Hunter Water Corporation A.B.N. 46 228 513 446

Standard Technical Specification for:

CHEMICAL UNLOADING, STORAGE AND DOSING SYSTEMS

STS 670

This Standard Technical Specification was developed by Hunter Water Corporation to be used for the design, construction/installation and/or maintenance of facilities that are, or are to become, the property of Hunter Water Corporation. It is intended that this Standard Technical Specification be used in conjunction with various other standard and project specific drawings and design requirements as defined by Hunter Water Corporation for each particular project.

Hunter Water Corporation does not consider this Standard Technical Specification suitable for use for any other purpose or in any other manner. Use of this Standard Technical Specification for any other purpose or in any other manner is wholly at the user's risk.

Hunter Water Corporation does not assume a duty of care to any person using this Standard Technical Specification for any purpose other than stated.

In the case of this document having been downloaded from Hunter Water Corporation's website;

- Hunter Water Corporation has no responsibility to inform you of any matter relating to the accuracy of this Standard Technical Specification which is known to Hunter Water Corporation at the time of downloading or subsequently comes to the attention of Hunter Water Corporation.
- This document is current at the date of downloading. Hunter Water Corporation may update this document at any time.

Copyright in this document belongs to Hunter Water Corporation.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Appendices

Tables

Figures

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Standard Technical Specification – Chemical Unloading, Storage and Dosing System – STS 670

1 Purpose

This document describes the requirements for chemical unloading, storage and dosing systems at Hunter Water Corporation (HWC), to achieve a safe work place and protection of the environment.

1.1 Scope

This document applies:

- from the chemical supplier's transfer point to the point of use
- to new chemical unloading, storage and dosing systems
- to upgrades to existing chemical unloading, storage and dosing systems.
- to all chemicals used at Hunter Water.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

2 Interpretation

For the purposes of interpretation of this Standard Technical Specification, except where the context requires otherwise:

- 'Drawings' means the drawings detailing the work involved in a particular project in hand
- ‘Include’ means including but not limited to, and is used to provide clarification or examples of the type and nature of items intended
- 'Specification' means a specification detailing the work involved in a particular project
- ‘Standards’ means applicable industry standards include the Australian Standards (AS), Australian / New Zealand Standards (AS/NZS), American National Standards Institute (ANSI) and ISO Standards (ISO) referenced in Appendix A
- 'Standard Drawings' means Hunter Water Corporation Limited drawings
- 'Standard Technical Specification' (STS) references any of Hunter Water’s Standard Technical Specifications, as implied by the text.

Headings are for the convenience of the reader and must not be used in the interpretation of this Standard Technical Specification.

Unless stated otherwise any expression such as "give notice", "submit", "approval", or "directed" means give notice to, submit to, approval by, or directed by the person nominated by the Hunter Water.

Approval does not imply acceptance of responsibility by Hunter Water for compliance with this technical specification. Unless approval has been issued in writing, approval has not been granted.

Failure to comply with the requirements of this STS or any referred documentation will result in rejection. Where equipment and / or manufacture is rejected, notice will be given by Hunter Water in writing. All associated rectification work must be completed by the contractor at their cost.

2.1 Order of Precedence

The order of precedence, from high to lowest are:

- Legislative requirements
- Content in this STS
- Australian Standards
- WSAA standards

2.2 Exception to this Document

Project specific requirements, including those in project specifications or Drawings, take precedence over general requirements in this document. Deviation from this specification must be approved in writing by Hunter Water.

2.3 Referenced Documents

In addition to STS670, all work must comply with relevant current Australian Standard (AS) and Australian/New Zealand Standard (AS/NZS) and regulations inclusive of all amendments. In particular:

- Workplace Health and Safety Regulations
- National Codes of Practice (For example, Safe Work Australia Codes of Practice)
- WorkCover NSW Codes of Practice
- Hunter Water’s Standard Technical Specifications
- Hunter Water’s Isolation, Lockout and Tagout Manual
- Hunter Waters NPV template

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- ISO 9001 Quality Management Systems

A list of relevant Australian and International Standards is contained in Appendix A.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

3 Roles and Responsibilities

3.1 Document Owner

The Document Owner of this Hunter Water Standard Technical Specification of Chemical Delivery, Storage and Dosing Systems is Hunter Water's Manager Mechanical Engineering.

3.2 Responsibilities

The Document Owner or approved delegate must approve in writing the issue of any updated version of this Standard Technical Specification.

Any concession to any requirement in this STS 670 is valid only when authorised in writing by the Document Owner.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

4 Abbreviations and Definitions

Where the following term and abbreviation occurs in this STS, it is defined as follows, unless the context implies otherwise:

Table 1 Abbreviations

Abbreviation	Definition
ADG Code	Australian Dangerous Goods Code
AS	Australian Standards
ASTM	American Society for Testing and Materials
CHAIR	Construction Hazard Assessment Implication Review
DC	Direct Current
EPA	NSW Environment Protection Authority
FRP	Fibre Reinforced Plastic
GHS	Globally Harmonised System
GPO	General Power Outlet
GRP	Glass Reinforced Plastic referred to as FRP
HAZCHEM	Hazardous Chemical
HWC	Hunter Water Corporation
IBC	Intermediate Bulk Container
ISO	International Organization for Standardization
LED	Light Emitting Diode
NHVR	National Heavy Vehicle Regulator
NSW	New South Wales
NZS	New Zealand Standard
P&ID	Piping and Instrumentation Diagram
PE	Polyethylene
PID	Proportional Integral Derivative
PLC	Programmable Logic Controller
PN	Pressure Nominal, pressure rating
POEO	Protection of the Environment Operations Act (NSW)
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
RPZD	Reduced Pressure Zone Device
SCADA	Supervisory Control And Data Acquisition (software)
SDS	Safety Data Sheet
STS	(Hunter Water Corporate) Standard Technical Specification
UPS	Uninterruptable Power Supply
UV	Ultraviolet
VSD	Variable Speed Drive
WHS	Work Health and Safety

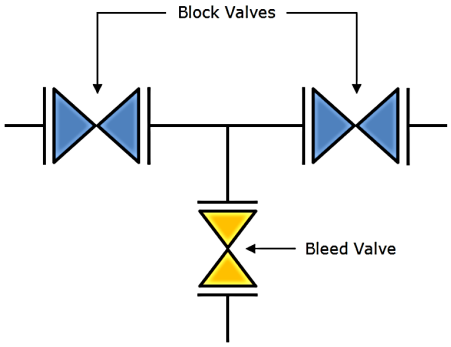
Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Abbreviation	Definition
WSAA	Water Services Association of Australia

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

This STS adopts the following definitions from AS3780 – 2008 the storage and handling of corrosive substances.

Table 2 Definitions

Definitions	Explanation
Block and bleed valve configuration	
Boundary	The perimeter of the whole of the site under the same occupancy as the storage area.
Bulk	Liquid, gas or solid substances that are not in packages.
Bund	An embankment or wall that may form part or all of the perimeter of a compound.
Chemical injection point	The chemical injection point, is the point where the chemical is added to the process. The injection point will be into a pipe, a water body or to atmosphere over a water body.
Crest Locus	The angle between the top of the bund wall and the top of tanks and their associated fittings
Chemical Dosing System	The chemical system components from the dosing tanks to the inject points
Fail-safe	Function whereby equipment fails to a safe position. For valves it will either automatically open or close depending on the required fail-safe condition
Fibre Glass	FRP or GRP
Incompatible	In relation to dangerous goods and other goods, goods that are— • Likely to interact with the dangerous goods so as to increase the risk when mixed or otherwise brought into contact with the dangerous goods; • Listed in the ADG Code as being incompatible; or • Declared by the regulatory authority as being incompatible. In relation to packaging or transfer equipment, a container or item of equipment that is constructed of a material that is likely to interact with the dangerous goods such that it is weakened or damaged, to the extent that risk increases.
Invert	The bottom of a pipe, with reference to the internal diameter
May	Indicates the existence of an option
Mechanical pipe joiner	Flanged or compression pipe joiners
Must	Indicates that a statement is mandatory.
Obvert	Top of the inside diameter of a pipe
Operational Tank Volume	The usable volume in the tank. This is the volume of chemical from the low-low level indication (pump cut off level) to the high level indication (filling cut off level). This excludes the volume below the low-low level cut out and the volume from the high level to the tank roof.
Pipework	An assembly of pipes, pumps, hoses, valves, fittings and associated appliances used in receiving, handling or exporting bulk goods.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Definitions	Explanation
Rotameter	A flowmeter that measures flow rate mechanically in a transparent tube, with flow rate read physically from the tube by the operator. Rotameters are typically not monitored.
Spectacle blind	A plate cut into two discs of a certain thickness. The two discs are attached to each other by a section similar to the nose piece of a pair of glasses. One of the discs is a solid plate, and the other is a ring, whose inside diameter is equal to that of a flange
Starter bars	Reinforcing bars cast into or welded to a member to give a lapped connection to further reinforcement in another concrete element to be cast against it.
Stormwater	Rainwater systems that leave Hunter Water controlled property
Tank	A container other than a packaging or intermediate bulk container.
Tanker vehicle	A road tank vehicle, minimum 19 m long.
Tracer Wire	Wire run with non-conductive pipework to aid underground identification. Tracer wire, also known as locating wire or locator wire.
Vapour Scrubber	A system component where gas flow is brought into contact with a fluid to remove the hazardous gas components of the gas.
Welded pipe join	Metal or plastic fusion joining of pipe. Chemical bonding of pipe where the pipe chemically bonds with the joiner.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

5 Compliance Requirements

Chemical unloading, storage and dosing systems at Hunter Water must comply with Commonwealth and New South Wales (NSW) legislation requirements at the time of commissioning. Legislation relevant to chemical delivery, storage and dosing systems includes:

- Work Health and Safety Act 2011 (WHS Act)
- Work Health and Safety Regulation 2017 (WHS Regulation)
- Protection of the Environment Operations Act 1997 (POEO Act)
- Protection of the Environment Operations (General) Regulation 2009
- Protection of the Environment Operations (Clean Air) Regulation 2010
- State Environmental Planning Policy No.33 (SEPP 33)
- Fluoridation of Public Water Supplies Act 1957 – Fluoride dosing systems only

The CHAIR report for new and upgraded chemical dosing systems must include supporting evidence that all compliance requirements are met.

5.1 Legislative Requirements

5.1.1 WHS Compliance

Chemical unloading, storage and dosing systems at Hunter Water must comply with the WHS Act and WHS Regulation requirements, including, but not limited to:

- Requirements to identify foreseeable hazards and either eliminate the hazard or minimise the risks through a hierarchy of controls, so far as is reasonably practical. – see WHS Regulation, Chapter 3, Part 3.1.
- Requirements associated with airborne contaminants, hazardous atmospheres and storage of flammable and combustible substances. - see WHS Regulation, Chapter 3, Part 3.2, Divisions 7, 8 and 9, respectively.
- Requirements in relation to the design, manufacture, import, supply, installation, construction and / or commissioning of equipment. Whether these are directly applicable to the contractor, OEM or indirectly to Hunter Water, these provisions must be met and a contractor must provide all equipment, services and documentation within its scope of supply to meet these requirements. – See WHS Regulation, Chapter 5.Plant and Structures.
- Requirements in relation to the use, handling and storage of hazardous chemicals, generation of hazardous substances and pipelines used to convey hazardous chemicals. – See WHS Regulation Chapter 7, Part 7.1.
- The application of the relevant SafeWork NSW Codes of Practice.

5.1.1.1 SafeWork NSW Codes of Practice and Guidelines

SafeWork NSW approved Codes of Practice and Guidelines are practical guides to achieving the standards of health, safety and welfare under the WHS Act and WHS Regulations.

The following SafeWork NSW Codes of Practice apply to hazardous chemicals systems:

- managing risks of hazardous chemicals in the workplace (August 2019)
- labelling of workplace hazardous chemicals (August 2019)
- preparation of Safety Data Sheets for hazardous chemicals (August 2019)

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

The following SafeWork NSW Guidelines apply to hazardous chemicals systems:

- placarding for storage of hazardous chemicals
- factsheets and Guides 27/11/2014 (from SafeWork NSW site)
    - o Class 9 dangerous goods are no longer included in Schedule 11 table for placarding. That is, GHS pictograms are not used for placarding of tanks and storage areas.
- notifications for schedule 11 hazardous chemicals and abandoned tanks – guidance material.

5.1.2 Environmental Compliance

All chemical delivery, storage and dosing systems must be designed to be operated and maintained without causing pollution. NSW Legislation defines a 'pollution incident' as including situations that are likely to result in pollution, not only situations in which pollution is occurring or has occurred.

The Protection of the Environment Operations Act and related regulations have requirements relating to the protection of the environment from contamination. Chemical delivery, storage and dosing systems must be designed, supplied, installed, commissioned and be capable of being operated and maintained so they do not create any pollution incidents. The designer or constructor must meet these requirements for all equipment, services and documentation within its scope.

Potential sources of pollution, include:

- disposal of waste in a manner that harms or is likely to harm the environment
- allowing any substance to leak, spill or otherwise escape in a manner that harms or is likely to harm the environment
- emission of ozone depleting substances
- pollution of waters, other than within the terms of a NSW Environment Protection Authority (EPA) Environment Protection Licence for the location
- causing air pollution.

The design and construction of new or modified chemical delivery, storage and dosing systems must comply with the POEO legislation including site specific EPA Environmental Protection Licence conditions. Environment Protection Licences applying to the operation of Hunter Water infrastructure are available from Hunter Water.

Chemical delivery, storage and dosing systems must comply with the NSW WorkCover code of practice: storage and handling of dangerous goods (2005). Note: this is also a requirement of the EPA.

Chemical delivery, storage and dosing systems must comply with the NSW Department of Environment and Climate Change's Participant's manual, *Storing and Handling Liquids: Environmental Protection*. This is a guide to managing environmental risks associated with the storage and handling of liquid substances, including chemicals.

5.1.3 Health Act Fluoride Requirements

The NSW Code of Practice for Fluoridation of Public Water Supplies – March 2011 is a NSW Health Department approved Code of Practice under the Fluoridation of Public Water Supplies Act 1957. Sections of this Code of Practice include requirements for fluoridation facilities, including:

- Section 5 – Design controls for fluoridation facilities
- Section 7 – Environmental safety
- Section 8.2 – Storage of fluoridating agent
- Section 9.1 – Sample requirements.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

5.1.3.1 Code of Practice for Fluoridation of Public Water Supplies

All fluoridation facilities must comply with the NSW Department of Health Code of Practice Fluoridation of Public Water Supplies.

5.1.4 Risk Assessment

Section 34 of the WHS Regulation, requires identification of reasonably foreseeable hazards that could give rise to risks to health and safety. Section 35 of the WHS Regulation requires that these risks to health and safety must be managed by eliminating the risks, so far as is reasonable practicable, or if elimination is not reasonable practicable, minimising the risks, so far as is reasonable practicable. Section 47 of the WHS Act advises that consultation must be undertaken with workers who are likely to be affected (e.g. plant operator and maintenance personnel). Chapter 3 of SafeWork NSW Managing Risks of Hazardous Chemicals in the Workplace Code of Practice advises when a risk assessment is appropriate and provides three options (basic, generic, or detailed).

