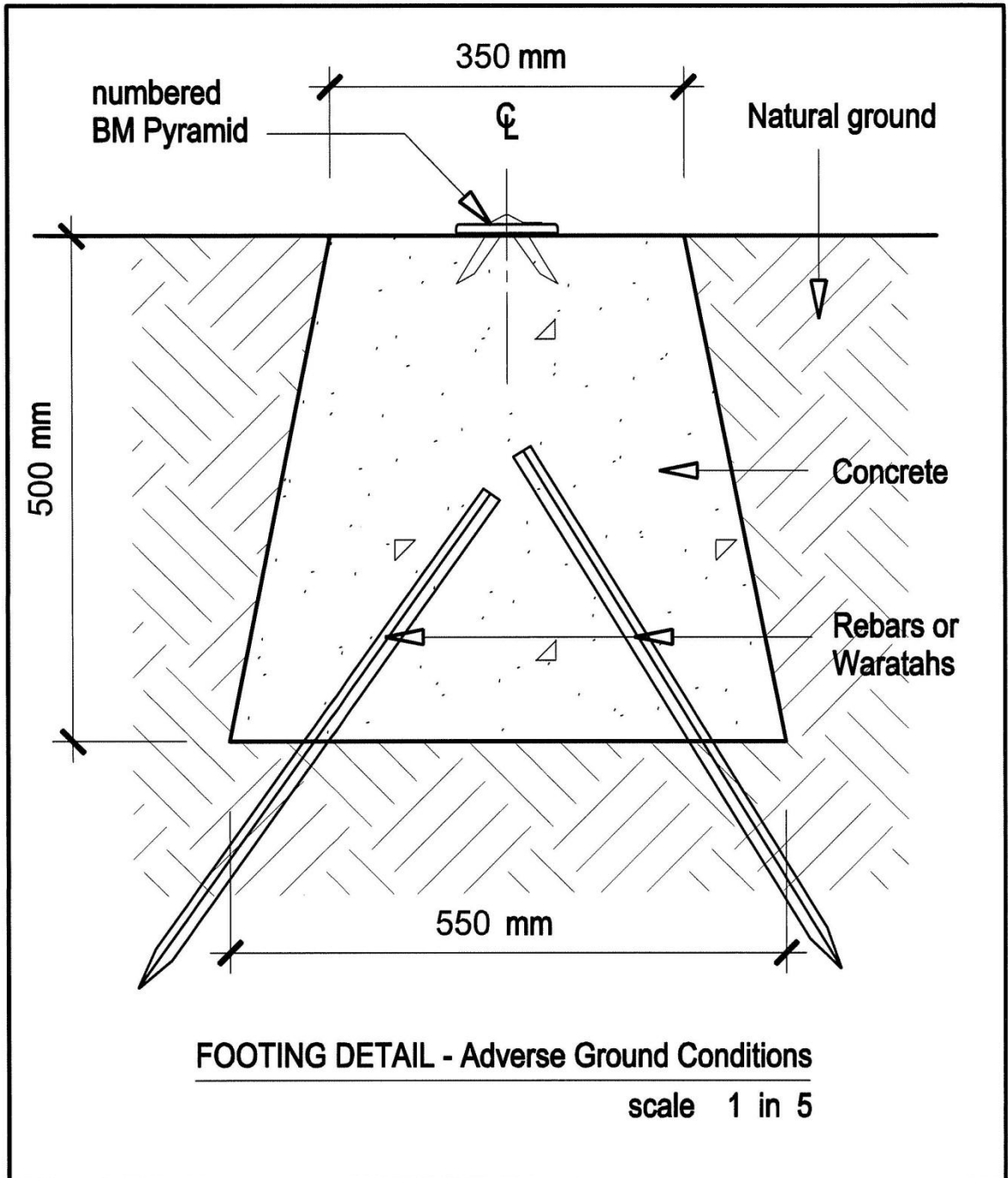
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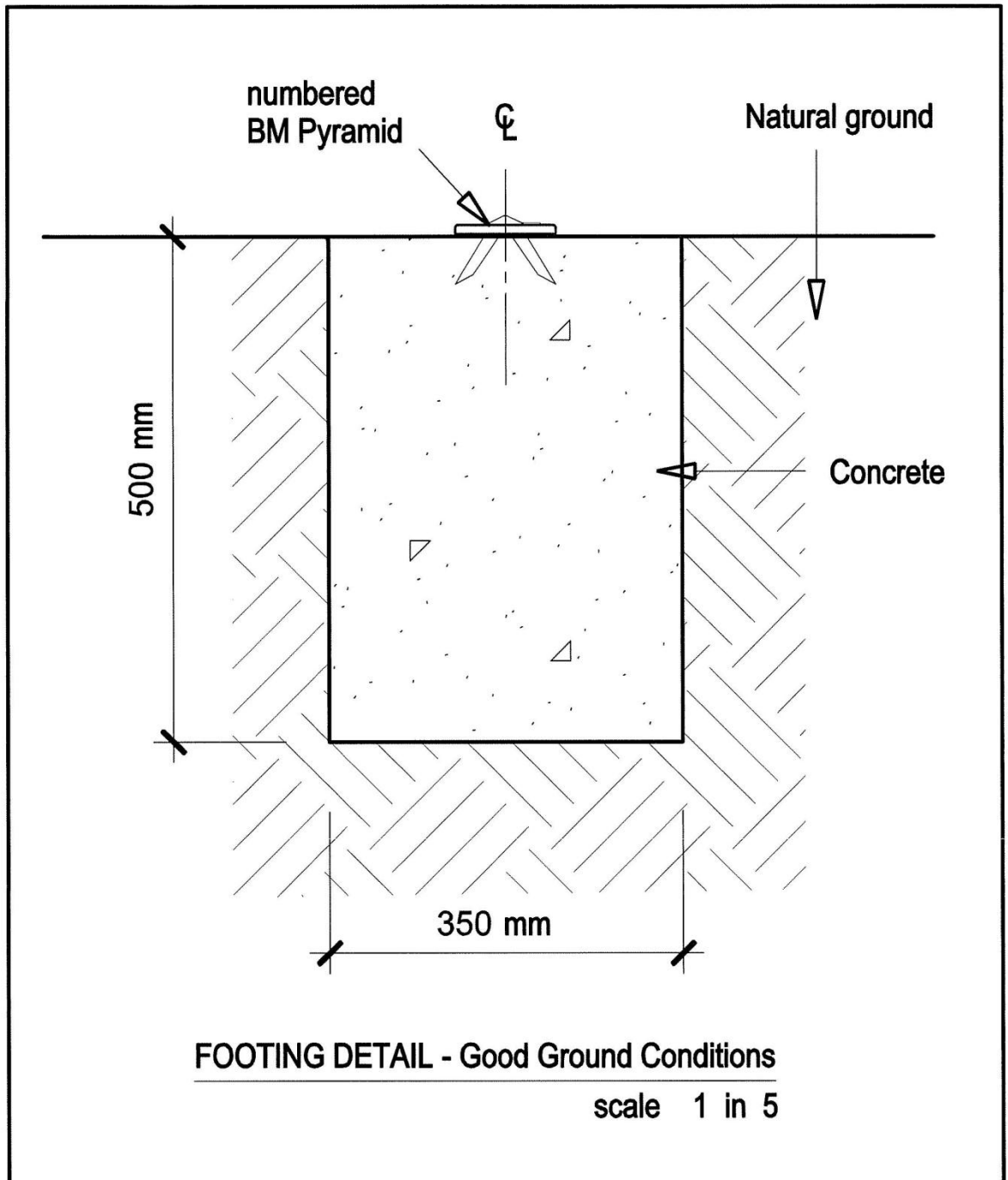
Feb 2011

