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Foreword

This document defines the water planning principles adopted by Yarra Valley Water. They are intended for use by Yarra Valley Water planners and approved external consultants.

The purpose of these planning principles is to:
- document the knowledge of water planning engineers;
- accelerate the learning of inexperienced water planning engineers;
- make the decision making processes transparent;
- encourage scrutiny of Yarra Valley Water standards to promote innovation and change;
- ensure consistency and equity of decision making; and
- Provide clear guidelines to improve the responsiveness of planning engineers.

It is intended that this document will be regularly reviewed and a complete review undertaken no longer than 5 years from the release of this version. Other considerations or related reviews may result in a complete review of this document and a reduced major review period, these will be considered as they arise.

Document Review

It is intended that this document will be subject to a complete review at no longer than 5 years from the release of this version. A minor review will be undertaken annually by the Water Growth Planning team, at which time, any accepted proposed changes will be incorporated (see below).

Other considerations or related reviews may result in a complete review of this document and a reduced major review period, these will be considered as they arise.

Proposals or nominated changes to the document are welcome at any time. A change register for the Water Planning and Design Principles is located on the Asset Standards Document Library, and can be viewed at any time:

Asset Standards Document Library

The process for registering changes within this document is as follows:

1. Email nominated change to Manager Water Growth Planning, Sustainable Development
2. The Manager of Water Growth Planning will review the proposal and if accepted will add the details to the register
3. All accepted proposals will be incorporated into the next major document review
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1 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to define the principles and philosophies that YVW apply to the planning, building and operation of drinking and non-drinking water supply infrastructure.

1.2 SCOPE

This document provides a reference for the preparation of strategies and servicing plans, conceptual, functional, and detailed designs. Consultants and external parties MUST use it as a reference document for the design and construction of YVW water supply assets. Unless otherwise stated, this document is applicable to both drinking and non-drinking water assets.

This document MUST be read in conjunction with the Water Services Association of Australia WSA03-2011 Water Supply Code of Australia (Melbourne Retail Water Agencies Version 2.0 (MRWA)), hereafter referred to as the “MRWA”, and YVW’s Standard Specifications. Where sections of the MRWA specify that advice or guidance should be sought by the relevant Water Agency; this document seeks to provide such guidance.

This document seeks to ensure satisfaction of customer service levels and sound asset management practices by defining the principles and philosophies not covered in the above standards.

This document has been prepared by collating the data and design criteria used for planning purposes by the Sustainable Planning, Infrastructure Planning, and Network Operations Divisions. Different criteria and/or exceptions may apply to special one-off situations and will require the approval of the relevant Manager(s).

Unless otherwise specified, this document relates to the supply of drinking and non-drinking water.

Symbols used in this document are in accordance with those set out in MRWA drawing MRWA-W-100, Water Supply Symbol Library.

1.3 REFERENCED DOCUMENTS

Referenced Documents:

a) WSA03-2011-3.1 Water Supply Code of Australia (Melbourne Retail Water Agencies (MRWA) Version 2.0)

b) YVW Service Reservoir – Water Tank Technical Standards, Version 2.0

c) YVW Water Pumping Station Technical Standards, Version 1.0a

d) YVW Pressure Reducing Station Technical Standards (draft Version 1.0)

e) Yarra Valley Water Bulk Water Supply Agreement (BWSA)

f) Guidelines for environmental management: Dual pipe water recycling schemes – health and environmental risk management, EPA Victoria, publication 1015

1.4 ORDER OF PRECEDENCE

In the event of differences or discrepancies between this document and referenced documents, the order of precedence is as follows:

1. **This Document - WATER PLANNING AND DESIGN PRINCIPLES**

2. **Yarra Valley Water Technical Standards as per Section 1.3 of this document**

3. **WSAA Guidelines**

4. **Melbourne Water Standards**

5. **Australian Standards**

6. **Referenced Manufacturers Guidelines**
1.5 DEFINITIONS

95%ile Peak Summer Day (95%ile PSD) This design scenario represents a typical hot summer day (i.e. >32 degrees which occurs 15 to 20 times a year). It is applied in contingency scenarios to determine criticality and redundancy measures.

Altitude Valve Hydraulically actuated valve that provides automatic opening and closing; most commonly for filling of elevated tanks or reservoirs.

Alternate Supply A secondary source to a supply zone, capable of supplying 10m pressure to the worst affected customer during the Peak hour of a 95%ile PSD day.

Altitude Control When a drop in level/pressure is sensed below a predetermined set point, the valve opens fully (to atmosphere) and when the level/pressure again reaches the set point, the valve will close.

Average Day Demand The average annual daily demand or the Average Day Demand represents the demand likely to occur 50% of the time throughout a given year.

Balancing Storage Tank This is a storage reservoir located at a Non-drinking water (NDW) treatment plant. Treated water is transferred to the Balancing Storage Tank from the NDW treatment plant for distribution to the supply zone.

Bypass Valve A valve that controls flow through the pipework around a divide valve (see Divide Valve).

Cathodic Protection Is the partial or complete protection of a metal from corrosion by making it a cathode and using either a galvanic or an impressed current. It is usually applied to mitigate external corrosion of electrically continuous welded steel buried pipelines and internal and under base corrosion of welded steel service reservoirs.

Continuity of Supply Relates to the provision of water supply pressure and flows at specified values as defined in the Bulk Water Supply Agreement with Melbourne Water and the service levels defined in YVW’s Customer Charter.

Customer Charter The Customer Charter provides information about YVW service commitments and outlines the customer’s rights and responsibilities.

Developer A person, organisation, local government authority or government authority (other than the Water Agency) responsible for provision of a water supply scheme or water reticulation system.

Distribution Main A water main serving as the principal distributor within a supply area, normally without direct consumer connections, that delivers the peak instantaneous demand.

Divide Valve A stop valve in line with a pipe that divides the length of the pipeline into smaller sections (See Stop valve).

Drinking Water Potable water, water that is fit for human consumption.
**HACCP**
Hazard Analysis and Critical Control Points. The HACCP process is a systematic method that identifies specific hazards and measures for their control to ensure public health and quality of products. HACCP assesses hazards and establishes control systems that focus on prevention rather than relying on end product testing.

**HEMP**
Health and Environmental Management Plan. A plan covering the use of Class A non-drinking water (see definition) that details the management of health and environmental risks.

**Infrastructure Planning Division**
The Infrastructure Planning division of YVW is responsible for developing strategies to maximise the life of YVW’s existing civil asset base whilst minimising interruptions to customer supplies. In addition, they are responsible for ensuring the supply of clean and safe drinking water and creating and updating hydraulic models for use by planners and operators.

**Mandated Area**
Under Clause 56 of the Victorian Planning Provisions, Water Companies can mandate the installation of dual pipe, water-recycling schemes, for new residential developments. This occurs as part of an integrated water management plan via the residential subdivision process.

**MRWA**
Refers to the national code for water supply infrastructure which is specific to the Melbourne Retail Water Agencies, namely Yarra Valley Water, South East Water and City West Water.

WSA03-2011 Water Supply Code of Australia (Melbourne Retail Water Agencies Version 2.0)

**Must**
Indicates that a statement is mandatory

**Network Operations Division**
Network Operations is accountable for optimising the operation of the water and sewerage networks to meet defined levels of customer service and environmental performance. The Division is also responsible providing technical services to customers relating to system operations.

**Non-Drinking water (NDW)**
Any water other than drinking water including wastewater, stormwater, bore water, ground water, lake or river water, which has been treated to meet a Standard (as defined by the Regulator), and which is satisfactory for its intended use(s).

**Offtake valve**
The first valve at the connection point of a smaller diameter water main and a larger diameter water main.

**Peak Summer Day (PSD) also known as Dry Summer Day (DSD)**
YVW adopts a design “peak summer day” which represents a peak day demand event. YVW commits to maintaining service levels up to and including this event. This design principle is common across the Melbourne Metropolitan Water Companies.

**Peak Week**
YVW adopts a design “Peak week” demand Scenario in the sizing of Non-Drinking Water Balancing Storage Tanks. A Peak Week represents the largest weekly demand event.
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<td>Permanent Water Saving Rules</td>
<td>Permanent Water Saving Rules are a set of common sense rules aimed at ensuring efficiency in water use, whilst providing flexibility as to when and how watering is undertaken. These rules are in place at all times.</td>
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<td>PLC – Programmable Logic Controller</td>
<td>A programmable logic controller (PLC) is a digital computer used for automation of electromechanical processes. PLCs are armored for severe conditions (such as dust, moisture, heat, cold) and have the facility for extensive input/output (I/O) arrangements.</td>
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<td>Potable Water</td>
<td>Water that is fit for human consumption, see Drinking Water</td>
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<td>Pressure Reduced Zone (PR Zone)</td>
<td>An area of supply where the pressure is actively controlled by via pressure reducing valves, historically referred to as a PMA (Pressure Management Area)</td>
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<td>Pressure Reducing Valve (PRV)</td>
<td>A valve fitted with a dynamic control system to regulate the downstream pressure.</td>
</tr>
<tr>
<td>Pressure Limiting Valve (PLV)</td>
<td>A domestic sized valve to dynamically control the downstream pressure.</td>
</tr>
<tr>
<td>Pressure Sustaining Valve (PSV)</td>
<td>Valve fitted with a dynamic control system to regulate the upstream pressure.</td>
</tr>
<tr>
<td>Private Main</td>
<td>See Trunk Main</td>
</tr>
<tr>
<td>Recycled Water</td>
<td>Water that has been reclaimed from wastewater, and treated to a standard for reuse. The treatment standard is defined by the Regulator. See Non-Drinking Water</td>
</tr>
<tr>
<td>Regulator</td>
<td>Entity that has the power to enforce Regulations related to the activities and responsibilities of a Commonwealth, state, territory or local government. It applies to environmental management and protection, occupational health and safety and the like</td>
</tr>
<tr>
<td>Reliability of Supply</td>
<td>Relates to the management of assets and consideration of interruptions to the provision of drinking and non-drinking water supply services due to unplanned events (i.e. burst water mains). Includes consideration of the number of affected customers, shut off block sizing, single source of supply, and inherent system redundancy.</td>
</tr>
<tr>
<td>SCADA</td>
<td>Supervisory control and data acquisition (SCADA). An IT system for acquisition and monitoring of operational data and control of equipment.</td>
</tr>
<tr>
<td>Security of Supply</td>
<td>Relates to the declaration of water restrictions due to bulk water shortage, as allowed for under the Melbourne Metropolitan Drought Response Protocol. Under the Bulk Water Supply Agreement, Melbourne Water is responsible for providing a level of security of supply of 95% (i.e. water restrictions would be expected to be imposed every 20 years at not more than level 3 and for no longer than 12 months).</td>
</tr>
<tr>
<td>Shutoff Block</td>
<td>Is the area impacted by the closing of valves in the water reticulation network for operational work. Also known as a shutoff area in MRWA.</td>
</tr>
<tr>
<td>Sustainable Growth Planning Division</td>
<td>The Sustainable Growth Planning Division of YVW is responsible for the development of sustainable servicing strategies to service new developments within YVW’s business area</td>
</tr>
<tr>
<td>Should</td>
<td>Indicates a recommendation</td>
</tr>
<tr>
<td>Service Reservoir</td>
<td>A tank used for storing water.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Tapping</td>
<td>A property connection to a water main</td>
</tr>
<tr>
<td>Telemetry</td>
<td>The transmission of data from a remote unattended facility to an attended receiving station.</td>
</tr>
<tr>
<td>Transfer Main</td>
<td>The term historically used within some water Agencies for a water main designed for bulk transfer that does not deliver the peak instantaneous demand e.g. supply to a reservoir. The term is applied to a main, that is not available for connection, other than in exceptional circumstances.</td>
</tr>
<tr>
<td>Trunk Main</td>
<td>Also known as a Private Main, a trunk main is a temporary water supply connected to either a Yarra Valley Water reticulated water system or a Melbourne Water aqueduct. Trunk services are generally only permitted for domestic usage on properties currently not supplied by a water main.</td>
</tr>
<tr>
<td>Variable Speed Drive (VSD)</td>
<td>Describes equipment used to control the speed of machinery. If the output speed can be changed without steps over a range, the drive is usually referred to as “variable speed”</td>
</tr>
<tr>
<td>Water Growth Planning Team</td>
<td>The YVW Water Growth Planning team manages the investigation and planning of the water supply network to cater for servicing growth, responses to developer enquiries and requests for servicing advice.</td>
</tr>
<tr>
<td>WSAA</td>
<td>Water Services Association of Australia (WSAA) is the peak body of the Australian urban water industry and has offices in Melbourne and Sydney. Its members provide water and wastewater services to approximately 16 million Australians and many of Australia’s largest industrial and commercial enterprises. Founded in 1995, WSAA provides a forum for debate on issues of importance to the urban water industry, and provides a focus for communicating the industry’s views. WSAA develops and is responsible for national design and construction codes that are adopted across industry. The relevant national code for water supply infrastructure is WSA03-2011 Water Supply Code of Australia (Melbourne Retail Water Agencies Latest Version 2.0).</td>
</tr>
</tbody>
</table>
1.6 AUSTRALIAN STANDARDS

The following Australian Standards may be of use:

- AS 2118.1-2006 Automatic Fire Sprinkler Systems – General Systems
- AS 2419.1 Fire Hydrant Installations
- AS 3500.1:2003 Plumbing and Drainage – Water Services
- AS6400:2005 Water efficient products - Rating and labelling
2 BULK WATER SUPPLY AGREEMENT (BWSA)

The Yarra Valley Water Bulk Water Supply Agreement (BWSA), between YVW and Melbourne Water, stipulates the minimum service levels in terms of hydraulic grade, quantity of water, and quality of water that Melbourne Water must provide to Yarra Valley Water at interface points as defined in the document. Melbourne Water’s supply to YVW is guaranteed up to a 3100 ML total metropolitan demand day (note that the largest volume recorded since 1995 was 3085 ML on 21 January 1997). This obligation is generally referred to as the guarantee of ‘continuity of supply’.

Melbourne Water, as the Wholesaler, is required to harvest, treat and transfer water to deliver water subject to BWSA obligations.

The Bulk Entitlement Management Committee (BEMC) entitlement holders and the storage operator will aim to provide a ‘security of supply’ for Melbourne defined by the following criteria:

- 5% chance of entering restrictions in any one year, 1 in 20 year drought event
- Restrictions not to be more severe than Stage 3 (i.e. minimal economic impacts)
- Restrictions not to be required for more than 12 consecutive months

Melbourne Water is also, and separately, responsible for catchment management and management of environmental flows in some catchments.
3 YVW CUSTOMER CHARTER OBLIGATIONS

3.1 YVW CUSTOMER CHARTERS

All new water supply systems must comply with commitments made in YVW's customer charters. The following charters outline our service commitments and standards:

- Residential Customer Charter
- Business Customer Charter
- Summary Charter for Customers in Recycled Water Areas

3.2 MINIMUM FLOW RATES

The customer charter defines YVW commitments for the minimum flow rate for given sized meters up to 50mm diameter.

In order to maintain the flow rates stipulated in the Customer Charter, and in accordance with MRWA Section 2.5.3.3, YVW adopt a desirable minimum residual pressure of 20 metres to be maintained to the worst affected residential supply point(s) within the network during the peak hour on a Peak Summer Demand Day. For commercial / industrial areas this minimum residual pressure is 25 metres.

3.3 CUSTOMER METERING

3.3.1 Meter sizing

Meters are sized using a probable maximum flow rate as determined under the Plumbing Code AS3500. YVW will not supply water above the rated nominal (maximum continuous) flow rate of the meter installed on the customer's property. If the customer requires a greater flow rate, then a main to meter and meter upsizing shall be required.

Meter sizing should account for the hydraulic losses through the meter assembly and backflow prevention device, if required.

3.3.2 Meter ownership & obligations

Main to meter pipework, including connections, stop taps, and risers, less than or equal to 50mm diameter, are owned by the property owner. However, under the Water Act, YVW is obliged to maintain these assets in perpetuity. YVW owns the meter and repairs leaks on the main to meter free of charge.
3.4 **FIRE FIGHTING CAPACITY**

3.4.1 **General**
YVW is not required to provide a specific level of fire-fighting capacity within the network. The Water Industry Act (1994) does not require a licensee to make sure that water pressure is adequate for fire-fighting in Clause 81, Part 5 sub-section 4 (a). There are however some cases where additional storage or pumping capacity has been included into the network in bushfire areas such as the Dandenong Ridge scheme.

3.4.2 **Pressure and Flow Information (PFI)**
The following applies to YVW provide detailed PFI advice to a property owner as to the network hydraulic capacity o for the purposes of the installation of private fire services:

1. Advice is based on the Peak Summer Day and 95%ile PSD hydraulic modelling demand scenarios.

2. A hydrant curve (or equivalent data points) is quoted for the peak hour on the peak summer day at the node supplying the fire service up to a maximum flow rate dependent on the size of the main or the flow at which the minimum residual pressure in the zone is 10m.