The design of any new or modified chemical storage and delivery systems on Hunter Water sites must require a risk assessment to be undertaken for any risks to health, safety or the environment that cannot be eliminated. The risk ranking of each risk must be determined using the Hunter Water Risk Ranking Matrix.

These risk assessments must occur at the following stages in any project:

- concept design
- detail design
- commissioning

At each stage, these risk assessments must include operation and maintenance risks, as well as the construction, installation and commissioning risks usually considered during the Construction Hazard Assessment Implication Review (CHAIR) for a project.

The risk assessments must meet the requirements of the relevant SafeWork NSW Codes of Practice, including:

- How to manage work, health and safety risks
- Managing risks of hazardous chemicals in the workplace
- Managing the risks of plant in the workplace
- Work, health and safety consultation, coordination and cooperation
- Managing the work environment and facilities.

Considerations in these risk assessments must include:

- hazardous properties of the chemical, particularly hazardous chemicals
- possible hazardous reactions
- nature of work
- plant or system used in handling, generation or storage of the chemical, or plant / system that could interact with the chemical.

The outcomes from each risk assessment, including the recommended risk control measures, must be provided in a written report to Hunter Water. Where alternative risk control measures for the same hazard are proposed, Hunter Water must confirm in writing the risk control measures to be implemented in the project.

A WHS risk template is provided in Appendix B:WHS Checklist

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

5.2 Compliance Review

Third party audit of new or upgraded chemical dosing systems against Legislative Requirements outlined in Section 5.1 must be undertaken by a qualified professional engineer with experience in the design of the associated chemical system (a template for the audit is provided in Appendix B). The audit must be performed:

- at detail design
- during commissioning with water, before chemical is introduced.

5.2.1 Audit by Chemical Supplier

The chemical supplier must audit new or upgraded chemical dosing systems for:

- Proposed delivery procedures and operability of equipment relating to loading and unloading chemicals
- Vehicular access
- Risk assessment development of the chemical delivery process
- Aiding the project team as required for information used in the design and construction phase

The audits must be undertaken at:

- detail design
- during commissioning with water, before chemical is introduced.

5.3 Australian Standards

The legislation and Codes of Practice mentioned above provide the high-level requirements to meet compliance.
The Australian Standards are a technical guide that must be followed unless alternative methods for compliance are provided and have been endorsed by Hunter Water.

Compliance with the relevant Australian Standard does not necessarily mean compliance with the legislation or Code of Practice. Guidelines on their use is provided in the Codes of Practice.

If there is conflict or omission between the legislative requirements and Australian Standards, then the issue is to be risk assessed and managed as per the relevant Code of Practice and documentation must be provided with the project information. Examples of common NSW Codes of Practice are Managing the Risks of Plant in the Workplace and / or Managing Risks Chemicals in the Workplace.

A list of relevant codes and standards are provided in Appendix A:Relevant Standards.

5.4 Hunter Water Standard Technical Specifications

All installations must comply with relevant Hunter Water STSs which can be found via https://www.hunterwater.com.au/building-and-developing/drawings-plans-and-specifications/standard-technical-specifications

5.5 Hunter Water Approved Products and Manufacturers

All installations must comply with relevant Hunter Water approved products which can be found via

https://www.hunterwater.com.au/building-and-developing/drawings-plans-and-specifications/approved-products-and-manufacturers

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

6 Design Requirements – General

6.1 General

Design requirements general includes requirements that apply to all chemical unloading, storage and dosing systems. A chemical dosing system must:

- be designed for lowest lifecycle cost
- be capable of operating automatically without operator intervention
- include manual operation to support specific operations and maintenance requirements (E.g. priming or pump calibration tests)
- have local controls accessible from outside the tank bund or wet areas
- prevent syphoning
- prevent back flow
- all chemical storage and delivery systems must be designed so that their operation and maintenance must minimise waste and not result in the generation of pollution
- have a minimum service life of:

Chemical Dosing System Element	Minimum Number Years Life
Bunding and service pits	50
Bund coatings	10
Chemical storage tanks	20
Pipework	20
Double containment measures	20

The life expectancy of the specific project must be considered when applying this STS.

6.1.1 Equipment Isolation

Chemical dosing equipment must be isolatable in accordance with Hunter Water's Isolation, Lockout and Tagout Manual.

6.1.2 Material

Materials selected or adopted in the design must be:

- suitable for installation in the proposed environment
- compatible with the chemical, the operating pressure and temperatures
- able to meet the required design life.

Chemical dosing equipment and pipework must be shaded from direct sun exposure, at all times of year, preference for equipment with digital displays to face south. Dosing equipment and pipework must be compatible with any equipment it attaches to.

6.2 Carrier Water System

Carrier water is used to transport chemical to the point of injection. The carrier water system must:

- be site recycle water, when available
- minimise use of potable water.

Where the chemical dosing system includes carrier water, the carrier water system must include:

- non-return valve (with chemically compatible materials)
- RPZD valve when supply is taken from potable water (with chemically compatible materials)

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- isolation valves
- flow switch
- rotameter
- pressure transmitters
- low flow switch
- actuated stop valve: solenoid valve for pipe less than 50mm diameter; motorized valve for pipe greater or equal to 50mm. Actuated valves must be fail-safe (Fail-Open)
- pressure regulating valve: to control downstream carrier water pressure.

6.3 Site and Building Requirements

Chemical dosing sites must:

- include a Hazardous Material document holder, located at the entrance to the site. The Hazardous Materials document holder must:
    - include the SDS, site manifest and site emergency plan
    - be locked L003 fire panel key
- be compliance with separation distance requirements to boundaries and protection placed corresponding with the chemicals class and Australian Standards.

Chemical dosing installations must include:

- laminated Piping and Instrumentation Diagrams of the chemical dosing system, mounted at the entry of the chemical storage system
- a storage area for emergency response kits and spill kits, outside the bunded areas
- hard copies of SDS and SDS QR code for access to the Hunter Water SDS system.

Site vehicle movement plans must aim for heavy vehicles only travelling forward. Reversing of heavy vehicles must be avoided. Risk assessment of proposed movements must be completed and will assist in identifying appropriate measures (e.g. bollards, signs, mirrors, road markings) to reduce risk.

6.3.1 Separation Distance – Site Boundary

Designers must consider separation distances between the chemical dosing system and the property boundary. Separation distances are dependent on the type and volume of chemical being stored, refer to Appendix A for Standards addressing minimum distances.

6.3.2 Security and Fencing

Chemical dosing systems must comply with STS105. Barrel locks and padlocks must be to Hunter Waters key system.

6.3.3 Chemical Dosing System Enclosures:

The chemical dosing system enclosure (typically consisting of chemical tank and dosing cabinet) must include:

- a roof
- walls
- an emergency exit with panic bar.
- doors that secure open.
- 1000mm concrete apron around the perimeter on open mesh sides, for operator access and inspection

The roof and walls must prevent rainwater entering the tank bund. The roof must include:

- roof sheeting extending 120 to 180mm beyond the roof fascia
- 1.2 m clearance above the top of the tank, for side mounted access hatches

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- 2.4 m clearance above the top of the tank, for top mounted access hatches
- an overhanging eave for mesh walls to restrict rain ingress into the tank bund. The roof must overhang the bund wall by at least 12 degrees from the vertical plane of the bund wall. Overhang angle must be demonstrated on design drawings.
- no equipment or services suspended from the roof above tanks, to enable tank replacement.

The walls must be a combination of mesh and solid sheeting designed to protect the system from direct sunlight, wildlife, rainwater ingress and achieve security outcomes. Where the walls are solid, the top 600mm (minimum) must be mesh to allow for ventilation; thermal insulation of the building should also be considered.

Preference is for rooves without gutters, with rain water falling to non-erodible spoon drains on the ground, the spoon drains must connect to the site stormwater system. Rain water must not fall across accessways. The site stormwater system must include erosion control.

The emergency exit must lead to a safe area where there is no risk of exposure to chemicals. Panic bars must be vandal proof & not accessible from outside the bund.

6.3.4 Maintenance Access

Chemical dosing systems must have operation and maintenance access compliant with STS600. In addition to STS600:

- equipment mounted to the top of tanks can be withdrawn from the top of tanks including man access and lifting equipment, without the need to disturb the roof. Equipment mounted to the top of tanks must be accessible by a permanent platform, elevated work platform or platform ladder. The footprint of elevated work platform or platform ladders must be shown on the design
- tanks must be able to be replaced by removal of the roof or dismantling of the roof. Where the roof of the tank bund cannot be removed, an alternate method for tank replacement must be included.

6.3.5 Ventilation

Chemical dosing systems must be designed to incorporate passive ventilation. Where chemical dosing systems are in a room, forced ventilation must be included. Ventilation of chemical storage systems must comply with the applicable standard for the chemical:

- AS1940
- AS3780
- AS2927 – Liquefied Chlorine Gas
- WorkSafe code of practice: Managing risks of hazardous chemicals in the workplace

Passive and forced ventilation systems must prevent:

- residual fumes above a safe threshold for the individual chemical
- accumulation of chemical fumes
- dispersion of chemical dust
- condensation build up.

Forced ventilation systems on chemical dosing or storage rooms must include:

- fans capable of achieving a minimum of 6 air changes per hour, or higher to meet the requirements of the specific chemical
- fans located to generate cross flow from the vents
- fans corrosion resistant to the chemical fume
- vents above the bund wall. Vents must be vermin proof

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- safe access for cleaning and maintenance of fans, filters, vents
- discharge to a safe place away from where people would congregate including assembly areas

6.3.6 Lighting

Chemical dosing systems must have lighting;

- complying with AS1680 and STS500
- for night work when identified:
    - by risk assessment
    - to meet operational and maintenance needs.

In addition to AS1680 and STS500 lights in chemical bunds must be:

- located to meet operation and maintenance requirements, and as identified by risk assessment during detail design
- mounted on posts or the walls, not the roof
- internal lights must be positioned above the walkways with sufficient space for a platform ladder (for maintenance access)
- external lighting must:
    - be vandal proof, when accessible by the general public
    - utilise the building for mounting (where practicable)
    - have a timer switch that is manually switched on and off, with the 'OFF' providing 15 minutes delay for network installations (to allow operators to safely egress the site with lights still on). Note: Motion sensors are not required for external lighting
- a minimum illumination level for internal lighting of average 400 LUX using LEDs must be supplied and installed in each room
- one emergency luminary must be supplied and installed for each room and must:
    - have a 2-hour battery backup
    - be located above doors fitted with panic bars
- lighting must not illuminate outside the property boundary.

6.3.7 Testing Bench and Basin

A testing bench and basin for analyser calibration must be included in the design, located near the chemical storage. Where a suitable existing test bench or laboratory exists on site, this requirement does not apply.

The testing bench must be a minimum of 1500 x 600mm and drain to the wash basin.

The basin must:

- be a minimum 300 x 400mm
- have a potable water supply
- drain to site sewer or a 20L container for disposal.

6.4 Emergency Response Spill Kits

Emergency response spill kits must be provided to match the requirements of the chemical installation. Emergency response spill kit must be:

- in a red or yellow bin with wheels
- stored within nominal 10 metres of the chemical bund. The storage footprint must be shown on design drawings.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

6.5 Signage

Chemical dosing systems must include the following signage:

- a sign at the main property entry with the Hunter Water site name, emergency telephone number and details of chemicals on site including:
    - chemical name
    - volume of chemical
    - dangerous goods class hazards associated with that chemical
- chemical storage and delivery systems labelled to identify the:
    - presence of a chemical
    - warn of the hazards associated with that chemical
    - PPE requirements.
- labelling in accordance with clauses 349 and 350 and Schedules 11 and 13 of the WHS Regulation, including placard and HAZCHEM signage:
    - “Confined Space Entry Permit” placed on chemical storage tanks
    - manufacturing information, minimum:
        - tank contents, 100mm tall font
        - total tank capacity, 100mm tall font
        - tank number, 100mm tall font
    - tank nameplate (15mm tall font), including:
        - tank manufacturer name and address
        - serial number
        - Hunter Water equipment number
        - tank material
        - lining material
        - design temperature
        - design pressure
        - date of manufacturing of the tank
    - a sign adjacent to the fill point that identifies the chemical:
        - tank asset number
        - full tank capacity
        - operational tank fill volume
- luminous emergency EXIT sign must be placed inside above the exit door, if required by National Construction Code (>100 square metres floor area)
- other relevant WHS signs must be installed in accordance with AS 1319. The signs may include, but are not limited to, safety shower, eye wash station, and non-potable water tap.

PPE signs must be installed:

- Adjacent to entry points to the area where the PPE is required;
- Inside the chemical area, visible from the entry point to the chemical area

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

7 Design Requirements – Containment and Safety

7.1 Chemical Containment Requirements

The chemical dosing system must include primary containment for chemical storage and conveyance.

The chemical dosing system must include secondary containment to protect personnel, the environment and surrounding equipment in the event of failure of the primary containment. The secondary containment must be designed to include:

- chemical unloading on site
- chemical storage
- chemical conveyance from the tank bund to the injection
- chemical injection arrangement.

The chemical dosing systems secondary containment must:

- contain a chemical leak within the secondary containment
- direct a leak to a bund or other safe containment
- include leak detection and alarm notification on SCADA
- allow safe and ergonomical access for leak isolation and recovery, and repair
- ensure non-compatible chemicals and materials do not come into contact
- include shielding, deflection screens or similar devices to ensure any spray leaks are captured in the secondary containment system (examples include transparent doors on the front of dosing pump cabinets or spray guarding on overhead pipe within the bund which is not pipe-in-pipe)
- be designed for leak testing.

Chemical dosing tank bunds and chemical unloading bunds must be hydraulically independent, without pipe connection between the two bunds.

7.2 Primary containment

Primary containment includes permanent tanks and pipes.

IBC’s must not be used for permanent chemical storage.

Primary containment pipe must:

- be a continuous pipe between service pits(e.g. PE with welded joints). Must not have mechanical pipe joiners within the secondary pipe
- have any mechanical joins on the chemical pipe located in the service pits
- ensure pipe can be adequately drained (self-draining where possible) for safe removal of dosing equipment
- have excellent compatibility with the chemical/s it is designed to contain

7.2.1 Chemical Leak Detection

7.2.2 Secondary containments systems must include leak detection at all low points. E.g. bund sumps, low points in double containment outer pipe/pit Chemicals in IBC’s

Where IBC’s are approved by exception, IBC’s must:

- not be used as storage tanks
- comply with the requirements of this STS
- allow inspection of all surfaces and fittings of the IBC in the storage bund

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- be stored on portable bund pallets, when not located in a permanent bund.

7.3 Chemical Unloading Containment

An unloading bund is required for the transfer of concentrated liquid chemicals from road transport vehicles. For solid chemicals, a concrete area that contains chemical during the transfer and any washdown must be provided.

The chemical unloading system:

- comprises the truck unloading bund or area and the chemical unloading control panel
- must be accessible from outside the tank bund. The delivery driver must not be required to enter the tank bund.

Gaseous chemicals require a firm, stable, level and non-combustible surface to undertake deliveries. The surface must not adversely impact the container transfer between delivery vehicle and chemical plant.

7.3.1 Chemical Unloading Bund

Chemical unloading must be performed within a truck unloading bund. Where a single chemical unloading bund is utilised for multiple chemical systems, it must meet the requirements of all the chemicals. The truck unloading bund can be remote to the chemical tank bund, where a single truck unloading bund is being utilised for multiple chemicals and for upgrading of existing installations.

