Specification

Design Specification for Water Pumping Stations

Table of Contents

Revision details 5
Introduction 5
Copyright 5
Acronyms 5
General Terms & Definitions 6
1. General 8
1.1 Objectives 8
1.2 Scope 8
1.3 Use of the Document 9
2. References 10
3. Site Selection 12
3.1 General 12
3.2 Capital and Operational & Maintenance Costs 12
3.3 Community 12
3.4 Environment 12
3.4.1 Climate Change 12
3.4.2 Environmental Risks 13
3.5 Hydraulics 13
3.6 Operation and Maintenance 13
3.7 Constructability 13
4. Land Acquisition 15
5. Site Layout & Infrastructure 16
5.1 Access 16
5.2 Security and Fencing 16
5.3 Signage 17
5.4 Water Service 17
5.5 Site Drainage 17
5.6 Landscaping 18
6. Building 19
6.1 General 19
6.2 Fire Resistance 19
6.2.1 Building Classification 19
6.2.2 Bush Fire Protection 19
6.3 Layout 19
6.4 Floor Slab 21
6.5 Walls 21
6.5.1 Double Brick or Blockwork 21
6.5.2 Pre-cast Concrete Panels 21
6.6 Roof 21
6.7 Doors 22
6.7.1 General 22
6.7.2 Truck Access Door 22
6.7.3 Personnel Doors 23

6.8 Ventilation 23
6.8.1 Sizing 23
6.8.2 Louvres 24
6.8.3 Natural Ventilation 24
6.8.4 Mechanical Ventilation 24
6.9 Lifting Facilities 26
6.10 Access Stairs, Ladders and Platforms 26
6.10.1 General 26
6.10.2 Electrical Platform 27
6.10.3 Crane Service Platform 28
6.10.4 Valve Operating Platform 28
6.10.5 External Platform 29
6.11 Amenities 29
6.12 Station Drainage 29

7. Pumps 31
7.1 General 31
7.2 Type of Pumps 31
7.3 Pump Sizing and Selection 31
7.3.1 Performance Requirements 32
7.3.2 Standby Requirements 33
7.3.3 Pump Efficiency 33
7.3.4 Resilience Requirements 34

8. Pipework and Fittings 35
8.1 Sizing 35
8.2 Pipework 35
8.2.1 General 35
8.2.2 Manifolds 36
8.2.3 Pump Offtakes 37
8.2.4 Recirculation Line 39
8.2.5 Station Bypass 39
8.3 Model Tests 40
8.4 Valves 40
8.4.1 Isolation Valves 41
8.4.2 Delivery Control Valves 41
8.4.3 Non-Return Valves 42
8.5 Flowmeters 42
8.6 Valve Chambers 43

9. Vibration 44

10. Noise 45

11. Water Hammer 46
11.1 General 46
11.2 Surge Vessels 46
11.2.1 General 46
11.2.2 Connecting Pipework 47
11.2.3 Bladder-type Surge Vessels 47
11.2.4 Air-over-water Vessel 48

12. Monitoring and Control 49
12.1 General 49
12.2 Pressure Tapping Points 50

12.3 Station Suction and Delivery Monitoring ... 50
12.4 Pump Suction and Delivery Safety ... 51
12.5 Surge Vessel Monitoring ... 51

13. Electrical ... 53
13.1 Power Supply ... 53
13.2 Switchrooms ... 53
13.2.1 General ... 53
13.2.2 High Voltage ... 54
13.2.3 Low Voltage ... 54
13.3 Electrical Equipment ... 54
13.3.1 High Voltage Equipment ... 54
13.3.2 Low Voltage Equipment ... 55
13.3.3 Lighting ... 55
13.3.4 Standby Generator ... 56
13.3.5 Latch Stop Station ... 56

14. Design Drawings ... 57

15. Commissioning ... 58

Ownership ... 59
Ownership ... 59
Change history ... 59
Appendices ... 59

Supplement to WSA-03-2011 V3.1 Sydney Water Edition 2014 ... 60

Tables

Table 6-1 Minimum clearances ... 20
Table 6-2 Acceptable type of panel and access ... 26
Table 7-1 System heads conditions ... 32
Table 8-1 Maximum velocity ... 35
Table 8-2 Location of dismantling joint and its loose ring ... 38
Table 8-3 Locations of air release vents and drain valves ... 38
Table 8-4 Minimum air release vent size ... 39
Table 8-5 Minimum drain size ... 39
Table 12-1 Pressure tapping points for water pumping stations ... 50

Revision details

Version No.	Clause	Description of revision
1		New document

Introduction

This document is to be used by designers for the design of Sydney Water drinking and non-drinking water pumping stations.

Sydney Water makes no warranties, express or implied, that compliance with the contents of this document will be sufficient to ensure safe systems of work or operation.

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Acronyms

Acronym	Definition
ADD	Average day demand
AEP	Annual exceedance probability
AS	Australian standard
BEP	Best efficiency point
CFD	Computational fluid dynamics
DCV	Delivery control valve
DICL	Ductile iron cement lined
DTC	Deemed-to-comply
DN	Nominal diameter
FDS	Functional design specification
FSL	Full storage level
FRL	Fire resistance level
HV	High voltage
I&C	Instrumentation and control
IICATS	Integrated instrumentation, control, automation and telemetry system
LV	Low voltage
MCC	Motor control centre

Acronym	Definition
MOL	Minimum operating level
MWL	Mean water level (mean of FSL and RSL)
NCC	National Construction Code
NPSHa	Net positive suction head available
NPSHr	Net positive suction head required
OD	Outside diameter
OT	Operational Technology
PEFD	Plain English Functional Description
PS	Product specification
RCP	Representative concentration pathway
REF	Review of environmental factors
RP	Recycled water pumping station
RPZD	Reduced pressure zone device
RSL	Reserve storage level
RTU	Remote telemetry unit
Rw	Weighted sound reduction index
SCA	Switchgear and control gear assembly
TEFC	Totally enclosed fan cooled
TEWC	Totally enclosed water cooled
VSD	Variable speed drive
WP	Water pumping station
WSAA	Water Services Association of Australia Limited

General Terms & Definitions

Term	Definition
1% AEP	1% chance of flood occurring in any given year. Model must be based on the latest edition of Australian Rainfall and Runoff method using RCP 4.5 (2°C temperature increase scenario).
assist pumps	The pumps that add to the performance of the system when the duty pumps cannot meet the requirements on their own. The performance of these pumps must match the duty pump.
delivery main	The pipeline from the discharge manifold to the delivery reservoir or reticulation zone
design life	The period adopted in design for which a product, equipment or component is required to perform its function within the specified parameters with periodic maintenance but without replacement or major overhaul.
duty pumps	The main pumps designed to supply a system with the required flow and pressure for the majority of the time.
finished floor level	The level, or height, at which the floor of a building or structure is built
manifold	The section of pipe to which individual suction or discharge pipes from all the pumps are connected

Term	Definition
operating level	The level from which to operate an equipment
pipework	Includes manifolds and offtakes to the pumps within the station boundary
pump offtake	The individual pipe or set of pipes connected to the pump between the suction and discharge manifolds
pumping unit	Complete unit including pump, motor, coupling, base plate/ skid
suction main	The pipeline from the suction reservoir or reticulation zone to the suction manifold
Representative concentration pathways	Predictions of greenhouse gas concentration trends (adopted by Intergovernmental Panel on Climate Change) as a result of human activities
Reserve storage level	Refer to Water Supply Code of Australia, Sydney Water Edition
service life	The forecast life expectancy of a product based on operational experience and actual installed conditions during which it remains in use, which may include replacement of critical parts and major overhauls.
standby pumps	The backup pumps which are the same size as duty/ assist pumps. They only run as part of the pump auto rotation cycle or when a duty/ assist pump(s) is taken offline or fails.
supplier	The person or organisation responsible for the fabrication or manufacture and/ or supply of products, materials, equipment and components described herein.
Sydney Water	The nominated person or organisation that has written authority to act on Sydney Water's behalf.
water	Includes drinking and non-drinking water (excluding stormwater and sewage)
WSAA Codes	Codes of Practice issued by Water Services Association of Australia
WSAA Code – Sydney Water Edition	WSAA Code with modifications by Sydney Water for use in Sydney Water assets, where available.

1. General

1.1 Objectives

The purpose of this document is to detail the technical requirements for drinking and non-drinking water pumping stations during concept and detailed design. As the design of drinking and non-drinking water pumping stations are fundamentally the same, the term 'water' henceforth refers to both.

The objectives of this document are to:

- provide a standardised approach in designing water pumping stations
- improve efficiency in design and review
- provide direction based on lessons learnt from previous installations and current best practice.

1.2 Scope

In Sydney Water's water supply system, pumping stations can be broadly classified into:

- conventional water pumping stations which supply water primarily to reservoirs
- in-line booster water pumping stations which boost pressure of the water supplied to the customers to meet licence requirements

Planning and design requirements for in-line booster pumping stations are specified in the Water Supply Code of Australia WSA 03-2011 V3.1 Sydney Water Edition 2014. Departures from the Code and additional Sydney Water requirements for in-line booster pumping stations are specified in Sydney Water's Supplement to WSA-03 Code (Appendix 1 of this document). Where requirements for the booster stations are the same as the water pumping stations, they are referenced to this specification to minimize duplication. Requirements from the Supplement will be incorporated into the Code in time when WSA-03-2011 V3.1 Sydney Water Edition 2014 is next reviewed.

Planning requirements for water pumping stations are specified in the Water System Planning Guideline AMQ0562. Where there are gaps in the planning requirements, they will be broadly described in this document and incorporated into the Water System Planning Guideline when it is due for review.

This document covers the design requirements for new water pumping stations, which include:

- site layout and infrastructure
- general arrangement
- building
- pumping units, valves, lifting gear, ventilation and other mechanical equipment
- pumping station pipework and fittings up to manifold connections with suction and delivery mains
- electrical and controls.

This document does not cover design requirements for suction and delivery mains which are specified in Water Supply Code of Australia WSA 03-2011 V3.1 Sydney Water Edition 2014. It also does not cover design requirements for renewal of water pumping stations, although the principles specified hereunder must be considered and adopted when renewing existing pumping stations. Although general requirements of the building are described in this document, details will be covered in Sydney Water's Technical Specification – Building D0002084 (in progress).

1.3 Use of the Document

This document must be read in conjunction with the relevant Standards and Specifications (Section 2). Additional site-specific requirements not covered in the Standards and Specifications must be included by the designer as part of the project documentation.

In the event of any ambiguity or discrepancy, Sydney Water must be consulted as to the interpretation to be followed in carrying out the work.

2. References

The works must comply with the latest editions of all relevant codes, standards, and reference documents, including but not limited to:

- NSW Work Health & Safety Act 2011
- NSW Work Health and Safety Regulation 2017
- NSW Environmental Planning and Assessment Act 1979
- Protection of the Environment Operations Act 1997
- Environmental Planning and Assessment Regulation 2000
- Planning Decision Framework Doc no: D0000732
- Asset Class Strategy – Water Pumping Stations (in progress)
- Asset Class Plan – Water Pumping Stations (in progress)
- Sydney Water Asset Maintenance Policy Doc no: AMQ0002
- Resilience Policy Doc no: D0000503
- Position Statement - Climate Change Adaptation Doc no: D0002092
- WSA 03 – Water Supply Code of Australia, Sydney Water Edition
- WSA 201 – Manual for selection and application of protective coatings
- National Construction Code
- Technical Specification – Civil Doc no: CPDMS00023
- Technical Specification – Mechanical Doc no: BMIS0209
- Technical Specification – Electrical Doc no: CPDMS0022
- Technical Specification –Building Doc no: D0002084 (in progress)
- Technical Specification – Network Rechlorination Plant Doc no: D0000389
- Technical Specification – High Voltage Motors Doc no: DOC0008
- Technical Specification – High Voltage Switchrooms Doc no: DOC0018
- Technical Specification – Solar Photovoltaic Doc no: D0001431
- Technical Specification – Commissioning Doc no: D0001440
- Specification – Maintenance Doc no: D0001441
- Specification – Computer Aided Drafting (CAD) Doc no: CPDMS0021
- Specification – Facility Safety Signage Doc no: SDIMS0026
- Critical Control Standard – Hazardous Atmosphere Management Doc no: 1024800
- IICATS Instrumentation & Control Standards (General) – TS01 Doc no: HSS0009
- IICATS Water and Recycled Water Distribution Related Instrumentation and Control Standards - TS02 Doc no: HSS0008

- IICATS Water Flow Monitoring Standards – Flowmeter TS05 Doc no: HSS0005
- Digital Engineering Standard Doc no: 1262663
- Procedure – Safety in Design Doc no: D0000653
- Procedure – Environmental Considerations for Land Acquisition Doc no: SWEMS0034
- Restricted Keys and Locks Procedure Doc no: D0000688
- Asset Numbering Standard Operating Procedure Doc no: ACP0055
- Water System Planning Guideline Doc no: AMQ0562
- Climate Change Adaption Guidebook Parts 1 to 3 (in progress)
- Guideline – Transient Analysis Doc no: D0002125
- Water Meter Installation Guide Doc no: 420374
- NSW Rural Fire Services – Planning for Bush Fire Protection Guide
- Bushfire Management – National Good Practice Operational Guidelines for the Australian Water Industry, WSAA
- Planning Guideline – Best Practice Energy Efficiency Doc no: D0001652
- Design Guideline – Best Practice Energy Efficiency Doc no: D0001653
- Sydney Water Easement Guidelines Doc No: AMQ0188

3. Site Selection

3.1 General

Water pumping stations sites must be selected in accordance with the requirements of the Planning Decision Framework D0000732 and Water Systems Planning Guideline AMQ0562.

The following factors must be considered in selecting the location of the pumping station:

- Capital and Operational & Maintenance Costs
- Community
- Environment
- Hydraulics
- Operation and Maintenance
- Constructability

The location must have a land area sized for the design of the water pumping station at ultimate stage including:

- any requirements from NSW Rural Fires Regulation (if located in bush fire areas)
- earthworks including cuttings, retaining walls or embankments, required to deliver the pumping station.

The site boundary must extend at least 1500 mm beyond the top of the cutting/ retaining wall and toe of the embankment.