3. The maximum flows, shown in Table 1 below, are specified to limit velocity in a single direction to less than 3.5m/s and protect against scouring in cement lined pipes:

<table>
<thead>
<tr>
<th>Nominal Main Size (DN mm)</th>
<th>Maximum Flow Rate (L/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 single direction feed</td>
<td>25</td>
</tr>
<tr>
<td>100 dual direction feed</td>
<td>40</td>
</tr>
<tr>
<td>150</td>
<td>60</td>
</tr>
<tr>
<td>225 and larger</td>
<td>75</td>
</tr>
</tbody>
</table>

4. A hydrant curve is provided to the fire service consultant to give them an understanding of the flow capacity of the main in peak demand conditions.

5. The “minimum pressure that can be supplied 95% of the time” as per AS2419.1 is stated by YVW as the pressure at the node supplying the service at peak hour on the 95%ile day. This value is conservative as the pressure that is actually maintained “95% of the time” will be greater than the quoted value.

6. Where no hydraulic model exists PFI advice is based on calculations made using the PFI calculation sheet and relevant SCADA data. Water Operations should be consulted. Minimum Grades are taken from known recording points and hydraulic calculations are made assuming a single source feed to produce a hydrant curve. Refer YFRM 0550
7. Under AS2419.1, fire service consultants can also take 67% of the maximum static pressure for the design of the fire service which is often more conservative than the peak hour 95%ile day value quoted by YVW.

8. PFI advice states that pressures and flows may vary due to demands and operational changes. These changes can be significant in growth areas.

9. Only where YVW makes operational changes to the supply arrangements (i.e. zone boundary changes and Pressure Management Areas), are fire service owners notified of the potential impact on their fire services.

10. Fire services the same size as the main are allowable
4 CONNECTION ENQUIRIES

4.1 ASSESSMENT CRITERIA

The following criteria applies to proposed connections to YVW’s water supply network, and, results in an automatic referral to Water Growth Planning under the BEA (Beyond Easy Access) system:

Residential
- Any single property development requesting a ≥ 40mm meter
- All multi-property developments of greater than 19 lots
- In line booster pump (ILBP) applications
- Connection to a potential dead-end main
- Development of between 10 to 20 lots inclusive proposing to connect to:
  - A shut-off block count of greater than 25 lots on a main sized < 225mm
  - A shut-off block count of greater than 100 lots on a main sized ≥ 225mm

Non-residential
- All developments requesting a ≥40mm meter,
- 80mm – 150mm Fire Hydrant and Hose Reel Services

Assessment of these applications should identify:
- If there is sufficient capacity in the network to supply the proposed development demand.
- Hydraulic deficiencies created to the existing network resulting from the additional demand;
- Compliance with existing YVW business rules.
- Whether nominated pumps will provide required pressures and flows given the existing network capacity (ILBP applications); and,
- Required upgrades to accommodate this increased demand.

Assessment of applications is typically undertaken using hydraulic modelling and in accordance with YVW Business Rule YWIN 0125 - Water Supply Enquiries,¹ and applies specific hydraulic criteria to assess YVW’s water supply network given the additional demand. Section 9, Pipelines, of this document details the applicable hydraulic criteria.

YVW adopt a “first in- first served” approach to providing access to available capacity within the existing network.

Once the capacity of the existing assets are exceeded, developers are liable for any upsizing costs for “basic sized assets” - defined as being any mains 150mm in diameter or less.

¹ YWIN0125 Water Supply Enquiries
4.2 CONNECTIONS

4.2.1 Typical Sizes

When submitting a request for connection to YVW supply network, a developer is required to nominate a connection size with regard to nature of their proposed development, up to and including 40mm, beyond which a nominal flow rate is required for assessment. The nominal connection size is that which is required to meet the Customer Charter flow rates, as per the examples below:

Table 2 - Typical Connection Sizes

<table>
<thead>
<tr>
<th>Property Type</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single House/Factoryette</td>
<td>20mm min</td>
</tr>
<tr>
<td>Dual Occupancy / Factoryette / Separate Driveway</td>
<td>2 x 20mm</td>
</tr>
<tr>
<td>Dual Occupancy / Factoryette / Shared Driveway</td>
<td>25mm min</td>
</tr>
<tr>
<td>Dual Occupancy / Factoryette / Different Mains</td>
<td>2 x 20mm</td>
</tr>
<tr>
<td>3 Multi Units / Factoryettes</td>
<td>25mm min</td>
</tr>
<tr>
<td>3 Multi Units / Factoryettes / Different Mains</td>
<td>3 x 20mm</td>
</tr>
<tr>
<td>4-5 Multi Units / Factoryettes</td>
<td>32mm min</td>
</tr>
<tr>
<td>6-9 Multi Units / Factoryettes</td>
<td>40mm min²</td>
</tr>
<tr>
<td>&gt;10 Multi Units / Factoryettes</td>
<td>Developer Notifies Size</td>
</tr>
</tbody>
</table>

4.2.2 Multi-dwelling Residential Development

The following applies to the provision of infrastructure to multi-dwelling residential low-rise owners corporation developments with twenty (20) or more dwellings, whereby the developer is required to adopt one (1) of the following options for water supply, either:

- Install common water supply and sewerage infrastructure to AS/NZS 3500 Acceptable Solutions, or AS/NZS 3500 Performance Requirements, with the owners corporation owning, operating and maintaining the works; or
- Install common water supply and sewerage infrastructure to WSAA MRWA standards with YVW owning, operating and maintaining the assets.

YVW approval for the above rules was finalised in July 2012, and was developed by assessing previous policies and the risks they created for YVW³.

² 40mm size is based on an inferential type water meter with a nominal flow rate of 2.08L/s
³ Approved by Managers of Sustainable Development & Infrastructure Planning and Managing Director, July 2012

Green - G267 Owners Corp Developments Rule Modification.pdf
4.3 INTERCONNECTED WATER SUPPLY FOR NEW DEVELOPMENTS (MRWA 8.2.4)

In accordance with MRWA Table 8.2, YVW specifies a maximum of 25 property service connections in a shut off area on mains sized ≤ DN150, thereby limiting the maximum number of customers (proximate to the failure) without water at any one time to 25.

MRWA Section 8.2.4 also states:
“Where a new development increases the maximum number of connections between existing valves beyond the nominated maximum, additional valves shall be provided to maintain the number of connections within specified limits”

This has led to a number of developments creating shut off blocks of 25 lots, however shut off blocks are successive with single or multiple dead ends, accumulating more than one shut off block if the main is isolated i.e. more than 25 customers without water whilst the main is isolated.

YVW’s requirements are:

Successive shut off blocks can create a single source of supply area. The developer **MUST** provide either:
- A valving arrangement to provide supply; or,
- An alternate supply to the development, Refer Section 8.3

---

*Approved by General Manager of Sustainable Development and General Manager of Infrastructure Services (August 2011)*

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*Example 1: Candlebark Close & Tetragona Way, Diamond Creek – 45 properties*
YVW’s preference for the servicing and connection requirements of a large body corporate development, 25 dwellings or greater, is as per Case 2 of the YVW Business Rule “Developer Shutoff Blocks”.  

4.3.1 Dual Connections

The MRWA does not specifically address what non-residential development types require a dual supply connection; MRWA Section 8.2.8 does however illustrate the different dual supply connection arrangements and states they may be required for a “customer requiring a greater security of supply such as hospitals and large industrial or commercial developments.”

On this basis YVW have developed a list of high-risk development types, namely high-risk groups (i.e. children, sick or elderly people), or those where a significant number of customers or significant businesses are likely to be impacted by a water supply failure.
As a minimum, the following high-risk development types **MUST** provide a dual supply connection:

- Hospitals* and medical clinics
- Aged care facilities / Nursing homes
- Schools
- Childcare facilities
- Shopping Complexes
- Supermarkets (Initial recommendation)

*Large hospitals may require two independent supplies and larger shut-off impacts should be assessed on a case-by-case basis

### 4.3.2 Private mains (trunk services) and “Supply by Agreement” Customers

Where properties are not serviced by a reticulation water main, permission may be granted for the installation of a temporary water supply connected to either Yarra Valley Water reticulation or a Melbourne Water transfer asset or aqueduct. Private mains are not a permanent method of supply, although in some instances the private main may be in place for many years.

In some cases, private mains are connected to untreated supplies such as aqueducts or conduits and the water supply is not suitable for drinking or food preparation.

Further information on Private Mains can be found [here](http://thesource.yvw.com.au/sites/fido/RatesCharges/Pages/Trunk-Services.aspx)

### 4.4 PRIVATE FIRE SERVICES

Dual supply requirements for fire services and sizing of fire services are the applicant’s responsibility.

Any fire-fighting equipment (or assets) that can be operated by a non-MFB or non-CFA personnel **MUST NOT** be connected to recycled water.

This requirement addresses indoor or internal fire-fighting equipment such as sprinklers and hydrants, and assets that can be operated by non MFB/CFA personnel. YVW do not have adequate controls in place to ensure proper installation of these assets, and the user (i.e. non-MFB or non-CFA personnel) may not be aware of the risks of using non-drinking water through their internal fire services.
5 SYSTEM PLANNING

5.1 GENERAL

In accordance with Section 2.1 of the MRWA, YVW is responsible for system planning, including demand forecasting, definition of supply zones and system configuration of the overall water supply area (for which it is responsible). Assessment and planning of the following supply scenarios must be undertaken in accordance with principles and guidelines established by this document, as follows:

a) Upgrading existing drinking water and non-drinking water networks
b) Extending or providing new drinking and non-drinking water networks

5.2 NON-DRINKING WATER (NDW)

5.2.1 General

The planning and design of YVW supplied NDW networks must be undertaken in accordance with the planning and design, requirements and guidelines, specified by this document.

5.2.2 Approval

The supply of NDW sourced from treated wastewater, is subject to approval by YVW Board, the EPA and the Department of Health (DH). NDW sourced from harvested stormwater is not subject to regulatory approval by either the EPA or DH; however, it still requires YVW Board approval. Where NDW is to be blended, i.e. treated stormwater is transferred to a Class A NDW distribution network, approval by the DH and EPA is required in addition to the YVW Board. The approvals process for NDW schemes is outlined in Section 5.2.5 of this document.

5.2.3 Sources of Non-Drinking Water

YVW produces NDW from various sources, such as Class A recycled water sourced from treated effluent and from stormwater.

5.2.3.1 Wastewater

Treated wastewater is safe to use for a variety of purposes appropriate to the level of treatment it has undergone. It is classified in Australia according to its quality and range of uses. YVW provides Class A non-drinking water to customers via a dual pipe network. YVW also supply recycled water of lower classes however these schemes are not the subject of this document and are managed via the Treatment Plants and Trade Waste division of YVW.
Class A
Class A is the highest quality of wastewater sourced non-drinking water; produced after a tertiary treatment process combined with pathogen removal.

Class A non-drinking water is used in the following applications, including but not limited to:

- residential garden watering
- closed system toilet flushing
- process/cooling water for industry
- fire hydrants
- irrigation of municipal parks and sportsgrounds
- water for contained wetlands or ornamental ponds
- food crops that are consumed raw or sold to consumers uncooked or processed
- cold water taps for washing machines

In addition, the Department of Health has prepared a guideline designed to help non-drinking water scheme proponents develop a Recycled Water Quality Management Plan (RWQMP) for Class A non-drinking water schemes.7

Health and Environmental Management Plans (HEMP) are prepared for Class A recycled water schemes using a preventative, risk management framework, making use of Hazard Analysis at Critical Control Points (HACCP) framework for the water safety and environmental protection aspects of the proposed recycled water scheme.

5.2.3.2 Stormwater

Stormwater treatment and distribution in Victoria are currently unregulated and do not require approval. Yarra Valley Water decided to adopt the framework in the Victorian EPA Guidelines for Dual Pipe Schemes and the Australian Guidelines for Water Recycling for our stormwater harvesting schemes to be consistent with our approach to Class A schemes. Department of Health and EPA who currently approve our Health and Environment Management Plan (HEMP) for Class A schemes are willing to review our risk management plans and provide comments for stormwater harvesting schemes. Department of Health recently concluded a public consultation on an options paper, which discussed the potential future regulatory frameworks in Victoria for Alternative Sources.

There are currently no dedicated stormwater schemes, proposed schemes involve supply of stormwater blended and used within other NDW networks. Any investigation or planning in regard to harvesting and reuse of storm water MUST involve consultation with the relevant waterway manager and all applicable stakeholders, i.e. Office of Living Victoria (OLV), Melbourne Water, Local Council.

5.2.4 Mandated use of Non-drinking water

When the provision of non-drinking water services to an area is recommended as part of a servicing plan, YVW Board approval **MUST** be obtained prior to any requirements being included in a development offer. Under Clause 56 of the Victorian Planning Provisions, water companies can mandate the installation of dual pipe water recycling schemes for new residential developments as part of an integrated water management plan via the residential subdivision process. Recommending that non-drinking water use be mandated in an area occurs following a comprehensive analysis of the available servicing options, typically for one or more of the following reasons:

- If the cost of providing non-drinking water is lower than other long term supply augmentation options
- There are significant environmental or social drivers for providing non-drinking water
- The developers in the area are requesting provision of non-drinking water and are willing to pay for it

5.2.5 New non-drinking water schemes

The creation of a new NDW scheme is subject to the following process for approval:

- Water Growth Planning analysis recommends NDW use & mandate (Section 5.2.4)
- Board approval sought for NDW mandate
- YVW Board approves NDW mandate
- Water Quality Planning team (IP) seek approval from DH & EPA
5.2.6 Health and Environmental Management Plan (HEMP)

In Victoria, all Class A water recycling schemes (i.e. those with a high potential for direct human contact) require endorsement by the EPA and the Department of Health (DH).

The following EPA documents outline the regulatory arrangements for such water recycling schemes:

- “Victorian Environment Protection Authority Guidelines for Environmental Management: Use of Reclaimed Water (GEM 464.2)”; and,
- “Guidelines for Environmental Management: Dual Pipe Water Recycling Schemes (GEM 1015)”.

There is currently no such approval or regulation applicable to NDW schemes with a stormwater source. YVW however have provided a commitment to the Department of Health and EPA, that the above guidelines will be adopted for stormwater sourced NDW. Whilst the risk of pathogens in stormwater is typically lower than in wastewater, this approach is considered by YVW best-practice risk management for non-drinking water.
5.3 OPERATING PRESSURES (MRWA 2.5.3)

Section 2.5.3 of the MRWA outlines the definitions and considerations for service pressure, maximum allowable service pressure and minimum service pressure, with pressure limits listed in Table 2.3. YVW aims to maintain service pressures between 25m and 80m. Limiting maximum service pressure to 80m is not feasible in all instances particularly in undulating areas and zones with very large elevation differences, see Section 5.3.2 below.

5.3.1 Service Pressure (MRWA Section 2.5.3.1)

MRWA defines the Service Pressure of the network as:

“Internal pressure delivered at the point of connection to a consumer’s installation at zero flow in the service pipe. Service pressure does not include surge pressure.”

In the above, YVW understands the “consumer’s installation” to be at the front tap.

5.3.2 Maximum allowable Service Pressure (MRWA Section 2.5.3.2)

Table 2.3 of the MRWA specifies a maximum allowable service pressure of 800kPa (~80m).

YVW do not specify a maximum allowable Service Pressure.

5.3.3 Minimum allowable Service Pressure (MRWA Section 2.5.3.3)

YVW adopt a minimum allowable service pressure of 200kPa (20m head) during the peak hour of the peak summer day (PSD).

5.4 FIRE FIGHTING CAPACITY

YVW is not required to provide a specific level of fire-fighting capacity within the network. The Water Act (1989) does not require a licensee to make sure that water pressure is adequate for fire-fighting in Clause 81, Part 5 sub-section 4 (a). There are however cases where additional storage or pumping capacity has been included into the network in bushfire prone areas after consultation with the local community such as the Olinda Superzone. Sections 11 & 12 cover the requirements of this additional capacity for Pump Stations and Reservoirs respectively.
6 DEMANDS

6.1 GENERAL
Drinking and non-drinking water demands are calculated at a lot scale through to entire water supply areas, consisting of multiple supply zones, by combining development/population/lot forecasts with estimated volumetric demands.

The following sections outline the process for forecasting development rates and volume.

The process is simplified as follows:

6.2 DEVELOPMENT FORECASTING

YVW obtain development estimates for use in calculating a total demand estimate as follows:

- For infill development, developers typically provide estimates of the number of lots proposed, nominal demand required and any requirements for fire services or pressure boosted supply. In every instance YVW seek to verify the exact demands.
- For Greenfields development in growth areas, YVW obtain estimates from various sources, depending on the nature of development and the time frames for development. Developers provide plans of the proposed development, including estimates detailing the proposed layout, number of lots, and annual development rate. This type and scale of development, often involving thousands of proposed lots, typically has interim asset requirements and requires detailed planning in consultation with the Developer and the Metropolitan Planning Authority (MPA) - previously known as the Growth Areas Authority (GAA).