The chemical unloading bund design must:

- eliminate full penetrations (eg pipes through bund walls, chemical anchors through the full thickness of the bund)
- any penetration depth to be no more than 50% of the thickness of the bund
- be orientated for the delivery connection point on the passenger side of the delivery truck
- be part of a one-way loop road. Reverse in drive out unloading bunds will only be accepted when a one-way loop path cannot be achieved
- have a maximum depth of 225mm
- have evenly graded vehicle access/egress, with rollovers 1200mm long and 110mm high
- any driver over humps will allow underbody clearance for passenger vehicles.
- allow the entire bulk chemical delivery trailer to be positioned within the unloading bund during the chemical unloading process
- have a minimum dimension of length 12m and width 4.5m
- include continuous kerb complying with AS2876 Concrete kerbs and channels (gutters)
- have surface run off from the surrounding area directed away from the bund, to limit rainwater ingress
- have a grade between 1:100 and 1:75 sloping to a sump, without pooling
- have a minimum capacity of 9000L above the leak detection alarm. The bund capacity must be achieved in the bund area and depth (including sump). Preference is for below ground spill retention tanks to be avoided.
- include a sump
- include a minimum of one ‘No Parking’ sign, in a clearly visible location close to the delivery bund
- include a pedestrian path from the truck unloading bund to the chemical transfer connection point, the path must:
    - o be designed to lay the unloading hose in the centre of the path
    - o be concrete
    - o minimum 1.2m wide

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

    - less than 3m long
    - drain to the unloading bund
- avoid being located over existing buried assets.

The chemical unloading bund construction must:

- be in accordance to STS 404. All construction joints must be fully sealed using sealants and water bar to guarantee integrity of the containment system. The sealants must be compatible with the chemical
- include a trowel finish to provide a cleanable surface
- include leak tested with potable water for a period of 48 hours. A Hunter Water representative must witness this test.

The truck unloading bund must not drain to stormwater, under any circumstances.

Where underground chemical spill retention tanks are required due to specific site constraints:

- a risk assessment must be conducted for Hunter Water's approval prior to design
- the chemical retention tank must:
    - be located adjacent to the truck unloading bund
    - have a level indication signage with 100mm tall font in upper case

7.3.2 Truck Unloading Bund Sump

The truck unloading bund sump must drain into the sewerage network or site wastewater system. Where the truck unloading bund sump cannot gravity drain to sewer, apply one of the following arrangements:

- install a chemically rated pump and pipe in the sump with a float and / or conductivity switch to pump spilled chemical and / or rainwater to the sewerage system or other appropriate location that is explicitly approved by Hunter Water in writing. The operation of the sump pump must be operator initiated.
- if a sewer does not exist, a roof over the bund area is required and a controlled method to remove stormwater must be provided.

The truck unloading bund sump must:

- be located at the perimeter of the bund, with preference for placement outside the vehicle path
- be accessible from outside the unloading bund (in the event the bund needs to be pumped out)
- be 600mm x 600mm x 600mm with grating. The grating must be:
    - compatible with the chemical
    - load bearing to AS3996 class E (minimum) where trafficable
- drain to sewer or site wastewater system. Where a sewer system is not accessible, the sump must be blind (ie no drain).
- blind sumps must be fitted with a level switch. The level switch must alarm when the sump contains 300mm of liquid
- have a pump fitted where gravity drainage to the sewer cannot be achieved

The truck unloading bund sump drain must:

- have a Non Return Valve at the sewer connection (to prevent odours coming back up the drain)
- have an isolation valve in the drain pipe:
    - located outside the bund
    - ¼ turn valve
    - marked "Truck Unloading Bund Isolation Valve" 100mm high font

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- marked “Drains to XXXX” 100mm high font
- marked “OPEN” “CLOSE” in upper case, 100mm high font
- fitted with a position indicator
- be interlocked with the delivery tanker power supply GPO to ensure the valve is closed to enable power
- be pad lockable in the close position

7.3.3 Coating of Truck Unloading Bunds

Chemical Specific Design Requirements includes a table identifying chemicals identified as requiring a coating for concrete truck unloading bunds. Where the requirement is not identified in the table, a risk assessment must be completed, considering the materials compatibility between the chemical and the bund material. Truck unloading bund coatings must be:

- a contrasting colour to the chemical
- coated in accordance with Manual for Selection and Application of Protective Coatings [WSAA 201-2020, version 2.3]
- with no penetrations of the impervious coating. Patch repairs must be applied where there is damage to the impervious coating.

7.3.4 Chemical Unloading Control Panel

The chemical unloading control panel must be located:

- adjacent to the truck unloading bund
- to provide line of sight to a digital display of the tank level
- to include line of sight to the truck unloading hoses

The control panel cabinet for chemical unloading must include:

- a 415V (20amps) and a 240V (15amps) chemical truck unloading pump power outlets. The power outlets must be interlocked (see control section). The power outlets must include:
    - an E-stop and separate reset button for chemical unloading (see control section)
- a siren (see control section), including a “silencing button”
- a beacon (see control section)
- indicators for:
    - power available
    - chemical storage tank levels (%)
    - truck unloading sump isolation valve position
    - Emergency stop alarm
    - Tank High level alarm
    - Alarm acknowledge push button
- all penetrations into the cabinet through a gland plate at the bottom of the cabinet
- power outlets, sirens and beacons must be mounted adjacent to the panel, and not fixed to the panel

Transparent windows or panels (Perspex or similar) must not be used on control panels.

7.3.5 Chemical Unloading Connection Points

The chemical unloading connection point(s) must:

- be a single unloading point per chemical
- a Banjo Dry-Mate coupling

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- be angled between 20° and 45° downwards from the horizontal, or support the tanker hose close to the coupling
- be between 900 to 1100mm above the access walkway
- be located within the tank bund. So that any drips or spills connecting or disconnecting the unloading hose drain into the tank bund or a drip tray
- incorporate a removable drip tray that sits under the connection point, approximately 400mm x 400mm
- be accessible from a pedestrian access outside of the tank storage bund
- be supported with mounting brackets positioned close to the couplings, which consider the weight of the pipe and contents.

Pipe work from the chemical unloading connection point to the chemical tank must rise vertically from the transfer connection point to above the top level of the tank then slope towards the tank. The transfer pipe must include:

- an isolation valve positioned in the vertical section of the transfer pipe. The isolation valve must be accessible from outside the bulk chemical bund
- a drain valve and drain pipe to the tank bund sump. The drain must be fitted at a low point between isolation valve and tanker coupling to allow the transfer and delivery hose to be completely drained to a sump. The outlet of the drain pipe must be visible from the unloading control panel (to ensure that it has not become inoperable/blocked)
- a system to confirm the transfer pipework is drained, before uncoupling the delivery hose
- double containment or spray guarding from the unloading point cabinet to the tank.

The chemical unloading connection point(s) must be clearly labelled including:

- storage chemical
- destination tank number
- the labels must have 50mm tall font.

7.3.6 Truck Unloading Hose

The distance from the truck connection to the chemical unloading point must be such that the truck unloading hose is required to be a maximum of 6m long. The chemical dosing system must include a method for washing chemical residual from the inside of the truck unloading hose. Designers must assume 100L of waste water will be generated from washing residual from the truck hose. Options for managing the disposal of the waste water include:

- a dedicated sewer connection. The truck unloading hose must be positively attached to the sewer connection for washing
- collection in truck unloading sump. The hose end must be fastened in a cradle to discharge into the sump during washing. The wash water must be able to be disposed from the sump in a controlled manner.

7.3.7 Chemical Unloading Hand Wash Basin

A hand washbasin must be provided within 25m of the chemical unloading control panel. The hand washbasin must:

- drain to site sewer system
- be accessible to the chemical delivery driver
- external to the tank bund.

Where an existing washbasin exists within 25m, no addition washbasin is required.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

7.4 Tank Bunding of Multiple Chemicals

Chemically compatible chemicals can be contained within a single tank bund. Where a designer intends to store multiple chemicals within a single chemical tank bund, there must be:

- separate control panels for each chemical
- separate unloading connections
- separate truck unloading pump power outlets
- separate containment measures for individual chemicals outside the tank bund, including separate:
    - dosing pump cabinets
    - chemical dosing pipe
- clear separation and segregation of each chemical system within the bund, including:
    - safety systems
    - safety signage;
    - chemical pipes for each chemical routed in separate service corridors
- clear and intuitive equipment arrangement

7.5 Pipe in Pipe Containment

“Pipe in pipe” is the containment of the chemical pipe inside a secondary pipe. The pipe in pipe system can be a proprietary system or bespoke to suit the site requirements. Secondary containment pipe must:

- contain a single chemical pipe
- use long radius bends for pull through systems. Elbows are acceptable for proprietary double containment systems
- incorporate leak detection at low points
- include a site glass at the low point for above ground pipework, with a lockable manual drain valve
- be located in service corridors (refer STS600)
- be chemically compatible with the chemical being transferred
- be designed to direct any leak from the primary pipe to a detection point containing level switch or conductivity probe. Rainwater ingress or condensation must be managed to avoid false alarms
- be designed and installed to enable annual leak testing
- be leak tested during commissioning
- preferably be above ground.
- not drain to the tank bund when carrier water is used.

Where pipe in pipe containment is buried, it must:

- be buried at 600mm depth
- have sealed service pits at the start, end and changes of directions
- be a straight line between service pits
- have a maximum of 50m between service pits
- replacement of the inner pipe must be able to be completed by pulling or pushing
- have service pits of minimum area 900x900mm, with water proof lids. Lids must be box lightweight type lid over pit to stop rain water ingress. Pits must not be placed in trafficable areas and have bollards for protection from vehicles
- have a double containment pipe of a minimum of 100mm and if the carrier pipe is greater than 40mm the double containment pipe must be a minimum of 3 times the outside diameter of the chemical pipe

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- not have joiners unless accessible at a pit

Secondary containment pipe, in aboveground installations, must be supported to manage:

- pipe sag
- thermal expansion
- thermal contraction.

7.6 Injection Point and Dosing Pits

The chemical injection point must be designed to achieve even dispersion and mixing of the injected chemical. Chemical injection points that can syphon must be installed with a pressure sustaining valve as close as possible, but no more than 2m, from the injection point.

Chemical injection into a pipe must:

- be accessible for operation and maintenance
- be a retractable chemical injection quill
- be located within a pit or enclosure, when above ground.

Chemical injection into a tanks or channel must:

- be nominally 300mm from the wall. To avoid direct contact with the wall.

Chemical injection to atmosphere above a water body must be:

- nominally 300mm from the wall. To avoid direct contact with the wall
- visible for witnessing
- guarded for
    - physical contact
    - environmental conditions (E.g. wind)
- accessible for maintenance and removal.

7.6.1 Retractable Chemical Injection Quill

Retractable chemical injection quills must pass through the injection point isolation valve. The injection quill must include:

- a restraint that:
    - keeps the quill in place, holding back against the process pressure
    - allows insertion and retraction of the quill to a point where it is clear of the isolation valve and sealed off by a compression gland
- flexible hose that is:
    - pressure rated
    - chemically compatible
    - long enough to allow removal of the injection quill through the isolation valve;
- have valves on the injection point and the injection pipe to facilitate disconnection
- release of the chemical 25-50% of the receiving pipe diameter from the pipe wall.

The dosing quill must be capable of removal without the disassembly of the dosing line or containment system. Manual handling risks for dosing quill insertion/removal must be minimised when practicable.

7.6.2 Chemical Injection Pit or Enclosure

Chemical injection pits or enclosures must:

- encapsulate the receiving pipe
- be sealed to prevent chemical escape, and water ingress or condensation;
- have a lid that:

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

  - is weather proof
  - is lockable
  - is vandal proof
  - latches in the open position
  - protects dosing equipment from UV radiation
- consider buoyancy
- ensure leaks within this area can be detected via online monitoring
- allow ergonomic access to operable/maintainable equipment

Either Cast in situ or precast to the specified size without risers

Note: Concrete chemical injection pits do not need to be designed as water retaining structures, however must be designed to retain liquids.

Pipe encapsulation must involve the:

- pipe passing though the pit, or
- pit being positively attached to the pipe (example: starter bars welded to steel pipe for a concrete pit or a poly pit welded to a polyethylene pipe or metal pit welded to a metal pipe.)

7.7 On-site Roads

The access roads on the Hunter Water site to the unloading bund must:

- comply with Guide to Road Design Part 3: Geometric Design by Austroads (edition 3.3)
- be designed for a 19m Semi Trailer (as per NHVR).
  - Where it is demonstrated to be impractical design roads for 12.5 rigid truck
- be sealed; with maximum grades of 9% (to reduce the chance of chemical spill from tanker breather)
- have the maximum grade reduced by 1% if the road is unsealed
- be a loop road that allows the delivery truck to drive through the unloading bund (drive-in, drive-out)
- be integrated with the site traffic management plan.

7.8 Pipework

In addition to STS 600, chemical dosing pipework:

- must have joints covered with spray guard (i.e. flange guards) where pressurised connections chemical could escape outside the chemical's secondary containment system
- must be in a service corridor (that provides protection) or provided with mechanical protection
- can be flexible black PVC pipe for the inner chemical pipe in pipe arrangements, to allow pull-through installation, where materials compatibility permits.

Pipe labelling must comply with STS 600.

7.9 Valves

Valves in chemical dosing installation must be:

- labelled with the P&ID identifier, adjacent to the valve or by stainless steel wire
- lockable with a 6mm diameter padlock shackle, to facilitate isolation, where they must be lockable.

Actuated chemical dosing valves must be designed to fail-safe.

7.10 Safety Equipment

Chemical dosing systems must include the following safety equipment:

- safety shower and eyewash stations

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- hose reel
- fire extinguisher for flammable chemicals.

Safety shower and eyewash stations must:

- be provided with a water service that can provide 77 L/min at a pressure greater than 210k Pa
- comply with AS4775 – proven during pre-commissioning to meet 75.5 L/min flow rate for safety showers, and 1.5 L/min flow rate for eye wash at 210 kPa
- be located with 2m to 7m of the point it is servicing
- be located at the same ground level as the point it is servicing, be unobstructed by equipment and access doors and with no changes in ground level between the hazard point and the safety shower and eyewash station
- pipework shaded from direct sun or the water supply pipe must be either:
    - lagged and insulated, to maintain a pipe water temperature a maximum of 5°C above atmospheric temperature. The insulated pipe must have a sheet metal cladding to stop water ingress
    - include a thermal pressure release valve, set to 37.8°C or insulation to achieve safe operating temperature. The thermal pressure relieve valve must drain outside the chemical bunds
- include a monitored flow switch. The flow switch must be dedicated to safety showers and not be triggered by use of a hose
- include a common monitored pressure switch. The pressure switch must detect if the water supply has been isolated.
- not obstruct pedestrian or vehicle paths or be obstructed by gates or doors.

The safety shower and eyewash stations must be located at:

- chemical unloading bund
- chemical dosing cabinet, near the exit
- chemical tank bund, near the exit.
- Note: where the safety showers are within the required distance, one safety shower and eyewash station can service 2 of these locations.