3.2 Capital and Operational & Maintenance Costs

Costs must include land acquisition, supply, installation, construction, commissioning, operational and maintenance costs of the water pumping station and associated infrastructure.

3.3 Community

The pumping station must be located such that there is minimal impact on present and future surrounding land use during construction, operation and maintenance. The sentiment and outlook of the current landowners about water pumping station being located on or near to their property must also be considered.

3.4 Environment

3.4.1 Climate Change

In line with the Resilience Policy D0000503 and Position Statement - Climate Change Adaptation D0002092, Sydney Water is ensuring all assets to be resilient to climate change driven effects such as increased temperatures, increased rainfall intensity and sea level rise. In order to prepare for the plausible future, a climate change risk assessment using Easy XDI tool must be carried out as per Sydney Water Climate Change Adaption Guidebook to identify and mitigate climate hazards.

Sydney Water uses Representative Concentration Pathway (RCP) 4.5 as the standard adaptation level. The designer must obtain information on climate risks relevant to the site including but not limited to flooding.

In the case of flooding, the 1% AEP must be taken from the Council mapping using Australian Rainfall and Runoff flood estimation method based on RCP 4.5. In the event where such information is not available and 0.5% AEP is higher than the station finished floor level, the designer must carry out a flood study using Australian Rainfall and Runoff method to determine 1% AEP based on RCP 4.5.

Where the pumping station is deemed critical, high value or high risk, climate risk assessment must also be carried out for RCP 8.5 to identify adaptation actions which could be implemented at no cost or define actions if adaptation is required in future.

3.4.2 Environmental Risks

The designer must identify any environmental risks as per Sydney Water's Procedure – Environmental Considerations for Land Acquisition SWEMS0034 as part of the site options assessment and prior to the commitment to acquire or construct on any non-Sydney Water land. This is to ensure that potential land contamination risks are assessed early and factored into design and acquisition processes (Section 4).

The location of the pumping station must consider the geology including any soil contamination to assess potential high risk aspects, constructability and liability to Sydney Water. Geotechnical investigation must be carried out for the pumping station site and logged in accordance with AS 1726 and Sydney Water's Technical Specification – Civil.

The design and construction of the water pumping station must comply with the approved Review of Environmental Factors.

3.5 Hydraulics

The station must be sited such that the suction pipework to the pumps is primed at all times. Minimum suction HGL must be at least 1 m above the top of pump volute.

NPSHa must also be at least 2 m above the pump NPSHr over the entire pump operating range.

Where the suction main supplies water to customers, water pressure to consumers on the suction side of the pumping station must also meet Sydney Water's criteria.

3.6 Operation and Maintenance

In deciding the location of the water pumping station, constraints or risks associated with future operation, maintenance and access of the pumping station must be addressed e.g. potential for vandalism, mining, difficult to access, etc.

The finished floor level of the station, its access and any pad mounted substation or emergency generator must be located a minimum of 300mm above 1% AEP.

The site must be selected to provide free drainage to the environment and where possible, be away from the bush fire risk areas.

3.7 Constructability

There must be sufficient clearance from surface and subsurface obstructions to allow for construction. All underground obstructions and services, surface obstructions and structures affected by the construction of the water pumping stations must be determined and shown on the design drawings. The design drawings must address the detail of avoiding any obstruction or service or structure in accordance with the clearances set in Sydney Water Edition of WSA-03.

Details of existing services must be obtained from the relevant owner using before-you-dig-Australia and look-up-and-live services.

Hand excavation (potholing) must be carried out to determine the exact location and depth of underground obstructions during design and again immediately prior to construction to consider unknown services, especially within existing Sydney Water sites.

Sites located under power lines are not acceptable. Where the water pumping station is located close to power poles or overhead high voltage lines, minimum safety approach as per AS 2067 and relevant energy authority's requirements must be considered for any moving plant or movement of materials in the immediate vicinity.

The pumping station must also be sited to avoid steeply falling terrain. Where possible, align the pumping station site parallel to the contours to minimize excavation and need for retaining walls. This in turn will reduce construction costs and the impact of visual amenity on neighbouring properties.

4. Land Acquisition

The designer must confirm land acquisition requirements with Sydney Water during concept and detail design. All land acquisition or easement requests must be sent to acquisitions@sydneywater.com.au. Generally, a cadastral survey for the purpose of land acquisition (different from the survey for engineering) along with the Property Contamination Assessment Form and Environmental Green Slip are required.

The size of the proposed land acquisition for the pumping station must consider ultimate condition, access road within the site, operation and maintenance. An easement may be required for the access road outside of the pumping station operational site.

The route of any mains required as part of the land acquisition site must be located in public roads, or with minimal impact on private landowners, public reserves, crown etc. Where required, easements must be acquired for sewer, potable and recycled water mains, access and services as per Sydney Water Easement Guidelines AMQ0188.

5. Site Layout & Infrastructure

5.1 Access

A minimum 4 m wide all-weather sealed access road/ driveway for the pumping station must be provided off the nearest or most convenient public road. Valve chambers, flowmeters and critical mains must not be located within the access road or vehicle turning areas. The access road must include a kerb and gutter with surface and subsurface drainage system (as required). The access road must consist of a 15 m long setback from the main road or a 15 m long slip road on each side of the gate to allow driver to open and close the station gate safely. Where the station is more than 50 m away from the public road, a lockable boom gate must be provided at the end of the setback.

The access road must include a turning area suitable for:

- 8.8 m long service vehicle
- 12.5 m long chemical delivery truck (if re-chlorination plant is co-located – Refer to Technical Specification - Network Rechlorination Plant D0000389 and Chemical Dosing team for site specific requirements).

A minimum of four parking spaces must be provided within the pumping station site. A truck loading bay inside the pumping station must also be provided. The need to provide electrical infrastructure for electric vehicles charging must be assessed and determined on a project basis. If required, the electrical infrastructure must be designed to support future electric vehicles in minimum two parking spaces.

Fixed bollards and wheel stops must be provided at the end of the driveway, loading bay and chemical delivery bund to prevent vehicles from running off the sealed trafficable surfaces. Fixed or removable bollards must also be placed, where required, to protect the pump and equipment from vehicles. Refer to Sydney Water Technical Specifications – Civil and Mechanical for design requirements of bollards.

The station access road must be reinforced concrete in:

- areas specified in Technical Specification – Civil
- all turning areas of the road.

5.2 Security and Fencing

The fencing must be located along the site boundary. The fence must be 2900 mm high chain link fence with straight extensions for three strands of barb wire. Where aesthetic appearance is required, a palisade fence 2700 mm high may be used. Sites adjacent to developed residential property may consider:

- shared fencing of Colorbond or brick wall type or similar (minimum 2100 mm high), and
- chain link or palisade fences for the other side(s) accessible by the public.

Refer to Sydney Water's facility fencing deemed-to-comply drawings DTC 5000 series for details on chain link and palisade fences.

The designer must consult Sydney Water Security Delivery Team to confirm the site security requirements. As a minimum, Sydney Water swipe card reader next to the main personnel access door must be installed.

Padlocks must be provided in accordance with Restricted Keys and Locks Procedure D0000688.

5.3 Signage

Signage complying with Sydney Water Facility Safety Signage Specification SDIMS0026 must be installed at the access road/ slip road (if applicable), on the facility fencing and inside the pumping station site. Two 'No Parking – Sydney Water vehicles excepted' signs must be installed on both sides of the driveway.

Site facility sign indicating Sydney Water ownership, station number and emergency telephone number must be installed about 2 m inside the fence near the main entry gate facing towards the public road. A facility number sign is also required on the building wall above the double door. Details of the signages can be found in Drawing DTC 6000 series.

5.4 Water Service

Minimum two DN25 hose connections must be provided at suitable locations to cover the whole station site. More hose connection(s) must be provided (if required) to service the entire landscaped area. The hose connection must consist of (approximately 900 mm high) copper pipe and brass vandal proof tap, attached to galvanised steel post or wall.

The water service line must be provided from the reticulation system with a DN50 backflow prevention device. It must consist of a line strainer, reduced pressure zone device (RPZD) and resilient seated isolation valves, to protect water supply from contamination.

Where there is a rechlorination plant proposed as part of the pumping station design, a separate minimum DN25 RPZD must be provided for the emergency shower and eye wash facilities. The DN50 RPZD will provide water for the pumping station's amenities, landscaping requirements and dilution water for the rechlorination plant. All RPZDs must:

- be installed in vandal proof enclosures
- separately connected to the water service line downstream of the water meter. The RPZDs must not be connected in series to the water service line (refer to Drawings DTC 6000 series)
- be within the fenced boundary of the station.

The water meter must be installed upstream of the RPZD(s) as per Sydney Water's Water Meter Installation Guide. The water meter must be located outside the station fence to allow easy access. Where that is not possible, a proposal showing the location of the water meter must be sent to meters@sydneywater.com.au for approval.

5.5 Site Drainage

A drainage system within the pumping station site must be provided to avoid erosion, protect the access road, station and surrounds, and prevent rainwater ingress into the pumping station. The site must be graded such that it is free of ponding.

As a minimum, the drainage system must be designed for a 1% AEP. Overland flows must be intercepted upstream of the site and be routed around the station site via a swale to the approved stormwater system. Where a swale is not feasible, the upstream overland flows must be piped below ground through the site. Access roads must be provided with kerb and gutter. The drainage system must discharge into a designated stormwater system. Design of the drainage system including onsite detention and water sensitive urban design (where required) must comply with:

- Project's Review of Environmental Factors

- Local Government Authority's requirements
- Department of Planning, Infrastructure and Environment – Water.

5.6 Landscaping

The design team must consult with Sydney Water's Environment and Heritage team to confirm the landscaping requirements for the site.

The landscaping must be of low maintenance native species and must not impede normal access to and around the building. Existing trees must be protected in accordance with the approved REF of the project.

As a minimum, native shrubs must be planted within 2 m around the pumping station site fence with heavy mulch and weed mat underneath (refer to Drawing DTC-6004).

6. Building

6.1 General

The pumping station building must comply with Sydney Water's Technical Specifications – Building (in progress), Civil, Electrical and all relevant Australian Standards. The design of the building must be developed in consultation with the community to obtain mutually acceptable outcome for the local community and the customers of Sydney Water.

6.2 Fire Resistance

6.2.1 Building Classification

As Sydney Water is the determining authority, building approval process to National Construction Code (NCC) is not required. However, the fire resistance level of water pumping must be designed in accordance with NCC, Sydney Water's Technical Specifications and all relevant Australian Standards.

Sydney Water considers water pumping stations as Class 10a – non-habitable building.

6.2.2 Bush Fire Protection

The designer must prepare a bush fire report if the site is considered as:

- bush fire prone by NSW Planning/ Council/ NSW Rural Fire Service; or
- forest fire hazardous (current or future) from the XDI tool.

The bush fire report must advise on compliance and propose protection measures to mitigate the bush fire attack as per:

- NSW Rural Fire Services – Planning for Bush Fire Protection Guide
- Bushfire Management – National Good Practice Operational Guidelines for the Australian Water Industry, WSAA.

6.3 Layout

The building must be sized to accommodate:

- all mechanical and electrical equipment such as pumps, pipework, fans, lifting equipment, electrical switchgear at the ultimate stage
- space for access, operations, maintenance and renewals
- workspace for a work table and two chairs
- amenities.

Any surge vessels or permanent generator must be installed outside the building. High voltage equipment must be in a separate building or in a separate room of the pumping station building.

A minimum 1000 mm wide concrete footpath must be provided all around the building.

Spare floor space must be allowed for future switchboards expansion as per Technical Specification – Electrical.

The need for additional floor space for future pump upgrade/ renewal must be assessed and determined as part of the risk assessment design workshops. The risk assessment must consider:

- feasibility of installing larger impeller or running the pumps at higher speed
- availability of alternate water supply (re-zoning)
- feasibility of shutting down pump(s) for extended period of time to facilitate the upgrade.

Additional floor space options may include provision of:

- more space between pumps/ plinths,
- oversized plinths for larger pumps in the future,
- more space in the building for an additional pump/ plinth; or
- land space (free of services) to allow extension of the building.

Minimum clearances for safe operation and maintenance of equipment are shown in the following table.

Table 6-1 Minimum clearances

Description	Minimum clearance
Wall to back of pipework flange (at pipe wall penetrations)	300 mm
Between wall/ back of pipework flange and tapping points	150 mm
Flange OD to the nearest side obstruction (e.g. to the stairs or side wall)	Largest of: • 300 mm, • pipe DN + 150 mm, or • 600 mm (if access is required).
Flange OD to the floor	For pipe ≤ DN450 – 300 mm For pipe > DN450 – 450 mm
Between walls and pumping units/ plinths and between pumping units/ plinths	2000 mm
Height clearance when lifting a pumping unit/ electrical switchboard over other pumping unit(s) or equipment	500 mm
Height clearance when lifting electrical switchboard over electrical platform[1]	300 mm
Height clearance from top of low voltage electrical platform to underside of crane rails	3000 mm with consideration for venting from the switchgear if required[2]

Description	Minimum clearance
Height of low voltage electrical platform above finished floor level	Whichever is higher: • 1000 mm; or • Minimum height required to accommodate staggering of the float switches for the pumps (Refer to HSS0008)

Notes:

1. Any guardrailing, if in the way, must be removable for that purpose.
2. The electrical platform must be capable of housing all SCAs and MCCs.

6.4 Floor Slab

The building must be founded on a reinforced concrete slab. The pumping station slab/ floor must be non-slippery when wet or dry, e.g. have a broom or similar finish, and be sloped towards drainage channel. It must be a single level with even surface without steps or irregularities which may cause a tripping hazard.

A permanent brass survey mark must be clearly visible and set in the floor slab of the station next to the double door. A stainless steel label plate must be affixed within 100 mm from the survey mark showing the reduced level in AHD clearly in a well-lit area (refer to DTC 6000 series for details).

6.5 Walls

The pumping station walls may be of a double brick/ blockwork or pre-cast concrete panels.

6.5.1 Double Brick or Blockwork

Double brick or blockwork is cost effective for smaller pumping stations. It is also considered suitable for pumping stations located within residential areas where it blends well with private houses and provides good noise attenuation. Such construction is also a good choice for bush fire prone or similar areas where fire resistance is important.

Where blockwork is used, the clean-out blocks must face towards the inside of the building.