6.3 WATER USAGE FORECAST

6.3.1 General
The Historical water usage patterns of residential households are used in demand estimation. This data is used to determine both the factors by which average demands are inflated to represent peak conditions, and to provide a "typical" diurnal pattern of water use. These demand profiles, used in the hydraulic modelling of water supply networks, represent an average of many households, and do not necessarily represent the instantaneous demand from a single lot.
6.3.2 Demand Builder

Sustainable Growth Planning has developed a Water and Sewer Demand Calculator for residential areas (referred to as the Demand Builder), that incorporates all currently endorsed assumptions regarding demands for sewer, drinking and non-drinking water.

The Demand Builder\(^8\) MUST be used to determine the drinking and NDW demands to be applied per lot when considering new developments.

6.3.3 General

The Demand Builder enables the user to calculate the following demands, used for sizing both drinking and non-drinking water assets:

- Peak Summer Day
- 95\%ile Peak Summer Day
- Average daily – annual day, summer & winter days

The Demand Builder spreadsheet contains all calculation assumptions, drinking and non-drinking water splits in dual pipe areas. It also contains other information used to calculate demands and peaking factors.

6.4 PEAK WEEK

A Peak Week Demand Scenario is used in the sizing of Non-Drinking Water Balancing Storage Tanks, Section 12.6. This design event was developed specifically to assist in the sizing analysis of this asset type.

The period from 15-21 Feb 1997 is YVWs highest demand week on record. Daily diurnal profiles for this historical week have been scaled down such that the peak flows observed in this historical week match the peak flows of the demand profiles produced by the Demand Builder.

\(^8\) I:\SGP4\ Design Principles\Water\Water And Sewer Demand Builder.xls
Based on this information, the following seven-day demand profile should be used to simulate a peak week scenario:

Table 3 - Peak Week Demand Profile

<table>
<thead>
<tr>
<th>Day</th>
<th>Demand Day</th>
<th>95%ile PSD</th>
<th>95%ile PSD</th>
<th>95%ile PSD</th>
<th>95%ile PSD</th>
<th>Peak Summer</th>
<th>95%ile PSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>Day 2</td>
<td>Day 3</td>
<td>Day 4</td>
<td>Day 5</td>
<td>Day 6</td>
<td></td>
<td>Day 7</td>
</tr>
</tbody>
</table>

6.5 DEMAND ASSESSMENT – NON-RESIDENTIAL DEVELOPMENT

6.5.1 Commercial / Industrial Areas

Commercial demands should be assessed on a case by case basis, and preferentially in consultation with the Commercial / Industrial Business. Applications for supply by Commercial / Industrial customers in infill areas are typically accompanied by specific demand information.

In the absence of specific information, the following demands should be applied to Commercial / Industrial areas, these demands are gross area:

- Drinking Water only area – 5,000L/hectare/day
- NDW Mandated area –
  - 3750 L/hectare/day – drinking water
  - 1250 L/hectare/day – non-drinking water

Commercial / Industrial Areas are not mandated to connect to NDW infrastructure. If a Commercial / Industrial customer is located close to a mandated area, they can apply to YVW for supply of NDW.

6.5.2 Public Open Space Irrigation

YVW do not actively allocate these demands. Public open space is generally not watered. Demand estimates for sports reserves are provided by the respective Council. Where specific demands are unknown, a default value of 4.5ML/ha/year may be used.
PLANNING COST ANALYSIS

7.1 COST ESTIMATION

Cost curves exist for all drinking and non-drinking water assets, with the exceptions of flow meters and water quality monitoring stations; estimates for these assets should be sought as required. Estimates made for the capital and operating costs of an asset during the Planning Phase of a project must be obtained from the CAPEX and OPEX Cost Curves (respectively).

During the Design Phase, when specific site information may is available, cost estimates can be refined. The CAPEX and OPEX Cost Curves should be used as the basis or starting point for all estimates.

Reports containing additional information on the CAPEX and OPEX Cost Curves is available and should be referred to for any information required beyond that included in this document. These reports outline:

- The process undertaken to update the cost curves and rates;
- The cost equations or rates that can be used to estimate the cost of a particular asset class; and,
- Any caveats that apply to the use of the cost curves or rates

7.1.1 Capital Expenditure (CAPEX)

An estimate of the capital cost of a project is developed using the asset CAPEX Cost Curves. Cost Curves for Capital Expenditure were created using the following information and should be used when preparing project cost estimates:

- Recent tenders received by Yarra Valley Water for the construction of assets:
- Winning tenders received for reimbursable works;
- Insured Value of Yarra Valley Water's assets;
- Recent as-constructed costs known by Yarra Valley Water
- Estimates of supply and construction costs provided by suppliers
- Schedules of rates and payments made by Yarra Valley Water to subcontractors.

These cost estimates are based on construction contracts and do not include the cost to design, YVW project management or contingency allowances. As such, costs calculated from the curves should be adjusted as follows:

---

Table 4 - CAPEX Cost Estimate Contingency Allowances

<table>
<thead>
<tr>
<th>Project Phase</th>
<th>Contingency Allowance added to Cost Estimate Derived From Cost Curves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept / Functional Design</td>
<td>15%</td>
</tr>
<tr>
<td>Preliminary Design</td>
<td>10%</td>
</tr>
<tr>
<td>Detailed Design</td>
<td>5%</td>
</tr>
</tbody>
</table>

Should the cost estimate differ by more than 20% between the conceptual/functional design phase and the detailed design phase, the project **MUST** be referred back to the relevant planning team to ensure that the recommended option is still preferred.

### 7.1.2 Operational Expenditure (OPEX)

The annual operating costs of a proposed asset are estimated using drinking and non-drinking water asset OPEX Cost Curves\(^\text{11}\).

For a particular asset class, the OPEX costs, as per the Cost Curves, assume that the costs are a combination of the following:

- Scheduled and unscheduled maintenance (including labour and materials costs)
- Electricity costs;
- Grounds maintenance;
- SCADA costs - the costs of maintaining the SCADA network inclusive of both scheduled and unscheduled maintenance
- Cathodic Protection costs

The above is assumed to address all operating and maintenance activities, and therefore no other costs need to be taken into consideration.

Differing OPEX Cost components are separated for each asset class. This enables them to be applied only as required, e.g. Cathodic Protection will only be required for mild-steel water pipelines.

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7.1.2.1 OPEX Data sources
All data used to prepare the OPEX cost rates was obtained from information held by YVW for the 2010/2011 financial year. A large number of data sources were used to derive the rates, the data therefore provides a useful overview of the annual operating and maintenance costs for each asset class, refer to the OPEX Cost Rates report for more information.

7.1.3 NPV Analysis
An NPV analysis is required when a range of servicing options exists, and typically for projects expected to cost in excess of $100K. Net Present Value is the expected future returns of an investment (asset creation) minus the value of expected future costs expressed in today’s dollars.

NPV analysis should be undertaken as part of the Servicing Plan update and preparation process\(^\text{12}\) and is undertaken using the NPV model:


The NPV model contains depreciation rates for specific asset types, together with specific rates of depreciation for the ancillary components of that asset (e.g. for a Service Reservoir there are separate depreciation rates for design, inlet and outlet mains, earthworks, fencing etc.)

Depreciation rates quoted in the NPV model are not to be confused with the Design Life of an asset. YVW water supply distribution assets MUST be designed for a nominal asset life in accordance with the design lives shown in Table 1.2 of the MRWA.

7.2 ELECTRICITY PRICING
All electricity-costing calculations should assume the use of 100% green energy
The NPV model includes electricity-costing rates, including the option to purchase up to 100% green energy, to specify large or small sites and to specify peak/off-peak usage. The model MUST be used to calculate projected electricity costs.
If a proposed site, (e.g. the entire WPS or STP) consumes over 160MWh per year, it is defined as a large site. Generally, this applies to most STPs and some large WPS and SPS sites. Electricity is cheaper at large sites. Higher rates are charged for electricity at smaller sites.
Electricity prices for specific sites will vary depending on whether usage is peak/off-peak, site location, electricity supplier and contestability of site. A default split of 60% peak, 40% off-peak is to applied during NPV analysis and is adjusted if the expected peak and off-peak usage is known.

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\(^\text{12}\) YWIN1083 Servicing Plan update and preparation process
8 RELIABILITY OF SUPPLY

8.1 OBJECTIVES

Reliability of Supply refers to YVW’s risk based approach to the creation of a water supply network; a network that enables an adherence and compliance with our Customer Charter obligations and commitments, specifically, reduced customer interruptions and complaints, and, more broadly, the creation of resilience within the network to prevent bulk customer interruptions.

In planning and design, this relates to the planning and design of water supply networks and assets that are created with consideration to their modes of failure and include multiple failure redundancies; such that the likelihood of a total network failure is reduced.

When planning new water supply networks and assets, the following process of analysis of **MUST** be undertaken to achieve reliability of supply objectives:

- **ASSET DESIGNED -** asset is sized in accordance with the principles and guidelines set out in this document
- **HYDRAULIC MODELLING -** performance of asset within water supply network is assessed and resized if required, to achieve acceptable hydraulic characteristics
- **FAILURE ANALYSIS -** test the interruption of key assets via hydraulic modelling. Assess network performance during failure, resize or modify asset (if required) to achieve acceptable hydraulic performance during failure. Document process and results.

* This assessment aims to verify that key planning criteria have been applied to the design of an asset and ensure the previous sizing and failure analysis is completed. A process map has been developed for the following asset types: Water Pumping Stations; Service Reservoirs; Pressure Reducing Station and Distribution Pipelines to assist planners with sizing and failure analysis.

This assessment **should** be reviewed and approved by the YVW Water Operations Team during the development of a functional design statement, prior to and completion of a Functional Design, or during the development of a Servicing Plan.
8.2 SINGLE SOURCE OF SUPPLY

YVW refer to an area that supplies over 500 customers via a single source as a Single Source of Supply Area, and the supply main as the Single Source Supply.

YVW’s preference is that no temporary water supply scheme exceed 500 customers on a Single Source of Supply, however this may be difficult to apply in certain circumstances.

An area may be supplied temporarily by a Single Source Supply during an interim stage of growth. In these instances, a risk assessment MUST be undertaken to identify:

- Feasibility of providing a second source
- Financial implications of providing a second source
- Capacity of current source / network
- Any other risks

Sustainable Growth Planning will be responsible for identifying single source supply issues affecting greater than 500 customers in new developments.

The design of a Single Source Supply main MUST give consideration to the nominated pipe material and construction methods, and include additional developer consultation, to provide a greater level of redundancy. Ultimately an area’s supply should comply with shut-off block rules and include a secondary source. A single source supply area does not include the required pipe redundancies to provide Reliability of Supply and is therefore not sufficient ultimately.

8.3 SECONDARY/ALTERNATE SOURCE OF SUPPLY

An alternate supply source or secondary source of supply is essentially an alternate source of water supply, available to a zone, if the primary source is unavailable. An alternate source MUST supply the following to qualify as an operational or approved alternate source:

A MINIMUM 10m pressure to the worst affected customer on a 95%ile PSD

This criteria is applicable to emergency alternate supply sources only and is not sufficient for planned works.
9 WATER MAINS / PIPELINES

9.1 GENERAL
This Section sets out the requirements for the design of drinking and non-drinking water reticulation, distribution and transfer mains.

9.2 TRANSFER MAINS
The following MUST apply to the design of transfer pipelines:

- Main is to be sized by hydraulic analysis using a computerised hydraulic model
- Main is to be located in a Pipe reserve in accordance with the provisions set out in Section 9.15 of this document.

All other requirements for the design of Transfer pipelines MUST be in accordance with the Melbourne Water Corporation document – “Water Transfer Pipelines – Design Guidelines”\(^\text{13}\)

9.3 SIZING (MRWA 3.1)
All YVW water mains (reticulation and distribution) MUST be sized by hydraulic analysis using a computerised hydraulic model. Hydraulic modelling is currently undertaken using the hydraulic modelling software, described in more detail in Section 17.

YVW water mains MUST be sized such that they exhibit acceptable hydraulic characteristics, as set out in this document and the MRWA, during the peak hour of the Peak Summer Day.

The MRWA includes an empirical sizing table for water mains, Table 3.2. Sizing in accordance with the MRWA table results in very conservative sized assets and often results in excess hydraulic capacity, inflated costs and the creation of water quality issues and should not be used.

9.4 VELOCITIES (MRWA 3.1.6.4)
Section 3.1.6.4 of the MRWA states that the design shall ensure that acceptable velocities are achieved by the supply network. The following Sections nominate acceptable flow velocities within YVW water mains.

9.4.1 Minimum velocity
YVW attempts to size both reticulation and distribution mains so that they experience flow velocities sufficient to ensure self-cleaning or sediment re-suspension, and thereby maintain water quality. This requirement is specific to the ultimate operating conditions of an asset. During an interim phase, minimum velocities may not be achieved.

\(^\text{13}\) Melbourne Water Corporation – Water Transfer Pipelines – Design Guidelines
\text{l:\SGP4, Design Principles\Water\Other Documents\MW transfer pipelines design requirements.pdf}
To avoid sediment accumulation in mains, YVW requires that mains are sized to achieve self-cleaning velocities during the morning peak of a 95%PSD for drinking water, and during the afternoon peak of a 95%ile PSD for non-drinking water.

Table 5 below provides a more accurate estimate of required self-cleaning flows and velocities for various pipe diameters. Values are provided for pipes up to and including DN900, and those shown are consistent with those of MRWA Table 3.5.

Hydraulic models **MUST** be run to simulate this scenario and the resulting self-cleaning flow rates and velocities must be determined. If the rates shown in Table 5 are not exhibited for a given main size, downsizing of the main **should** be considered.

**Table 5 - Minimum Velocities**

<table>
<thead>
<tr>
<th>Pipe Diameter (mm)</th>
<th>Self-cleaning flow rate (L/s)</th>
<th>Self-Cleaning Velocity (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>0.13</td>
<td>0.10</td>
</tr>
<tr>
<td>50</td>
<td>0.25</td>
<td>0.13</td>
</tr>
<tr>
<td>63</td>
<td>0.50</td>
<td>0.16</td>
</tr>
<tr>
<td>100</td>
<td>2.0</td>
<td>0.25</td>
</tr>
<tr>
<td>150</td>
<td>8.2</td>
<td>0.41</td>
</tr>
<tr>
<td>225</td>
<td>21.3</td>
<td>0.56</td>
</tr>
<tr>
<td>300</td>
<td>54.0</td>
<td>0.76</td>
</tr>
<tr>
<td>375</td>
<td>110</td>
<td>0.97</td>
</tr>
<tr>
<td>450</td>
<td>179</td>
<td>1.13</td>
</tr>
<tr>
<td>525</td>
<td>286</td>
<td>1.36</td>
</tr>
<tr>
<td>600</td>
<td>424</td>
<td>1.5</td>
</tr>
<tr>
<td>675</td>
<td>615</td>
<td>1.72</td>
</tr>
<tr>
<td>750</td>
<td>843</td>
<td>1.91</td>
</tr>
<tr>
<td>825</td>
<td>1123</td>
<td>2.1</td>
</tr>
<tr>
<td>900</td>
<td>1431</td>
<td>2.25</td>
</tr>
</tbody>
</table>

---

14 Table provided by Infrastructure Planning Quality Team, calculations based on work undertaken by MWH. I:\SGP4. Design Principles\Water\Other Documents\Self Cleansing velocity calculations (from MWH).xls
9.5 HEADLOSS (MRWA 3.2.5.2)

9.5.1 Methods for calculating headloss

The Darcy-Weisbach (Colebrook White) formula **MUST** be applied when undertaking computer hydraulic modelling.

The Darcy-Weisbach formula relates the head loss in a pipeline due to the friction along a given length to the average velocity of the fluid flow. The equation includes a dimensionless friction coefficient which is calculated using the Colebrook-White formula.

9.5.2 Colebrook White friction coefficient/roughness (K values)

Roughness coefficients used in hydraulic modelling of YVW assets **should** be selected from Table 6 (below). As shown by the table, smaller values are the expected and therefore applicable for clean, new pipes laid straight. With increased age of the pipe and angular deflections at joints, the initial roughness values will be higher.