Hose reels must:

- be located adjacent to the chemical storage system, but outside the chemical areas
- be permanently connected to a water supply
- be able to reach all parts of the chemical dosing system, including the unloading area
- have an RPZD fitted to the supply (one RPZD can service a system, not required per device) if it is supplied with potable water
- be fitted with a 20mm female camlock fitting for use with the flushing connections
- be UV resistant hose
- be fitted with minimum 20m hose
- Not be utilised for firefighting purposes.

A fire extinguisher must be:

- located adjacent to the chemical tank bund, but outside the chemical tank bund
- 9kg ABE type, for electrical fires.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

8 Liquid Chemical Handling Equipment Design Requirements

The section details the physical requirements for the components of a liquid chemical dosing system. Sample Piping and Instrumentation Diagrams are included in the Appendices of this document.

8.1 Bunding of Chemical Tanks

This section applies to bunds containing chemical tanks. Chemical tank bunds must be designed to:

- be hydraulically isolated from the truck unloading bund and other inflows that would reduce the bund capacity
- STS 404 Concrete Supply and Construction (Water Retaining Structures)
- AS 3735 - Concrete structures retaining liquids
- allow for uneven loading of chemical tanks (e.g. one full and one empty)
- minimise construction joints; Joints must be:
  - have welded chemically compatible waterstop (e.g. PVC)
  - fully sealed using chemical compatible sealants to guarantee integrity of the containment system
- have floor:
  - slope between 1:100 and 1:75
  - falling towards the sump
  - laid to prevent pooling
  - without obstruction and trip hazards
  - without trenches
  - Note: where the floor is a raised platform, the solid floor underneath must comply with the requirements above
- without penetrations in tank bunds.

Chemical tank bunds must:

- have at least 110% of the capacity of the largest tank or 25% of the total capacity of all tanks within the bund, whichever is greater. If two or more tanks are interconnected, the bund capacity must be 110% of the combined volume of the interconnected tanks
- have walls with a crest locus containment ratio of 2:1, including from the tank connecting pipework as per AS 3780-2009 clause 5.4.3. Splash guarding can be used to achieve crest locus requirements. Splash guarding must drain into the bund
- include splash guarding adjacent to all pumps, valves and pipe joints to protect personnel and prevent discharge to the environment. In the event of a leak, the splash guarding must drain the chemical into the containment bund
- have at least two egress points for floor area 25m2 or greater, the egresses must:
  - be accessible from a safe place where there is no risk of chemical exposure
  - be at a location that operators do not need to go across a barrier to access them
- pipework and services in a service corridor (as per STS600) from the perimeter of the bund to the centre in one location
- include a sump
- have all mounting brackets and electrical cabling installed a minimum 100mm above the 100% bund capacity level unless it is servicing equipment within the bund. Equipment within the 100% bund capacity level must be IP68 rated and chemically compatible with the stored chemical
- be leak tested for a minimum 48hr period. The test must be witnessed by a Hunter Water representative and must be done before and after installation of all equipment in the bund as

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

part of handover and yearly thereafter as an operational routine test. Leak testing must be completed before applying concrete coating.
- not be located over existing buried assets

8.1.1 Chemical Tank Bund Walls

Chemical tanks bund walls must be a combination of solid and mesh walls to minimise rainwater entry and maximise passive ventilation. Mesh wall must be:
- chain wire mesh when the chemical storage is within a fully fenced property (eg a WWTP), as a minimum
- 3mm x 50mm x 50mm welded mesh in publicly accessible areas (eg a WWPS);
- fitted externally with shade cloth over the mesh to reduce:
    - rainwater ingress
    - impact of direct sunlight on equipment
    - leaf litter and debris entering the bund

8.1.2 Chemical Tank Bund Sump

Chemical tank sump must:
- be blind, with no outlet
- be accessible from outside the tank bund (in the event the bund needs to be pumped out), with a permanent standpipe accessible from outside the bund to connect to a portable pump or waste truck for emptying
- be 600mm x 600mm x 600mm with grating. The grating must be:
    - o compatible with the chemical
    - o load bearing AS3996 class A
- be fitted with a level switch. The level switch must alarm when the sump contains 300mm of liquid
- be located adjacent to the chemical unloading control panel and accessible from the delivery bund side
- have a GPO within 4m of the sump. The GPO must be located away from the truck unloading panel (to avoid it being used for truck unloading)
- suction pipe for connection of a pump or vacuum truck. The suction pipe must:
    - o be minimum 50mm diameter
    - o extend to 50mm from the bottom of the sump
    - o terminate above the bund wall, but within the bund area
    - o have a camlock fitting on the end (matching the pipe diameter)

A portable pump must be provided as part of new or upgrade works complete with accessories required to attach to the standpipe and discharge to a suitable location agreed during the design phase.

8.1.3 Coating of Chemical Bunds

Chemical Specific Design Requirements includes a table identifying chemicals previously identified as requiring a coating for concrete tank bunds. Where the requirement is not identified in the table, a risk assessment must be completed, considering the materials compatibility between the chemical and the bund material. Chemical tank bund coatings must be:
- be a contrasting colour to the chemical
- coated in accordance with Manual for Selection and Application of Protective Coatings [WSAA 201-2017, 2nd edition, version 2.1]

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- with no penetrations of the impervious coating. Patch repairs must be applied where there is damage to the impervious coating.

8.2 Chemical Storage Tanks

The chemical tank design must consider:

- chemical delivery volumes
- shelf life of chemical
- frequency of tank maintenance

Preferences for chemical tanks are:

- maximum 20,000L tank for a single tank system
- chemical storage greater than 20,000L be split across multiple tanks
- where multiple tanks are installed they can be larger than 20,000L.

8.2.1 Tank Design, Manufacture and Installation

The section covers the design and manufacture of chemical tanks. The tank design must:

- include a wall thickness based on a minimum of 1.1 times the specific gravity (1.1 x SG) of the fluid to be stored in the tank
- have sloping floors of 1:50 or greater, falling to the tank offtake
- be reinforced and supported to withstand forces during filling and when full
- be sized to have the operational volume between the low-low and high levels
- be sized for a minimum 30 days storage, at average dose rate
- have external surfaces that are self-draining.

During manufacture the tank must:

- be fitted with the required fittings labelling and identification number.

The tank must be installed:

- with anti-siphoning measures (relative height or valves), to avoid siphoning to the injection point
- on a minimum 100mm concrete plinth. The plinth must have concrete finish of class U2 wood float finish, in accordance with STS404
- with anchoring (to offset buoyancy forces if the bund is flooded and the tank is empty)
- with a minimum 6mm compressible membrane between the plinth and the chemical tank
- without equipment mounted or passing over the top of the tank, including cable trays, pipes, lighting. This requirement does not apply to services connected to the tank.

The 100% tank capacity is defined as the volume from empty up to the invert of the tank overflow nozzle.

8.2.2 Tank Material

The tank material must be compatible with the chemical to achieve the required life, refer to materials table.

FRP tanks must comply with AS2634.

Polyethylene tanks are not suitable for chemicals that are over 40°C at the time of delivery.

8.2.3 Tank Level Indication

Chemical storage tanks must have the following level indication:

- a level transmitter
- non-contact level switches

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- Either a:
    - Level transmitter display, or
    - magnetic level indicator

Sight glasses must not be used.

Tank level indicators must:

- be full height of the tank
- be visible from the truck unloading control panel
- be labelled with the “Safe Fill Level”
- be labelled with the tank level High/High, High, Low, and Low/Low in font size 50mm

Magnetic level indicators must:

- include a lockable double block and bleed valve configuration (for maintenance)

Level transmitters must be:

- radar type
- mounted to the top of the tank:
    - o mounted above the chemical tank, for non-metal tanks (with preference for a hinged support arm to assist with maintenance)
    - o mounted to a nozzle with a flange (minimum 50mm), for metal tanks
- located approximately 400 to 600mm from the wall of the chemical tank (to simplify access).

Level switches must be:

- installed at the Low Low and High High level of the tank. For non-metallic tanks these must be non contact capacitive switches. The level switches are redundancy for the controlling level sensor. Metallic tanks must use pressure switches for redundancy.

Contact level transmitters can be used where identified by risk assessment. Contact level transmitters must:

- be pressure transmitters
- mounted at the lowest point of the tank wall
- installed with a lockable isolation valve and a bleed valve. The bleed valve must be fitted with a blank flange or plug.

Digital Level display must be visible at the truck unloading bund and at the tank bund. Where the truck bund is remote a second digital level display must be installed at the bund.

8.2.4 Tank Connections

Chemical tanks must be fitted with the following:

- flanged connections, as a minimum:
    - o tank vent
    - o fill pipe inlet
    - o chemical dosing system return pipe
    - o overflow
    - o tank outlet to chemical dosing cabinet
    - o temporary connection of IBC
    - o drain pipe
    - o tank valves
    - o connection to neighbouring tank/s for multiple chemical tank configurations tanks access hatch

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- instruments:
    - o level transmitter
    - o high-high level switch
    - o low-low level switch

Chemical tank nozzles must be flanged, the flanges nozzle connections must:

- be minimum 40mm diameter
- have a maximum length of 150mm for nozzle up to diameter 80mm
- have a maximum length of 200mm for nozzle diameter greater than 100mm
- be reinforced when these dimensions cannot be achieved

All associated equipment that are attached to tank connections (e.g. pipes, instruments) must be appropriately supported and protected against mechanical damage from operational and maintenance activities.

8.2.4.1 Tank Vent

The tank vent must be:

- a minimum 50 mm diameter or twice the diameter (4 times the area) of either the inlet or outlet connection, whichever is the greater (to accommodate safe venting when the truck unloading hose and delivery pipe are purged with compressed air (10bar) after chemical unloading);
- a flanged nozzle
- vertically with a weather proof top hat or 180 degree bend to eliminate rain ingress
- vermin proof, with 2mm aperture vermin mesh covering the vent. The mesh must be mechanically fastened, attachment by adhesive is not acceptable
- vent the tank to a safe location where the chemical is flammable or has an inhalation or aspiration risk

8.2.4.1.1 Chemical Vapour Scrubbers

Chemical tank vapour scrubbers must:

- be designed for a minimum media life of 3 months, including tank filling and tank breathing
- have a visual indicator that media replacement is required
- include safe access for media replacement
- be designed to ensure the media is contained during replacement (avoid spilling).
- for water scrubbers, scrubbing liquor must not discharge to the environment

8.2.4.2 Fill Pipe

The tank inlet pipe must:

- discharge into the tank through the roof
- be on the opposite side of the tank to the overflow
- be located a minimum distance of 50mm above the invert of the overflow pipe
- be located away from the level switches (to avoid chemical falling onto the switches & falsely triggering them during chemical transfer).
- rise vertically to its high point, then fall to the chemical tank

8.2.4.3 Chemical Dosing System Return Pipe

The chemical dosing system must include a chemical return pipe, the chemical return pipe directs chemical from pressure relief valves and vents to the chemical tank. The chemical return pipe must:

- be unrestricted (i.e. no fittings)

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- discharge into a chemical tank a minimum distance of 50mm above the top of the tank overflow pipe
- rise vertically to its high point, then fall to the chemical tank
- include a spectacle blind, located at the flange of the chemical tank
- be connected to a minimum of two tanks, where there are multiple tanks that can supply the dosing system.

8.2.4.4 Overflow

The tank must contain an overflow. The overflow pipe must:

- be sized at least 1.5 times the diameter of the fill pipe;
- discharge directly into the bund sump. The overflow pipe discharge must be visible from the chemical unloading control panel
- be routed in the service corridor to the outside of the tank bund.

8.2.4.5 Tank Outlet

The tank outlet must be:

- located at the lowest point of the tank
- have a lockable isolation valve prior to other fittings
- include a sample point, with a lockable valve and plug

Actuated valves must be fitted to the outlet of chemical tanks when identified by risk assessment during design. The risk assessment must consider the:

- chemical hazard level
- volume of chemical
- process impact of chemical

Actuated chemical tank outlets must:

- be fail safe valves
- be a spring actuated fail safe mechanism
- be fitted downstream of the tank isolation valve.

8.2.4.6 Drain pipe

Chemical tanks must be fitted with a drain pipe. The drain pipe must be:

- a minimum of 50mm
- either located at the lowest accessible point of the tank; or tee off immediately downstream of the tank discharge nozzle in a double block and bleed arrangement, with camlock and fitted cap
- piped to the bund sump
- dedicated to an individual tank.

8.2.4.7 Multiple Chemical Tanks

Where multiple chemical tanks are installed to achieve the required chemical storage volume, they must:

- be installed with pipework to enable:
    - isolation of a single tank and keep the remaining tank/s operational
    - operation to avoid mixing of fresh and old chemical
- have connecting pipework designed to accommodate thermal expansion and contraction (straight pipe interconnection between tanks is not acceptable)
- include double block and bleed valve configuration within interconnection pipework

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- include spectacle blinds or removable pipe spool on all chemical return pipes to each tank.

8.2.4.8 Tank Access Hatch

The chemical tanks must have a minimum of one access hatch (top or wall manhole) to enable tank access for cleaning, condition assessment and repair. The access hatch must be a:

- side access hatch:
  - of minimum 600mm diameter for tanks of diameter 2m or less, and 900mm for tanks of diameter more than 2m
  - with bottom of aperture 500mm above base of tank
  - of less than 15kg, or hinged horizontally if more than 15kg
  - complying with the wall thickness design requirements or
- top access hatch:
  - of minimum of 750x750mm square or 900mm diameter
  - with aperture starting a minimum of 400mm from wall of tank
  - of weight less than 15kg
  - complying with AS3996, Class A or
- 450mm diameter inspection only hatch, where the tank volume is less than 3000L.

8.2.5 Chemical Tank Mixing

Chemical tank mixing must be by rotating impeller or aeration.

Mixing impellers must be positively attached to the impeller shaft.

8.3 Transfer Pumps

Transfer pumps are used to move chemical between permanently installed tanks and to accept delivery of chemical in small containers. Transfer pumps for accepting deliveries of chemical in small containers must be designed to:

- minimise manual handling
- include spray guarding.

8.4 Chemical Dosing Skid

The chemical dosing skid contains the chemical dosing pump and control equipment. The chemical dosing skid must be mounted in a cabinet. The cabinet must:

- be on the opposite side of the tank bund to the truck unloading connection
- be mounted over the chemical tank bund and wall with the doors flush with the outside of the bund wall
- be accessible from outside the tank bund
- form part of the secondary containment system
- be installed with a clear egress path (to enable a person to leave the vicinity under emergency conditions)
- have doors, the doors must:
  - be accessible from outside the tank bund
  - be transparent
  - be hinging
  - provide spray protection, by overlapping or recessed in the cabinet frame
  - have a minimum of 900mm clearance between the end of an open cabinet door and any fixed structure
  - be capable of latching in the open position
- Incorporated a drip tray in the base

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- drain to the sump of the tank bund. The drain must discharge 25mm below the top of the sump
- be manufactured from materials resistant to the chemical
- be shaded from direct sunlight
- be lockable
- include a mounting board to attached pipes, pumps, valves and fittings
- vent to a safe area or tank.

The chemical dosing skid cabinet must contain the chemical dosing equipment, including:

- dosing pumps
- calibration cylinder
- flowmeters
- strainers
- pulsation dampeners
- pressure transmitter
- valves, including:
    - o pressure relief valves
    - o non-return valves
    - o degassing valves
    - o pressure sustaining valves
- isolation valves.