6.5.2 Pre-cast Concrete Panels

Pre-cast concrete panel design can be used for large pumping station buildings where aesthetic appearance is not of great importance, e.g. within industrial or commercial areas or in open spaces where they can be screened or painted to match the environment. The panels can also be provided with murals/ carvings on the exterior to improve their visual appearance (e.g. WP0369).

6.6 Roof

Metal roof sheeting, such as Colorbond®, is preferred to tiled roofing due to its longer design life and reduced maintenance requirements.

The shape of the pumping station roof must be determined with consideration of the aesthetic criteria. Within an existing or future residential area, the station roof must blend with the roofs of the surrounding houses. If consistent with the neighbouring roofs, skillion roof (preferably facing North) is preferred to facilitate solar panels installation. Flat roof is not acceptable.

The skillion roof slope must be between 10° to 12.5° to allow self-cleaning of flush-mounted solar panels and facilitate maintenance of roof. The pitched roof must have a maximum 22.5° slope. A concrete roof must be constructed in bush fire prone areas, topped with a skillion or pitched roof structure to improve its visual appearance and reduce solar heat load. All roofs must be designed to take the weight of future solar panels. Refer to Technical Specification – Solar Photovoltaic D0001431 for design considerations of solar panels.

Solar heat load must be reduced by appropriate roof design.

Colour of roof sheeting must have a low solar absorptance value i.e. light colour. This will help to reflect light, heat and improve thermal efficiency of the building. Where glare to the neighbours is a concern, the roof must have low solar absorptance and low light reflection.

The roof must be thermally insulated (minimum R4) and fitted with a flat ceiling level with the top of the building walls. The thermal insulation must be covered with a non-flammable sarking to prevent fibres from becoming an airborne contaminate. The roof must have minimum 1.2 m wide eaves around the whole perimeter to shade the building walls.

The roof must be fitted with leafless guttering and the required number of minimum DN100 down pipes as per NCC, before discharging to the stormwater system.

6.7 Doors

6.7.1 General

The pumping station must be provided with one truck access door and minimum two personnel doors.

All doors must be located to comply with the exit path clearance required for switchboards as per AS/NZS 3000.

All door leaves must be:

(a) extra heavy-duty metal clad
(b) designed with a minimum thermal resistance of R2.5
(c) acoustically rated with a minimum airborne weighted sound reduction index Rw of 50
(d) fitted with Sydney Water bi-locks (refer to Sydney Water Security Delivery Team)
(e) fitted with two proximity switches:
    (i) one monitored by IICATS (refer HSS0008 for details)
    (ii) one monitored by Sydney Water Security (refer to Sydney Water Security Delivery Team for details)
(f) fitted with door closers
(g) fitted with turn handles
(h) fitted with panic bars on the inside.

No doors or any part of the doors to be used as air intake or exhaust louvres.

More specific requirements for truck access and personnel doors are detailed in the following sections.

6.7.2 Truck Access Door

The truck access door must:

(a) be vermin proof complete with door seals along adjoining door leaves, top and bottom of doors

(b) be double leaf hinged type, sized to allow transport of the largest equipment mounted on a service vehicle into and out of the building with a minimum 500 mm clearance above the equipment and on each side

(c) open to the outside by approximately 180 degrees be secured to the walls with suitable stainless steel 316 latching mechanism in fully open position to prevent slamming during high winds. Where latching to the walls is not feasible, fixed bollards must be provided at either side of the double door to provide a latching facility to ensure door open outwards by more than 90 degrees.

(d) have a fully welded minimum 6 mm thick steel frame fabricated from a 100 mm minimum steel square hollow section

(e) be clad with 1.6mm thick steel sheet on both sides with 25 mm medium density fibre board fastened/ glued to it and acoustic Rockwool inserted in the remaining gap

(f) be fitted with minimum six hinges per door leaf; four hinges must be in the top half of the door leaf.

Subject to Sydney Water's acceptance, motor operated roller type door for truck access may be acceptable if it meets the site specific thermal resistance and noise reduction requirements.

6.7.3 Personnel Doors

One of the two personnel doors must be the main entry door. Additional personnel door(s) may be required to satisfy AS/NZS 3000 and relevant Australian Standards and regulations for emergency exit.

All personnel access doors must:

(a) have minimum 900 mm x 2200 mm clear opening

(b) have frames fabricated from minimum 3 mm thick steel

(c) have minimum 0.8 mm thick steel sheet cladding on both sides with medium density fibreboard infill fastened/ glued to it

(d) be vermin proof complete with door seals along top and bottom of doors

(e) open to the outside with a SS316 latching mechanism or shortest possible SS316 chain to maintain door opening by more than 90 degrees.

6.8 Ventilation

6.8.1 Sizing

Sizing of the ventilation system must be based on the maximum heat load (both latent and sensible) calculations. The calculations must consider all:

- heat loads from the motors, electrical and control equipment, lighting, people, and sun
- heat losses through the pumping station pipework, concrete slab and walls out of sun.

The solar heat must be calculated for the hottest day of the year at the site.

To minimise the heat load from variable speed drives, if installed in the building their exhausts must be ducted out through the building wall to discharge hot air to the atmosphere. For that purpose, their internal fans must be upsized to cope with the increased pressure loss. Each variable speed drive must have its individual fan, exhaust duct and outlet louvre. The exhaust ducts must slope towards the outlet louvres, which must be protected from driving rain. No damper is required for VSD exhaust ductwork. Refer to Instrumentation and Control Standards – General HSS0009 for cubicle ventilation requirements.

The intake louvres must be sized for the total air flow, i.e. that required for the pumping station ventilation plus the variable speed drives cooling fans flow.

6.8.2 Louvres

The ventilation louvres positioned in the building walls must be vandal (no screw heads visible), vermin, bird, and ember proof, as well as acoustically rated. They must incorporate a SS316 mesh with:

- 6.5 mm aperture for non-bush fire prone areas, or
- 2 mm aperture as per AS 3959 for bush fire prone areas.

In bush fire prone areas, the louvres must be positioned on the walls that face away from the bushes.

All louvres must be heavy duty, industrial grade stainless steel 316 plates in matte finish to reduce reflection, with minimum:

- 1.5 mm thick blades
- 3 mm thick external frames.

Ductwork and louvres external to the building do not require painting unless there are specific environment or community requirements. If painting is required, it must be in accordance with WSA 201. The colour must be selected to suit the local environment. The painting system must be selected based on the material selection. Generally, external components must be painted to systems PUR-B or PSL as they have anti-graffiti properties.

6.8.3 Natural Ventilation

Depending on the roof design, the designer must determine the number, sizes and locations of the inlet vents in the eaves of building as part of the ventilation design.

The ridge must be fitted with a passive ridge vent with a total throat area equal to the area of the eave vents. If the station has roof gables, bird and vermin proof vents with a total area equal to the area of the eave vents must be provided in the roof gables instead of the ridge vent.

Whirlybirds on the roof are not acceptable.

In most cases, natural ventilation will not be sufficient to maintain the temperature within the pumping station below 40^{O}C and will require mechanical ventilation.

6.8.4 Mechanical Ventilation

6.8.4.1 General

Water pumping stations must be provided with mechanical ventilation system comprising of electrically operated fans, starters, cabling, ducting, louvers etc. Minimum two equally sized single speed fans with isolators nearby must be provided to operate in a duty + duty assist arrangement. They must be designed to meet the maximum required duty in parallel operation. It is expected, however, that most of the time only the duty fan will be required to run with the duty assist coming online on hot and high demand days. This will provide partial redundancy if one fan fails.

Mechanical ventilation must be designed such that incoming air is drawn through low level intake louvres (approximately 300 mm – 500 mm above ground on one side of the building), moves across the room, over the pump motors, electrical and control equipment, before being extracted at ceiling level on the opposite side of the building by the exhaust air system. Where the pump gallery finished floor level is lower than the surrounding ground levels, low level intake louvres must be ducted to approximately 300 mm – 500 mm above pump gallery finished floor level. The top of the hot air intake ductwork must be maximum 300 mm below ceiling. The fans must withdraw hot air via exhaust ductwork and force it out of the building through outlet louvres. The ductwork must terminate with a transition piece when connecting to the outlet louvre, ensuring all air is exhausted outside.

Refer to Technical Specification – Mechanical and Electrical for building ventilation requirements. Additional requirements for building ventilation are in the following sections.

6.8.4.2 Fans and accessories

The fans must be installed with the following requirements:

(a) Install silencer (if required) next to the fan

(b) Locate the fans and (if installed) silencers inside the building within crane envelope at maximum 1500 mm above operating level for maintenance

(c) Provide minimum 600 mm clearance behind the fans and silencers for maintenance

(d) Mount fans and silencers on individual supports with anti-vibration pads at the feet

(e) Face fan terminal box towards the main access area

(f) Provide an isolator within 500 mm of each fan

(g) Provide a separate standalone electrical panel for each fan

(h) Connect plastic tubings immediately upstream and downstream of the fan to the differential pressure switch

(i) Install DN32 electrical glands in the middle of duct work upstream and downstream of fan for air flow measurement

6.8.4.3 Control philosophy

Each fan must be provided with two thermostats to control its starting and stopping as per the following conditions:

(a) One fan starts when the temperature inside the building reaches 35 ºC.

(b) The fan stops if the inside temperature drops to 30 ºC.

(c) If the inside temperature reaches 40 ºC, the second fan starts and operates in parallel with the first fan.

(d) The second fan stops when the temperature drops to 35 ºC.

The thermostats must have digital or analogue controls to adjust the above temperature settings within a range from 0 ºC to 60 ºC. They must be within 1 m of the electrical switchboards and about 2 m above the electrical platform to reduce unnecessary fan run, noise and to facilitate maintenance

If the station is in bush fire prone area, both fans must stop when the outside temperature reaches 60 ºC. A resistance temperature detector (RTD) must be provided as per HSS0009, located within 1 m of the building's low level inlet louvres and 2 m from finished floor level.

Where specified, the control equipment must permit auto sequencing to alternate duty fans so that a new fan will be called into operation in the new duty cycle.

Duty and control of the vent fans must be via local hardwired control. IICATS monitors failure of the ventilation fans by reference to the low differential pressure across each fan. If the fan fails to start, an alarm must be sent to Sydney Water's System Operations Centre (SOC).

The ventilation fans must be capable of operating in both an automatic mode as well as a manual on/off mode.

6.9 Lifting Facilities

An overhead travelling gantry crane and hoist must be provided within the pumping station for the installation and removal of the pumping units and ancillary equipment.

The design and construction of the crane and associated equipment must comply with Sydney Water's Technical Specification – Mechanical.

As a minimum, the crane's operating envelope must cover all pumping units, valves and fans. The crane must be capable of transporting the complete pumping units (pump, motor, coupling, base plate etc.), valves and other equipment to and from the cabin end of a truck parked in the loading area in a single movement. The crane must also be capable of transporting the electrical equipment to the electrical platforms as close as possible to their installed position.

Fully retracted hoist hook must be able to reach the crane service platforms without hitting or interfering with the handrails.

The crane must stop 100 mm before the end stop (hard stop) in both longitudinal and cross travel directions.

6.10 Access Stairs, Ladders and Platforms

6.10.1 General

Safe access over and around pipework and other equipment within the pumping station site must be provided.

All access stairs, ladders and platforms must comply with Technical Specifications – Civil and Electrical, AS 1657, WSA PS-315 and SafeWork NSW.

All internal and external stairs must be open floor gratings with serrated top finish. Top of the stairs must finish flush with the top landing as per AS 1657. Bright safety yellow anti-slip stair nosing to be mechanically attached to the stairs including the top stair. Adhesive is not acceptable.

The type of panel and access acceptable for various types of platform is shown in Table 6-2. The designer must specify the thickness of panel required to carry the design loads within the deflection limits as per Technical Specification – Civil. The thickness of the panel must not be less than the minimum thickness given in Table 6-2. More details for each platform are given in the following sections.

Table 6-2 Acceptable type of panel and access

Type of platform	Acceptable type of panel	Acceptable type of access
Electrical platform	Gratings with minimum 3 mm mild steel floor plates	Stairs

Type of platform	Acceptable type of panel	Acceptable type of access
Crane platform and crane walkway	• Minimum 6 mm mild steel floor plates; or • Gratings with minimum 3 mm mild steel floor plates	Inclined step ladder
Valve operating platform (internal)	Open floor gratings with serrated top finish (and protective mesh to AS 1657 where people might work on and below the platform)	Stairs
Valve operating platform (external) External platform to access station building	Open floor gratings with serrated top finish	Stairs
External platform for surge vessels	• Open floor gratings with serrated top finish; or Where people could work on and below platform: • Minimum 6 mm mild steel floor plates; or • Gratings with minimum 3 mm mild steel floor plates	Stairs or inclined step ladder

6.10.2 Electrical Platform

Elevated electrical platform must be gratings with floor plates to:

- allow easy transport and installation of electrical cubicles
- withstand the heavy weights of cubicles during transport
- protect the electrical and control gear from possible water spays
- prevent tools from falling through.

The platform must be widened to achieve:

- minimum 600 mm clearance in front of the electrical panels when the electrical panel doors are in 90 degree open position
- minimum of 1000 mm clearance when the electrical panel doors are in closed position.

At least one set of stairs must be provided at each end of the electrical platform if the switchboard is more than 3 m long or rated 800 A and above per phase as per AS/NZS 3000.

Fall prevention means such as handrails and kickplates meeting AS 1657 requirements must be provided including all the gaps in the platform.

The platform must be designed to withstand all design loads, including those imposed by the equipment installed on top of them, such as electrical switchboards (including allowance for the spare capacity), actuators etc. and workers.

The platform panels must be suitably segmented for easy removal by the pumping station lifting facilities or manually in accordance with Technical Specification – Civil. They must firmly attach to the supporting steel frame so that they do not move or become loose during the transport and installation of the electrical cubicles.

Electrical switchboards must be installed on the platform supporting steel frames with no floor gratings or plates directly under the switchboards to allow cables access. Dimensions, position and loading of supporting frames for the switchboards must be confirmed prior to the fabrication of the steel frames.

6.10.3 Crane Service Platform

No service platforms are required for manually operated cranes.