The nominated design life of YVW pipelines is 100 years as per Table 1.2.6 of the MRWA, and therefore, in most cases, the roughness **should** be selected for the aged pipe (50+ years)

<table>
<thead>
<tr>
<th>Pipe Material</th>
<th>AGE (Years)</th>
<th>0-20</th>
<th>21-50</th>
<th>50+</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td></td>
<td>0.015</td>
<td>0.03</td>
<td>0.06</td>
</tr>
<tr>
<td>CI</td>
<td></td>
<td>0.15</td>
<td>0.375</td>
<td>0.6</td>
</tr>
<tr>
<td>CICL</td>
<td></td>
<td>0.01</td>
<td>0.035</td>
<td>0.06</td>
</tr>
<tr>
<td>CU</td>
<td></td>
<td>0.03</td>
<td>0.0765</td>
<td>0.15</td>
</tr>
<tr>
<td>DICL</td>
<td></td>
<td>0.01</td>
<td>0.035</td>
<td>0.06</td>
</tr>
<tr>
<td>MSCL</td>
<td></td>
<td>0.01</td>
<td>0.035</td>
<td>0.06</td>
</tr>
<tr>
<td>MSEL</td>
<td></td>
<td>0.003</td>
<td>0.01</td>
<td>0.015</td>
</tr>
<tr>
<td>PE</td>
<td></td>
<td>0.003</td>
<td>0.01</td>
<td>0.015</td>
</tr>
<tr>
<td>PVC-U, PVC-O, PVC-M</td>
<td></td>
<td>0.003</td>
<td>0.01</td>
<td>0.015</td>
</tr>
</tbody>
</table>

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15 Provided by Hydraulic Modelling Team, Infrastructure Planning, 17/05/2013
\text{I:\SGP4, Design Principles\Water\Other Documents\RE Roughness Coefficients.msg}
9.6 PIPE DIAMETERS

Drawing MRWA-W-103 General Pipeline System Requirements includes a table for each of PVC, DI, PE and Mild Steel pipes showing nominal diameters for a range of sizes and the corresponding internal and outside pipe diameters.

The sizes quoted by these tables can be used for sizing analysis where manufacturer data is unavailable. Where and when manufacturer data is available it should be used.

9.6.1 Nominal Diameter (DN):

The nominal diameter of the pipe is used for purposes of general identification and refers to internal diameter for all pipe materials but PE. PE pipes use a nominal diameter based on the outside diameter.

Note: All pipe materials except Polyethylene (PE) have standardised nominal diameters i.e. DN100, DN225, DN300 etc.

PE sizing is based on international sizing not Australian standards.

9.6.2 Internal Diameter:

The internal diameter of a pipe is relevant for hydraulic calculations and use in hydraulic models. The sizing methodologies used by YVW are typically conservative such that the internal diameter can be nominated as the nominal diameter. Pipes constructed from different materials usually have different internal diameters even if the nominal diameter is the same. The reason for this is that the pipe wall thicknesses vary between materials in order to achieve similar strengths. The internal diameter of a pipe is dependent on the pipe material.

During hydraulic model calibration, the known internal diameter of a pipeline is applied and the model updated.

9.6.3 Outside Diameter:

The outside diameter of the pipe is required in construction to determine clearances to other services / infrastructure.

9.7 DEPTH OF MAINS (MRWA 5.4)

MRWA Section 5.4 specifies that water mains should be preferentially be located in the non-trafficable areas of a road reserve and that the minimum cover levels specified in Drawing MRWA-W-202 are required.
9.8 PRESSURE CLASS OF SYSTEM COMPONENTS (MRWA 3.3)

Section 3.3 of the MRWA refers to the required pressure class of not only pipes, but all fittings and appurtenances that form part of the water supply system and are subject to pressure.

The pressure rating of all YVW pipes and fitting **MUST**:
- Be in accordance with design requirements specified by this document, and,
- Be rated to accommodate the test pressure nominated by the design.

MRWA Table 3.6 sets out PN (Nominal Pressure) classes and their associated pressure limits and is to be adopted for the design of YVW assets as a guide only. Table 3.6 nominates a 20m difference between operating and design pressures for “surge allowance,” however in certain circumstances, i.e. pumped mains, this may be inadequate; conversely there may be instances where this is excessive. Designers should give consideration when selecting the required PN class to the specific system requirements and conditions when calculating design pressure.

9.9 PUMPED MAINS

Pumped mains typically operate in one of the following modes:
- Transfer between pump station and reservoir, with no reticulation off takes.
- Transfer between pump station and reservoir, with reticulation off takes.
- Variable speed drive (VSD), pressure controlled pumping directly into a zone.

A comprehensive water hammer analysis **MUST** be undertaken for all applications. The worst case is usually a power outage while the pumps are running causing immediate stoppage of the water column. The pipeline must be capable of withstanding this event without failure.

9.9.1 Transfer between pump station and reservoir, with no reticulation off takes.
This is the only category suitable for pumping where pressure exceeds 108m, i.e. no reticulation assets are permitted off transfer mains where water hammer results in pressures in excess of 108m. Refer to the Water Pumping Station Technical Standard for the applicable pump controls for this scenario.

9.9.2 Transfer between pump station and reservoir, with reticulation off takes.
This application has the potential to cause significant service level and asset management impacts on the network (i.e. pump starts and stops may result in variations to customer service levels, potential water hammer issues and decrease the life of pipeline assets).
In such cases, YVW requires controls to minimise sudden pressure changes and water hammer.
9.10 PRODUCTS AND MATERIALS (MRWA 4)

The MRWA sets out the details for the following pipeline systems:

- DICL Section 4.3
- PVC Section 4.4
- PE Section 4.5
- Steel Section 4.6

ABS and GRP or equivalent pipe MUST NOT be used in any circumstance for YVW pipelines.

MRWA Standard Drawing MRWA-W-103 sets out default pipeline selection options for both DW and NDW systems. In addition to these requirements, material selection and nominal sizing for YVW pipelines MUST be in accordance with the requirements specified by this document.

YVW does not adopt mild steel pipeline sizes of 200mm, 250mm or 500mm shown in Table 5 of MRWA Standard Drawing MRWA-W-103, except in special cases where the hydraulic requirements of PRVs, flow meters or pumps require this size pipe to be installed.

Note: There are some existing 200 and 250 AC mains within the network inherited from the Water Trusts but YVW is not continuing the use of mains in these sizes.

WSAA maintain an MRWA Product Web Portal that enables users to search and obtain details of adopted industry standards, products and materials currently accepted by the MRWAs for the installation of pipeline systems and associated Infrastructure works.
**9.10.1 Notes regarding Drawing MRWA-W-103**

- Cold bending of PVC pipe MUST not be undertaken
- Pipework under footings and slabs MUST be welded MSCL.
- YVW does not use plastic or rubber ring jointed pipework as any part of pumping station headers due to the regular cyclical loadings and thrust restraint required. There have been numerous cases where plastic headers have failed and RRJ DICL fittings blown resulting in lengthy repairs and significant damage to electrical and control equipment.
- Comment on note F.D – NDW risk profile is the same as DW.
- For PE mains only, DN250 valves can be used in lieu of DN225.

**9.11 NON-THRUST TYPE JOINTS**

Uniflanges and dismantling joints should not be used for critical water mains. Critical mains MUST be fully welded and enough room should be provided in pits to enable cut and welding for removal of fittings where required.

**9.12 STOP VALVES (MRWA 8.2)**

MRWA adopts the term stop valve to describe a valve that is used to permanently or temporarily stop flow, including uses in bypasses and scours. Stop valve requirements set out in MRWA are applicable to divide valves, offtake valves and bypass valves.

Sections 8.2.3 and 8.2.4 of the MRWA set out the requirements for stop valves on transfer/distribution mains (> DN300) and reticulation mains (≤ DN300) respectively. YVW requirements are as per the MRWA with additional requirements for distribution and transfer mains as per Section 9.12.1 of this document.

**9.12.1 Divide valves for Transfer and distribution mains (> DN300)**

YVW’s requirements for transfer and distribution main divide valves (stop valves in MRWA) are as per MRWA drawing MRWA-W-105 and the following:

- YVW does not design and construct large mains so that they can be pigged. Mains cannot be pigged if butterfly valves are used. Launchers and retrievers may be installed for the operation if required.
- Horizontal separation requirements between DW and NDW valves refer to Section 10.3.2
- On mains sized over 525mm, a scour and hydrant should be included as part of a divide valve arrangements, where required. This statement does not apply to the design of Scours and Pump out Branches (and associated control valve) which MUST be located and designed in accordance with the provisions of MRWA Section 8.6 and MRWA Drawing MRWA-W-307.
9.12.2 Bypass for stop valves

Table 1 of Drawing MRWA-W-105 lists YVW specific requirements for bypass sizes for a nominated main size and MUST be adopted in lieu of the default sizes listed MRWA Section 8.2.3.1.

9.12.3 Spacing (MRWA 8.2.4.1)

9.12.3.1 Drinking Water

Maximum spacing of stop valves on drinking water reticulation mains MUST be as per MRWA Table 8.2, Stop Valve Spacing Criteria.

9.12.3.2 Non-Drinking Water

Maximum spacing of stop valves on NDW mains MUST be in accordance with the requirements of this document. Discharge of Non-Drinking Water during a planned or emergency event is in accordance with YVW’s obligations set out in the relevant Health and Environmental Management Plans (HEMP). The HEMP specifies that in the event of an unplanned or emergency event YVW can discharge to a stormwater network, however discharge resulting from planned events should, where possible, be contained and disposed of correctly (i.e. contain and discharge to sewerage network). A Stop valves enables sections of main to be isolated and therefore, the volumes to be limited to that contained in the pipe/or lost from the pipe, between valves.

YVW’s required stop valve spacing on NDW mains is shown below in Table 7. The nominated maximum spacing between valves for NDW mains is half that of the MRWA nominated minimum for drinking water mains. This is to limit the potential volumes loss, discharged or disposed of during planned and unplanned events.

Table 7 – Maximum Stop Valve Spacing, Non-Drinking Water Assets

<table>
<thead>
<tr>
<th>NDW main size (mm)</th>
<th>Maximum Spacing (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 150</td>
<td>150</td>
</tr>
<tr>
<td>200-300</td>
<td>375</td>
</tr>
<tr>
<td>375</td>
<td>500</td>
</tr>
<tr>
<td>450</td>
<td>575</td>
</tr>
<tr>
<td>525</td>
<td>625</td>
</tr>
<tr>
<td>600</td>
<td>750</td>
</tr>
<tr>
<td>750</td>
<td>950</td>
</tr>
<tr>
<td>&gt;750</td>
<td>2500</td>
</tr>
</tbody>
</table>
9.12.4 Locations and Arrangements (MRWA 8.2.7)

9.12.4.1 Shut Valves (MRWA 8.2.7.4)

MRWA Section 8.2.7.4 nominates the preferred arrangements for pressure zone dividing valves (shut valves). MRWA Figure 8.10 should include additional arrangements (shown below) which reduces the number of dead ends created. Order of preference is A or B, then C then D. Note that the shut valve should be immediately adjacent to the tee in each case to ensure no stagnant water exists otherwise hydrant installation is required as per C or D. It is noted for configuration B, an operational hydrant is still required within the shut off block either side of the pressure zone divide valve.

Figure 3 - Shut Valve Arrangements

A

B

C

D
9.12.4.2 NON-RETURN Valves

MRWA Figure 8.13 should not be applied in design of non-return pressure reducing or pressure sustaining valves.

YVW has a clear preference for two arrangements:

1. For DN150 and DN100 reticulation mains, the hydrant should be located on the downstream side of the reflux valve to allow the potential dead end to be flushed; and,

2. For DN225 or greater mains, a double valved bypass one size smaller than the main with a hydrant should be included to allow full operational flexibility including back feeding and flushing.

Figure 4 - YVW Preferences, Control Valve Arrangements
9.12.5 Interconnection of Mains (MRWA 8.2.10)

Section 8.2.10 of the MRWA sets out the requirements for interconnecting reticulation and distribution mains, YVW has requirements in addition to the MRWA as detailed in this section.

The following section of the Water Planning and Design Principles sets out these requirements in detail, with associated schematics, and identifies:

- Interim arrangements and staging – how the valve arrangement should be constructed to avoid multiple shutdowns as development progresses;
- Supply options during main shutdowns
- Operational requirements provided by the arrangement; including, avoiding large main shutdowns, installing valves at later dates, constructing as much of the cluster as possible initially

The following arrangements are detailed in this section:

- **Arrangement A** – Reticulation and Distribution, connected
- **Arrangement B** – Reticulation and Distribution, crossing with bypass
- **Arrangement C** – Two (2) Distribution mains, connected
- **Arrangement D** – Two (2) Distribution mains, crossing with bypass**

These arrangements do not cover all interconnections. The process of identifying interim and ultimate arrangements, consideration of operational requirements including during main shutdowns are however applicable to all arrangements and should be considered during planning and design thereof.

Main sizes shown are nominal.

** Not covered by the MRWA.
9.12.5.1 ARRANGEMENT A – Reticulation and Distribution main connection

YVW’s requirements for this connection are as per MRWA Section 8.2.10 (b). In this arrangement, mains can be isolated from each other in the event of failure. The ultimate arrangement, when both mains are operational is as per MRWA Figure 8.17. This arrangement is specified by YVW when the reticulation main off take (i.e. DN150 or 225) is considered critical for supply, or if it services a large number of customers, and requires dual supply.

During an interim stage, i.e. construction of the distribution main for service, provision for the future reticulation main is as follows:

Figure 5 - Reticulation & Distribution Connection, Interim Arrangement

This arrangement provides the following operational functionality, as shown in Figures 6 & 7. This also applies to failures of the section of distribution main heading west (not shown).

The Reticulation main always has dual supply (when available through development)

- The reticulation main can be isolated without affecting the distribution main
- The distribution main can be closed either side of the valve and still and maintain supply to the reticulation main
- This is an alternate to Arrangement B, Section 9.11.5.2 of this document. Arrangement B assumes the reticulation main has a dual supply and is not relying on the distribution supply
Figure 6 - DN150 Isolated from DN375 during failure, supply to DN375 maintained

Figure 7 - Supply maintained to DN 150 main with failure of DN375
9.12.5.2 Arrangement B – Connection of continuing reticulation main to distribution main

YVW's requirements for this connection are as per MRWA Section 8.2.10 (d). In this arrangement, mains can be isolated from each other in the event of failure.

The ultimate arrangement, when both mains are operational is as per MRWA Figure 8.19

During an interim stage, i.e. construction of the distribution main for service, provision for the future reticulation main is as follows:

Figure 8 - Reticulation main crossing distribution main, Interim Arrangement

Operational Functionality – Mains can be isolated from each other in the event of failure, as per Figures 9 & 10.. Operational hydrants are to be provided in the DN150 shut-off block and an appropriate point to drain the distribution main along the DN375 main.

Figure 9 - DN150 Isolated from DN375 during failure, DN375 remains in operation.
9.12.5.3 Arrangement C – Connection of two distribution mains (i.e. 2 x DN450 mains)

YVW’s requirements for this connection are as per MRWA Section 8.2.10 (c). In this arrangement, the bypass is sized to maintain supply in the event of one section requiring shut down. In all failure scenarios the hydrant can be isolated and used for recharging the main.

The ultimate arrangement, when both mains are operational is as per MRWA Figure 8.18.

At an interim stage, when one main is constructed with provision for the other at a later stage; the interim arrangement may be as per Figure 11 below. This arrangement enables construction and connection of the future DN450 main to the existing operational DN450 main without having to shut the operational main down.

Figure 10 – DN375 Isolated from DN150 during failure, DN150 remains in operation

Figure 11 - Connection of two (2) distribution mains, Interim Arrangement
Operational Functionality - Mains can be isolated from each other in the event of failure, as per Figures 12 & 13. This also applies to failures of the section of main heading south (not shown).

Figure 12 - Mains isolated during failure

Figure 13 - Mains isolated during failure
9.12.5.4 Arrangement D – Crossing of two distribution mains

YVW has a preferred arrangement for crossing two distribution mains as shown below in Figure 14. This arrangement is adopted in lieu of installing a four-way junction to connect the two mains, which is not practicable.

Figure 14 - Ultimate arrangement, DN450 and DN300 in operation

This arrangement provides the flexibility to supply water from either direction from the DN450 main and to control the DN 300 main to the north and south. The bypass is large enough to maintain supply in the event of one section requiring shut down. In all failure scenarios the hydrant can be isolated and used for recharging the main.

Operational Functionality - Mains can be isolated from each other in the event of failure, as per Figures 15 & 16. This also applies to failures of the sections of main heading south and east (not shown).
Figure 15 - Mains isolated during failure or when offline

Figure 16 - Mains isolated during failure or when offline
9.13 AIR VALVES (MRWA 8.4)

YVW air valve requirements are as per MRWA 8.4. YVW permits the use of L type hydrants as per MRWA section 8.4.6. As per drawing MRWA-W-305, YVW does not permit below ground air valve pits.

Air valves or L type hydrants that function as air valves must be connected off the top of the main. YVW’s preference is to install a hydrant on the valve controlled arrangement for the air valve to confirm water quality and to utilise pressure gauges.