8.4.1 Chemical Dosing Cabinet Flushing System

The chemical dosing cabinet must include flushing points that enable flushing of all equipment and pipes within the cabinet (to make it safe for maintenance). The chemical dosing cabinet flushing must include:

- a hose connection, 20mm male Camlock
- a discharge, 20mm male Camlock
- an isolation valve adjacent to each Camlock fitting
- access to a water source for flushing. (Note: Where the water source is potable water the supply must have a backflow prevention devise installed).

The flushing connection point(s) must operate by flushing:

- forward into the process or
- to a container for disposal.

8.4.2 Dosing Pumps

Chemical dosing pumps must comply with STS600. In addition to STS600, the chemical dosing pumps must:

- be used to control chemical dose rate
- be able to pump the chemical tank down to the obvert of the tank outlet
- be installed to avoid loss of prime
- be installed with a valve on the pump suction and discharge to facilitate priming and draining. Vents and drains must discharge to safe containment without the risk of splashing or escape of chemical.
- be designed for future flow rates aligning with the serviceable life of the pump

Digital dosing pumps must:

- Incorporate integrated flow metering and flow control.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

8.4.3 Calibration Cylinder

The calibration cylinder is used to calibrate the dosing pump. The calibration cylinder must:

- be sized for 60 seconds at maximum pump capacity
- be operable at tank low level. Pipework may be required to allow the dosing pump to fill the calibration cylinder
- be vented to the chemical storage tank
- be fitted with an inlet valve
- have its inlet valve within 600mm of the inlet valve to the pump (to enable simultaneous switching)
- have the top of the calibration cylinder between 900 & 1200mm above the personnel access platform to enable an operator to clearly sight the top level in the calibration cylinder.

8.4.4 Flow Meters

Independent flow meters must be installed when identified by risk assessment or HAZOP during concept design. When an independent flow meter is installed it must be:

- measuring neat chemical
- used as the process variable for the dosing pump
- installed prior to any carrier water, where carrier water is required.

8.4.4.1 Rotameters

Rotameters must be sized to indicate the full flow range, but not more than 50% of the maximum flow.

8.4.4.2 Temporary Connection of IBC

Where the chemical dosing pumps are fed by one tank, the dosing pump suction pipework must have a tee into the pipe for temporary connection of a chemical supply (E.g. IBC). The tee must be:

- downstream of the tank isolation valve
- outside the dosing cabinet
- fitted with an isolation valve and then a blank flange or plug.

8.4.5 Strainers

Liquid chemicals must pass through a strainer to remove impurities, scale and sediment. Strainers must be:

- sized to protect the dosing pumps
- prior to the dosing pumps
- located in the dosing cabinet
- 2 in parallel to allow continuous operation during strainer cleaning
- installed with manual isolation valves on each side of each strainer and flushing connections inside the isolation valves to enable flushing of the strainer prior to cleaning.

8.4.6 Pulsation Dampener

Pulsation dampeners must be installed downstream (and upstream if required) of positive displacement dosing pumps. The pulsation dampener must:

- reduce pressure fluctuations corresponding with the pump stroke
- be pressure adjustable (for bladder type)
- include an integrated pressure gauge
- located on the outlet of each dosing pump (where required)
- be sized to achieve flow smoothing at 75% of the dosing pressure range.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

8.4.7 Pressure Sustaining Valves

Pressure sustaining valves must be installed at the end of the dosing pipe, prior to the injection point (to avoid syphoning). The pressure sustaining valve must be testable in the installed position.

8.4.8 Pressure Relief Valves

Pressure relief valves must be installed immediately downstream of positive displacement dosing pumps. The pressure relief valve must:

- be sized in accordance with AS1271
- discharge to the vent pipe on top of the calibration tube (this allows witness of the bypassing flow)
- take into account the back pressure from the discharge pipe.

8.4.9 Backflow Prevention

A back-flow prevention device (non-return valve) must be fitted after pressure relief valves to prevent chemical or processed liquid from flowing back through the pump and into the storage tank.

8.4.10 Degassing Valves

Liquid chemical dosing systems that generate gas must be fitted with degassing valves. Degassing valves must:

- be installed downstream of the dosing pump but upstream of any independent flowmeter to ensure accurate flow measurement
- the degassing valves must discharge to a chemical tank via a dedicated line.

8.4.11 Dosing of Slurry

Chemical dosing of a slurry must include a redundant dosing pipe (duty/standby). The slurry dosing pipe must include:

- control to automatically switch between duty and standby pipes
- a permanent flushing water supply
- an automatic flushing cycle
- a pressure indicator.

The flushing water can be site re-use water when available.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

9 Gaseous Chemical Design Requirements

This clause applies to chemical systems which:

- include gaseous chemicals stored as a gas
- generate hazardous gas intentionally or
- can inadvertently generate hazardous gases.

Sites with gaseous chemicals, the chemical system must have:

- the health and safety impacts assessed by an occupational hygienist;
- an emergency response plan
- emergency response equipment identified by the occupational hygienist.

9.1 Plume Modelling

Gaseous chemicals systems are permitted only when the associated societal risks from potential leaks are confirmed as “negligible” in accordance with NSW Hazardous Industry Planning Advisory Paper (HIPAP) 10. Where there is development nearby, plume modelling must be undertaken to positively confirm this, prior to any gaseous chemicals systems being approved, in accordance with Table 3 Requirements for plume studies below:

Table 3 Requirements for plume studies

Quantity of gaseous chemical to be stored on site	Requirement
<20kg total or individual container	Plume modelling required if development* within 50m
20kg-300kg total; or up to 75kg individual cylinder/container	Plume modelling required if development* within 200m
>=300kg total or >75kg container	Plume modelling required if development* within 1000m

*includes any residential, commercial industrial or other development that may be occupied at time of potential leak occurring

Where plume modelling has been completed, the results must be included in the emergency plan for the site and submitted to Hunter Water as part of delivery of the project.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

10 Powder Chemical Design Requirements

This section defines details the requirements for the unloading, storage and dosing of powder chemicals.

10.1 Powder Chemical General Requirements

Powder chemical dosing systems must include

- secondary containment for the powder, with no product escape to atmosphere
- chemical addition to water utilising a mixing tank or venturi to dissolve the powder chemical
- materials that are compatible with the powder chemical, the dissolved chemical, with heat of reaction generated by the chemical or gasses produced during dissolving and cleaning/descaling chemicals
- features to eliminate manual handling
- delivery to site in bulk or in bags
- a method to manually load hoppers with a vacuum bag unloader, as a contingency measure.

10.2 Powder Chemical Material Handling

Powder chemical material handling equipment must incorporate vibrators and diffused air to manage:

- compaction
- rat holing
- fluidisation.

10.3 Powder Chemical Delivery - Bags

Powder chemical bag delivery systems must include:

- delivery and unloading of bags, without manual handling of bags
- a bag storage area
- a vacuum unloading system.

10.3.1 Powder Chemical Bag Storage area

Powder chemical bag storage area must be:

- accessible to vacuum unloading system vacuum nozzle
- low humidity
- ventilated
- isolated from wet areas.

10.3.2 Powder Chemical Bag Vacuum Unloading System

Powder chemical bag vacuum unloading system must:

- eliminate manual handling of bags of powder chemical
- contain the powder chemical and eliminate generation of airborne dust
- transfer the powder chemical to a silo or mixing tank.

10.4 Powder Chemical Load In-Control Panel

A powder chemical storage silo must include a local ‘load-in’ control panel adjacent to the filling point. The silo ‘load-in’ panel must include:

- power supply healthy indication
- silo vent fan on/off switch or local control

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- common alarm derived from:
    - o silo filter failure alarm
    - o silo high-level
    - o silo high-pressure
    - o vacuum relief valve closed
    - o access hatch not closed
- alarm acknowledgment/silence pushbutton
- level indication (0 – 100%)
- load indication (Tonne)
- filling valve open indication
- emergency stop button that manages residual pressure in the unloading system

10.5 Powder Chemical Bulk Storage Silos

Powder chemical bulk storage silos must include:

- a cylindrical design with conical base
- features and fittings to avoid clumping and blockages.

Powder chemical bulk storage silos must be fitted with:

- an actuated filling valve
- level sensing
- a high level switch
- load sensors, located within the silo support structure
- silo cone vibrators
- an automatic self cleaning filtered vent
- differential pressure monitoring across filter for filter cleaning monitoring and alarming
- a vent fan
- a pressure/vacuum relief valve with relief detection
- a high pressure switch
- silo discharge valves
- a load-in control panel
- operator access hatch with position sensor.

10.5.1 Powder Chemical Silo Level Sensor

Powder chemical bulk storage silos level sensing must include a:

- roof mounted cone radar for continuous level monitoring of the silo
- vibrating fork to monitor high level within the silo.

10.5.2 Powder Chemical Silo Load Sensors

Powder chemical silo load sensors must:

- monitor the mass of powder in the silo
- provide accuracy of +/- 1%
- be an inline load cell or strain gauge
- be removable without dismantling the silo or associated equipment.

10.5.3 Powder Chemical Silo Vibrators

Powder chemical silo vibrators must be fitted to the outside of the silo to:

- aid flow of the powder
- prevent “rat holing” of the powder

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- prevent bridging of the powder.

Powder chemical silo vibrators must:

- operating during discharge of the powder.

10.5.4 Powder Chemical Silo Filtered Vent

Powder chemical silo filtered vent must be:

- sized to discharge the delivery transport air and maintain the pressure accumulation within the silo to below the Maximum Allowable Operation Pressure (as defined in AS2885.1), when the vent fan is not operating
- cleaned by pneumatic reverse pulse cleaning system which operates during filling and after filling to ensure accumulated powder is cleaned from the filters
- fitted with differential pressure transmitter to detect filter blinding
- designed for monthly cleaning and washing.

10.5.5 Powder Chemical Silo Vent Fan

Powder chemical silo vent fans must be designed to maintain a negative pressure on the silo during filling.

10.5.6 Powder Chemical Silo Pressure Vacuum Relief Valve

Powder chemical silo pressure/vacuum relief valve must be designed to:

- operate at Maximum Allowable Operation Pressure plus 10% to prevent overpressure
- act as a vacuum break device to prevent a vacuum collapsing the tank
- be monitored by a control system for when a vacuum break has occurred.

10.5.7 Powder Chemical Silo Discharge Valves

Powder chemical silo discharge must be fitted with a:

- Actuated knife gate valve, and
- Rotary valve.

Powder chemical silo discharge rotary valve must:

- be fitted below the knife gate valve
- be electrically driven
- operate at a fixed speed.

10.6 Powder Chemical Feed Hopper

The powder chemical must transfer from the silo to a feed hopper. The feed hopper must:

- be high level monitored by vibrating fork level switch
- be fitted with a vent and filter. The filter system must be cleaned by a pneumatic reverse pulse cleaning system
- be fitted with vibrators. The vibrators must:
  - o be fitted to the outside of the lime feed hopper discharge cone
  - o aid powder flow and prevent “rat holing” or bridging
- be fitted with aeration
- incorporate a macerator prior to the discharge screw

10.7 Powder Chemical Conveyance

Powder chemicals must be conveyed by:

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- screw conveyors, or
- vacuum system, or
- blown or compressed air.

Screw conveyors, also called screw feeders or augers must comply with STS600.

10.8 Powder Chemical Mixing Tank

Powder chemical mixing tanks must include:

- have 2 outlets for redundancy.
- a cloth sock vent filter
- access hatch, with a safety limit switch and safety relay to stop the impeller when access hatch is opened – risk assess to AS4024

Powder chemicals can be mixed with water in a mixing tank by:

- a motorised impellor
- air agitator or bubble mixer.

Powder chemicals mixed by a motor driven impeller must have a VSD.

An air agitator is inherently safer than a motorised mixer as it has no moving parts. No interlock is required for the access hatch if using a compressed air venturi mixer.

Avoid internal tank baffles as they impede cleaning.

10.8.1 Cloth Sock Vent filters

Cloth sock vent filters must be:

- designed for weekly cleaning
- internally supported by a wire cage
- quick release plug on/plug off, fitted with 100mm camlock fitting and cap
- isolated by a sealed slide gate valve.

10.9 Powder Chemical Slurry System Cleaning

Powder chemical slurry systems must be flushable with a cleaning chemical to remove scale and powder residual. The flushing chemical must be introduced:

- upstream of the process feed water isolation valve and downstream of the RPZD, to clean the mixing tank
- at the dosing pump suction flush point.

10.10 Powder Chemical Dosing Pumps

Powder chemical dosing pumps must comply with STS600. In addition to STS600, the dosing pump must:

- be a progressive cavity or peristaltic pump
- have VSD motor drives to control the dosing flow rate
- have a pressure relief mechanism at the pump discharge.

The powder chemical dosing pump pressure relief mechanism must:

- include operator indication pressure release has occurred
- return the flow into the tank above the fill-level and below the overflow.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

10.11 Venturi Dosing Systems

Venturi dosing systems can be used to dose into piped process streams. Venturi dosing systems are:

- suitable for variable slurry concentration and fixed flow rate dosing. Lag in feedback loop must be defined
- less suitable for constant slurry concentration and variable slurry dosing.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

The table below contains control requirements specific to powder chemical systems.

Table 4 Powder Chemical - Equipment Control

Equipment name	Equipment Details	Control requirement	Local Alarm	SCADA Local Alarm	SCADA Control Centre Alarm	Notes
Powder unloading blower power outlet	415V power outlet	Permissive for the power supply to outlet: • Actuated Valve Open				
Actuated fill valve	Valve	Interlocks to close the valve: • E-Stop activated • high pressure switch • high level switch • silo Vent filter differential pressure 'out of' tolerance • Hatch open • Level transmitter high • Hopper weight high • Pressure relief switch high Vent fan not running				to protect against overpressure to protect against overfilling to detect filter blinding
		Fail safe in CLOSE position				

Equipment name	Equipment Details	Control requirement	Local Alarm	SCADA Local Alarm	SCADA Control Centre Alarm	Notes
Silo filter pneumatic reverse pulse cleaning system		Operates during filling				To ensure accumulated powder is cleaned from the filters
		Operate minimum 10 minutes after filling				
Silo vent fan		Operate during filling				
		Operate minimum 15 minutes after filling				
Silo discharge rotary valve	Valve	Permissive to run: • Knife gate valve open • both feed hopper high level switches not high both feed hopper hatch position switches closed				
Silo vibrators		Intermittently operate during transfer from the storage silo				
Mixing tank agitator		Permissive to run: Hatch limit switch closed				
Screw Feeder		Permissive to run: • Screw Door limit switch closed Feed hopper limit switch closed				
Silo pressure/vacuum relief valve	Valve	Alarm when valve active by pressure or vacuum				
silo pressure/vacuum relief valve	Valve	Alarm when a vacuum break has occurred				

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

11 Chemical Specific Design Requirements

This section addresses specific requirements of chemicals. Specific requirements in this section take precedence over general requirements.

Refer to the model Piping and Instrumentation Diagram's provided within Appendix C: Model Piping and Instrumentation Diagrams.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

The table below contains chemical specific attributes to be used for design.