Wellington City Council Benchmark Installation:
Adverse Ground Conditions



| | | |
|---|--|-------------------------------------|
| <p>Absolutely POSITIVELY <small>HE HEKE KI PĒHEHE</small> Wellington <small>WELLINGTON CITY COUNCIL</small></p> <p>General Subdivision Practise</p> <p>INSTALLATION OF NEW BENCHMARKS - ADVERSE GROUND CONDITIONS</p> | <p>PLAN No. S / A002</p> | <p>AMENDMENT July.09</p> |
| | <p>REFERENCE No. FILE No.</p> | |
| | <p>APPROVED BY: J. Boot</p> <p>DATE: 12/08 SCALE: AS SHOWN</p> | |

Wellington City Council Benchmark Installation:
Good Ground Conditions



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| <p>Absolutely POSITIVELY <small>ME HENE KI PŌNEKE</small> WELLINGTON CITY COUNCIL Wellington</p> <p>General Subdivision Practise</p> <p>INSTALLATION OF NEW BENCHMARKS - GOOD GROUND CONDITIONS</p> | <p>PLAN No. S / A001</p> | <p>AMENDMENT July.09</p> |
| | <p>REFERENCE No. FILE No.</p> | |
| | <p>APPROVED BY: J. Boot</p> <p>DATE: 12/08 SCALE: AS SHOWN</p> | |