9.14 DISTRIBUTION SCOURS (MRWA 8.6)

9.14.1 Drinking Water

YVW preferences beyond MRWA for sizing and location of scour valves on large mains are:

- No scour to discharge to kerb or gutter, only to formed drainage.
- Scour must have defined discharge path to watercourse not through properties.
- Prefer discharge to closest stormwater pit, must be able to visually verify water quality.
- A scour pit is required in areas where mains are constructed ahead of formal drainage. Scours must be connected to formal drainage once it is installed.

Scours function to empty and flush mains. Sometimes it is necessary to flush a main for extended periods prior to bringing it back into service for water quality reasons. If scours are not located in the correct positions (i.e. more than just low points, the full volume of the main cannot be turned over).

When formal drainage is not available, drinking water scours are to be designed as per YVW Drawing shown in Appendix A.

9.14.2 Non Drinking Water

In addition to the preferences set out in Section 9.14.1 – Drinking Water Distribution Scours above, YVW's preference for NDW distribution scours are:

- Unless the EPA has provided written agreement for discharge to be transferred to a drain/creek or discharged to land, NDW scours MUST discharge to a pit. This pit is to be separate from drinking water scours.

- Scour to be designed as per drawing shown in Appendix A. This arrangement MUST be adopted for all NDW scours. This arrangement also applies to drinking water mains not connected to formed drainage.

- Scour arrangement to incorporate non-return valve, as per Appendix B.
9.15 PIPE RESERVES

9.15.1 General
All YVW DW and NDW transfer pipelines are to be located in a designated pipe reserve. The provisions set out in this section are applicable to YVW transfer mains only, and do not apply to reticulation or distribution mains.

This document sets out the following pipe reserve arrangements:
1. One water main
2. Multiple water mains
3. Water main(s) with a Main Sewer

For a single pipeline, the location of the pipeline within the reserve shall be such that a minimum width of 4.0 metres is provided for vehicle and maintenance access clear of the point where the soil failure plane meets the surface, based on a line drawn at 45 degrees from the base of the trench excavation. Where the soil conditions are such that an assumed failure plane of 45 degrees is inappropriate, full trench support conditions shall be assumed rather than increasing easement width.

9.15.2 Reserve Requirements – Single Pipe
YVW’s preferred arrangements are as follows:

Figure 17 - Transfer Pipeline, Single Pipe Reserve Requirements
9.15.3 Pipe Reserve Requirements – Multiple transfer mains

For multiple pipelines, the requirements are as per Section 9.15.2, with a minimum clearance of 1200mm clearance between pipes (outside pipe to outside pipe), refer to Figure 18 below.

Figure 18 - Transfer Pipeline, Multiple Pipe Reserve Requirements

Minimum clearances for multiple transfer mains within one reserve

\[ D = A + B + C \]
9.15.4 Pipe Reserve Requirements – DW or NDW Transfer main & main sewer in common reserve.

In this arrangement, the distance between the water main and the sewer main shoring are specified to maintain the integrity of the water main during any excavation of the sewer. Sewer Growth Planning specify a minimum clearance of 2.0 metre for vehicle and maintenance access from the edge of the trench support\textsuperscript{16}. Water Growth Planning’s required provision for a minimum 4.0 width for vehicle, plant and maintenance access, as per Sections 9.15.2 and 9.15.3 of this document, is achieved by the combined width of the 2m sewer access provision, and the width of the sewer in the reserve (see Figure 19), i.e. over the sewer. If access is required over the water mains during any repairs to the sewer, the water main MUST be protected using suitable methods, i.e. steel plates.

\textsuperscript{16} This allowance has been formulated by the YVW Sewer Growth Planning Team.
Figure 19 - Pipe Reserve Requirements, DW, NDW & Sewer Main

**Minimum clearances for water transfer main(s) and main sewer within one reserve**

**WATER - Vehicle Plant and Maintenance access**

**SEWER - Vehicle Plant and Maintenance access, min 2000mm**

- **D**
- **Pipe OD (A)**
- **2 (A)**
- **Sewer Pipe OD (S)**
- **Trench support 150mm**
- **Trench support 150mm**
- **Cover (C)**
- **Bedding (B)**
- **45°**
- **Water main**

**D = A + B + C**

< 10m

**S**
Pipe reserves are required to be sized, and widened if necessary, to accommodate the pipeline and all associated infrastructure and assets, including but not limited to:

- Thrust blocks
- Connections
- Valve arrangements
- Duplications
- Pits
- Scours and pumping points
- Pig launch and retrieval points
- Storage areas for waste from pigging activities
- Corrosion protection infrastructure

Widening of the pipe reserve at locations of the above mentioned infrastructure shall be considered in the design and land tenure requirements. Pipe reserves shall accommodate the full bearing area of thrust restraints such that no future excavations in proximity to the pipe reserve would jeopardise the integrity of the pipe thrust restraint system.

The design shall consider the implications of cross fall on existing drainage systems.

### 9.16 LAND TENURE REQUIREMENTS

Detailed below are the land tenure requirements for the pipeline and the guiding principles for pipeline location. The overriding principle is that permanent protection/rights must be provided over the pipeline to enable the pipeline and all associated assets to be protected and to enable the asset owner unimpeded access to maintain and replace or duplicate the pipe(s).

#### 9.16.1 Freehold Title

Freehold title is required where substantial above ground structures are located on the land that preclude a secondary use of the land (e.g. pump stations).

If the land is crown land, a reserve for YVW for water supply purposes is preferred and shall be requested. Otherwise an appropriate agreement with the manager of the crown land will be negotiated.

Freehold title is required where the pipeline is located inside the Melbourne 2030 Urban Growth Boundary or built up areas unless the pipeline is located within road reserve or on crown land.

Where opportunity arises (i.e. subdivision or development of land) existing mains should be relocated to road reserve or a pipe reserve created.
### 9.17 TAPINGS

#### 9.17.1 General

A tapping is a procedure that consists of drilling and tapping the pipe wall. A tapping connects customers to the water supply network. A tapping provides a point of weakness on a main and is more likely to fail at that point and undermine the integrity of assets. YVW mains sized DN225 or larger are assigned a tapping status of either “tapping” or “non-tapping” and this is shown in YVW's GIS and can also be viewed by developers when applying to connect to YVW's water supply network.

Having larger mains as non-tapping reduces the likelihood of failures and allows these assets to be out of service in non-peak periods for repairs or scheduled works, and, where an alternate supply exists, without directly affecting customers. This will facilitate those repairs that normally take considerably longer to complete.

#### 9.17.2 Tapping Status

The following guidelines **MUST** be applied when nominating the tapping status of a YVW water main:

- **Tapping Main ≤ DN 150**
  - All mains sized ≤ DN 150 are tapping mains

- **Tapping Main DN 225 & DN 300**
  - All mains sized DN225 & DN 300, except where water quality or operational issues arise (refer section 9.17.3)

- **Non-Tapping Main DN 225 & DN 300**
  - DN225 & DN 300 mains with water quality issues and operational constraints exist

- **Non-Tapping Main ≥ DN 375**
  - All mains sized ≥ DN375 are non-tapping mains
9.17.3 Non-Tapping Mains

All new water mains of DN375mm or greater shall be non-tapping mains. These mains are given a unique number for identification, as provided by Infrastructure Planning\(^{17}\)

The water quality and operational constraints which may result in a DN225 or DN300 main being defined as non-tapping may include but are not limited to the following:

- Where acceptable water quality cannot be achieved (i.e. proximate to chlorinators and pH plants);
- Where key account customers rely on the main as a sole source of supply;
- Where the main provides the sole source of supply for greater than 500 lots;
- Alignment issues that impede access for repairs or maintenance;
- Mains subject to pressures greater than 80m;
- Pumped rising mains;
- Located proximate to a booster pump (less critical if VSD); and,
- Mains that function as a reservoir inlet/outlet.

MRWA requires shut off blocks of 100 lots for DN225 and DN300 mains, and also requires that stop valves be spaced no more than 750m apart. The design of all DN225mm and DN300mm mains MUST be submitted to YVW for approval. YVW’s review of the design will seek to ensure that valving at critical off takes and stop valves meets the operational needs of the business. A valve MUST be installed between a main that is tapped and one that is not.

Converting a non-tapping main to a tapping main is subject to the approval by the Manager Network Operations and the Manager Sustainable Growth Planning. At that time, the principles of suitable divide valves and hydrants to comply with shut off block sizes and 5-hour interruption time should be applied and addressed.

Where there is no alternative, and where water quality and hydraulics are acceptable, YVW may approve the installation of a smaller tapping main in parallel to the main sized $\geq$ DN375, referred to as a Rider Main, refer to MRWA Section 5.8.

Pipeline to meet the following criteria:

Section 9 & 10 – Water Planning and Design Principles

1. DESIGN
   - Size main to transfer peak hour, Peak Summer Day flows
   - Maximum stop valve spacing and appropriately located offtakes
   - For Dual Water Supply Systems - mains located according to requirements of Section 10.2.2 of the Water Planning and Design Principles and fittings offtakes and bypass arrangements as per Section 10.2.3.
   - Include adequate provision for future interconnections, refer Section 9.12.5
   - Use fully welded MSCL on critical mains with full Cathodic protection

2. HYDRAULIC MODELLING
   - Verify main exhibits acceptable hydraulic characteristics as per Sections 9.4 & 9.5 of the Water Planning and Design Principles

3. FAILURE ANALYSIS – DISTRIBUTION MAIN FAILURE

Via hydraulic modelling, using 95th percentile PSD scenario, fail main at key locations, i.e. at source and between valves and offtakes. Verify a minimum 10 m pressure supplied to entire zone for all failure scenarios. If a minimum pressure of 10 m is not achieved, consider additional valving and alternate arrangements (looping mains) to ensure continued network connectivity. Document results.
10 DUAL WATER SUPPLY SYSTEMS (MRWA 5.4.5 & 5.6)

10.1 GENERAL
Dual water supply systems are those with both drinking and non-drinking water mains.

10.2 SHARED TRENCHING (MRWA-W-202)
YVW Approval MUST be obtained for shared trenching of water mains sized >DN250.

10.3 CLEARANCE RULES FOR DRINKING AND NON-DRINKING WATER MAINS
MRWA Section 5.4.5 outlines the trenching options for Dual Water Supply Systems relative to their proposed location in public road reserves.

In addition, MRWA Section 5.6, and drawings MRWA-W-202 and MRWA-W-205B, outline the detailed requirements and arrangements for the shared trenching of drinking, non-drinking water and gas mains.

Drawings MRWA-W-102A and MRWA-W-102B provides examples of design plans for drinking and non-drinking water systems.

YVW has developed clearance rules for the design of distribution mains of dual water supply systems. These rules apply to the location of drinking and non-drinking water supply mains relative to each other.

10.3.1 Vertical separation

MRWA Section 5.6 states that:

“The vertical alignment of water main / conduit levels in industrial / commercial zoned areas shall be staggered to allow for the future installation of property services and fire services”

A vertical separation of at least 200mm between the bottom of the DW main and the top of the NDW main, MUST be allowed by the design of dual water supply systems in industrial/commercial zoned areas, this also includes residential developments with a proposed town centre or commercial buildings (not specifically zoned industrial or commercial)

10.3.2 Horizontal separation - Pipelines
The following sets out YVW’s order of preference for the location of drinking and/or non-drinking water distribution mains. Preferences is given in all options to the isolation of the drinking water distribution main, which is of the highest priority for customer supply of the mains shown.

The guiding principle here is to keep the large DW and NDW distribution mains on different sides of the street/road wherever possible to minimise the likelihood of a burst or failure in one main, impacting the other.
10.3.2.1 PREFERRED OPTION

This option is YVW’s preferred option due to the trenching benefits of the reticulation mains, the separation of the distribution mains, potential sharing of property service crossing conduits, and the isolation of the drinking water main.

Any failure of the NDW mains or the DW retic are unlikely to cause a failure in the DW distribution main, which is the supply priority.

- DW distribution main on one side of road reserve, isolated from all other water mains
- NDW distribution main on the opposite side together with the DW and NDW reticulation mains

Figure 20 - Preferred Option, DW and NDW alignment

10.3.2.2 ALTERNATE OPTION 1

- DW distribution main and DW reticulation main located on one side of road reserve
- NDW reticulation and distribution mains on the opposite side

Figure 21 - Acceptable Option 1, DW and NDW alignment
10.3.2.3 ALTERNATE OPTION 2

- DW distribution main, and DW and NDW reticulation mains located on one side of road reserve
- NDW distribution main located on the opposite side
- This option is less preferred than Alternate Option 1 as the drinking and non-drinking water pipelines are not separated.

Figure 22 - Acceptable Option 2, DW and NDW alignment

The following options represent a last resort and should not be nominated by the design without extensive consultation with both YVW and the Road Reserve managers.
10.3.2.4 ALTERNATE OPTION 3 – LEAST PREFERRED

- DW & NDW distribution mains located on one side of road reserve
- DW and NDW reticulation mains located on the opposite side
- In some instances distribution mains are located as per this option, on the same side of a road reserve, to allow for future widening of the road reserve. If one of the preferred options are adopted this may result in a distribution main located in a future median strip which is not preferred.
- Minimum pipe clearances (outside pipe to outside pipe) apply to this option:
  a. DN375 to ≤ DN600 – 800mm minimum
  b. DN750 to ≤ DN1150 -1000mm minimum

Figure 23 – Option 3 – Least preferred, DW and NDW alignment

10.3.2.5 OPTION TO AVOID

- Both DN and NDW distribution mains and DW/NDW reticulation mains located on the same side of the road reserve.

Figure 24 - Option to avoid, DW and NDW alignment
10.3.3 Horizontal separation – Fittings, offtakes & bypasses

Where DW and NDW reticulation mains are located on the same side of a road reserve, the designer shall ensure that valves on the DW and NDW main are not installed immediately next to one another and preferably in front of separate properties. This avoids problems with valve supports and reduces maintenance and operational issues. MRWA Drawing MRWA-W-102B shows an indicative offset of 2.5m between DW/NDW valves, which MUST be adopted as a minimum for the design of YVW mains.

The same principle MUST also be applied to the design of hydrants and offtakes and bypass assemblies (for larger mains).

Where bypasses are constructed, pipeline clearances set out in this document and MRWA still apply.

If alternative locations cannot be achieved resulting in distribution mains located on the same side of a road reserve, valve clusters located near road intersections MUST be located on opposite sides of road intersection as follows*:

Figure 25 - Preferred location of valve bypasses at road intersections (DW & NDW)

*Note that the arrangements shown are nominal and the intent is to demonstrate the location of distribution valve bypasses proximate to intersections.
10.4 TEMPORARY CROSS CONNECTIONS (MRWA 2.7)

Temporary cross connections are an accepted method for NDW scheme “start-ups”, and provide an interim supply of DW to a NDW network, supply of water and satisfaction of developer to owner contract obligations. This occurs when a NDW reticulation network is constructed and residents connected, ahead of the distribution assets to a development. Initially the dual pipe reticulation networks supply drinking water via temporary cross connections.

All temporary cross connections MUST be completely removed prior to the commissioning of the NDW reticulation network with NDW. YVW has formulated a Business Rule for the management of temporary cross connections that MUST be referred to during the planning and design of all temporary cross connections. This Business Rule defines the responsibilities and tasks assigned to the process of planning; installing and removing a temporary cross connection.

Appendix B shows YVW’ Standard Design for Temporary Cross Connections, WM-000-008, which MUST be adopted for the design of all temporary cross-connections.

10.5 CROSS CONNECTION FACILITY

YVW are developing a standard drawing for a Cross Connection Facility that will enable supply from a drinking water network, to an adjacent non-drinking water network in the event of a NDW supply failure. This facility will be used to maintain supply to a non-drinking water network that has lost supply and has no alternate source. This connection is to be sized to supply minimum 10m pressure on a 95th percentile Peak Summer Day demand. During Planning of such a facility, the Water Growth Planning team are to identify location preferences and undertake hydraulic modelling to verify there is no detrimental impact to the DW network resulting from operation of the facility.

This facility will be used where permanent single sources of supply will exist. When interim or staged growth will propose a single source of supply for a substantial period a cross connection facility should also be considered, however this single source of supply may also exist for DW and therefore alternate arrangements or limiting the number of customers to <500 should also be considered.

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18 YWIN1016 – Business Rule, Management of Temporary Cross Connections
11 PUMPING STATIONS

11.1 GENERAL

With the exception of the principles relating to sizing of water pumping stations, which are covered by this document, the YVW document, Water Pumping Stations - Technical Standards19 and Standard Drawings, consolidates the requirements and specifications for the planning, design and construction of water pumping stations and MUST be read in conjunction with this document.