For electric cranes, a service platform must be installed for each crane rail to maintain:

- end-carriage, hoist, long and cross travel motors, crane controls and electrical equipment, crane light fittings (main platform)
- other end-carriage and its motor (secondary platform).

Each platform must be fitted with an inclined step ladder and a self-closing gate. Where there are space constraints, the two platforms can be connected with a walkway and accessed by a single inclined step ladder and single self-closing gate.

The self-closing gate must open inwards towards the service platform. Minimum 600 mm standing space between the ladder and self-closing gate must be provided at the top of the ladder as per AS 1657.

The main and secondary platforms for the crane maintenance must be sized to access all maintainable items when the crane is at its nominated parking position (end stop).

The length (in the long travel rail direction) of the main and secondary platforms must have minimum 600 mm clearance to all maintainable items.

The width (in the cross travel rail direction) of the main platform must:

- extend minimum 150 mm past the long travel rail (towards the building wall) to access the end-carriage fasteners, and
- have 600 mm clearance to all maintainable items.

The secondary crane platform must be minimum 1000 mm wide (in the cross travel rail direction).

Low headroom signage meeting Sydney Water's Technical Specification – Mechanical must be installed at the service platforms.

6.10.4 Valve Operating Platform

Operating platforms must be provided (if required) to meet valve installation requirements as per Technical Specification – Mechanical. Step up platforms are not acceptable. The electrical platform can double up as valve operating platform.

Where an additional walkway is provided on the opposite wall to the electrical platform for valve operation in the building, stairs must be provided between each pump. Rung type and step-type ladders are not acceptable.

6.10.5 External Platform

6.10.5.1 Building

Depending on the building design and terrain, external stairs may be required to access the personnel doors.

6.10.5.2 Surge Vessels

External platform for surge vessels must be open floor gratings. Protective mesh is not required as it could collect litter. If there are maintainable items such as valves and instruments under the platform or if head clearance under the platform is ≥ 2 m, the platform must be fitted with floor plates. Where glare is an issue, the floor plates must be non-reflective.

A self-closing swing gate that swings towards the platform and minimum 600 mm standing space between the self-closing gate and top of stairs/ inclined step ladder must be provided as per AS 1657.

6.11 Amenities

Toilet amenities must be provided at the water pumping station. The toilet must connect to the existing sewer by gravity. Connection to the sewer via a pressure sewerage system is not acceptable unless the site is already serviced by low pressure sewerage system.

6.12 Station Drainage

The floor of the pumping station must be graded to a central drainage channel to prevent ponding. All minor drains from the electrical trenches that are within the building and pump offtakes must flow to the central drainage channel.

The central drainage channel must run along near the pumping units to a sump, which in turn drains by gravity to the approved stormwater system. A non-return flap valve must be installed at the outlet drainage pipe to the approved stormwater system to prevent backflow and vermin ingress. If gravity drainage cannot be provided, a sump with 230 V duty sump pump(s) must be provided. No standby sump pump is required. Refer to HSS0008 for sump pump alarm requirements.

The central drainage channel must be:

- designed to limit the rise of water level within the pumping station (due to possible pipe breaks) to maximum 100 mm below motor pedestal, but must not be sized less than 400 mm wide x 250 mm deep
- installed with removable open grid covers.

Where (a) is not practicable, the pump motors are considered as ‘mounted in a location subject to flooding’ and must be provided with ‘unit stopped due to flooding’ alarms and protection as per HSS0008. Notwithstanding, all pumps rated 500 kW and above must be provided with ‘unit stopped due to flooding’ alarms and protection.

The ’unit stopped due to flooding’ alarms are activated via float switches. The float switch for each pump must be located near the respective pump starter and be wired directly to the starter without intermediate junction box. For that reason, it is normally located under the electrical platform and 500 mm from the front of the platform for accessibility purposes. The float switch must be hung securely from the underside of the platform e.g. to an unistrut spanned below platform beams. Where unistruct is installed, the cable of the float switch must run inside the unistruct to the cable ladder. The unistruct must also be provided with end and top covers.

Each station must also be provided with a machinery well flooded alarm as per HSS0008.

7. Pumps

7.1 General

The pumping units and their installation must comply with Technical Specification – Mechanical and the following requirements:

(a) The pumps must be selected, designed and sized for the required duties, including all flow ranges and differential heads in single and parallel operation.

(b) Pump suction and discharge connections must be in the horizontal plane and on the opposite sides of the pump volute (except for end suction back pull-out pumps) to simplify pipework arrangement.

(c) All pumps must have "no flow" protection. This must be provided by industrial proximity switches providing closed/ not closed indication of the pump discharge non-return valves (Refer to HSS0008 Water Distribution Related Instrumentation and Control Standards TOG_TS02). No pump must operate against a closed valve except during starting and stopping.

(d) All pumps must have suction and differential pressure protection. This must be provided by pressure sensors installed on the suction and delivery pipework of each pumping unit. Refer to HSS0008 Water Distribution Related Instrumentation and Control Standards TOG_TS02.

7.2 Type of Pumps

The pumps must be horizontal centrifugal pumps of the following types, in the order of preference:

(a) double suction axial split casing

(b) double suction two-stage axial split casing*

(c) multi-stage ring section*

(d) end suction back pull-out (single or multi stage*)

* *for high head requirements which cannot be achieved by single stage pumps*

Vertical centrifugal and other types of pumps must not be used.

Double suction axial split casing pumps are preferred for their simple design, high efficiency, proven reliability, ease of maintenance and the position of suction and discharge connections which enable favourable suction and discharge pipework arrangement.

End suction back pull-out pumping units, if used, must be provided with a spacer coupling for removal of the pump rotating element without the need to disturb pipe connections or remove the pump motor.

7.3 Pump Sizing and Selection

Pump selection must be undertaken early during design. Sizing, selection of the type and number of pumps and their drives will determine the arrangement of the mechanical and electrical equipment within the pumping station and size of the building.

To facilitate operation and maintenance, all pumps must be of the same size except when they are delivering to different reservoir.

Pumps must be selected based on design flow at design head conditions. Pumps are required to provide flows over a range of system heads to satisfy system demand criteria. Each pump must be able to operate individually or in parallel with any number of the duty pumps over the whole range of operating heads defined by the minimum and maximum system curves.

Consideration must be given to:

- Performance Requirements – System flow and head for initial and ultimate requirements (where applicable)
- Standby Requirements
- Pump Efficiency – Best Efficiency Point (BEP) to be as close as practical to the mean head duty point
- Resilience Requirements – Availability of spare parts supported by adequate local service agent

7.3.1 Performance Requirements

Variations in demand may be handled effectively by use of multiple fixed speed pumps or variable speed pumps. Many pumps are available with a range of impeller sizes. Meeting future pumping requirements may be possible by changing impeller sizes rather than changing or adding more pumps. This may be an economical solution, however, consideration of a change in motor size to drive a larger impeller may be necessary.

Using a number of smaller pumps rather than one larger unit may be an economical alternative over the life of the asset. This will allow a smaller pump operating at high efficiency to be used during low demand periods with a resultant saving in running costs. Also, smaller pumps will enable operation of the pumping units on a readily available emergency generator in an emergency or during renewal work. However, the change from single pumps to multiple pump operation may affect individual pump efficiencies and maintenance costs. This aspect must be considered to ensure a multiple pump installation is feasible.

The pumping station may be required to meet multiple system demands for different operating modes. It may pump to a surface/ elevated reservoir and may need to pump directly to the reticulation system when the delivery reservoir is taken offline for maintenance. The design capacity must be determined in accordance with Sydney Water's Water System Planning Guideline and confirmed with Sydney Water. Where the pumping station is required to transfer flow to improve the security of water supply, its design capacity must be based on water production rate (e.g. from desalination plant/ water filtration plant) or transfer rate determined by supply and demand.

Sydney Water must be consulted when determining the design duty head. By default, the design head must be based on the supply reservoir at Reserve Storage Level (RSL) and the discharge reservoir at Full Storage Level (FSL) as shown in the table below. Mean Water Level (MWL) is taken as the average of RSL and FSL.

Table 7-1 System heads conditions

	Supply Reservoir	Discharge Reservoir
Maximum Head	MOL	FSL
Design Head	RSL	FSL
Mean Head	MWL	MWL

	Supply Reservoir	Discharge Reservoir
Minimum Head	FSL	MOL

Each pump must have a minimum flooded suction head of 1000 mm above the top of the pump volute at all times.

7.3.2 Standby Requirements

Depending on the station criticality and pump size, standby pump(s) may be required. The number of standby pumps must be determined on a project basis as per Water System Planning Guidelines.

Generally, one or more standby pump(s) is needed when:

- the station is the sole source of supply to an area; or
- the station is critical (e.g. Ultimate ADD > 75 ML/d or serving >100,000 properties); or
- large pumps (e.g. > 500 kW) are installed as they require a long time to repair and overhaul; or
- it is a transfer station with fixed flows all year round (e.g. pumping purified recycled/ desalinated water).

7.3.3 Pump Efficiency

Fixed speed pumps will, generally, operate over a wide range of duties due to varying suction and delivery conditions and the number of pumps running. Pump efficiency may vary greatly for single pump and parallel operation, depending on the variation between maximum and minimum pump head condition and the number of duty pumps. The pumps must be selected to operate as close as possible to the best efficiency point during average demand periods and mean head conditions.

For variable speed operation, it is usually preferable to select a pump with a shut off head being significantly higher than the operating range and a broader efficiency range, with the pump duty to the left of the BEP on the pump performance curve so that lower speed operation typical of average demand is closer to the BEP.

Variable speed pumps must be considered where there is a functional need to:

- vary the flow/head requirements or maintain a set delivery pressure, e.g. pumping to the zone when the delivery reservoir is taken offline or does not exist, or for use in booster pumping stations
- optimise pump operation especially in high friction loss systems (‘steep’ system curve), so that potential savings in friction head loss outweigh the loss of overall efficiency due to variable speed drives
- reduce motor inrush current to avoid impacting the grid and allow use of smaller generators in case of power loss
- reduce pressure transients during normal pump starts and stops.

Details on assessing the feasibility of variable speed drives can be found in Sydney Water’s Water System Planning Guideline.

One of the main criteria when selecting pumps is their efficiency, as ongoing power costs are usually many times greater than the pump procurement and lifetime maintenance costs. The selected pump must be suited to the application, require minimal maintenance, and be efficient in operation to achieve minimum life cycle costs.

To allow comparison of the annual operating costs of pumping units, pump suppliers must supply guaranteed figures for specific pumping energy in kilowatt hours per kilolitre for the specified duty points. The comparison may be based on the simplified formula for computing the estimated annual electricity and capital cost per pump in the form:

$$C\ [\$/yr] = 365 \times ADD \times Es \times Ec + P/30$$

where:

C	-	approximately annual electricity and capital cost
ADD	-	average day demand (kL/D)
Es	-	specific pumping energy at specified duty point (kWh/kL)
Ec	-	average electricity charge ($/kWh) as per Sydney Water Electricity Forecast Tool (Net-zero carbon (ads.swc))
P	-	pumping unit purchase price, $
30	-	assumed pumping unit design life, years

However, for large pumping units with multiple guaranteed duty points, a more complex formula must be developed and consider weighted energy consumption at the specified duty points with peak, shoulder and off-peak electricity charges.

7.3.4 Resilience Requirements

Resilience principles must be considered within the design to provide a secure and reliable water supply. The pumping station must be designed to be adaptable, able to maintain service and have a quick recovery from asset failure.

To ensure availability of spare parts supported by an adequate local service agent, all equipment including pumps must be sourced from one of the current Sydney Water's pre-qualified suppliers. The final pump selection must be confirmed with the pump supplier and Sydney Water.

8. Pipework and Fittings

All materials that may come into contact with potable or recycled water must comply with AS 4020 and relevant Drinking Water Guidelines.

8.1 Sizing

Pump suction pipework must provide uniform velocity profile without swirl and vortex and be stable over time with sufficient pressure to avoid cavitation. The velocity in the pump suction pipework must be constant or increasing as the flow approaches the pumps.

Pump discharge pipework must be designed to avoid excessive head losses, cavitation and damage to the valves or pipework lining.

Pump suction offtake must be at least one size larger than the pump suction flange, provided that the maximum velocities (Table 8-1) are not exceeded. These velocity limits do not apply to the taper or a short straight run of pipe, e.g. a dismantling joint, immediately upstream of the pump suction flange.

Table 8-1 Maximum velocity

Station Pipework	Maximum Velocity (m/s)	
	At design flow	At maximum flow
Suction manifold	1.5	2.4[1]
Pump suction offtake	1.5	2.4[2]
Pump discharge offtake	2.5	3[2]
Discharge manifold	2.5	3[1]

Notes:

1. E.g. when all duty pumps run in parallel at maximum speed against minimum head conditions
2. E.g. when single pump runs at maximum speed against minimum head conditions

8.2 Pipework

8.2.1 General

Pumping station pipework must provide even and steady flow to and from the pumping units without adversely affecting the performance or overall efficiency of the pumping system. The pipework design must consider the position of the pump suction and discharge flanges and valves to:

- minimise head losses, noise and turbulence
- maximise design life of system components
- provide accessibility to equipment for operation and maintenance.

All pumping station pipework must be metallic – ductile iron, mild steel or stainless steel. Ductile iron and mild steel pipework must be cement lined or thermal-bonded polymeric coated. Refer to Sydney Water

Technical Specification – Mechanical for requirements of these pipe materials. All metallic pipes must be bonded to earth as per Sydney Water's Technical Specification – Electrical.

All flanges must comply to AS 4087 and pressure rated to minimum PN16.

Refer to Sydney Water Technical Specification – Mechanical for penetration requirements of pipework through walls.

Pipework installed within the station building must be above the station floor level.

When installing pipework, fixed mechanical items such as pumping units must be installed first so that misalignment can be easily remedied by pipework adjustment.

Load-bearing dismantling joints must be long bodied and installed to facilitate dismantling and re-installation of valves and pumps with no need to remove other fittings.

No rubber expansion joints/ bellows are allowed. Where expansion joints are proposed, only thrust-type metallic bellows must be used, and they must be installed such that they do not release pressure forces.