Table 5 Chemical Specific Attributes

Chemical Name	Dangerous goods	Chemical Packing Group	Design Concentration w/w% Range	Maximum Delivery Temperature	Fluid specific gravity
Aluminium Sulphate	N/A	-	47 - 52%	65°C	1.31 @52%
Citric Acid	N/A	-	10 – 50%	30°C	1.25 @50%
Chlorine Gas (Liquefied)	2.3/5.1/8				
Chlorine solution / water					
Ferrous Chloride	8	3	10 - 30%	65°C	1.5 @50%
Ferric sulphate	8	2	20 - 30%	65°C	1.33 @30%
Hydrofluorosilic Acid	8	2	20 – 40%	30°C	1.18 @40%
Hydrated Lime, Calcium Hydroxide ($Ca(OH)_2$ >85%)	N/A	-	Not applicable	30°C	
Hydrated Lime Slurry	N/A	-			
Polymer emulsion	N/A	-		30°C	
Polymer powder	N/A	-		30°C	
Sodium Bisulphite	8	2	25 – 40%	30°C	1.37 @40%
Sodium Hypochlorite	8	2	25 - 30%	30°C	1.52 @50%
Sodium Hydroxide	8	2	6 – 15%	30°C	1.21 @12%
Sulphur Dioxide (Compressed SO2)	2.3/8			30°C	
Sulphur Dioxide solution / water	N/A				
Sucrose	N/A	-		30°C	

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

The table below contains chemical specific design requirements.

Table 6 Chemical Specific Design Requirements

Chemical Name	Coating of concrete truck unloading bund	Tank Bund coating of concrete	Tank materials	Scrubber on chemical tank vent	Tank floor	Dosing Pump type
Aluminium Sulphate	No	No	FRP	No	Sloping	Digital dosing pump
Citric Acid	Yes	Yes	PE or FRP	No	Sloping	Digital dosing pump
Chlorine Gas (Liquefied)	No	No	Steel	N/A	N/A	N/A
Chlorine solution / water	N/A	N/A	N/A	N/A		Digital Dosing Pump
Ferrous Chloride	No	No	PE or FRP	No	Sloping	Digital Dosing Pump
Ferric sulphate	No	No	PE or FRP	No	Sloping	Digital Dosing Pump
Hydrofluorosilicic Acid		Yes	PE or FRP	Yes	Sloping	Digital dosing pump
Hydrated Lime, Calcium Hydroxide ($Ca(OH)_2$ >85%)	No	No	Mild steel, PE or FRP	No	Conical	
Hydrated Lime Slurry			Mild steel, stainless steel	No	Conical	Peristaltic
Phosphoric Acid		Yes		No	Sloping	Digital dosing pump
Polymer emulsion	No	No	PE or FRP	No	Sloping	Peristaltic
Polymer powder	No	No	PE or FRP	No	Conical	
Sodium Bisulphite				No	Sloping	Digital Dosing Pump
Sodium Hypochlorite	No	Yes	PE / FRP / Vinyl Ester	No	Sloping	Digital Dosing Pump

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Chemical Name	Coating of concrete truck unloading bund	Tank Bund coating of concrete	Tank materials	Scrubber on chemical tank vent	Tank floor	Dosing Pump type
Sodium Hydroxide	No	No	PE or FRP	No	Sloping	Digital Dosing Pump
Sulphur Dioxide (Compressed SO2)	No	No		No	N/A	N/A
Sulphur Dioxide solution / water	No	No		No		
Sucrose	No	No		No	Conical	Digital Dosing Pump

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

11.1 Aluminium Sulphate (Alum)

Aluminium Sulphate can be delivered to site at 65°C. Equipment exposed to the Alum during delivery must be rated for this temperature, including:

- pressure derating at higher temperatures
- thermal expansion.

Non-contact level sensors (Radar) must be used on Aluminium Sulphate tanks (Alum can precipitate on the bottom of the tank which blocks Hydrostatic level transmitters).

11.2 Citric Acid (Citric)

Citric acid is used for cleaning micro filtration membranes.

11.3 Chlorine Gas

Chemical dosing system with chlorine gas must comply with AS2927.

11.4 Chlorine in Water

Chlorine gas dissolved in carrier water must be treated as sodium hypochlorite.

11.5 Ferrous Chloride (Ferrous) / Ferric Sulphate (Ferric)

Ferrous chloride or ferric sulphate must be flow metered by the dosing pump. Free standing magnetic type flow meters must not be used (due to scaling impacting accuracy), unless identified by risk assessment.

Where ferrous chloride or ferric sulphate dosing systems have forced ventilation, the ventilation fans must run continuously.

The condensate from the vent must drain back to tank, to prevent staining at tank roof level.

Non-contact level sensors (Radar) must be used on ferrous chloride or ferric sulphate.

11.6 Hydrofluosilicic Acid (Fluoride)

In addition to this STS, the design for fluoridation system must comply with NSW Code of Practice Fluoridation of Public Water Supplies Section 5 – Design controls for fluoridation facilities (Apr 2018).

11.7 Lime

The hydrated lime (calcium hydroxide) powder dosing systems must:

- be based on a volumetric design
- include redundancy to allow for cleaning cycles
- use peristaltic pumps to pump the lime slurry
- utilise gravity flow from mixing tank to process stream where possible
- minimise pipe length to reduce the settling of solids in the pipe.
- feed each lime slurry pump directly from the batch tank, with no common pipework
- cleaned/descaled with hydrochloric acid or citric acid or continuous high velocity flushing (>2.0 m/s)
- include anti-wear pipe elbows and fittings, also called impact elbows or dead end elbow

11.7.1 Lime Slurry Tank

Lime slurry tanks must have a spare outlet. The spare outlet must be:

- adjacent to the operational outlet

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

- identical to the operational outlet.

11.7.2 Lime Slurry Transfer Hoses

Lime slurry dosing pump suction pipe must be a vacuum rated flexible hose from the discharging tank, with quick release fittings.

Lime slurry dosing pump discharge pipe must connect to any fixed dosing pipe system using flexible hoses (minimum 2m) with quick release fittings.

11.7.3 Lime Powder Chemical Micro Feeders

Lime powder chemical screw feeders must:

- incorporate heaters to reduce binding.

11.8 Polymer Dosing System (Poly)

Polymer dosing system must be installed with:

- a mixed polymer storage tank
- carrier water
- site recycled effluent and potable water supplies and polymer preparation system
- a static mixer
- a flushing system
- actual chemical composition must be show on P&ID or design drawings.

11.9 Sodium Bisulphite (SBS)

Sodium Bisulphate is a yellow liquid with a pungent sulphur dioxide gas odour. Sodium Bisulphate installations must:

- have pipes externally insulated and trace heated (crystallization temperature is 15°C)
- have degassing valves fitted to the dosing pumps
- have tanks out of direct sunlight, to reduce degassing
- discharge vents to a safe area or vapour scrubber.

11.10 Sodium Hydroxide (Caustic Soda)

Sodium hydroxide dosing systems must:

- when concentration is 25% w/w or greater, pipe must be installed:
  - o with pipe insulation
  - o with heat tracing for pipes ≤ 80mm
- include non-contact level sensors (Radar).
- not use aluminium, copper, zinc, lead and their alloys (E.g. brass and bronze) in chemical contact (due to incompatibility).

The sodium hydroxide pipework heat tracing must be:

- continuous for the full length of pipework
- temperature controllable by the operator

Figure 1 Sodium Hydroxide Solubility Curve is include below.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

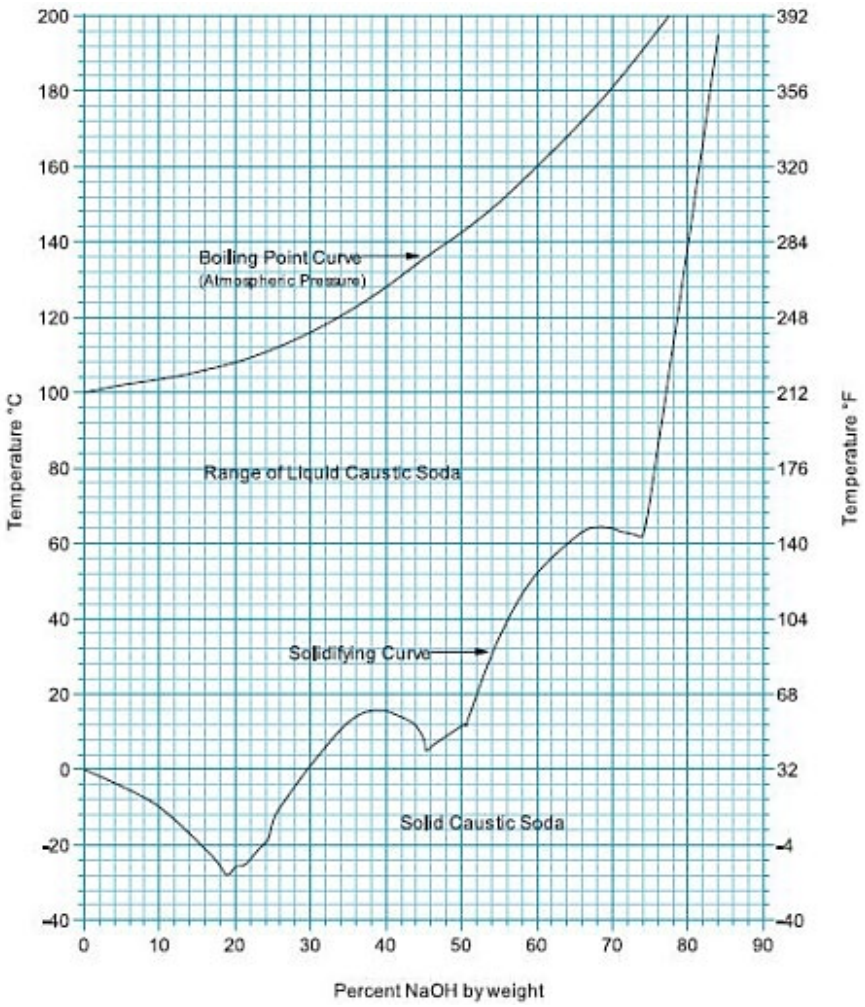


Figure 1 Sodium Hydroxide Solubility Curve

11.11 Sodium Hypochlorite (Hypo)

Sodium hypochlorite dosing systems must include:

- include dosing pumps fitted with degassing valves
- placement of tanks out of direct sunlight to reduce degassing
- tanks in series (where there are multiple tanks), with:
  - o a transfer pump between tanks
  - o first tank in the series of tanks sized for chemical deliveries
  - o chemical unloading to either tank
  - o discharge from a minimum of 2 tanks to the dosing cabinet
- tank sizing and storage time that takes into account the chemical degradation. Sodium hypochlorite degrades in proportional to its concentration, I.e. stronger concentrations degrade faster than more dilute ones (refer to Figure 2 Sodium Hypochlorite Degradation Curve below).

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

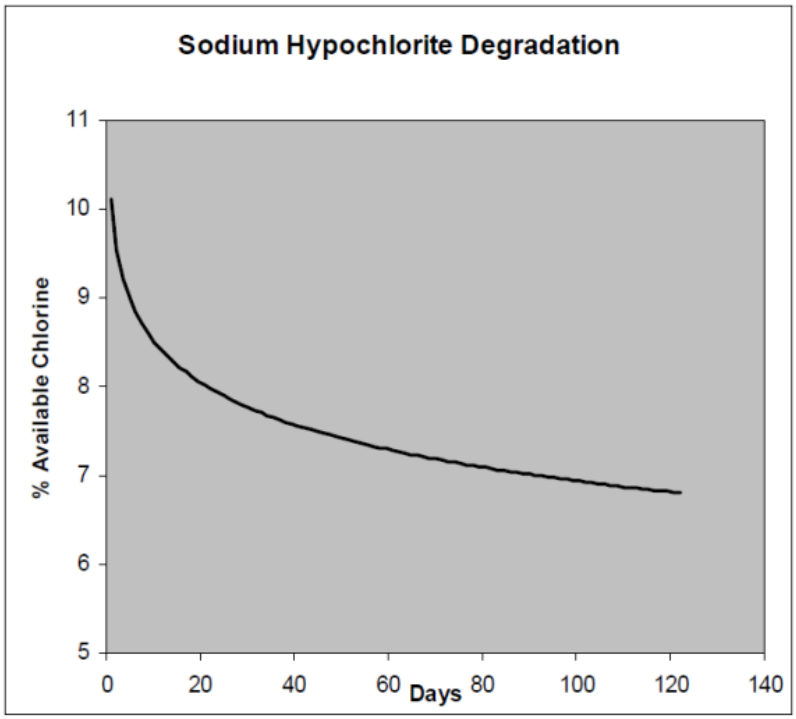


Figure 2 Sodium Hypochlorite Degradation Curve

11.12 Sulphur Dioxide

Compressed sulphur dioxide requirements are covered in Australian standard AS4332 the storage and handling of gases in cylinder.

Sulphur dioxide solution in water must be treated similarly to corrosive liquid chemicals.

11.13 Sucrose (Sugar)

Sucrose systems must be installed with:

- a hot water source for cleaning and washdown. The hot water source must be:
  - o a minimum 50°C at the outlet
  - o a maximum 155°C at the outlet
  - o sized to enable tank and system cleaning duration of 4 hours
  - o connected to a hose reel with hot water gun (approved during design development) for bund washdown
- a tank “spray ball” (for tank cleaning). The spray ball nozzle must be:
  - o mounted in the centre of the tank
  - o sized for the tank geometry
  - o be routed for top entry of the tank
  - o connected to the hot water system
- conical tank bottoms and with slope greater than 45%.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

12 Chemical Dosing Control

Chemical dosing systems must be installed with the following control:

- Chemical dose rate is adjustable on SCADA:
  - o Dosing rates must not be adjustable on local control panel
- Chemical dosing only occurs when product is flowing past the injection point
- Chemical dosing flow monitored, controlled and totalised flow metering with an inline flow meter
- Detection of process faults
- Detection of instrument faults.

12.1 Chemical Dosing Control Modes

Chemical dosing systems must have the following modes of operations:

- Flow Paced Mode (Default)
- Fixed Flow Mode
- Time of Day (TOD) Mode.

The modes of operation must be:

- selectable from SCADA.

12.1.1 Flow Paced Mode

Flow paced dosing is controlled by the inlet flow meter (eg plant inflow). The flow pacing output is controlled by the PID loop. The PID loop is formed by inputs from the:

- dosing skid inline flowmeter as the Process Variable (PV) in L/Hr;
- dosing pump speed input signal (4-20mA) as the Control Variable (CV) in %; and
- calculated flow paced Setpoint (SP) in L/Hr.

The dosing pump dose rate will be compared to the required Dosing Flowrate. The pump dosing rate will be controlled via the 4-20mA output to achieve the desired flow rate as measured by the flow meter.

The contingency for flow paced mode must be risk assessed. If the inlet flowmeter is unavailable the mode is temporarily forced to time-of-day dosing mode until the inlet flowmeter becomes available; otherwise alternate means of operation via flow paced mode (e.g. outlet flow meter, combined filter flows) must be provided if determined by risk assessment.

12.1.1.1 Flow Pacing Calculation

The pacing flow is the measured flow (Inlet Flow) averaged over the “pacing flow averaging time” (SCADA adjustable), and then used to calculate each chemical dose rate using the formula below.