11.1.1 Pumping Station functions (MRWA 2.8)

Section 2.8.1 of the MRWA outlines the typical functions for which Water Pumping stations are used. With reference to this list, YVW design and operate pumping stations requiring the following functionality:

Figure 26 - Pumping Station Functions

- **Transfer**
  - Transfers water to a service reservoir
  - Operates in Level Control Mode
  - Known as Reservoir Water Pump Station in YVW Technical Standards

- **Distribution**
  - Distributes water to a distribution zone and concurrently supplies a service reservoir
  - Normal operation in Level Control Mode.
  - Pressure Control Mode available for operational outages of the service reservoir.
  - Known as Reservoir Water Pump Station in YVW Technical Standards

- **Booster**
  - Supplies customers directly
  - Increases or boosts pressure in a distribution zone either continuously or only during peak periods
  - Operates in Pressure Control Mode
  - Known as Booster Water Pump Station in YVW Technical Standards

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11.2 PUMPING STATION DESIGN

It is the intention of this document to set out the guidelines for sizing of water pumping stations, specifically the total demands the pumps are to supply, or total station flow. During planning, preliminary estimates are made as to the likely number of pumps and the possible configuration of the station. Staging of pump stations or temporary pump stations in growth areas should be considered as part of the Service Plan process.

These are nominal pumping arrangements formulated for the purpose of sizing, hydraulic modelling, network failure analysis and costing of the pumping station during the planning phase of the project.

The final configuration and number of pumps nominated for a specific pumping station is determined during the design phase of a project.

Further information is provided in YVW Document Water Pumping Stations – Technical Standards on the detailed design requirements of pumping arrangements.

11.3 SIZING REQUIREMENTS

11.3.1 General

Sections 11.3.2 and 11.3.3 outline the required demands a water reservoir and booster pumping station are to supply. The “size” of the water pumping station is calculated using these demand scenarios, and the performance of the station when supplying this demand evaluated by hydraulic modelling. This evaluation includes verifying pipe diameters, head loss and pump head requirements. The ultimate station size needs to ensure that the pump operates and provides sufficient head in all modes.

11.3.2 Reservoir pumping station

For a pumping station that fills a service reservoir, the required flow rate is based on replenishment of the Operating Storage of the Service Reservoir, rather than directly resulting from customer demand.

The supply zone may be located between the pumping station and the reservoir; and in most instances the function of the pumping station is to supply the reservoir, however when the pumps are operating, the zone demand is also concurrently being supplied by the pumps (usually overnight demands).

The station MUST be sized to supply the following demands:

- Transfer Average Day demand to service reservoir in a maximum of 8 hours (assumed to occur between 11pm and 7am)
- Transfer Peak Summer Daily demand to Service Reservoir in a maximum of 20 hours

11.3.2.1 Failure Analysis

If the pumping station is required to provide bypass to the Service Reservoir i.e. in the event of a service interruption to the service reservoir, the station MUST be sized to supply the following demands:

- Peak hour flow (L/s), during a 95% Peak Summer Demand day
- Minimum flow (L/s) on an Average Demand day.
All pumps (duty and standby) can operate to achieve these flow requirements (total station flow). No additional standby capacity is required in the event of a service interruption to the reservoir, unless the demands exceed the total capacity of the station (duty and standby).

This only applies to water pumping stations providing an alternate supply to a service reservoir zone when the service reservoir is offline. Specific design and equipment may be required to provide continuous supply during minimum flow periods depending on the individual pump size and arrangement. Refer to the Technical Standards for further information on pump station configurations and Section 8.3 for alternate sources of supply.

11.3.3 Booster Pumping Station

For a pumping station that provides continuous supply directly to customers the required flow rate is based on instantaneous demands.

The station MUST be designed to supply the following range of flows:

- Average Daily Demand - Minimum & Maximum instantaneous flow rate (L/s),
- 95% Peak Summer Demand Day – Minimum and Maximum instantaneous flow rates (L/s)
- Peak Summer Demand day – Peak hour flows, with a minimum of 20m pressure to the worst affected customer.

11.3.3.1 Failure Analysis

In the event of a mechanical failure, the station MUST supply the following demands:

- 95% Peak Summer Day – with the failure of a single pump, station to deliver Peak Hour demand (L/s), with a minimum of 10m pressure to worst affected customer.

Booster pumping stations may require specific design and equipment to provide continuous supply during minimum flow periods depending on the individual pump size and arrangement. Refer to the Technical Standards for further information on booster pump stations configurations.

When additional capability is required of the station beyond the modes of operation set out in Section 11.3.1.1 and 11.3.1.2 then these should be considered on a case-by-case basis. These are guidelines that must be satisfied as a minimum, if additional capabilities are required beyond those listed herein then they should be considered during the planning and design of the station and in consultation with YVW directly.
11.4 POWER RELIABILITY

This section includes guidelines for determining whether a Water Pumping Station Facility requires a permanent generator. The following guidelines may be varied based on the outcome of a site specific risk assessment and advice from Network Operations.

11.4.1 Booster Pumping Station

- A permanent generator is not required in boosted zones if the worst affected customer (e.g. the customer at the highest elevation) receives a minimum 10m pressure during the peak instantaneous demand on a 95%ile PSD, from an automatic alternate supply source. This provision is applied to emergency outages only and is not considered sufficient for planned interruptions.
- Permanent generators are required where the above requirement cannot be met.

11.4.2 Reservoir Pumping Station

Permanent generators are generally not required but may be deemed necessary after a site-specific risk assessment.

Note: In YVW's Fire Danger Day Zone a mobile generator is installed at pumping stations for the summer operating period if no permanent generator is installed.

The following should be considered in determining the requirement for a permanent generator:

- Can a mobile generator deliver the required electrical capacity? If not then consider permanent generator
- Are dual power feeds available to the site? Can these be sourced for interim and ultimate service requirements? If yes, then the site does not require a generator, if no consider a permanent generator.
- A station specific risk assessment

The requirement of a generator should be discussed with the project team during the design phase of a project.

11.5 STAGING PUMP CAPACITIES

In growth areas pump stations can be staged with the installation of a lesser number of pumps or different sized pumps in the initial construction with provision for installation of future pumps.

In these instances the number of lots the pump station can service, based on the flow capacity of the interim station, and the number of lots released by YVW through Complete Servicing Advice, MUST be tracked to ensure augmentation works are completed as required. This should also be documented in Water Growth Planning’s Service Plans for growth areas.

Temporary pump stations should also be considered to help defer larger infrastructure, particularly if costly or difficult to construct (alignment through paddocks, difficult access etc.) in the interim. An NPV and risk assessment should be completed where temporary pump station options exist. This should also be documented in Water Growth Planning’s Service Plans for growth areas.
11.6 PUMP POWER CONSUMPTION & COST

Pump power consumption is calculated using the following equation:

Equation 1 - Pump power consumption

\[ \text{Pump kW} = \frac{Q \times H \times S.G. \times g}{1000 \times E_f} \]

Where

- \( Q \) = Flow rate (L/s)
- \( H \) = Pump head (m)
- \( E_f \) = Pump efficiency*
- \( S.G. \) = fluid specific gravity (1.0 for DW and NDW)
- \( g \) = acceleration due to gravity (9.81m/s²)

* \( E_f \) = combined pump & motor efficiency (0.7)

The applied flow rate (L/s) and pump head (m) should be based on an Average Day peak hour demand (i.e. not a peak summer day, peak hour demand).

Power Consumption of the motor can be estimated using the following equation:

Equation 2 - Motor Power Consumption

\[ \text{Motor kW} = \frac{\text{pump kW}}{E_f \text{motor}} \]

Cost per year = ($/kWh) x (number hours run per year) x (motor kW)

For water pump stations, the number of hours run will be in the range of:
- 24hrs per day for booster pump stations constantly boosting a zone
- 8hrs per day for pump station filling a tank
- Will need to be calculated for other booster pump stations based on operation (look at SCADA data)

11.7 RELIABILITY OF SUPPLY

Prior to issuing a Functional Design Statement, the design of a water pumping station and associated supply zone should be subject to a design criteria check (overleaf) to assess the provision of supply to the zone in the event of failures.

In addition, a dual supply is preferred on both the inlet and outlet of a Booster Pump Station.
11.7.1 Reliability of Supply – Reservoir Pumping Stations

**RESERVOIR PUMPING STATION**

Verify the station meets the following criteria:

Section 11 - Water Planning and Design Principles

1. **DESIGN**
   - Station MUST be able to transfer average day demand to service reservoir in a maximum of 8 hours (assumed to occur between 11pm to 7pm)
   - Transfer Peak Summer Daily demand to Service Reservoir in a maximum of 20 hours
   - Standby pump to be of equal capacity to largest pump in station (See Water Pumping Stations – Technical Standard, Section 2.3 (b))

2. **HYDRAULIC MODELLING**
   - Station is sized such that the water level in the tank does not go below the bottom level of the nominated Operating Storage for any non-failure scenario
   - Verify station transfers average day demand to service reservoir in a maximum of 8 hours
   - Verify the station can transfer the Peak Summer Day demand to the Service Reservoir in a maximum of 20 hours.

3. **FAILURE ANALYSIS**
   If the pumping station is to include the functionality of bypassing the Service Reservoir, verify the following:

   During an interruption to the Service Reservoir (tank offline), pumps can supply:
   - A minimum 10m pressure to entire supply zone during Peak Hour of a 95%ile Peak Summer Day flows (l/s)

**Analysis Complete**
11.7.2 Reliability of Supply - Booster Pumping Station

Verify the station meets the following criteria:

1. DESIGN

Section 11 Water Planning and Design Principles

- Station MUST be able to supply range of flows as per Section 11.3.3, Water Planning and Design Principles
- Standby pump to be of equal capacity to largest pump in station (See Water Pumping Stations – Technical Standard, Section 2.3 (b))

2. HYDRAULIC MODELLING

- Verify station delivers a minimum 20m pressure to entire supply zone during the Peak Hour of the Peak Summer Day

3. FAILURE ANALYSIS

ELECTRICAL FAILURE

- Verify Alternate source (Service reservoir) can supply zone with Peak Hour (L/s) flows on a 95%ile PSD with a minimum of 10m pressure. If alternate source cannot deliver minimum pressure, site requires a permanent generator

MECHANICAL FAILURE

- Test via hydraulic modelling that Station can deliver peak hour demands (L/s) with a minimum of 10m pressure across the zone, on a 95%ile PSD, with the failure of any one pump

Analysis Complete
12 SERVICE RESERVOIRS/BALANCING STORAGE TANKS

12.1 GENERAL

The following principles for the planning and design of reservoirs MUST be read in conjunction with the YVW document, *Service Reservoirs – Water Tank Technical Standards*.

It is the intention of this section to outline YVW’s planning and design principles for Service Reservoirs and Balancing Storage Tanks, specifically the methodology and associated considerations for sizing these storage facilities. Both this document and the Technical Standards outline the components of from which a total tank volume is comprised, and discrepancies between the two documents should be referred to the Manager of Water Growth Planning for clarification.

12.2 STORAGE TYPES

There are two (2) separate types of water storage facilities in YVW’s network:

1. Service Reservoirs (Drinking or Non-Drinking water) - typically and often preferentially this storage takes the form of a cylindrical steel tank or a number of such tanks
2. Balancing Storage Tanks (NDW) – this tank receives inflows directly from a NDW treatment plant for transfer to a service reservoir or direct to a distribution zone via pumping.

12.2.1 Service Reservoirs

A Service Reservoir serves three major functions within the water supply network:

1. Provide an operating storage to balance the fluctuating demands from the distribution network against water supplied during a preferred operating time frame (typically supply to the tank occurs between 11pm to 7am, whereas demand is continuous);
2. Provide an emergency storage component for failures;
3. Reduce ongoing supply/distribution costs by passively maintaining pressures in the network (achieved by locating tanks at suitably high locations, proximate to the network).

In addition to the above functions typical of all Service Reservoirs, certain Service Reservoirs may be required to provide an additional transfer function, whereby it supplies both directly to a supply zone and other reservoirs (further downstream) for which it is a source. Specific design allowances are applicable to the design of Service Reservoirs that include a transfer function, as set out in Section 12.5.4 – Emergency Storage

12.2.2 Balancing Storage Tanks

A Balancing Storage Tanks serves two major functions:

1. To buffer non-drinking water pump station flows and the lesser treatment plant inflows (which may be reduced to nil during periods of plant backwash); and,
2. Provide a stable pressure for the NDW pump station to operate efficiently.

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20 Service Reservoirs - Water Tank Technical Standards & Standard Drawings
12.3 SERVICE RESERVOIRS

12.3.1 Control philosophy
The basic control philosophy for service reservoirs is outlined in Section 1.6 of the Service Reservoir – Water Tank Technical Standards.

12.4 SERVICE RESERVOIR TYPE
YVW prefer that new tanks are a cylindrical steel reservoir with an aluminium-covered roof. Section 5 of the Service Reservoir – Water Tank Technical Standards outlines YVW reservoir requirements in detail.

12.5 SERVICE RESERVOIR SIZING
The following Sections outline the methodology and principles used for sizing Service Reservoirs.

12.5.1 Total Tank Volume
Total tank volume is the sum of the following components
1. Freeboard
2. Operating Storage
3. Emergency Storage
   a. Reserve Storage
   b. Fire Storage
   c. Transfer Storage
4. Dead Storage

Each of the tank components are estimated using the methods set out in this document. YVW have developed a calculator to estimate the size of a Service Reservoirs and Balancing Storage Tanks. This calculator provides a preliminary estimate of a Service Reservoir’s required size, and is outlined further in Section 13.7. Calculation of the required operating storage and emergency storage volumes MUST be verified by hydraulic modelling.

Figure 27 - Drinking Water Service Reservoir – Internal Volume Components
12.5.2 Freeboard

The freeboard in a tank refers to the volume between the top water level and the top of the shell. The guidelines for calculating Freeboard differ for drinking and non-drinking water tanks is determined using the methods set out in Section 12.5.2.1 and 12.5.2.2. NDW tanks are designed with a Drinking Water Top-Up, detailed in Section 12.9. The arrangement of this top-up is a drinking water pipe directly into the Balancing Storage or NDW Service Reservoir via the roof with an air gap. NDW tank freeboard includes an allowance for the top-up and air gap arrangement.

In both DW and NDW storage tanks, a one-hour response time between the top water level and the overflow level is included in the freeboard. This provides for possibly operational lag between signals (in addition to the provisions included in the Operating Storage Volume).

12.5.2.1 Freeboard – DW Tanks

For DW Tanks, in addition to the one-hour response volume, the freeboard should include provision for a 200mm gap between the spill level and the tank roof and 150mm between the overflow and spill levels, with the total freeboard calculated as follows:

<table>
<thead>
<tr>
<th>DW Freeboard Component</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-hour response</td>
<td>Peak pump capacity over one (1) hour</td>
</tr>
<tr>
<td>Overflow – Spill level</td>
<td>150mm* of tank height</td>
</tr>
<tr>
<td>Spill level – Tank roof</td>
<td>200mm of tank height</td>
</tr>
<tr>
<td><strong>TOTAL FREEBOARD</strong></td>
<td><strong>Peak pump capacity over one hour + 350mm</strong></td>
</tr>
</tbody>
</table>

*150mm is a fixed estimate based on AWWA guidelines
12.5.2.2 Freeboard – NDW Tanks

For NDW Tanks, in addition to the one-hour response volume, the freeboard should include provision for a 150mm gap between the spill level and the DW top-up pipe outlet, 150mm between the overflow and spill levels and 200mm between the DW top-up pipe outlet and the tank roof.

In summary, the total tank freeboard is:

<table>
<thead>
<tr>
<th>NDW Freeboard Component</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-hour response</td>
<td>Peak pump capacity over one (1) hour</td>
</tr>
<tr>
<td>Overflow – Spill level</td>
<td>150mm of tank height</td>
</tr>
<tr>
<td>Spill level – DW top-up pipe outlet</td>
<td>150mm of tank height</td>
</tr>
<tr>
<td>DW top-up pipe outlet – tank roof</td>
<td>200mm of tank height</td>
</tr>
</tbody>
</table>

**TOTAL FREEBOARD**  Peak pump capacity over one hour + 500mm
12.5.3 Operating Storage

The Operating Storage balances the fluctuating demand of the distribution supply zone against input into the reservoir and operating lag. When the rate of withdrawal is greater than the rate of input, the Operating Storage is utilised.

As this storage component balances demand and inflow, its size will depend on the following:

- Diurnal demand;
- Inlet capacity; and,
- Operating lag

*Diurnal demand* for new systems is calculated in accordance with Section 6. Calibrated hydraulic models and SCADA data *should* be used for existing systems.

The *Inlet capacity* is limited to the capacity of the inlet pipe, and the flow rate of the supply pumps.