Any pipework under the building slab must be designed as maintenance free. This may involve concrete encasing and/or using a more robust and corrosion resistant pipe system e.g. stainless steel. Where concrete encasement is proposed, the encasement must be designed to tie with the concrete floor slab to prevent pipe breakage due to differential settlement. Any pipework penetration through the concrete floor slab must be provided with a puddle flange.

Potable and recycled water pumping units, valves, pipes and fittings must be differently colour coded and labelled to avoid accidental swapping during maintenance and contamination of potable water supply. Labelling 'Potable Water' or 'Recycled Water' and flow direction arrows must be provided on the pipework in accordance with Sydney Water's Technical Specification – Mechanical.

All pipework and fittings must be:

- supported in accordance with Technical Specification – Mechanical
- provided with protective coatings in accordance with WSA 201.

8.2.2 Manifolds

Station isolation valves must be installed within the fenced boundary:

- upstream of all pumps in the suction manifold
- downstream of all pumps in the discharge manifold.

These common isolation valves are used to isolate the station and serve as a pump double isolation measure to fit blank flanges to the offtakes when the pump is removed for maintenance.

8.2.2.1 Hydrants

Hydrants must be installed to release air for filling and emptying pipework at the following locations:

- downstream of the station suction isolation valve in the suction manifold
- upstream of the station discharge isolation valve in the discharge manifold.

Refer to WSA 03 Sydney Water Edition for hydrant requirements.

8.2.2.2 Scours

Gravity scour must be provided at the manifold where it is greater than DN300 to allow effective draining of water from the manifold. The scour must be located:

- between station suction isolation valve and hydrant in the suction manifold
- between station discharge isolation valve and hydrant in the discharge manifold

Where gravity scour is not possible, a pump-out scour is acceptable. Road access to a pump-out scour must be provided to allow use of the mobile pump. Refer to WSA 03 Sydney Water Edition for requirements of scours.

8.2.2.3 Access Points

Access into the manifolds must be provided for manifold ≥ DN750. Refer to WSA 03 Sydney Water Edition for access point requirements. The access point must have two lifting lugs and installed in a half-size chamber. The half-size chamber must:

- not be located in the roads where possible
- be installed with hinged aluminium covers in non-trafficable areas or Class D gatic covers in trafficable areas.

8.2.3 Pump Offtakes

Pump suction offtakes must be simple, straight and connected directly to each pump with no bends or flow disturbing fittings (e.g. butterfly valves) close to the pumps. The offtakes must connect to the suction manifolds in a way to avoid air entrainment in the manifolds (refer to ANSI/HI 9.6.6 for type of reducers) . Any tapers on the pump suction offtakes must be eccentric with horizontal soffit. Minimum straight pipe length upstream of the pumps must comply with ANSI/HI 9.6.6.

Minimum 1 m pipe spool (SS316 Schedule 40S) in the pump suction or discharge offtake must be provided upstream of the pump suction or downstream of the pump discharge isolation valve within the station for installation of portable flowmeter transducers. The spool can be installed under the platform (where installed).

Pump offtakes adjacent to the pump must be anchored, supported, and restrained to avoid application of external forces and moments to the pump. The supports must be designed to support the:

- weight of the pipes, valves and fittings with water
- unrestrained pressure forces (if any)
- thermal expansion forces
- pipework misalignment forces
- vibrations caused by the pump operation which may be transferred onto the pipework.

Double isolation is required upstream and downstream of the pumping units for safe maintenance. In addition to the station isolation valves at the manifolds, each pumping unit must be fitted with isolation valves on the pump offtakes within the building. No isolation valves to be located under the platform.

The designer must consider the storage capacity of the delivery reservoir, system requirements and contingency plan to determine if additional isolation valves are required to facilitate pump maintenance. If the time taken to double isolate, e.g. fitting blank flanges and dewatering, exceeds the delivery reservoir depletion time, additional isolation valves in the pump offtakes must be installed.

8.2.3.1 Dismantling Joints

Load-bearing dismantling joint must be located at the following locations shown in Table 8-2:

Table 8-2 Location of dismantling joint and its loose ring

Location of dismantling joint	Location of dismantling joint's loose ring
Next to the pump suction isolation valve	On the valve side
Next to the pump suction flange	On the pump side
Between delivery control valve (if required) and non-return valve	On the delivery control valve side
Between non-return valve and pump discharge isolation valve	On the non-return valve side

8.2.3.2 Air Release Vents and Drain Valves

Manual air release vents and drain valves must be provided for filling and emptying pipework and also to enable proving of valve isolation. They must be located within the building in pipes/ spools shown in Table 8-3. They can be installed under the platform as long as they are accessible at maximum 150 mm from the front of the platform without having to go under the platform.

Table 8-3 Locations of air release vents and drain valves

Location	Air release vent	Drain valve
Between suction manifold and pump suction isolation valves	✓	✓
Between pump suction isolation valve and pump	✓	✓
Between pump and delivery control valve (if installed) or non-return valve	✓	✓
Between delivery control valve (if installed) and non-return valve		✓
Between non-return valve and pump discharge isolation valve	✓	✓
Between pump discharge and discharge manifold isolation valves	✓	✓

The air release vents must be sized based on the volume to be displaced during normal operation and charging, with the minimum requirements shown in Table 8-4. Each vent must be fitted with a ball valve and a ‘goose neck’ exhaust pipe directed towards the floor.

Table 8-4 Minimum air release vent size

For pipework	Minimum air release vent size
≤DN600	DN15
> DN600	DN25

Minimum drain size is shown in Table 8-5. Each drain must be fitted with a ball valve, fitted at the bottom of the pipework and piped to the central drainage channel.

Table 8-5 Minimum drain size

For pipework	Minimum drain size
≤ DN600	DN25
> DN600 to ≤ DN1000	DN50
> DN1000	DN80

8.2.4 Recirculation Line

A recirculation line must be provided to recirculate part of the pumped flow from the discharge to the suction side of the pumping station when delivery reservoir is taken offline (such as for maintenance) and station is required to pump directly into the reticulation zone. The reticulation line must be designed to protect the:

- pumps against cavitation and vibrations at low flows
- reticulation zone from over-pressure.

The recirculation line must be fitted with an eccentric plug valve, an orifice plate, a thrust-type dismantling joint and manual isolation valves on either side of the plug valve to facilitate maintenance. The loose ring of the dismantling joint must be on the plug valve side.

The plug valve and orifice plate must be sized for the return flow and the system head without cavitation. The orifice plate must be used as the primary means of throttling and the plug valve used for fine tuning to achieve the desired headloss during commissioning.

8.2.5 Station Bypass

The need for a station bypass must be assessed and determined as part of the risk assessment. Where specified, a cross connection between the suction and discharge manifolds must be provided to allow bypassing of the station. This arrangement could allow:

- gravity flow from supply reservoir to the discharge reservoir
- gravity reverse flow from discharge reservoir to the supply reservoir

- installation of an emergency diesel pump (if required) when the water pumping station has failed.

The bypass pipework must include a non-return valve, a thrust-type dismantling joint and a manual isolation valve on either side of the non-return valve. The non-return valve and dismantling joint must be installed in a chamber with gravity or pumped drainage to approved stormwater system. The loose ring of the dismantling joint must be on the non-return valve side.

Where automatic gravity reverse flow is required, bypass pipework with an actuated isolation valve around the non-return valve assembly must be installed. The actuated isolation valve must be installed with a dismantling joint and interlocked with pump operation.

The need to use emergency diesel pump as a contingency must be assessed and determined as part of the project risk assessment. If required, the designer must propose and design an above ground facility to enable easy connection to the emergency diesel pump.

8.3 Model Tests

Model tests may be required to predict the overall flow distribution in the pipework arrangement and confirm suitability of the pumping station design. The need for physical model study or computational fluid dynamics (CFD) must be determined as per ANSI/HI 9.6.6.

The fluid dynamics must be simulated based on the worst case scenario (during normal and abnormal operations) and adopt ANSI standards as the acceptable standards for model testing. As a minimum, the model test report must provide:

- Velocity distribution from the suction manifold up to the pump intake
- Analysis of the likelihood of turbulences and eddies at pump suctions
- Conclusion on whether fault-free operation of the pumps is possible or if any pipework changes are required

8.4 Valves

All valves in the pumping station building must be installed above floor level.

All valves installed outside the station building but within the fenced compound must be installed in chambers, except for manual gate valves which can be buried if they are:

- ≤ 3 m deep (to invert); and
- ≤ DN300.

Where valves are actuated, the electric valve actuators must be installed above ground on pedestals and protected against vandalism. Refer to Sydney Water Technical Specification – Mechanical and Technical Specification – Electrical for further details on actuators.

All valves DN80 and larger must be supported by concrete plinths. Concrete plinths must be:

- reinforced
- vibrated (refer to Technical Specification – Civil) to ensure a shrink-free installation
- extended to the valve. Non-shrink grout between the concrete plinths and valve is not acceptable.

For valves without support feet, concrete supports must be provided to cradle the valve body with 3mm thick neoprene sheet separating the valve body from the concrete support. The neoprene sheet must be trimmed to size and sealed to concrete and valve body with Sikaflex PRO or approved equivalent.

Valves DN80 and above must be double flanged. Smaller valves may be double flanged or have threaded end connections.

As a minimum, the following valves must be provided in each water pumping station:

- Suction manifold – isolation valve
- Pump suction offtake – isolation valve
- Pump discharge offtake – delivery control valve (for fixed speed pumps only), non-return valve, isolation valve
- Pump discharge manifold – isolation valve
- Drain and vent lines – isolation valves

All valves must comply with Sydney Water Technical Specification – Mechanical.

8.4.1 Isolation Valves

All isolation valves, except those on the drain and vent lines, must be metal seated gate valves. Manual air release vent line isolation valves must be stainless steel two-part ball valves, while drain valves can be either metal seated gate or stainless steel two-part ball valves.

Subject to Sydney Water acceptance, double offset butterfly valves may be acceptable for larger sizes to provide means for double isolation in conjunction with gate valves, e.g. those on the suction and discharge manifolds.

8.4.2 Delivery Control Valves

Each fixed speed pump must be provided with a delivery control valve (DCV) to manage pressure surges during pump start and stop.

The DCV must be a double or triple offset metal seated butterfly valve (refer to Technical Specification – Mechanical), automatically opened and closed by an electrical actuator. The electric actuator must be designed and sized to safely operate over the full range of valve operating conditions as per Technical Specification – Electrical.

The DCV must be bi-directional and preferably drop tight when pressurised from the downstream side. The DCV must not be used for flow control purposes.

The DCV must be installed downstream of each pump and upstream of its non-return valve to reduce the number of pipes and fittings subjected to high cyclic pressures at each pump start and stop. They must be installed so that they can be safely removed from the pipework even if jammed open. This may include a load bearing dismantling joint on one side and a pipe not shorter than the length of the valve disc protruding outside the valve body on the other.

The DCV opening and closing time requirements must be developed as part of the design package. Final setting to optimise pressure surge and pump operation duration against DCV in throttle condition to be adjusted during commissioning (if required). Further monitoring and control requirements are detailed in HSS0008 Water Distribution Related Instrumentation and Control Standards TOG_TS02.

8.4.3 Non-Return Valves

A non-return valve as per Technical Specification – Mechanical must be installed downstream of each pump to prevent reverse flow.

Non-return valves must be of a short-bodied tilting disc type, horizontally installed and provided with adjustable lever, and adjustable counterweight complete with guard for gravity assisted closure. Refer to Technical Specification – Mechanical for requirements of the guard. Subject to Sydney Water's acceptance, other types of non-return valves may be considered, e.g. where required to reduce water hammer.

A monitoring arrangement using inductive proximity switch (as per HSS0008) and a suitably sized metal flag must be provided to detect the position of the swing arm of the non-return valve. The proximity switch must activate when the non-return valve opens to minimum pump speed and remains active until the valve closes below the minimum pump speed. The proximity switch mounting bracket must be attached to the valve and the mounting slot elongated to enable adjustments.

8.5 Flowmeters

Each water pumping station must be provided with a flowmeter. The flowmeter must be installed in the discharge manifold/ delivery main and connected to the IICATS RTU for continuous monitoring. Refer to the following for details:

- Instrumentation and Control Standards (General) TOG_TS01 HSS0009
- Water and Recycled Water Distribution Related Instrumentation and Control Standards TS02 HSS0008
- Flow Monitoring Standards – Flowmeters TOG_TS05 HSS0005.

Details of the required type, accuracy and quality of the flowmeter must be sought from Sydney Water OT during design. The designer must specify the flow range required of the flowmeter. A traffolyte label showing the flow range in metric units must be affixed along with the flowmeter transmitter. Refer location and details of flowmeter transmitter and label to HSS0005.

The flowmeter must be installed within the station site in an external chamber.. Buried flowmeters are not permitted. The flowmeter chamber must be installed with lightweight aluminium covers and removable beams. The covers must be designed to minimize water and debris ingress through the gaps when closed. Where access to both sides of the flowmeter chamber is required, ladder tie off points can be installed to the side that is not accessed often. Minimum straight pipe sections on either side of the flowmeter must be provided as per Flow Monitoring Standards – Flowmeters TOG_TS05 HSS0005. To facilitate flowmeter maintenance, the designer must allow:

(a) isolation valves and hydrants outside the minimum straight pipe sections on either side of the flowmeter

(b) thrust type dismantling joint next to the flowmeter within the chamber (if electromagnetic flowmeter is installed)

(c) tapping point for manual air release within the chamber (refer Table 8-4 for sizing)

(d) DN25 drain line with a ball valve.

8.6 Valve Chambers

Pipework flange clearances in a chamber must comply with Table 6-1.

Pressure reducing valve chambers must have gatic covers to mitigate noise issues. All other valve chambers must have open grid covers with removable beams.

The chamber must be provided with a level switch connected to IICATS as per HSS0008 to monitor chamber flooding and drain by gravity to approved stormwater system. The designer must size the drainage pipe(s) required to limit the rise of water to 100 mm above floor level of the chamber. The drainage pipe must not be less than DN100 and must be located through the wall (not through the floor) at the lowest invert level of the chamber. Where gravity discharge is not possible, a 400 x 400 x 300 mm deep sump with a 230 V sump pump must be supplied. The chamber floor must be graded minimum 1% towards the drainage pipe(s) or sump.