The required dosing flowrate is calculated using the following formula:

Dosing Flow rate (L/hr) = 3.6 x (Dose x Pacing Inlet Flow) / (Density x Concentration)

Where:

- Dose (mg chemical /L process flow) is an operator adjustable setpoint.
- Pacing Flow (L/s) is the time-averaged inlet flow
- Density (kg/m3) is the chemical solution density (SCADA-adjustable)
- Concentration (%) is the chemical concentration %w/w as dosed, operator adjustable at the SCADA

12.1.2 Fixed Flow Mode

Fixed flow dosing is used when the chemical dosing inline flow meter becomes unavailable.

In this mode, the operator inputs the selected duty dosing pump flow rate.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

12.1.3 Time of Day (TOD) Mode

Time of day mode allows the operator to set the chemical dose rate for each hour of the day, using a look up table. The time-of-day dose rate can be entered:

- for each hour or
- for a single hour and a liner scaling factor then applied for the remaining 23 hours.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

12.2 Equipment Control and Notifications

The table below captures standard process control and notifications that apply to chemical dosing systems, project specific requirements must be defined in the project specification:

Table 7 Chemical dosing control

Equipment name	Equipment Details	Control requirement	Local Alarm	SCADA Local Alarm	SCADA Control Centre Alarm
Safety shower and Eyewash flow switch	Flow Switch	Raise alarm if the shower and / or eyewash is activated continuously for more than 60 seconds		High	High
Safety shower pressure switch	Pressure switch	Raise alarm if the water supply pressure is low continuously for more than 60 seconds		Medium	Medium
Chemical leak detection sensors	Site specific	Detection of primary containment loss inhibits the operation of the chemical dosing system.		High	High
Leak detection – secondary containment	Site specific	Detection of chemical in the secondary containment system must inhibit the operation of the chemical dosing system.		High	High
Chemical truck unloading pump power outlet	415V (20amps)	Permissives for the power supply to power outlet: • Chemical storage tank level switch - Not High-High, and (Note: High High switch is a hard wired interlock also) • Chemical storage tank level transmitter – Not High or High-High, and (Note: Level transmitter High Level is a hard wired interlock also) • Chemical storage bund level switch – High Level switch not activated, and • Delivery bund drain valve (where fitted) position switch – Closed, and • Delivery bund containment tank (where fitted) level switch – Not active, and • Delivery unloading panel local E-Stop not activated, and		Medium	

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Equipment name	Equipment Details	Control requirement	Local Alarm	SCADA Local Alarm	SCADA Control Centre Alarm
		• Safety showers flow switches (all switches) – Not Active • Safety Shower pressure switches (all switches) – Not Active			
Chemical truck unloading pump power outlet	240V (15amps)	Permissive for the power supply to power outlet: • Chemical storage tank level switch - Not High-High, and (Note: High High switch is a hard wired interlock also) • Chemical storage tank level transmitter – Not High or High-High, and (Note: Level transmitter High High Level is a hard wired interlock also) • Chemical storage bund level switch – High Level switch not activated, and • Delivery bund drain valve (where fitted) position switch – Closed, and • Delivery bund containment tank (where fitted) level switch – Not active, and • Delivery unloading panel local E-Stop not activated, and • Safety showers flow switches (all switches) – Not Active • Safety Shower pressure switches (all switches) – Not Active		Medium	
Valve in sump of truck unloading	Position indicator	Valve must be electrically interlocked with truck unloading power outlet. • be interlocked with the delivery tanker power supply GPO to ensure the valve is closed to enable power. • Can be overridden, on SCADA, if position indicator is failed. Must not be locally resettable. Must reset after a maximum of 2 hours.			
Level indicator in truck unloading bund sump	Level switch	The level switch must alarm when the sump contains 300mm of liquid	Audible & Visual. Inactivate after 15 minutes.	High	High

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Equipment name	Equipment Details	Control requirement	Local Alarm	SCADA Local Alarm	SCADA Control Centre Alarm
E-stop for chemical truck unloading power outlet	E Stop	Inhibits both 240V & 415V chemical truck unloading power outlets	Audible & Visual. Inactivate after 15 minutes.	High	High
Tank bund sump level switch	Level switch	Alarm when the sump contains 300mm +/- 25mm of liquid	Audible & Visual. Inactivate after 15 minutes.	High	High
Chemical tank outlet Fail-Safe actuated valves	Valve	Fail in the closed position. Close on rate of change of level alarm, or Close if sump level detected, or Close if leak detection		High	High
Carrier water flow switch	Flow switch	Generate a 'carrier water system failed' alarm when no or low water flow.		Medium	Medium
Slurry dosing pipes		The dosing pipes must alternate duty when one pipe is flushing, to provide continuous operation of the dosing system.			
Flushing water control	Solenoid	The flushing water must operate with a user configurable dedicated timer to control the flushing time.			
Truck unloading bund sump pumps (where installed)		Manual start, automatic stop on low level			

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

12.3 Tank Levels and Control

Chemical tank levels are defined in the table below:

Table 8 Tank Level Descriptions

Tank Level	Tank Level (%) (refer to note 1)	Description	Measure by LS or LT?	Tank Volume (L)	Relative level (RL) of tank level	Control	Local Alarm	SCADA Local Alarm Priority	SCADA Control Centre Alarm Priority
Overflow	100%	The 100% tank capacity is the level to the invert of the tank overflow pipe. This must be PLC Hard coded.	LT	*Site specific, identify during project.*	*Site specific, identify during project.*				
High-High	Nominally 95%	The High-High level must be installed a minimum 50mm below the invert of Overflow level. The high-high is indicated by the level transmitter and a level switch. The level switch provides redundancy for the level transmitter. Note: In the 2 tank scenario cut the power on High High based on which tank it is being unloading into (using valve with limit switch box or actuated valve to determine unloading tank destination).	LT and LS			Interlock the chemical truck unloading pump power outlets to stop chemical unloading. Silence after 15 minutes	Audible & Visual. inactivate after 15 minutes	High	High
High	Nominally above 90%	Upper tank fill Level – PLC Hardcoded.	LT			Interlock the chemical truck unloading pump power outlets to stop chemical unloading.	Visual Only. Inactivate after 15 minutes.	Medium	
Low	Nominally 30-50% (*Site specific)*	Chemical reorder level Must be operator configurable. (Based on delivery response time and consumption.)	LT					Medium	

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Tank Level	Tank Level (%) (refer to note 1)	Description	Measure by LS or LT?	Tank Volume (L)	Relative level (RL) of tank level	Control	Local Alarm	SCADA Local Alarm Priority	SCADA Control Centre Alarm Priority
Low-Low	Nominal 5%	Lower Level of usable volume. Low-Low level must be a minimum 5mm and maximum 30mm above the outlet pipe obvert. The low-low is indicated by the level indicator a level switch. The level switch is redundancy for the level indicator.	LT and LS			Interlock to stop chemical transfer/dosing pump to protect pump from running dry. The interlock must be PLC hard coded. Close Tank Outlet Valve	~	High (If dosing is non-critical, a Medium priority)	High (If dosing is non-critical, a Medium priority)
Minimum pumping level		Obvert of the outlet pipe.							
Tank empty	0% (not nominal)	Bottom of tank, the lowest point in the tank.							
All levels	Δ level	Rate of change in tank level indicating leak in tank. Rate of change 1.5 x Max pump draw out rate				Close actuated tank outlet valve (if fitted), interlock Chemical Dosing	Audible & Visual	High	High

Note 1: Nominal Levels. Level set points may require to be altered to suit level instrumentation hysteresis and control system response time.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

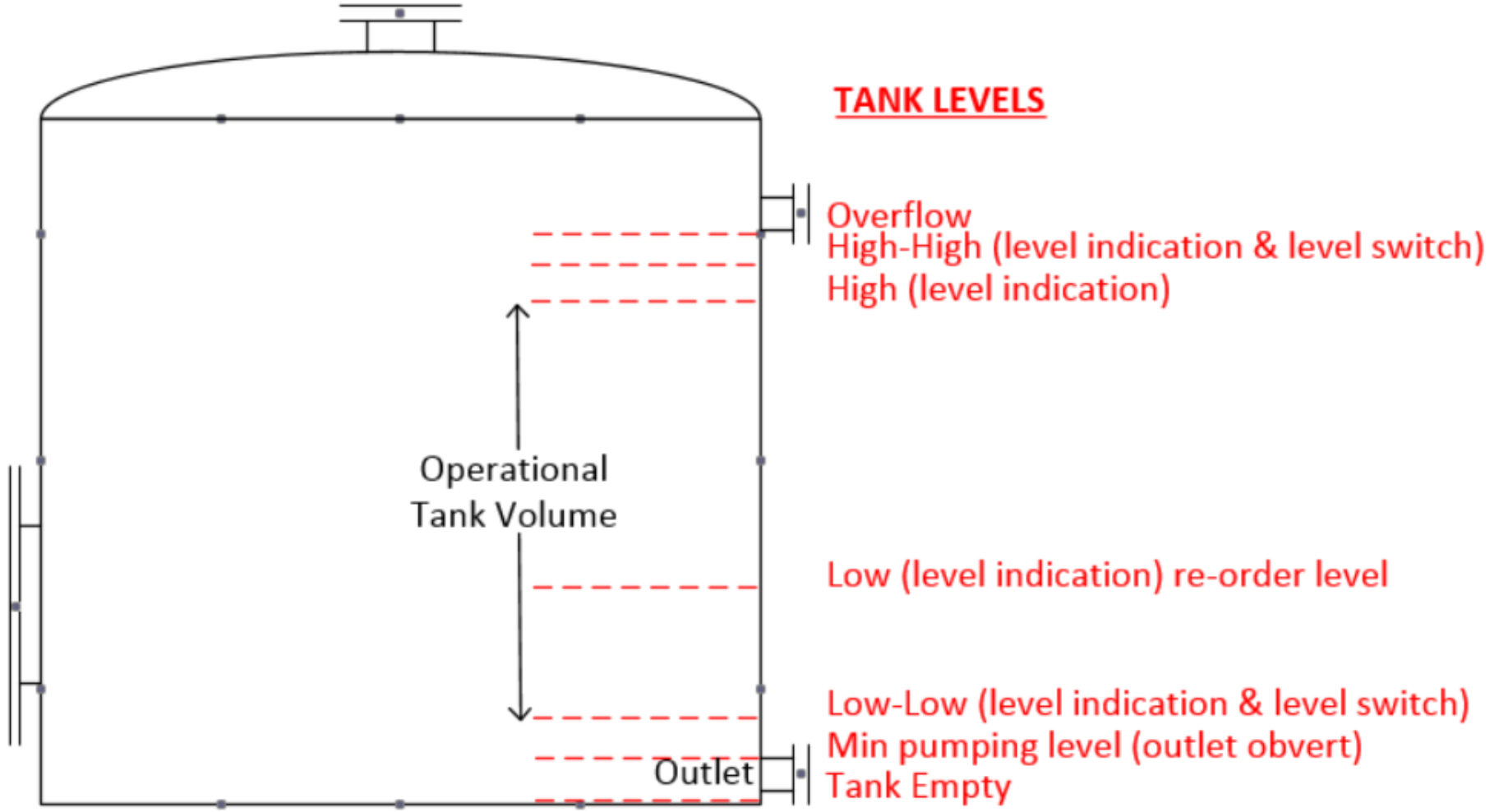


Figure 3 Tank Level Diagram

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

13 Document Control

Document Owner: Group Manager Planning & Engineering

Required Reviewers: Team Leader Mechanical and Electrical Engineering

Document Approver: Executive Manager Customer Delivery

Version	Author	Details of Change	Approval Date	Approved By	Next Scheduled Review
1.0	G Baker	Initial release	06/02/2018	D.Cleary	
2.0	G Baker	Update to 6.3.2 and 6.3.6	30/05/2019	L.Backhausen	
3.0	G Moore	Major re-write to capture lessons learnt	02/06/2021	C. Thomson	02/06/2023
4	A King	Update to capture lessons learnt	17 Sept 2024	Glen Robinson	17 Sept 2026

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Appendix A: Relevant Standards

A.1 Act

- Work Health and Safety Act
- Dangerous Goods (Road and Rail Transport) Act

A.2 Regulation

- Work Health and Safety Regulation
- Dangerous Goods (Road and Rain Transport) Regulation

A.3 Code of Practice

- NSW Code of Practice - Storage and handling of dangerous goods
- NSW Code of Practice - Managing risks of hazardous chemicals in the workplace
- NSW Code of Practice - Fluoridation of Public Water Supplies

A.4 Australian Standards

Table 9 Relevant Australian Standards

Reference Number	Title
AGRD03-16	Guide to Road Design Part 3: Geometric Design by Austroads (edition 3.3)
AS 1074	Steel tubes and tubulars for ordinary service
AS 1216	Class labels for dangerous goods
AS 1271	Safety valves, other valves, liquid level gauges and other fittings for boilers and unfired pressure vessels
AS 1319	Safety signs for the occupational environment
AS 1345	Identification of the contents of pipes, conduits and ducts
AS 1428.1	Design for access and mobility – General requirements for access – New building work
AS 1579	Arc-welded steel pipes and fittings for water and wastewater
AS 1692	Steel tanks for flammable and combustible liquids
AS 1894	The storage and handling of non-flammable cryogenic and refrigerated liquids
AS 1905.1	Components for the protection of openings in fire-resistant walls – fire-resistant doorsets
AS 1940	Storage and Handling of Flammable and Combustible Substances
AS 2129	Flanges for pipes, valves and fittings
AS 2243 series	Safety in laboratories, Parts 1-10.
AS 2508 series	Safe Storage and handling information for hazardous chemicals
AS 2594	Hose and hose assemblies for liquid chemicals
AS2876	Concrete kerbs and channels (gutters) – Manually or machine placed
AS 2927	The storage and handling of liquefied chlorine gas
AS 3559	Construction of buildings in bushfire prone areas

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Reference Number	Title
AS 3735	Concrete structures for retaining liquids
AS 3745	Planning for emergencies in facilities
AS 3780	Storage and handling of corrosive substances
AS 3996	Access covers and grates
AS 4041	Pressure piping
AS 4130	Polyethylene (PE) pipes for pressure application
AS 4145.1	Locksets and hardware for doors and windows – Glossary of terms and rating systems
AS 4326	The storage and handling of oxidising agents
AS 4332	The storage and handling of gases in cylinders
AS 4681	The storage and handling of Class 9 (miscellaneous) dangerous goods and articles
AS 4775	Emergency eyewash and shower equipment
AS 5026	The storage and handling of Class 4 dangerous goods
AS 5200.053	Plumbing and drainage products – Stainless steel pipes and tubes for pressure applications
AS/NZS 1477	PVC pipes and fittings for pressure applications
AS/NZS 1596	The storage and handling of LP gas
AS/NZS 2201.1	Intruder alarm systems
AS/NZS 3000	Electrical installation (Australian/New Zealand Wiring Rules)
AS/NZS 3833	The storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers
AS/NZS 3879	Solvent cements and priming fluids for use with unplasticized PVC (uPVC) pipes and fittings
AS/NZS 4024.1604	Safety of machinery - Design of controls, interlocks and guarding - Emergency stop - Principles for design
AS/NZS 4776	Polyethylene storage tanks for water and chemical
BS EN 13923	Filament-wound FRP pressure vessels - materials, design, manufacturing and testing