The *Operating Lag* is an allowance added to the Operating Storage volume that accounts for variations in supply to the tank due to operational settings and that tanks may not be full at the beginning of a peak day. The operational reasons include stepwise operation of reservoir inlet valves and non-continuous operation of pumps. To allow for such operational deficiencies, any calculated volume for the operating storage must be increased by 10 percent.
The Operating Storage volume is approximately the average day demand of the supply zone plus 10%. This volume **MUST** be verified by Hydraulic Modelling.

### 12.5.4 Emergency Storage

The Emergency Storage is reserved continually within the reservoir and is intended for use in specific emergencies only, namely, inlet main failure or fires in the supply zone.

In this guideline
- Reserve Storage applies to the volume required to cater for inlet main failure;
- Fire Storage applies to the volume required to cater for fire emergencies and is only to be included in fire prone areas;
- Emergency Storage provides for the greater of either Reserve storage or Fire storage requirements;
- Emergency Storage is a component of the tank volume in Service Reservoirs only. Emergency Storage **should not** be included in a Balancing Storage Tank. In the event of supply interruption from the associated Non-Drinking water treatment plant, the Balancing Storage Operating Storage volume is maintained by supply from a Drinking Water Backup directly into the tank.
- In addition, tanks that provide a transfer function, i.e. they supply not only a distribution zone/s but also other tanks in the network, are to include an Emergency Storage component called Transfer Storage.
- Reserve Storage for NDW tanks is based on the worst supply period on a 95%ile Peak Demand Day

#### 12.5.4.1 Background

Historically, the Emergency Storage volume was maintained in the tank to cater for all component failures and emergencies and was affected by multiple failure modes relating to the tank, the inlet supply main and the supplying pump station.

In 1998-99, a Yarra Valley Water Study concluded that increasing the Reserve Storage to cater for failures at the pump station was uneconomical, and the same level of security is achievable by other more efficient means. The study recommendations, adopted by YVW, are that Reserve Storage should **only** cater for emergency hydrant flows (fire).

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21 [204 Security of Supply Business case\Report\Appendix 1- Asset Sizing Memo in 1999.pdf](#)
12.5.4.2 Reserve Storage

The reserve storage for Service Reservoirs shall be determined from the table below:

Table 8 - Reserve Storage Calculation

<table>
<thead>
<tr>
<th>Customers Supplied</th>
<th>Design Reserve Storage for Worst X Hours of PSD demand</th>
<th>Design Reserve Storage for Worst X Hours of 95%ile PSD demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5000</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>5000-10000</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>10001 - 15000</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>&gt;15000</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

The reserve storage determined from Table 8 may be reduced by an amount available from an alternate supply (Refer Section 8.3) on a 95%ile PSD should the inlet main fail.

The provision for NDW is based on 95%ile PSD demands, rather than PSD demand, as this storage includes an additional redundancy via the Drinking Water Top-Up, refer to Section 12.9 of this document.

12.5.4.3 Fire Storage

Provided there is sufficient, spare pumping capacity, increased pumping into a reservoir will enable withdrawal in a supply zone for fire-fighting purposes. However, fires typically occur on days of hot, dry weather and this often promotes an increased use of electrical power, resulting in blackouts that may suspend the operation of a supply pump station. Consequently, provision of water for fire emergencies is located within a reservoir, as additional volume, rather than an increased capacity of supply pumps.

If supplying fire prone areas, the Emergency Storage should be at least equal to the Fire Storage. This is nominally 40L/s over 4 hours (0.6 ML) or as deemed appropriate by an independent study.

A fire prone area is either an area designated as bushfire prone by the local council, an area with a Fire Danger Day Zone or as determined by a site-specific study.


12.5.4.4 Transfer Storage

The purpose of transfer storage is to provide an emergency volume in Service Reservoirs that are a source for other Service Reservoirs. The required transfer storage volume is four (4) hours of the average Peak Summer Demand Day flow rate (L/s).
12.5.5 Dead Storage

The purpose of the dead storage is to provide a minimum water level required to maintain adequate hydraulic grade and prevent sediment wash off and air entrapment in the outlet main.

Guidelines for calculating the height of the Dead Storage should be shown in Table 2 of YVV Drawing Tank Floor Openings and Fittings Details, WR000-012-C with reference to Section B of the same drawing. The estimate is based on the diameter of the inlet main and the anti-vortex baffle.
12.6 BALANCING STORAGE TANK SIZING

The sizing of a Balancing Storage Tank is as per the method applied to Service Reservoirs in Section 13.5; however, the Balancing Storage includes a Drinking Water Backup system, in lieu of an Emergency Storage Volume.

Total Balancing Storage Tank volume is the sum of the following components:

1. Freeboard
2. Operating Storage
3. Dead Storage

For calculating the required freeboard and dead storage, refer to the methods set out in this document in Section 13.5.2 and 13.5.5 respectively.

12.6.1 Operating Storage
The Operating Storage in this tank must function to balance out the pump demands with the inflows from the NDW treatment plant. The operating storage will therefore largely depend on the following:

- System demands and capacity of the pumps (Refer to Sections 6 & 12.3)
- Operating lag (Refer to Section 13.5.3); and,
- Inlet supply from the treatment plant

The design of the treatment plant and subsequent Inlet Supply rate is outlined in Section 14 of this document, with inflows assumed to occur over 24 hours.
The sizing of the operating storage **MUST** be done using hydraulic simulation. Typically, the Balancing Storage Tank is sized once all other network components are sized; the balancing storage is sized to operate such that the level in the tank does not enter the dead storage at any time during a Peak Week Event (Refer Section 6.10 – Peak Week).

**12.6.2 Tank bypass - Service Reservoir**

Section 2.1 of Service Reservoir – Water Tank Technical Standards, specifies that all tanks with a separate inlet/outlet **should** be designed with a bypass, sized to meet 95%ile Peak Summer Day (95%ile PSD) demands. If there is an alternative source of supply to the zone that can meet 95%ile PSD demands, the bypass pipework size may be reduced. The bypass should have a valve with a pressure reducing function to protect the zone from excessive pressures.

In the above, the following applies:

Where a bypass is required for a Service Reservoir supplied by pumping, supply Water Pumping Station pumps **should** be sized to supply the Distribution Zone, with a minimum of 10m pressure during the peak hour on a 95% Peak Summer Demand day. Refer to Section 11 of this document for further information regarding the design of the Pumping Station.

If a bypass is required for a Service Reservoir supplied by gravity, the provisions set out in Section 2.6 of the Technical Standards are applicable.

This provision is intended to maintain supply during Emergency outages of the Service Reservoir, and is not considered sufficient for planned tank outages.

During planning of the Service Reservoir and/or supply Water Pumping Station, the efficacy of the systems operation in bypass mode is a requirement under Reliability of Supply Analysis.
12.7 DETERMINATION OF TANK SIZE

Water Growth Planning has developed a calculator for sizing of drinking and non-drinking water pumping stations, service reservoirs and balancing storage tanks (referred to as the Asset Calculator). The Asset Calculator\textsuperscript{23} incorporates all previously detailed design criteria and assumptions relating to Water Pumping Stations and Reservoirs. This tool enables the user to determine preliminary asset sizes for use and subsequent verification via hydraulic modelling; it also calculates the required volumes and sizes of the various storage components. The component volumes for both Service Reservoirs and Balancing Storage Tanks **MUST** be verified by Hydraulic Modelling.

The calculator enables the user to enter demand information and supply flow rate together with nominal estimates of the tank diameter, and will provide an estimate of the tank dimensions, including the height and volume for each of the internal components. A sample of the output from the calculator, for the sizing of a Drinking Water Service Reservoir is shown below in Figure 32.

\textbf{Figure 32 - Asset Calculator output}

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
\textbf{Scenario} & \textbf{Us} & \textbf{ML/d} \\
\hline
Average Day & 120.10 & 8.69 \\
95th Day & 186.96 & 14.16 \\
Peak Day & 240.24 & 19.98 \\
\hline
\end{tabular}
\end{table}

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|}
\hline
\textbf{Component} & \textbf{Volume (ML)} & \textbf{Storage (%)} & \textbf{Height (m)} \\
\hline
Operational Storage & 8.10 & 35.93 & 0.36 \\
Emergency Storage & 12.71 & 51.40 & 0.72 \\
Fire Storage & 0.00 & 0.00 & 0.00 \\
Freeboard & 1.44 & 2.68 & 0.36 \\
Dead Storage & 0.56 & 6.92 & 0.90 \\
\hline
\textbf{Total} & 20.80 & 100.09 & 13.09 \\
\hline
\end{tabular}
\end{table}

\textbf{Pumping Station}

\begin{itemize}
\item \textbf{Demand}:
\begin{itemize}
\item Average Day
\item 95th Day
\item Peak Day
\end{itemize}
\end{itemize}

\begin{itemize}
\item \textbf{Service Reservoir}:
\begin{itemize}
\item Operational Storage
\item Emergency Storage
\item Fire Storage
\item Freeboard
\item Dead Storage
\end{itemize}
\end{itemize}

\textbf{Drinking Water Service}

\begin{itemize}
\item \textbf{Freeboard} = 1.44 ML
\item \textbf{Operational Storage} = 8.10 ML
\item \textbf{Emergency Storage} = 12.71 ML
\item \textbf{Dead Storage} = 0.56 ML
\end{itemize}

\textbf{Total Tank Volume} = 20.80 ML

\textsuperscript{23} \textbf{ASSET CALCULATOR (I\:SGP\:4, Design Principles\:Water\:Potable & Class A Infrastructure Sizing.xlsx)}
12.8 BALANCING STORAGE TANKS

12.8.1 Control philosophy

Unlike Service Reservoirs, the preferred control philosophy for a Balancing Storage Tank is that in addition to maintaining set water levels and preferred pump operation as for Service Reservoirs; its operation needs to consider and aim for operational efficiency of the NDW treatment plant. Treated NDW is pumped from the NDW treatment plant to the Balancing Storage Tank; this water is then stored until it is required to supply the NDW water pump station.

Figure 33 - Transfer from NDW Treatment Plant to NDW network

12.9 DRINKING WATER TOP-UP

All NDW service reservoirs and Balancing Storage Tanks MUST be able to receive supply from the drinking water network; referred to as a Drinking Water Top-up.

The arrangement of this top-up is a drinking water pipe directly into the Balancing Storage or NDW Service Reservoir via the roof with an air gap. This inlet or supply point terminates at a level that is 150mm above the spill level of the overflow bell mouth located inside the NDW Service Reservoir to provide an air gap.

Supply from the Drinking Water Top-up occurs when a nominated cut-in level in the storage is reached, refer to Figure 34 overleaf. Operation of the Drinking Water Top-up will depend on the supply requirements, and may or may not operate automatically. A requirement for automatic operation of the Drinking Water Top-up should be identified during the design and the Top-Up designed to accommodate this requirement.
12.9.1 Drinking Water Backup - Design and Sizing

The drinking water backup system to both a Service Reservoir and Balancing Storage Tanks **MUST**: 

- Be sized to supply a minimum flow rate equal to that supplied from the NDW Treatment Plant i.e. average hour on a 95%ile day demand
- Be tested using hydraulic modelling to assess the effect on the drinking water supply (model)
- Not adversely impact the drinking water network it is supplied by on a 95%ile day, i.e. the drinking water network should continue to operate in accordance with the hydraulic parameters and other requirements set out in this document
- As a minimum, include a check valve on the DW supply main to prevent backflow, and a manually operated gate valve to stop the DW supply to the tank. Automatically controlled valves **should** be electrically actuated.
12.10 RELIABILITY OF SUPPLY ANALYSIS – SERVICE RESERVOIR

![Diagram of reliability analysis process]

Service Reservoir to meet the following criteria:

Section 12 – Water Planning and Design Principles

1. DESIGN
   - Tank volume components sized in accordance with Section 12.5 Water Design Principles
   - NDW tank design to include drinking water top-up, Section 12.9
   - Tank to be designed with bypass (reduced size if alternate supply available, refer Service Reservoir - Technical Standards, Section 2.1)

2. HYDRAULIC MODELLING
   - For all non-failure scenarios, verify Tank Operating Storage volume is sized correctly and water level in Service Reservoir does not go below base of nominated Operating Storage (Operating Storage cut-in level)
   - Verify reservoir can supply a minimum of 20m pressure to supply zone during Peak Summer Day

3. FAILURE ANALYSIS
   SERVICE RESERVOIR OFFLINE (Bypass flow)
   - Verify alternate supply (gravity or pumped) can supply 10m pressure during Peak Hour of 95%ile Peak Summer Day

FAILURE OF NDW INLET SUPPLY MAIN (NDW Service Reservoir Only)
   - Verify drinking water top-up to Service Reservoir can supply minimum 95%ile PSD average hour flow rate. If top-up cannot supply minimum flow rate, Consider the installation of a cross-connection facility, Section 10.4 of Water Planning and Design Principles

Analysis Complete
13 NON-DRINKING WATER TREATMENT PLANT

13.1 BACKGROUND

The NDW treatment plant directly supplies the Balancing Storage Tank located at a NDW treatment facility. Operation of the NDW supply is reliant on the production of non-drinking water from this facility.

13.2 SIZING

The key assumption applied to the sizing of a NDW Treatment Plant is that Drinking Water Top-up (see Section 12.9.1) is only engaged as an emergency supply to the Balancing Storage Tank storage when the treatment plant is off-line. It is not to be engaged to meet peak demand events and therefore the NDW supply system i.e. NDW treatment plant, NDW Balancing Storage Tank and NDW Pumping Station located at the treatment facility MUST be able to maintain supply during peak demand days.

The NDW Treatment Plant should be sized in accordance with the following guidelines:

- For supply to normal residential developments (i.e. with gardens), the ultimate NDW Treatment Plant size is to supply the average hour demands on the 95%ile Peak Day demand of the zone.
- Limiting the capacity to service a limited period of development will minimise the underutilisation of the membrane systems.
- In those instances where there is limited external water use, predominately in infill development, the treatment plant is designed for 1.2 times the Average Day. This additional allowance of 20% will cater for some external use should it arise, such as leakage.
- In most instances the NDW Treatment Plant should be sized to meet expected demand for the next 4-5 years. The treatment plant should only be upgraded once demand approaches the built capacity and not based on the duration of operation.

These guidelines are limited to the desired capacity of the NDW Treatment Plant, and do not apply to specific equipment and component figurations.
14 PRESSURE REDUCING STATIONS

14.1 GENERAL
The requirements for the planning and design of pressure reducing stations are set out in the YVW document, Pressure Reducing Stations – Technical Standards, Section 2.4.

14.2 SIZING
In addition to the requirements set out in the Technical Standards, the following applies to the sizing of Pressure Reducing Station:

- Each of the pressure reducing valves in a double valve pressure reducing station **MUST** be sized to deliver a minimum of 20m pressure to the supply zone on a 95%ile PSD.
- Every pressure reducing station must have a bypass capable of delivering as a minimum, 20m pressure to the supply zone, during the Peak Hour of a 95%ile PSD.

14.3 RELIABILITY OF SUPPLY ANALYSIS
Section 2.3 of the Technical Standards states that:

“A pressure reduced zone may be supplied by one pressure reducing station or multiple stations. The number of identical pressure reducing valves in each station shall be as follows:

- For a station which is the only source of supply to the zone - Two
- For multiple stations feeding the zone – Two for at least one station and one for others

In the double valve station, one of the valves has the downstream pressure setting at slightly lower than the other valve which can be taken as the primary valve. If the downstream pressure is higher than the setting of the secondary valve, only the primary valve will be in the open position. The secondary valve will open when the downstream pressure falls below its setting.”

In addition, a dual supply is preferred on both the inlet and outlet of the Pressure Reducing Station.

Prior to issuing a Functional Design Statement for the design of a pressure reducing station, the PRV station and associated supply zone **should** be subject to a design criteria check (overleaf) to assess the provision of supply to the zone in the event of failures. The number of stations supplying a zone and the configuration thereof should be clarified prior to undertaking this assessment.

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24 Pressure Reducing Stations - Technical Standards
Verify the station meets the following criteria:

1. DESIGN
   Section 14 - Water Planning and Design Principles
   - Designed in accordance with Section 14 of the Water Planning and Design Principles
   - Downstream distribution pipework (not reticulation) to be rated to suit maximum design pressure in the event of a PRV failure (open)
   - Station sized to transfer 95%ile PSD, Peak Hour flows (L/s), with a minimum 20m pressure
   - Station to include bypass capable of supplying Peak Hour flows (L/s) 95%ile PSD demand

2. HYDRAULIC MODELLING
   - Verify station(s) deliver a minimum 20m pressure to entire supply zone during the Peak Hour of the PSD demand
   - Outlet or downstream pressure is not less than 35% of the inlet pressure

3. RELIABILITY OF SUPPLY
   - Model supply zone with PRV station failed verify secondary pressure controlled source can supply a minimum 10m pressure to zone during 95%ile PSD demand scenario.