The chamber must be fitted with permanent inclined rung ladder(s) and fixed/ retractable stanchions. The design of the chamber, including access and landing, must comply with Technical Specification – Civil and AS 1657. The ladder must be positioned centrally under the access hatch. Where access to both sides of the chamber is required, inclined rung ladders must be provided.

9. Vibration

The pumps and their foundations must be designed such that the whole system operates without cavitation and within an acceptable vibration range defined in Sydney Water Technical Specification – Mechanical.

As a minimum, the mass of the pump foundation must be at least five times the mass of the entire pumpset.

10. Noise

The building must include acoustic noise reduction measures to comply with EPA requirements, AS 1055 and Sydney Water Technical Specification – Mechanical. The building ceiling and roof must be fitted with acoustic insulation.

All intake and exhaust louvers must be noise attenuated. If the noise is still outside the acceptable limits, other noise attenuating devices such as modifications/additions to louvres design, silencers or acoustic enclosures must be fitted to the ventilation fans. Acoustic enclosures for ventilation fans to be used only if other appropriate engineering measures are not practical.

Acoustic enclosures are not permitted over the pumping units as they limit access to the pumps and interfere with ventilation.

Any exposed suction and discharge pipework outside the station building must be buried to reduce vibration noise transmitting from the pumps to the manifolds.

11. Water Hammer

11.1 General

Water hammer analysis must be carried out as per Sydney Water's Transient Analysis Guideline D0002125 on any new pumping station system, or where substantial changes are carried out on existing pumping systems which result in meaningful system pressure changes. This is to ensure the new pressure surges envelope is within the acceptable pressure limits of the pipes.

The design must identify and include measures for surge transient pressure mitigation in the event of unacceptable positive or negative pressures. The pipes must be designed to withstand the maximum and minimum pressures as per Transient Analysis Guideline D0002125.

Fatigue analysis must be undertaken for thermoplastic suction and delivery mains in accordance with WSA 04 Sewage Pumping Code of Australia (Sydney Water Edition).

Maximum and minimum transient pressures must be addressed in the design with water hammer scenarios, which include, as a minimum:

(a) Normal single pump start and stop

(b) Uncontrolled pump start-up and shut down

(c) Power failure at maximum pumping rate (all duty and duty/assist pumps running) at maximum and minimum heads

(d) Control valve operation(s) (if applicable) (Rapid valve closure, or rapid valve opening)

(e) Mechanical device failure e.g. air valves not operating.

All the above scenarios must be considered with suction and delivery main air valves fully operational and closed.

Surge control devices such as special non-return valves, surge vessel(s), flywheels etc may be required to mitigate water hammer risk and minimize pressure variation when pumping into an existing/new system. These devices may also be more economical to control surge rather than designing pipes and fittings for a higher rating as the cost of large fittings at a higher pressure rating can be substantial.

11.2 Surge Vessels

11.2.1 General

Sydney Water uses both bladder-type and air-over-water surge vessels.

The need for standby surge vessel(s) must be assessed and determined as part of the project design risk assessment. If required, at least one standby surge vessel must be provided. As a minimum, the risk assessment must consider:

- Maintenance requirements of the vessel
- Feasibility of shutting down station for extended period of time to allow maintenance of vessel e.g. rezoning
- Feasibility of running the station with reduced number of pumps with no surge vessel protection

The vessel can be installed horizontally or vertically. If vertical vessel is higher than the pumping station height and there is space available, horizontal installation must be provided.

The design of the surge vessels must be fully certified and registered with SafeWork NSW requirements, complies with AS 1210 and the following requirements:

(a) Construct vessel from steel.

(b) Install pressure relief valve on the air side, vertically at the highest point of the vessel. The pressure relief valve must be sized to AS 1271 and meet noise requirements of EPA NSW Noise Policy for Industry and Sydney Water Technical Specification - Mechanical.

(c) For horizontal installation, install the piping for pressure relief valve such that condensation is drained back into the surge vessel. The piping must be independently supported and not be supported off the surge vessel.

(d) Provide access with stairs/ inclined step ladder, platform, handrails, kickboard to AS 1657 to maintainable items including bladder (if applicable) and pressure relief valve.

(e) Provide a drain-cock facility below the surge vessel (maximum 1500 mm from finished floor level) to enable safe water collection from the vessel for water quality testing.

Certificates of compliance for pressure relief valve to AS 1210 and AS/NZS 3788 must be provided to Sydney Water and made available on-site.

11.2.2 Connecting Pipework

The connecting pipework between the manifold and vessel can be installed above ground on a reinforced concrete slab and must include, as a minimum:

- a gate valve for isolation
- a scour valve and camlock with dust cap, sized to drain the vessel within one hour for maintenance. The scour valve must not be sized smaller than DN50.

A drainage pit connected to the station drainage system must also be provided within the surge vessel hardstand area.

A stainless steel label plate must be affixed on the hardstand area floor near the charging connection showing the reduced level in AHD (refer to DTC 6000 series for details).

11.2.3 Bladder-type Surge Vessels

For bladder-type surge vessels in water application, water typically enters and exits from the bottom of the vessel into the bladder with the compressed gas as stored energy to sustain flow after a transient event.

In addition to the general surge vessel design requirements covered in previous sections, bladder-type surge vessels must comply with the following requirements:

(a) Install a steel anti-extrusion grid at the outlet of the vessel to prevent bladder from being drawn into the pipework at low pressures. The exit velocity from the vessel outlet must be limited to 3 m/s to prevent bladder from folding over the anti-extrusion grid during the initial surge transient.

(b) Install a butyl rubber bladder that complies with AS 4020, minimum 3mm thick and reinforced 6 mm thick at openings.

(c) Where the vessel is in horizontal installation, the pressure relief valve may be located to the same platform accessing the bladder.

(d) Install pre-charge connection (Schrader) valve approximately 1500 mm from finished floor level with an analogue pressure gauge and a ball valve.

(e) Pre-charge vessel with nitrogen to minimize corrosion potential.

11.2.4 Air-over-water Vessel

Air-over-water vessel works in the same principle as bladder-type surge vessel except that there is no bladder and it uses on-site air compressor to maintain air (instead of nitrogen) pressure in the vessel.

In addition to the general surge vessel design requirements covered in previous sections, air-over-water vessel must comply with the following requirements:

- Refer Technical Specification – Mechanical BMIS0209 for requirements of compressed air system.
- There must be minimum two air compressors (1 duty + 1 standby) capable of running from the generator.

12. Monitoring and Control

12.1 General

The automatic control and remote monitoring of the pumping station must be provided by IICATS.

All instrumentation, monitoring and control equipment must comply with Sydney Water Instrumentation and Control Standards. This includes any reference to IICATS connected equipment identified in other sections of this document.

Full requirements are provided in:

- HSS0009 Instrumentation and Control Standards (General) TOG_TS01
- HSS0008 Water Distribution Related Instrumentation and Control Standards TOG_TS02
- HSS0005 Flow Monitoring Standards – Flowmeters TOG_TS05
- Associated standards sample drawings (SSD).

Control and continuous monitoring of the pumping station must be provided through the RTU and IICATS network with appropriate alarms. Notifications are directed to Sydney Water's System Operations Centre (SOC) when the alarms are triggered. The typical monitoring and control requirements for a water pumping station are:

- Control panel
- Power failure monitoring
- The IICATS RTU and modem
- Site 24 V DC power supplies
- Site access monitoring
- Station operation, monitoring and control
- Pump operation, monitoring and control
- DCV, monitoring and control (if fixed speed)
- Pressure boards
- Flow monitoring where required on the site
- Cable and conduit installation on the site
- An I/O list for the RTU, with allocation of analogue and digital alarm and controls.

Additional items may be required depending on site specific design.

A Plain English Functional Description (PEFD), developed in conjunction with the asset owner (Sydney Water Networks), must be provided. Sydney Water Operational Technology (OT), IICATS Solutions will develop the Functional Design Specification (FDS) and the control and monitoring sequences for the assets being controlled by the IICATS RTU in-coordination with the asset owner.

Standard Input/Output (I/O) lists are available in the Instrument and Control Standards as a guide. Designers must prepare the list of parameters and the Input/Output (I/O) signals to be monitored in IICATS as per HSS0008 I&C Standards - Water and Recycled Water Distribution TOG_TS02. This list of I/O must be confirmed with IICATS once the scope and control method are finalised during the detail design stage. The final I/O list for a site will be issued by Sydney Water OT, IICATS Solutions group.

All digital and analogue devices applicable to the site are to be installed and calibrated as specified in the Instrument and Control Standards.

On-site commissioning, or re-commissioning, of instrument and control equipment must only be completed by Sydney Water OT team.

12.2 Pressure Tapping Points

The following pressure tapping points for monitoring and control must be provided in the pumping station pipework. Additional tapping points for commissioning must also be provided (refer to Section – Commissioning of this Specification).

Refer to HSS0008 Water Distribution Related Instrumentation and Control Standards TOG_TS02 for details of pressure tapping points and layout of the pressure board (in progress).

Table 12-1 Pressure tapping points for water pumping stations

<table>
<tr><th>Purpose</th><th>Location</th><th>Orientation</th></tr>
<tr><td>For station suction pressure board</td><td>One downstream of suction manifold isolation valve</td><td rowspan="3">Provided in the horizontal or up to 30^{O} below the pipe horizontal centreline with isolation and rodding point facilities to enable cleaning of tubing e.g. due to pipe corrosion.</td></tr>
<tr><td>For station discharge pressure board</td><td>One upstream of discharge manifold isolation valve</td></tr>
<tr><td>For pump pressure board (pump protection)</td><td>• One between pump suction isolation valve and pump
• One between pump and delivery control valve (where installed) or non-return valve</td></tr>
</table>

All pressure tapping points must be DN15.

All tubings from the tapping points to the pressure boards must be laid and aligned such that:

(a) They do not adversely affect access to the pump, pipes, flanges etc. such as run under the pipework, around the valve supports and skirt around the pump plinth.

(b) High points are avoided to prevent airlock.

(c) They do not cause trip hazard.

12.3 Station Suction and Delivery Monitoring

Station suction and discharge pressure transmitters must be provided with an integrated display. The pumping station suction and delivery pressure boards must be installed:

- at easily accessible locations on the finished floor level
- with minimum 900 mm clear working area in front of the boards

- on the pumps suction and discharge side respectively
- separately for each reservoir zone if there are two or more zones within the station,

For station pressure board requirements, refer to HSS0009 Instrumentation and Control Standards (General) TOG_TS01 and Drawing SSD-132 Suction or delivery pressure board.

Connections of the station pressure transmitters to the manifolds must not be buried. If the manifolds are buried, the station tapping points for the station pressure transmitters to be located as close as possible to the manifolds in one of the pump suction and discharge offtakes.

12.4 Pump Suction and Delivery Safety

The pump suction safety must be provided by a pressure switch for each pump, to detect low pressures and prevent pump operation when the pressure in the pump suction is below a pre-set value (normally at minimum suction HGL). The suction safety pressure switches must reset automatically when the suction pressure increases to and above the pre-set value (normally 2 m above minimum suction HGL).

The pump delivery safety must be provided by a differential pressure switch for each pump, to prevent pump operation if the differential pressure across the pump is outside the pre-set range (normally pumping head corresponding to 50% BEP), indicating possible flow restriction in the delivery pipework.

The differential pressure switches must reset automatically when the differential pressure reduces to and below the pre-set value (normally 5m below the pumping head at 50% BEP). A differential pressure transmitter with local display must also be provided for each pump for monitoring only.

Refer to HSS0008 Water Distribution Related Instrumentation and Control Standards TOG_TS02 for full specifications.

All pre-set values for pump suction and delivery safety must be confirmed during commissioning.

The pump protection instruments for each pump must be installed on a pressure board close to the pump (Refer HSS0009 Instrumentation and Control Standards (General) TOG_TS01 and Drawing SSD-131 Pump differential pressure board for general layout of a pumping unit pressure board). A minimum 150 mm clearance behind the pump pressure safety board is required for cable access.

Sensors for temperature and vibration must comply with Technical Specifications – Mechanical and Electrical.

12.5 Surge Vessel Monitoring

Each surge vessel must be provided with a differential pressure transmitter to determine water level within the vessel or detect bladder failure. The transmitters must be connected to RTU for IICATS monitoring.

Where protection of the delivery main(s) is required by the surge vessels, additional protective instruments must be provided for each surge vessel:

- High water level switch to indicate possible loss of air/ nitrogen or bladder failure
- Low water level switch to indicate possible water leakage
- Surge vessel isolation valve open position switch

The water level and position switches must be interlocked with each pump starter PLC to prevent pump operation.

Some areas in Upper Blue Mountains require pipe lagging to prevent water freezing in the impulse lines. Refer to Sydney Water OT Team for details of these areas and Technical Specification – Mechanical for pipe lagging requirements.

All switches and transmitters to be installed in vandal-proof stainless steel 316 hinged cabinets at eye level (approximately 1600 mm from finished floor level). The cabinet must be drained and connected to the station drainage with stainless steel 316 tubes. Refer to HSS0009 for more requirements of control cubicles and enclosures.

13. Electrical

13.1 Power Supply

Incoming supply arrangement must be suitable for the full ultimate load of the site. Maximum demand calculation must be performed in accordance with Technical Specification - Electrical requirements. Based on the maximum demand information, an accredited service provider must make a connection application to the Electrical Supply Authority to acquire adequate power supply for the station. The number of supplies required for the site, need for an automatic transfer switch and the redundancy level must be assessed and approved by Sydney Water prior to the application.

Typically, for a high voltage installation, if N-1 redundancy level is required, the connection application must consist of a reserved supply allocation on both the primary and backup feeders fed from:

- separate bus-sections at one zone substation, or
- two different zone substations.

The two feeders must maintain separation along the route (minimum separation of 3 m for underground routes) from the zone substation to Sydney Water Point of Connection.

Sydney Water prefers low voltage motors where economically possible. The designer must consider the lifecycle cost of the installation and determine the voltage selection of the site in consultation with Sydney Water. The voltage selection of the motor and motor starter must consider:

- size of the motor
- type of the motor starter
- energy efficiency
- cooling requirements
- physical sizing requirements
- ongoing operation and maintenance requirements.

Critical load must be split across different switchboards or different bus section of a switchboard to provide sufficient level of redundancy. Auto changeover facilities and a permanent diesel generator may be needed to increase the supply security for critical pump stations.