Verify the station meets the following criteria:

1. DESIGN
   Section 14 - Water Planning and Design Principles
   - Designed in accordance with Section 14 of the Water Planning and Design Principles
   - Downstream distribution pipework (not reticulation) to be rated to suit maximum design pressure in the event of a PRV failure (open)
   - Station must be designed with a minimum of two (2) identical pressure reducing valves
   - One of the valves MUST be sized to transfer Peak Hour (L/s) 95%ile PSD demand
   - Station to include bypass capable of supplying Peak Hour flow (L/s) for 95%ile PSD Demand

2. HYDRAULIC MODELLING
   - Verify station delivers a minimum 20m pressure to entire supply zone during the Peak Hour of the PSD demand
   - Outlet or downstream pressure is not less than 35% of the inlet pressure

3. RELIABILITY OF SUPPLY
   - Model supply zone with PRV station failed verify secondary pressure controlled source can supply a minimum 10m pressure to zone during 95%ile PSD demand scenario
   - Based on hydraulic modelling results - summarise pressures supplied across zone from alternate source during PRV failure
15 DRINKING WATER QUALITY DESIGN PRINCIPLES

15.1 GENERAL
This section provides the design principles Yarra Valley Water (YVW) employs to manage the safety and quality of its drinking water. These principles are a compilation of issues and considerations unique to Yarra Valley Water and are to be used in addition to those specified in MRWA.

15.2 BACKGROUND
YVW has a legal obligation to provide safe and aesthetically pleasing water to customers. The Victorian Department of Health (DH), via its administration of the Safe Drinking Water Act 2003 (Act) and Safe Drinking Water Regulations 2005 (Regulations), enforces these obligations. The objectives of the Act and Regulations are to ensure that Victorian water companies comply with the standards therein, and, together with the adoption of a risk based approach to drinking water safety and quality, ensure that all Victorians have access to a base level of water safety and quality. In addition to the requirements of the Act and Regulations, YVW’s risk management plan for water quality complies with the Australian Drinking Water Guidelines 2004 (ADWG). The ADWG is a national guideline for water safety and quality, developed by the National Health and Medical Research Council, and is recognised as industry best practice.

15.3 SAFE DRINKING WATER – HEALTH CONSIDERATIONS (MRWA 2.6)
The MRWA specifies that the water supply network configuration shall include allowance for factors that influence water quality. From a design perspective, the key considerations for the provision of safe drinking water are:

- Adequate disinfection;
- Minimising the risk of back siphoning (backflow) from customer properties;
- Preventing/controlling contaminant intrusion;
- Preventing/controlling contamination during shut down of water mains (planned and emergency);
- Minimising water age which can result in high pH levels, taste issues, loss of chlorine residual;
- Corrosion and deterioration of infrastructure;
- Management of entities that extract water from our water supply (e.g. water carters);
- Material selection; and,
- Ongoing maintenance of all fittings
- Management of Cross Connections

The following sections outline in more detail some of the above considerations.

15.3.1 Providing Adequate Disinfection (MRWA 2.6.4)
Melbourne Water supplies YVW with water after primary disinfection and in accordance with the obligations of the BWSA. The majority of YVW service area is supplied with water that Melbourne Water disinfects with chlorine.

Chlorine is used to disinfect water from our catchments (raw water) to remove pathogens (disease causing microbes). Effective disinfection depends on the type of microbes in the raw water, the amount of suspended sediments present (that shield and feed these microbes) and an adequate chlorine Contact Time (Ct) being achieved to ensure that an adequate reaction time is provided to kill these microbes. Ct is a basic multiplication of the chlorine concentration by time. As time reduces chlorine concentration must increase to achieve adequate disinfection.

In YVW’s south-eastern fringe areas UV provides primary disinfection and chlorine secondary disinfection due to customer proximity to the treatment plants i.e. time to first customer is small and chlorine concentration would need to be very high.

### 15.3.2 Secondary (Booster) Chlorination

YVW uses secondary chlorination to manage variation in chlorine residuals for systems that experience significant variability and for long or low turnover systems (for example, pipeline to Wallan) where chlorine residual decays.

Chlorine is also used to manage taste and odour complaints in areas likely to have low turnover (greater than 2 days), particularly in those further away from the primary chlorinator. Chlorine variability and low chlorine residuals are likely causes of customer taste and odour complaints.

Ct does not apply to secondary chlorinators.

The installation of secondary chlorinators **MUST** be considered in system planning where chlorine residuals are likely to significantly deteriorate or vary. All efforts should be made to ensure a minimum chlorine residual is maintained throughout YVW's reticulation.

### 15.3.3 Prevention Of Back-Siphonage / Backflow (MRWA 2.6.2)

While the water supply system remains pressurised external contaminants cannot enter the water supply network. However in the event that the system loses pressure (e.g. a burst or shutdown) this barrier is removed and backflow can occur without adequate controls. Backflow sources include:

- The internal plumbing of customers (hospitals/morgues/industrial sites in particular)
- Contents of water tankers,
- Pits containing water with fittings connected to the water network e.g. air valves, hydrants, scour

YVW requires the risk of backflow from customers to be rated from low to high, and an appropriate Backflow Prevention Device to be selected and installed. Backflow prevention devices **MUST** be selected and maintained in accordance with AS 2845.1 Water Supply – Backflow Prevention Devices.

YVW maintain a policy on Backflow Prevention25

WSAA specifies that hydrants, air valves and scour should be located and operated to minimise the likelihood of external water (such as groundwater or stormwater) entering the system.

Where a hydrant is installed below ground, Designers **MUST** ensure that a spring-loaded hydrant is installed to counter the effects of a loss of pressure.

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25 [YBUS0093 Backflow Prevention Policy](#)
Dual acting air valves **MUST NOT** be installed in a pit. Dual acting air valves permit the passage of air in and out of the main which is essential when a main must be emptied, however this may also allow contaminants to enter the system if the valve is submerged in a pit.

### 15.3.4 Sedimentation

YVW's metropolitan water network is supplied with water from both filtered and unfiltered sources. Unfiltered water sources carry a higher sediment loading which settles during low flows in the water network. Resuspension of sediments occurs during higher flow conditions and generates customer calls. YVW has undertaken much research on dirty water issues and found fewer water quality issues are experienced downstream of tanks and in filtered water source areas.

Where economically feasible, the use of tanks (e.g. Off MW assets) is encouraged. Tanks allow sediments to settle and consequently less sediment is transported into the reticulation system.

### 15.4 TASTE AND ODOUR

#### 15.4.1 Water age and turnover (MRWA 2.6.3)

The MRWA specifies that drinking water supply systems shall be designed to optimise water age in the system. Designers therefore should adequately design the system to minimise water age and thus prevent excessive decay of chlorine residual leading to water quality deterioration. This deterioration can be due to stagnation, altered pH, aesthetics, and regrowth of microorganisms leading to Biofilm formation. There is no fixed age at which chlorine residual will drop below a level at which water quality deterioration begins, as the rate of chlorine decay is not only dependant on water age, but on several variables. These include temperature, the amount and type of Biofilms already present in the pipes the water passes through, and any other organics present with which the chlorine will react.

To manage water age and turnover, the following considerations **should** be made (unless a mandatory requirement is specified) during planning and design:

- **Large mains should** turnover at least once per day (based on average day demands), at full development.
- **Infrastructure MUST not** be oversized. Staging with smaller capacities reduces the likelihood of water quality issues.
- **Where a water age of greater than two (2) days, secondary** chlorination should be investigated, preferably at reservoir sites.
- **Where possible and as a priority, avoid low flow situations.**

#### 15.4.2 Biofilms

Biofilms are comprised of microbial cells and a matrix of polymers excreted by these cells. Biofilm development is undesirable in the water supply system because they create various tastes and odours,
accelerate chlorine decay, decrease internal pipe diameter and affect the coefficient of roughness. Biofilms can also be a source of sediments as they produce natural organic matter that can be released into the water supply through sloughing or natural shedding.

Biofilm formation depends on a complex combination of the following factors:

- Nutrient levels
- Disinfectant concentrations
- Temperature (this also affects chlorine decay rate)
- Pipe material
- Velocities

Biofilm formation is highly variable. Biofilms are capable of utilising a wide range of chemicals present in the water supply system for energy production, ranging from natural organic matter, to the rubber in joints and any plasticisers that may be present in PVC.

Low velocities allow settlement and adsorption of microbes to the pipe wall, and loss of chlorine residual means microbial growth is no longer inhibited. Biofilms become established and flourish, accelerating the decay of any new chlorine residual brought in by fresh water.

To minimise Biofilms, the water network must be planned to keep velocities and chlorine residual up. Susceptibility to Biofilm formation must be considered when selecting materials, particularly where velocities and chlorine residual are likely to be lower.

The velocity level and frequency required to slough Biofilms off surfaces is unknown. However, research into sediment re-suspension has determined that while in a 100mm diameter pipe a velocity of approximately 0.2m/s is required to self-clean, a velocity of 0.6m/s is required to resuspend sediment stuck to the walls of the pipe.

15.4.3 Mixing of source waters

Blending water from two sources or alternating supply sources, may lead to taste and odour, or sometimes-dirty water complaints.

Alternating the source results in customers accustomed to water with certain characteristics receiving water with different characteristics, leading to complaints related to aesthetic parameters such as colour or chlorine residual.

YVW’s preference is that systems are designed to maintain consistent water quality parameters, particularly aesthetic parameters. Where more than one water source is to supply a zone, blending in reservoirs is preferred to graduated changes in percentages. Secondary chlorination is often required to maintain consistent residuals to customers.

The following MUST be considered about water sources and water quality planning:

- Where practical, water quality zones should be designed to receive water from one source only; and,
- Zones MUST not be designed to mix chloraminated and chlorinated water.
16 NON DRINKING WATER (NDW) QUALITY DESIGN PRINCIPLES

16.1 GENERAL

This section outlines the principles employed by YVW to manage the safety and quality of its non-drinking water. These principles are a compilation of issues and considerations that are unique to YVW. As per Section 5 of this document, YVW treat all non-drinking water to Class A standards.

16.2 BACKGROUND

YVW has a legal obligation to provide customers safe and aesthetically pleasing non-drinking water that has been treated to a Class A standard. The Victorian Environment Protection Authority (EPA) and the Victorian Department of Health (DH), the EPA Guidelines for Dual Pipe Schemes in Victoria, Publication 1015, enforce these obligations.

The objectives of these guidelines are to ensure that Victorian water companies comply with the requirements therein, and, together with the adoption of a risk based approach to non-drinking water safety and quality, ensure that all Victorians have access to a base level of water safety and quality.

In addition to the requirements of the EPA Guidelines, YVW’s Health and Environmental Management Plan (HEMP) for Class A schemes complies with the Australian Guidelines for Water Recycling 2006 (AGWR).

16.3 NON-DRKING WATER – HEALTH CONSIDERATIONS

From a design perspective, the key considerations for the provision of safe non-drinking water are:

- Adequate treatment at the NDW Treatment Plant;
- Prevent cross connections in the distribution system
- Prevent back siphonage (e.g. drinking water top in non-drinking water tanks)
- Minimising the risk of back siphoning (backflow) from customer properties;
- Preventing/controlling contaminant intrusion;
- Preventing/controlling contamination during shut down of water mains (planned and emergency);
- Minimising water age which can result in growth of bio films and potential odour issues and loss of chlorine residual;
- Corrosion and deterioration of infrastructure;
- Management of entities that extract water from our water supply (e.g. water carters);
- Material selection;
- Ongoing maintenance of all fittings and,
- Management of cross-connection facilities
16.4 PROVIDING ADEQUATE TREATMENT (EPA PUBLICATION 1015)

Class A Non-drinking Water Treatment Plants are designed, operated and maintained to meet the requirements in the EPA and Department of Health Guidelines. These requirements are detailed and managed as specified in the Department of Health approved Recycled Water Quality Management Plan (RWQMP).

16.5 PREVENTION OF BACK-SIPHONAGE / BACKFLOW (MRWA 2.6.2)

The principles for the prevention of backflow in non-drinking water systems are the same as for drinking water, refer to Section 15.2 of this document.

16.6 COLOUR AND ODOUR

Refer to Section 15.6.2 of this document.
17 COMPUTERISED HYDRAULIC MODELLING

17.1 ASSET SIZING & NETWORK PERFORMANCE

All YVW water mains (reticulation and distribution) **MUST** be sized by hydraulic analysis using a computerised hydraulic model. Both InfoWorks WS and H2OMap are used by YVW for water hydraulic modelling. YVW are in the process of converting all hydraulic models to InfoWorks WS; eventually phasing out the use of H2OMap. All new Growth area models **MUST** be built using InfoWorks WS.

Hydraulic analysis of a proposed network is undertaken to ensure satisfaction of design criteria, including nominated size, performance and operation of all proposed infrastructure. Infrastructure Planning’s Hydraulic Modelling team are responsible for the maintenance and calibration of YVW’s water hydraulic models.

Growth area models, particularly non-drinking water models, are built and maintained by the Water Growth Planning team. Once the growth in demand reaches sufficient levels, the models can be calibrated using customer billing data.

17.2 COMPUTERISED HYDRAULIC MODELLING

17.2.1 General

Previously, YVW has used H2OMap hydraulic modelling software to build water models. In June 2013, YVW commenced migration of all H2OMap models to the InfoWorks WS modelling software platform.

17.2.2 Model Building

All hydraulic models are built by extracting asset data from YVW’s GIS (using Geomedia) and demand data from YVW’s billing system CC&B (using BI tool).

17.2.3 Model Calibration

Calibration of models is an important step in improving the accuracy of the models; notwithstanding this, un-calibrated models can be used for hydraulic modelling, however they may not provide an accurate reflection of the systems they represent in the real world. Typically, uncalibrated models are developed by the Water Growth Planning team where customer data is not yet available, and where future scenarios need to be tested.

Calibration can be split into two main categories, coarse calibration and fine calibration.
17.2.3.1 Course Calibration
Coarse calibration is generally the minimum calibration level to enable a model to be used. Coarse calibration of a model involves the following:

- Ensuring all boundary conditions are correct
- Ensuring a flow balance is achieved by altering patterns accordingly (i.e. all water coming into the model is taken out by demands)
- Matching permanent telemetry data at boundary points and other available recorder locations to the model and achieving a reasonable match

17.2.3.2 Fine Calibration
YVW water models are generally finely calibrated which gives a much more accurate model and higher level of confidence in modelling results.
Fine calibration of a model involves the following:

- Roughly calibrating the model as a starting point
- Assigning temporary pressure and flow monitoring sites against which to calibrate
- Calibration on pressure and flow velocities with tolerances between actual and modelled values. These are much stricter for fine calibration
- Pipe roughness values are altered to accurately simulate the pipe age and likely condition
17.2.3.3 Calibration Frequency & Recalibration

Model calibrations have a distinct life span that may be affected by changes in the network or ageing of the system.

A set of guidelines apply to determine when a model needs to be recalibrated, as follows:

- Build and calibrate all un-calibrated models.
- Build and calibrate models urgently required by the Water Growth Planning team or the Network team.
- Designated growth models should be recalibrated every 3 years.
- Models should be recalibrated if customer numbers increase by 15%.
- A zone should be re-calibrated immediately after a major asset is added to the zone (i.e. reservoir, pumping station, etc.)
- Recalibrate if 15% of distribution mains have been replaced.
- If none of the above are applicable, recalibrate the model if it hasn’t been calibrated in the last 10 years.

17.3 EXISTING H₂OMAP MODELS

Existing H₂OMap models are currently in two formats: old models that were built using HMI (Hydraulic Modelling Interface) and new models built using WMET (Water Model Extraction Tool). The old and new style models differ in several ways, the most important being how demands are allocated. Other differences include the spatial location of the models, how main ID’s are allocated, and the inclusion or exclusion of valves.

The new models have demands in average summer use (L/s) which is then multiplied by a dimensionless demand profile. The average summer use is calculated from IBIS data and is different for every household, thus moving demand around the zone to best represent where the water is actually being used. Demands are typically grouped by unique demand profiles for each distribution zone.

The older models assign demands based on the number lots connected to a node that are then multiplied by a demand profile in (L/s/hh). This method assumes that all households use the same volume of water.

When adding demands to either old or new models for new growth, the number of properties should be used as the demand is determined by multiplying the number of properties by the standard growth diurnal profile.

The spatial location or coordinate system of the new models is GDA94, in line with the current GIS. Previous models were constructed in the AGD66 coordinate system in line with the now obsolete Phoenix GIS. The coordinate system of a model is important when importing GIS layers to be overlaid on models or other spatial information.

Identification numbers for water mains in the new models match the Unique ID used in the GIS, which allows the ability to search for mains by their ID. This also allows model results to be linked directly to and be displayed in the GIS if required.

In order to maintain the compatibility of the models with the GIS, all valves are included in the new models. Previously only shut valves were included.

All new models built in InfoWorks WS will apply the new format, existing models will be revised new as they are calibrated through the model calibration program.