The main switchboard must incorporate the Supply Authority tariff meter(s).

13.2 Switchrooms

13.2.1 General

The high voltage switchroom and low voltage switchboards area, including equipment and personnel/ emergency access requirements, must comply with Technical Specification – Electrical, AS/NZS 3000 and all other relevant Australian Standards

The minimum size of the switchroom must consider layout of equipment, spare space for future equipment, and adequate space around the equipment to provide ease of maintenance. They must be sized to house all mechanical (e.g. ventilation) and electrical equipment.

All products used in the construction of the switchrooms must be resistant to fire and radiant heat.

13.2.2 High Voltage

The high voltage assets must be designed and installed in designated high voltage room or area as per High Voltage Switchrooms DOC0018. Where high voltage switchroom adjoins pump gallery, the high voltage switchroom must not be accessible from the pump gallery.

13.2.3 Low Voltage

The low voltage electrical equipment must be designed and installed inside the pump room on the elevated platform at the suction side of the station. No air-conditioners are required in the pump gallery.

The low voltage electrical equipment and their components must be designed to operate at the worst case ambient temperature inside the building for up to 24 hours with adequate ventilation.

13.3 Electrical Equipment

All power cables must be aligned to the motor terminal box directly so that access to pipework flanges is not impeded.

13.3.1 High Voltage Equipment

High Voltage Equipment must comply with Sydney Water HV Specifications:

- DOC0008- Batteries and Chargers
- DOC0009- HV Electrical Cables
- DOC0010- HV Motors
- DOC0011- HV Power Factor Correction Unit
- DOC0012- HV Switchgear
- DOC0015- HV Motor Starter
- DOC0016- Earthing and Lightning
- DOC0017- HV Overhead Equipment
- DOC0018- HV Switchrooms
- DOC0019- Power Transformers
- DOC0020- Prefabricated Substation
- DOC0270- HV Installation

The redundancy level for HV switchgear, power transformer, battery and charger design must be based on project- specific requirements.

For power transformers, the selection of oil must consider the environmental impact.

The designer must, in consultation with the supplier, propose and design a cooling system for high voltage pump motor that meets Sydney Water noise requirements (Section 10 of this Specification).

Totally enclosed fan cooled (TEFC) motors are preferred due to their simple design and low maintenance requirements but could be noisy for high voltage motors. If TEFC motors that can meet Sydney Water noise requirements are used, exhaust from the TEFC motors must be ducted outside the building through the walls unless the building ventilation can be designed to account for the heat load from HV motors. The ductwork must be designed such that they do not affect the operation and access to equipment (e.g. valves, crane, pumps, motors etc).

If totally enclosed water cooled (TEWC) motors are used, the designer must design the cooling pipework including valves and pumps (if required) to circulate a portion of the pumped water. The cooling pipework can be connected from the pump discharge or suction offtake to the cooling jacket/ heat exchanger in the motor frame before discharging back to pump suction offtake.

Starters and pump motors must be matched to ensure the motors are capable of providing the required torque, maximum number of starts and duration of run time as required without overheating or causing insulation degradation. Refer Sydney Water Technical Specification – HV Motors DOC0010 for details on motor electrical requirements.

13.3.2 Low Voltage Equipment

Low voltage equipment and design for a water pumping station includes but is not limited to the following:

- Switchboard
- Motor starter
- Motor starter control panel
- Mobile and permanent generator
- Mobile generator connection point
- Pump station auxiliary power supply
- Lighting
- Fire detection and security equipment
- Lightning protection
- Earthing system
- Cable selection and cable routes

The design of the low voltage system must comply with Technical Specification – Electrical. All low voltage motors to be TEFC. There are also a series of system studies and designer deliverables stipulated in the Technical Specification - Electrical that need to be produced at the appropriate stage of the design process. Some of these deliverables will form part of the input for the designer in later stages.

13.3.3 Lighting

All lights (internal and external) must be LED and comply with Sydney Water's Technical Specification - Electrical.

As a minimum, external lights must be wall mounted above all doors. Tilt-down light mast for external lightings must be provided to illuminate the bypass valve chamber, generator or any other area having an identified risk etc so that maintenance can be carried out at night and under low light conditions. All external lightings must be vandal-proof and must not spill over onto adjacent properties.

A push button pneumatic time switch or similar must be provided near the main personnel door within the station to allow the outside lights to remain "on" for about 15 minutes before turning off, providing safe exit after a night callout. Lighting switch without the 15-minute delay must also be provided.

Any internal lights must not be mounted on the ceiling.

13.3.4 Standby Generator

Where nominated in the project scope, a permanent generator set must be provided as per:

- Technical Specification - Permanent Emergency Diesel Generator D0002061
- Technical Specification - Permanent Gas Engine Driven Generator D0002097
- Technical Specification – Electrical CPDMS0022

Notwithstanding that a permanent generator may be installed onsite, to provide flexibility and back up during power failure, an emergency electrical connection with phase direction indicator for a mobile generator must be provided at the station. The generator connection terminals must be in a IP66 weather-proof outdoor, vandal proof, lockable panel on the outside of the pumping station building to facilitate ease of access by a trailer-mounted generator.

The permanent generator, mobile generator connection panel and the associated permanent cabling to the switchboards must be sized for starting and running all duty and duty assist pumps plus station auxiliaries and controls. The generator connection box must have labelling for the size of the portable generator required to operate the pumping station. Where HV motors are used, step-up transformers must be designed and installed as per Technical Specification – Power Transformers DOC0019 to enable connection of the emergency generator (LV).

The main incoming supply switches, permanent generator and the mobile generator circuit breakers must be interlocked so that only one of them can be ON at any time.

A reinforced concrete slab must be provided for permanent and mobile generators.

13.3.5 Latch Stop Station

A latch stop station must be installed for each pump. It must comply with Technical Specification – Electrical and:

- supplied with cabling where terminations are potted. Cable run lengths are to be determined on site to ensure the correct cable length is supplied. To facilitate cable replacement, conduits must be continuous with long sweep bends.
- located near the motor but away from the main trafficable area to avoid risk of accidental operation
- positioned 1500 mm above the finished floor level with minimum 900 mm clear space in front of it.

14. Design Drawings

Asset numbers must be allocated as per Asset Numbering Standard Operating Procedure ACP0055.

All design drawings (including concept design drawings) must comply with:

- Sydney Water's Computer Aided Drafting Standard and Specification Doc no: CPDMS0021
- Digital Engineering Standard Doc no: 1262663

The cover page must include address (street name, suburb) and a location map of the station.

15. Commissioning

Commissioning of all assets must comply with the Sydney Water Technical Specification – Commissioning – Transitioning Assets into Operation D0001440.

Separate DN15 pressure tapping points must be provided for:

- pump testing - at the top of the pump offtakes on each side of the pump flange
- system testing - at the top of the pump discharge offtake downstream of discharge isolation valve.

These tapping points must be fitted with block-and-bleed grade 316 stainless steel two-part ball valves connected via threadolet (refer to DTC 6040 for stainless steel pipe) or tapping band (for DI pipe), and plugs.

Separate receptacles (minimum SS304) suitably sized for A3 Work-As-Constructed drawings and O&M manuals must be mounted on the internal walls of the station.

The station must also be provided with a portable folding table and two folding chairs.

Ownership

Ownership

Role	Title
Group	Engineering, Engineering and Technical Support
Owner	Norbert Schaeper
Author	Rajiv Madhok, Nana Keong, Paul Zhou

Change history

Version No.	Prepared by	Reviewed by	Date	Approved by	Issue date
1	Rajiv Madhok Nana Keong Paul Zhou	Milan Rubcic Robert Lau	30/06/2023	Norbert Schaeper	30/06/2023

Appendices

Attachment	Title
1	Sydney Water's Supplement to WSA-03-2011 V3.1 Sydney Water Edition 2014 (Booster Stations)

Appendix 1 - Supplement to WSA-03-2011 V3.1 Sydney Water Edition 2014

Sydney Water Supplement to Water Supply Code of Australia WSA-03-2011 V3.1 Sydney Water Edition 2014

1. Purpose

This supplement details additional Sydney Water's requirements to Clause 6.2 – In-line pressure booster pumping stations of WSAA Water Supply Code of Australia WSA-03-2011 V3.1 Sydney Water Edition 2014. The supplement will be incorporated into the Sydney Water Edition of WSA-03 in the future versions.

In order to assist the reader, the tables include references and clause numbers presented as they appear in Water Supply Code of Australia WSA-03-2011 V3.1 Sydney Water Edition 2014. Only those clauses where changes have been made are shown in the supplement. Associated clause headings are also provided to provide context to the modified clauses. Informative text, where provided is italicised.

2. Scope

This supplement is intended for Sydney Water personnel, consultant engineers and contractors engaged in the planning, design and construction of in-line pressure booster pumping stations for Sydney Water.

This supplement is to be read in conjunction with:

- Water Supply Code of Australia WSA-03-2011 V3.1 Sydney Water Edition 2014
- Sydney Water's Design Specification for Water Pumping Stations D0002071

3. Amendments

Code References	Amendments to WSA 03-2011 V3.1 Sydney Water Edition 2014

Part 0: Glossary of Terms, Abbreviations and References

III REFERENCED DOCUMENTS	*Add the following at the end of the list:*
	SYDNEY WATER REFERENCES

Doc no	Title
AMQ0562	Water System Planning Guideline
CPDMS00023	Technical Specification - Civil
BMIS0209	Technical Specification - Mechanical
CPDMS0022	Technical Specification - Electrical
D0002071	Design Specification for Water Pumping Stations
HSS0009	IICATS Instrumentation & Control Standards (General) – TS01
HSS0008	IICATS Water and Recycled Water Distribution Related Instrumentation and Control Standards - TS02
D0001440	Commissioning Specification – Transitioning assets into operation

Code References	Amendments to WSA 03-2011 V3.1 Sydney Water Edition 2014
6.2 In-line pressure booster pumping stations	
General	*Replace 'OH&S' with 'Work Health & Safety' throughout Section 6.2.* *Replace 'pressure transducer' with 'pressure transmitter' throughout Section 6.2.*
6.2.2 Concept design	
6.2.2.3 Functionality	*Replace second paragraph with:* All boosters shall have IICATS interface. Boosters servicing less than 200 properties shall have IICATS interface for: • monitoring only (pressure and pump failure); or • monitoring and control if required by Sydney Water. Boosters servicing 200 and more properties shall have IICATS interface for monitoring and control as per Sydney Water instrumentation and control standards.
6.2.2.4 Due diligence requirements	*Delete last sentence of the clause.*
6.2.2.8 Location	*Add (vi) at the end of list:* (vi) where the finished ground level is minimum 300mm above 1% AEP.
6.2.2.11 Services	*Replace (c) with:* Minimum two DN25 vandal proof hose taps shall be provided at suitable locations to cover the whole station.
6.2.2.12 Access	*Insert at the end of third paragraph:* The station access road must be reinforced concrete in areas specified in Sydney Water's Technical Specification – Civil and at all turning areas of the road.
6.2.2.14 Landscaping	*Replace first sentence with:* A landscaping plan shall be prepared for the site as per the landscaping requirements in Sydney Water's Design Specification for Water Pumping Stations.

Code References	Amendments to WSA 03-2011 V3.1 Sydney Water Edition 2014
6.2.2.15 Security	*Add at the end of clause:* The station site shall be fenced if there is a pressure accumulator located outside the building/ enclosure. Refer to Sydney Water's Design Specification for Water Pumping Stations for security and fencing requirements.
6.2.2.16 Signage	*Replace 'regulatory and Water Agency requirements' with* 'Sydney Water's Design Specification for Water Pumping Stations D0002071'.
6.2.5 Booster design	
6.2.5.7 Booster set and pump selection	*Replace (b) with the following:* (b) Maximum number of starts/hr (not to exceed 90% of manufacturer's equipment capability guarantee or 40, whichever is the lowest).
6.2.5.8 Booster pipework and manifold design	*Replace second paragraph with:* All booster pipework shall be manufactured from Schedule 40 stainless Steel 316 seam welded pipe. The booster pumping station shall be designed with the following minimum clearances. a) Wall to back of flange at pipe wall penetrations – 300 mm b) Between wall/ back of pipework flange and tapping points – 150 mm c) Flange outside diameter to bottom obstruction (e.g. floor) - 300 mm d) Between pumps bodies – 450 mm e) Walkway around booster set - 600 mm clear working space f) Around accumulator – 600 mm clear working space + space for portable platform ladder (where required for access) g) Between top of pump and ceiling – 1000 mm or the minimum clearance required for lifting purposes, whichever is greater h) Internal height of building with switchgear inside – 3000 mm with consideration for venting from the switchgear if required Booster pipework shall be properly aligned to the prescribed centrelines and elevations, set and adjusted on stainless steel packers as per Sydney Water Technical Specification – Mechanical.
	Delete third paragraph.

Code References	Amendments to WSA 03-2011 V3.1 Sydney Water Edition 2014
6.2.5.10 Site specific requirements	*Add item (m) to the end of list:* (m) temporary cross-connection of suction and delivery manifolds with a gate valve in-between for testing and commissioning.

6.2.6 Booster pipework

Code References	Amendments to WSA 03-2011 V3.1 Sydney Water Edition 2014
6.2.6.1 General design parameters	*Add at the end of clause:* Hydrants must be installed to release air for filling and emptying pipework at the following locations: • downstream of the station suction isolation valve in the suction manifold • upstream of the station discharge isolation valve in the delivery manifold. All metallic pipes shall be bonded to earth as per Sydney Water's Technical Specification – Electrical.
6.2.6.2 Manifolds, off-takes, suction and delivery pipework	*Add at the end of second paragraph:* Booster set manifolds shall be supported during transport and when installed to avoid undue stress on the pump flanges. In-line strainer shall be provided in the suction manifold with sufficient room underneath to remove the screen.
	Replace third paragraph with: Manifolds and offtakes shall be designed to eliminate pockets that could trap air. Air valves complying with AS 4956 shall be provided in the suction and discharge manifolds. Refer sizing of air valves to WSA 03 Sydney Water Edition. Exhaust from the air valves shall be piped to station drain pit(s).
	Add at the end of clause: Dismantling joints (DJ) shall be thrust-type, double flanged and long-bodied. Where DJs below DN80 are not available in double flanged connection, threaded unions are acceptable. Where bellows are provided, they shall be SS316 and as per Sydney Water's Technical Specification – Mechanical. Provide colour coded labelling 'Potable Water' or 'Recycled Water' and flow direction arrows on pipework in accordance with Sydney Water's Technical Specification – Mechanical.

Code References	Amendments to WSA 03-2011 V3.1 Sydney Water Edition 2014
6.2.6.3 Pressure gauges and tappings	*Replace sub-heading 6.2.6.3 Pressure gauges and tappings with 6.2.6.3 Pressure transmitters, gauges and tappings*
	Replace second paragraph with: The pressure instruments shall comply with Sydney Water Technical Specification – Mechanical and Instrumentation & Control Standards. The following DN15 pressure tapping points shall be provided:

Table 6.2 Pressure transmitters, gauges and tappings

<table>
<tr><th>Purpose</th><th>Location</th><th>Details</th></tr>
<tr><td rowspan="2">For station suction pressure</td><td>One transmitter downstream of station stop valve, on top of suction manifold</td><td rowspan="4">Isolation, and block-and-bleed facilities shall be provided as described in HSS0009 Instrumentation and Control Standards (General) TOG_TS01.</td></tr>
<tr><td>One analogue pressure gauge (500 mm from suction pressure transmitter) on top of suction manifold</td></tr>
<tr><td rowspan="2">For station discharge pressure</td><td>One transmitter upstream of station stop valve, on top of discharge manifold</td></tr>
<tr><td>One analogue pressure gauge (500 mm from station discharge pressure transmitter) on top of discharge manifold</td></tr>
<tr><td>For pump testing</td><td>One on either side and top of pump offtakes; immediately upstream and downstream of the pump flanges</td><td>These tapping points shall be fitted with block-and-bleed grade 316 stainless steel two-part ball valves connected via threadolet (for stainless steel pipe)</td></tr>
<tr><td>For water quality check and system curve testing</td><td>One downstream of all pump discharge stop valves, on top of discharge manifold</td><td>Block-and-bleed arrangement with a 90 degree fitting on the horizontal end of ball valve to enable safe collection of water</td></tr>
</table>

Code References	Amendments to WSA 03-2011 V3.1 Sydney Water Edition 2014

6.2.7 Pressure accumulator tank

Code References	Amendments to WSA 03-2011 V3.1 Sydney Water Edition 2014
6.2.7 Pressure accumulator tank	*Replace (d) with 'fully certified and registered to meet SafeWork NSW requirements;'*
	Replace (h) to the end of the clause with the following: (h) connected to the discharge manifold with a metallic pipe (i) constructed as a freestanding bladder-type vertical steel tank in accordance with AS 1210 (j) rated to withstand a maximum pressure of at least 1600 kPa (k) fitted with a pressure relief valve as per AS 1210. Certificates of compliance for pressure relief valve to AS 1210 and AS/NZS 3788 must be provided to Sydney Water and made available on-site. (l) fitted with a pre-charge connection (Schrader) valve approximately 1500 mm from finished floor level with an analogue pressure gauge and a ball valve. (m) pre-charged with nitrogen gas to optimise vessel wall and bladder life (n) supported, secured to the floor and be easily accessible to the lifting equipment. A drain-cock shall be provided between the accumulator and the isolation valve to enable draining of the tank and checking of accumulator charge (by cracking the drain-cock with the vessel isolated). The drain of the accumulator shall connect to the station drainage system via a pit. The required charge pressure shall be marked permanently in letters at least 25 mm high on the tank near the pre-charge connection. Commissioning procedure shall be affixed on the accumulator or provided in O&M manual if there is insufficient space on the accumulator. If the accumulator is more than 1500 mm high (measured from finished floor level) and the site is fenced, it can be located outside the building/ enclosure with the instruments protected from the elements and vandalism.

Code References	Amendments to WSA 03-2011 V3.1 Sydney Water Edition 2014

6.2.8 Power system and supply

Code References	Amendments to WSA 03-2011 V3.1 Sydney Water Edition 2014
6.2.8.1 General	*Add at the end of second paragraph:* A 230 V GPO shall be provided on the inside of the building/ enclosure near the double door.
	Add at the end of clause: Any wall or pole mounted conduits (inside and outside the station) shall be neatly arranged to ensure access to the pumps, valves and instruments is not affected. – All incoming and outgoing conduits from an outdoor switchboard shall enter the building/ enclosure via separate pits for easy identification and maintenance.
6.2.8.9 Lighting	*Delete 'fluorescent' in the first sentence.*
	Add at the end of clause: All lights (internal and external) shall be LED and comply with Sydney Water's Design Specification for Water Pumping Stations.

Code References	Amendments to WSA 03-2011 V3.1 Sydney Water Edition 2014
6.2.9 Control and telemetry system	
6.2.9.2 Instrumentation	*Add at the end of the clause:* Each station shall be provided with a flowmeter as per Sydney Water's Design Specification for Water Pumping Stations . A pressure transmitter shall also be installed in the pipeline near the most disadvantaged customer for monitoring as per Sydney Water's instrumentation and Control Standards.
6.2.9.3 System requirements	*Insert at the end of second paragraph:* The set point pressure shall be based on the service pressure required at the most disadvantaged customer.
	Replace second sentence of the fifth paragraph: The designer shall, in consultation with Sydney Water, propose an integrated control philosophy and specify equipment requirements to achieve the required output from the booster set without reduction of service life in pumps.
	Replace the phrase 'manually or via remote' with 'manually and via remote' in item (ii) second sentence.
	Delete last sentence of the clause.
6.2.10 Alarms and controls	
6.2.10.1 General	*Replace phrase in first sentence 'the requirements of the Water Agency' with 'Sydney Water Instrumentation and Control Standards'.*
6.2.11 Telemetry	
6.2.11.2 Software	*Delete 'In the absence of the Water Agency direction' in third paragraph.* *Delete last paragraph of the clause.*
6.2.11.3 Communications	*Replace first sentence of the clause with 'A communication service shall be provided as per Sydney Water Instrumentation and Control Standards.'* *Delete second and third paragraphs.*

Code References	Amendments to WSA 03-2011 V3.1 Sydney Water Edition 2014

6.2.12 Building

6.2.12 Building

Add a new Clause 6.2.12 after Clause 6.2.11:

6.2.12.1 General

The building/ metal enclosure shall be:

- acoustically insulated to meet the EPA requirements and Sydney Water's Technical Specification – Mechanical
- designed as per the building requirements in Design Specification for Water Pumping Stations , with the following departures.

6.2.12.2 Building Classification

As Sydney Water is the determining authority, building approval process to National Construction Code (NCC) is not required. However, the fire resistance level (FRL) of booster stations must be designed in accordance with NCC, Sydney Water's Technical Specifications and all relevant Australian Standards.

Sydney Water considers booster stations as Class 10a – non-habitable building.

Refer to Design Specification for Water Pumping Stations for requirements of bush fire protection (if required).

6.2.12.3 Layout

The building/ enclosure shall be sized to accommodate:

- all mechanical equipment such as pumps, pipework, fans for the ultimate stage
- space for access, operations, maintenance and renewals.

Refer to Technical Specification – Electrical for location and requirements of variable speed drives. If the VSDs are installed in the building, the exhaust from each drive unit shall discharge through the walls to minimise head load from the VSDs.

Any on-site permanent generator to be installed outside the building/ enclosure.

A minimum 1000 mm wide concrete footpath must be provided all around the building/ enclosure.

Refer to Clause 6.2.5.8 of WSA 03 – Sydney Water Edition for minimum design clearances.

The outdoor switchboard shall face the station double door for better communication and, where possible, in the East-West direction to reduce heat gain. A hardstand area shall be provided as working space for the outdoor switchboard with minimum:

- 1500 mm clear space in front of the switchboard
- 900 mm side clearance (for generator connection)

Code References	Amendments to WSA 03-2011 V3.1 Sydney Water Edition 2014
	• 1300 mm side clearance (for MDF connection) • 600 mm back clearance. **6.2.12.4 Floor Slab** The building/ enclosure must be founded on a reinforced concrete slab. Refer to Design Specification for Water Pumping Stations for details. **6.2.12.5 Walls** The booster station walls may be double brick/ blockwork, pre-cast concrete panels, or metal cladding. Subject to Sydney Water's acceptance, metal enclosure can be used for booster stations which: • are small with metal enclosure area ≤ 15 m^2; • are located in industrial/ commercial areas where solar heat, noise and aesthetics are not considered important; and • have no VSDs installed inside the enclosure. Where metal enclosure are used, they must be: • stainless steel 316 matt finish for coastal areas (Category C4, generally less than 1 km from coastline and can extend inland along rivers as per AS 4312); or • galvanised steel with coating PUR-B as per WSA 201 or Colorbond® for non-coastal areas. The metal colour must be painted in Dulux Ocean Mist 96183250 or European Colour Standard No. RAL9018. Where the station is located in parks or bush areas, Environmental Green G66 can be used if agreed by Sydney Water. **6.2.12.6 Roof** Roof requirements are similar to those for conventional water pumping stations except that the roof does not need to be designed for future installation of solar panels. **6.2.12.7 Doors** The building/ enclosure shall have a minimum of two doors: • double door sized to allow transport of equipment through and for maintenance purposes, with a minimum clear opening of 2 m wide x 2.5 m high • single door for personnel access Where the switchboards are located within the building, an additional personnel door shall be provided as an emergency exit. All door leaves shall: (a) be provided with Sydney Water bi-locks

Code References	Amendments to WSA 03-2011 V3.1 Sydney Water Edition 2014
	(b) open outwards by approximately 180 degrees with SS316 facility to securely latch in open position. Where latching to the walls is not feasible, fixed bollards can be provided to secure door opening by more than 90 degrees. (c) be fitted with panic bar mechanisms on the inside to aid in emergency exit (d) fitted with a proximity switch monitored by IICATS (refer HSS0008 for details) (e) fitted with door closers (f) fitted with turn handles. **6.2.12.8 Ventilation** Ventilation requirements for booster stations are similar to those for conventional water pumping stations except that: • the fans can be installed directly onto the walls of the pumping stations at high level (top of fan maximum 500 mm from ceiling) • no ductwork and dampers are required. **6.2.12.9 Lifting Facilities** A manual gantry crane shall be installed in a brick/ blockwork or precast concrete building. No crane is required for metal enclosure, but its roof shall be designed as removable to facilitate access to the equipment with a mobile crane. **6.2.12.10 Access Stairs, Ladders and Platforms** No electrical or crane platforms are required in the booster station. Any indoor switchgear shall be installed on a 100 mm high concrete plinth. **6.2.12.11 Amenities** Toilet amenities shall be provided in a brick/ blockwork or precast concrete building. No toilet is required in a metal enclosure. The toilet shall connect to the existing sewer by gravity. Connection to the sewer via a pressure sewerage system is not acceptable. **6.2.12.12 Station Drainage** The floor of the booster station must be graded to a pit which discharges to the approved stormwater system by gravity. As a minimum, pits must be: • located under the strainer and drain-cock facility of the accumulator • minimum 400 mm square x 300 mm deep with galvanised gratings • discharged to the approved stormwater system via a minimum DN100 drain.

Code References	Amendments to WSA 03-2011 V3.1 Sydney Water Edition 2014
8 Appurtenances	
8.2.5 Stop valves for local in-line booster pumping stations	*Replace text after (d) to the end of the clause with the following:* (e) downstream of all pumps discharge isolating valves, on the discharge manifold within the building/ enclosure for system curve testing The suction and discharge station isolating valves shall be fully sized to pipeline size. They can be located outside the building/ enclosure but within the station boundary. Isolating valves (including those within the booster set) shall be metal-seated double-flanged gate valves. Smaller valves DN65 and below can be grade 316 stainless steel ball valves with flanged (preferred) or threaded connections as per Sydney Water's Technical Specification – Mechanical. The ball valves shall be installed such that the handle is on the top to facilitate easy operation.
8.5.3 Typical installations of non-return valves	*Replace (a) with:* (a) at booster station in each pump discharge offtake
	Replace second last paragraph with: Non-return valves shall not be buried. Booster station bypass non-return valve shall be installed in a pit within the station fenced compound as per Sydney Water's Design Specification for Water Pumping Stations . All non-return valves shall be resilient seated. Non-return valves DN80 and above shall be double flanged tilting disc as per AS 4794. Non-return valves below DN80 can be duo check valve. Wafer type non-return valves are not acceptable.
Appendix D – Booster Configuration	*Not Used*

<table>
<tr><th>Code References</th><th>Amendments to WSA 03-2011 V3.1 Sydney Water Edition 2014</th></tr>
<tr><td colspan="2">Appendix E</td></tr>
<tr><td rowspan="2">E7 Tank Requirements</td><td>Replace definitions of the following terms with:
ΔP = Difference between cut-in and cut-out pressures (relative), bar
Cut-in = Cut-in pressure (relative), bar
N_{max} = Maximum number of pump starts/ hour assuming one pump is taken offline for maintenance
= number of pump starts/hr/pump x (total no. of pumps -1)
k = Constant for tank pre-charge pressure
= 0.8 or as per manufacturer’s recommendation (whichever is lower)</td></tr>
<tr><td>Add the following at the end of the clause:
Pre-charge pressure (relative) = k x Cut-in pressure – 0.2, bar
The above required tank volume formula is to prevent rapid cycling of the pumps during low demands. A larger volume may be needed if required by water hammer.</td></tr>
</table>

4. Context

Accountabilities

Position	Accountabilities
Engineering, Engineering & Technical Support	Updating the standard
Asset Planning	Reviewing the standard
Asset and System Management (Networks)	
Instrumentation & Control Services	
Network Field Operations	
Network Regional Operations & Maintenance	
Planning Partner	
Project Engineering	
System Planning	
Work Programming & Optimisation	

5. Ownership

Role	Title
Group	Engineering, Engineering & Technical Support (ETS)
Owner	Norbert Schaeper, Engineering Manager
Author	Rajiv Madhok, Nana Keong

Change history

Version No.	Prepared by	Reviewed by	Date	Approved by	Issue date
1	Rajiv Madhok Nana Keong	Milan Rubcic	30/06/2023	Norbert Schaeper	30/06/2023