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Appendix B: WHS Checklist

HUNTER WATER	**WHS Checklist**						
Location Description:		Station ID:		Plant Item / Operational Area:		Area / Tank ID:	**None**
Area / Activity:		Task Details:	**Compliance Assessment of Hazardous Chemical Storage and Handling rev [insert revision number]**				
Personnel Present:							
Prepared By:		Site Assessment Date:			Next Review Due:		
Reviewed By:							

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

WHS Reg Clause	CONTROL MEASURE HEIRARCHY LEVEL	ACTIVITY / CIRCUMSTANCE	GUIDANCE FOR POTENTIAL SAFETY HAZARD OR ENVIRONMENTAL ASPECT	IDENTIFIED FORESEEABLE HAZARD	HAZARD RISK RATING			CONTROL APPLIED	RESIDUAL RISK RATING			ASSESSMENT NOTES	SUGGESTED ADDITIONAL CONTROL OR ACTION	RESULTANT RESIDUAL RISK RATING		
					L	C	R		L	C	R		Green = appears to be compliant	L	C	R
36	Elimination	Inventory control - can the hazardous chemical be eliminated, inventory minimised or replaced by a lower risk alternative?	Can hazardous chemicals be eliminated?													
36	Partial elimination	Is inventory of hazardous chemical minimised?	Can risk be minimised by less inventory?													
36	Substitution	Can hazardous chemical be substituted with a less dangerous alternative?	Can non-hazardous alternative be substituted?													
40 & 41	Isolation	Provide and maintain adequate facilities	Are hazardous chemicals secured from unauthorised access? is site in a secure / locked enclosure ?													
51	Admin	Managing risks to health and safety	Does a hazardous atmosphere exist?													
52	Admin	Ignition Sources	Do risks to health and safety associated with an ignition source in a hazardous atmosphere exist?													
330	Admin	Manufacturer to provide SDS	Does HWC generate hazardous chemicals?													
341 to 346 & others	Admin	Provision of information	Risks arising from personnel being unaware of the hazards													
341 to 346 & others	Admin	Hazardous characteristics - communication	Risks to personnel due to ignorance of the hazards of the material													
341	Admin	Labelling hazardous chemicals - general	Haz chemicals that are used, handled and stored, are they labelled ?													
342	Admin	Labelling hazardous chemicals - containers	Are containers including decant containers labelled ?													
343	Admin	Labelling hazardous chemicals - pipework	Are pipe runs sufficiently labelled at visible intervals ?													
344	Admin	Access to SDS	Is a current SDS available and accessible?													
345	Admin	Changes to SDS	Does HWC generate hazardous chemicals requiring modification to an SDS													
346	Admin	Hazardous Chemicals Register	Is the hazardous chemical listed on the register and is the register accessible?													

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

WHS Reg Clause	CONTROL MEASURE HEIRARCHY LEVEL	ACTIVITY / CIRCUMSTANCE	GUIDANCE FOR POTENTIAL SAFETY HAZARD OR ENVIRONMENTAL ASPECT	IDENTIFIED FORESEEABLE HAZARD	HAZARD RISK RATING			CONTROL APPLIED	RESIDUAL RISK RATING			ASSESSMENT NOTES	SUGGESTED ADDITIONAL CONTROL OR ACTION	RESULTANT RESIDUAL RISK RATING		
					L	C	R		L	C	R		Green = appears to be compliant	L	C	R
347	Admin	Manifest of Hazardous Chemicals	Is a manifest required for this site, and if so is this material listed? Is the manifest available for emergency services?													
348	Admin	Notification to Regulator (WorkCover)	If a manifest quantity exists on site, has the site been notified to WorkCover?													
349	Admin	Outer warning placard - requirement to display	Is an outer warning placard (HAZCHEM) required? Note: Placard is required if any storage exceeds placarding quantity													
350	Admin	Placard - requirement to display	Is the correct placard displayed on the tank?													
351 (1)	Admin	Management of risks to Health and Safety	Are hazards identified and managed ?													
351 (2) (a)	Admin	Hazardous properties of the chemical	Have the hazardous properties identified from the SDS been controlled?													
351 (2) (b)	Isolation / Engineering / Admin	Hazardous chemical or physical reaction	Are controls in place to ensure that hazardous reactions with other substances cannot occur?													
351 (2) (c)	Admin	Nature of the work	Do the operating procedures deal with the risks associated with the chemical?													
351 (2) (d)	Engineering	Structures, plant and system of work	Are the structures and plant suitable for the material?													
352	Isolation / Engineering / Admin	Review of control measures	Refer Clause 352 of WHS Regulation. Check if there is a policy to review control measures after a change in (a) SDS, (b) health monitoring requirements, (c) air quality monitoring or (d) every 5 years													
353	Admin	Safety signs	Are safety signs, required to control an identified risks, located next to the hazard, and clearly visible													
354	Isolation / Engineering / Admin	Identification of risk of physical or chemical reaction	Similar to 351 (2) (b)													

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

WHS Reg Clause	CONTROL MEASURE HEIRARCHY LEVEL	ACTIVITY / CIRCUMSTANCE	GUIDANCE FOR POTENTIAL SAFETY HAZARD OR ENVIRONMENTAL ASPECT	IDENTIFIED FORESEEABLE HAZARD	HAZARD RISK RATING			CONTROL APPLIED	RESIDUAL RISK RATING			ASSESSMENT NOTES	SUGGESTED ADDITIONAL CONTROL OR ACTION	RESULTANT RESIDUAL RISK RATING		
					L	C	R		L	C	R		Green = appears to be compliant	L	C	R
354	Isolation	Separation from other haz chem storages	Dangerous reaction, heating, toxic fumes													
354	Isolation / Engineering / Admin	Interaction with other hazardous chemicals	Reaction producing toxic reaction products													
354 (special instance)	Isolation	Introduction of incompatible material	Violent reaction, loss of containment, personnel exposure to fumes, splashing													
354 (3)	Isolation / Engineering / Admin	Identification of risk of hazardous chemical contaminating food (water product)	Can chemical inadvertently enter domestic water, or in too high a concentration ?													
354 (3)	Slightly different from 343	Contamination of food and personal products	Toxic effects to personnel													
355	Isolation / Engineering / Admin	Specific control - fire and explosion	Are ignition sources excluded from areas where there is a possibility of fire or explosion?													
356 (1)	Engineering / Admin	Keeping hazardous chemicals stable - is material stable?	Does storage, handling and shelf life cause instability / decomposition to create additional hazard ?													
356 (2)	Engineering / Admin	Keeping hazardous chemicals stable - are stabilizing controls maintained?	Is routine maintenance required and undertaken to maintain stability ? is site in a secure / locked enclosure ?													
357 (1)	Isolation / Engineering	Containing and managing spills	Is a spill containment system present and of sufficient capacity ? Is all plant containing hazardous chemical contained (including pressurised systems) ? Does capacity match this volume ?" Does bund collect rainwater, does this impact on containment volume & is this managed? Are bulk tanks interconnected and does bund capacity match this volume? See *separation from boundaries* for information on for unloading area / containment													

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

WHS Reg Clause	CONTROL MEASURE HEIRARCHY LEVEL	ACTIVITY / CIRCUMSTANCE	GUIDANCE FOR POTENTIAL SAFETY HAZARD OR ENVIRONMENTAL ASPECT	IDENTIFIED FORESEEABLE HAZARD	HAZARD RISK RATING			CONTROL APPLIED	RESIDUAL RISK RATING			ASSESSMENT NOTES	SUGGESTED ADDITIONAL CONTROL OR ACTION	RESULTANT RESIDUAL RISK RATING		
					L	C	R		L	C	R		Green = appears to be compliant	L	C	R
357 (2)	Isolation / Engineering	Containing and managing spills- Incompatible chemicals mixed	Is common bunding linking incompatible chemicals ?													
357 (3)	Engineering / Admin	Containing and managing spills- Contained spills clean up	Procedure for safe clean up of contained spills ?													
358	Isolation / Engineering / Admin	Protection of hazardous chemicals from damage	Is protection from impact or excessive loads ?													
359	Engineering	Fire Protection and firefighting equipment	Is a fire protection system present and suitable for hazardous chemical storage ?													
360	Engineering / Admin	Emergency Equipment	Is emergency equipment installed, maintained, & accessible ? (e.g. spills kits, fire control)													
361	Admin	Emergency planning	Fire, spill, chemical burn to personnel (Does the emergency plan deal with the correct responses and resources to deal with this particular material?)													
361 (and 43)	Admin	Emergency Plans														
362	Engineering / Admin	Safety equipment	Is safety equipment installed, maintained, & accessible ?Is safety shower water supply secure from damage / vandalism?													
363 (1)	Engineering / Admin	Control of risks from storage and handling systems Design and operation	Is the system being used as per design and is it maintained / tested ?													
363 (2)	Admin	Control of risks from storage and handling systems Personnel competence	Are staff trained / instructed ?													
364	Engineering	Containers for hazardous chemicals used, handled or stored in bulk	Foundations stable and tank secured to prevent movement ?													
365	Admin	Stopping use and disposing of handling systems	Is there a standard for decommissioning?													
366	Admin	Stopping use of underground tanks	Is there a standard for decommissioning?													
367	Admin	Notification of abandoned tank	Notification to WorkCover													

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

WHS Reg Clause	CONTROL MEASURE HEIRARCHY LEVEL	ACTIVITY / CIRCUMSTANCE	GUIDANCE FOR POTENTIAL SAFETY HAZARD OR ENVIRONMENTAL ASPECT	IDENTIFIED FORESEEABLE HAZARD	HAZARD RISK RATING			CONTROL APPLIED	RESIDUAL RISK RATING			ASSESSMENT NOTES	SUGGESTED ADDITIONAL CONTROL OR ACTION	RESULTANT RESIDUAL RISK RATING		
					L	C	R		L	C	R		Green = appears to be compliant	L	C	R
368 - 378	Admin	Health monitoring	Does this material have special characteristics or uses which indicate monitoring is required? Is there a health monitoring policy which is implemented?													
379	Admin	Duty to provide supervision	Is training and supervision appropriate ?													
389	Engineering / Admin	Pipelines	Is pipeline protected from adverse effects arising from activities, structure, equipment or substance?													
390	Admin	Pipelines builder's duties	If Hazchem pipe is on public property, has Notification to Regulator (WorkCover) ?													
391	Engineering / Admin	Pipeline operator	Is pipeline risk assessed & labelled ? Are pressurised pipe leaks contained from pump discharge through to injection point? Is there any potential for dosing point leakage into an uncontained environment? Does pipe-in-pipe drain to containment ? Are sections without pipe-in-pipe outside of containment ?													

Appendix C: Model Piping and Instrumentation Diagrams

The following Piping and Instrumentation Diagrams are to be obtained from your Hunter Water project manager representative through the plan room team plan_room@hunterwater.com.au.

Drawing Number	Description - Type	Drawing Type	Description - Line 5
16068-000	DRAWING INDEX	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	DRAWING INDEX
16068-001	TYPICAL WWTW CHEMICAL DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	Aluminium Sulphate Chemical Dosing System - Single Tank
16068-002	TYPICAL WWTW CHEMICAL DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	Sodium Hydroxide Chemical Dosing System - Single Tank
16068-003	TYPICAL WWTW CHEMICAL DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	Ferrous Chloride/Ferric Sulphate Chemical Dosing System - Single Tank
16068-004	TYPICAL WWTW CHEMICAL DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	Sodium Bisulphate Chemical Dosing System - Single Tank
16068-005	TYPICAL WWTW CHEMICAL DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	Citric Acid Chemical Dosing System - Single Tank
16068-006	TYPICAL WWTW CHEMICAL DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	Sugar Dosing System - Single Tank
16068-007	TYPICAL WWTW CHEMICAL DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	Emulsion Polymer Dosing System - single tank (to be developed)
16068-021	TYPICAL WWTW CHEMICAL DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	Aluminium Sulphate Chemical Dosing System - Dual Tank - Sheet 1 of 2
16068-022	TYPICAL WWTW CHEMICAL DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	Aluminium Sulphate Chemical Dosing System - Dual Tank - Sheet 2 of 2
16068-040	TYPICAL WTW LIME SYSTEM	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	HYDRATED LIME SILO
16068-041	TYPICAL WTW LIME SYSTEM	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	HYDRATED LIME DOSING - MIXING TANK 1
16068-042	TYPICAL WTW LIME SYSTEM	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	HYDRATED LIME DOSING - MIXING TANK 2
16068-043	TYPICAL WTW LIME SYSTEM	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	HYDRATED LIME DOSING - ALTERNATE ARANGEMENTS
16068-044	TYPICAL WTW LIME SYSTEM	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	HYDRATED LIME DOSING - ALTERNATE LIME HOPPER ARANGEMENT
16068-045	TYPICAL WTW LIME SYSTEM	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	HYDRATED LIME DOSING - ACID FLUSHING SKID
16068-051	TYPICAL WW NETWORK CHEMICAL DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	MAGNESIUM HYDROXIDE NETWORK CHEMICAL DOSING SYSTEM - GRAVITY SEWER
16068-052	TYPICAL WW NETWORK CHEMICAL DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	MAGNESIUM HYDROXIDE NETWORK CHEMICAL DOSING SYSTEM - PRESSURE MAIN
16068-053	TYPICAL WW NETWORK CHEMICAL DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	FERRIC/FERROUS CHLORIDE CHEMICAL DOSING UNIT (CDU) - GRAVITY SEWER
16068-054	TYPICAL WW NETWORK CHEMICAL DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	FERRIC/FERROUS CHLORIDE CHEMICAL DOSING UNIT (CDU) - PRESSURE MAIN
16068-060	HYPOCHLORITE DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	SODIUM HYPOCHLORITE STORAGE AND DOSING SYSTEM - Single Tank
16068-061	HYPOCHLORITE DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	SODIUM HYPOCHLORITE STORAGE AND DOSING SYSTEM - Dual Tank - SHEET 1 OF 2
16068-062	HYPOCHLORITE DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	SODIUM HYPOCHLORITE STORAGE AND DOSING SYSTEM - Dual Tank - SHEET 2 OF 2
16068-063	HYPOCHLORITE DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	SODIUM HYPOCHLORITE - PW BOOSTER, HOSE REEL, SAFETY SHOWER, EYE WASH AND SINK
16068-064	HYPOCHLORITE DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	CLOSED LOOP CHLORINE ANALYSER
16068-065	HYPOCHLORITE DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	RESERVOIR JET MIXER AND BUBBLE MIXER
16068-070	CHLORINE STORAGE AND DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	CHLORINE GAS STORAGE AND DOSING SYSTEM - SINGLE EJECTOR
16068-071	CHLORINE STORAGE AND DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	CHLORINE GAS SYSTEM - PW BOOSTER, HOSE REEL, SAFETY SHOWER, EYE WASH AND SINK
16068-072	CHLORINE STORAGE AND DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	CHLORINE GAS STARAGE AND DOSING SYSTEM DUAL EJECTORS - SHEET 1 OF 2
16068-073	CHLORINE STORAGE AND DOSING	PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)	CHLORINE GAS STARAGE AND DOSING SYSTEM DUAL EJECTORS - SHEET 2 OF 2

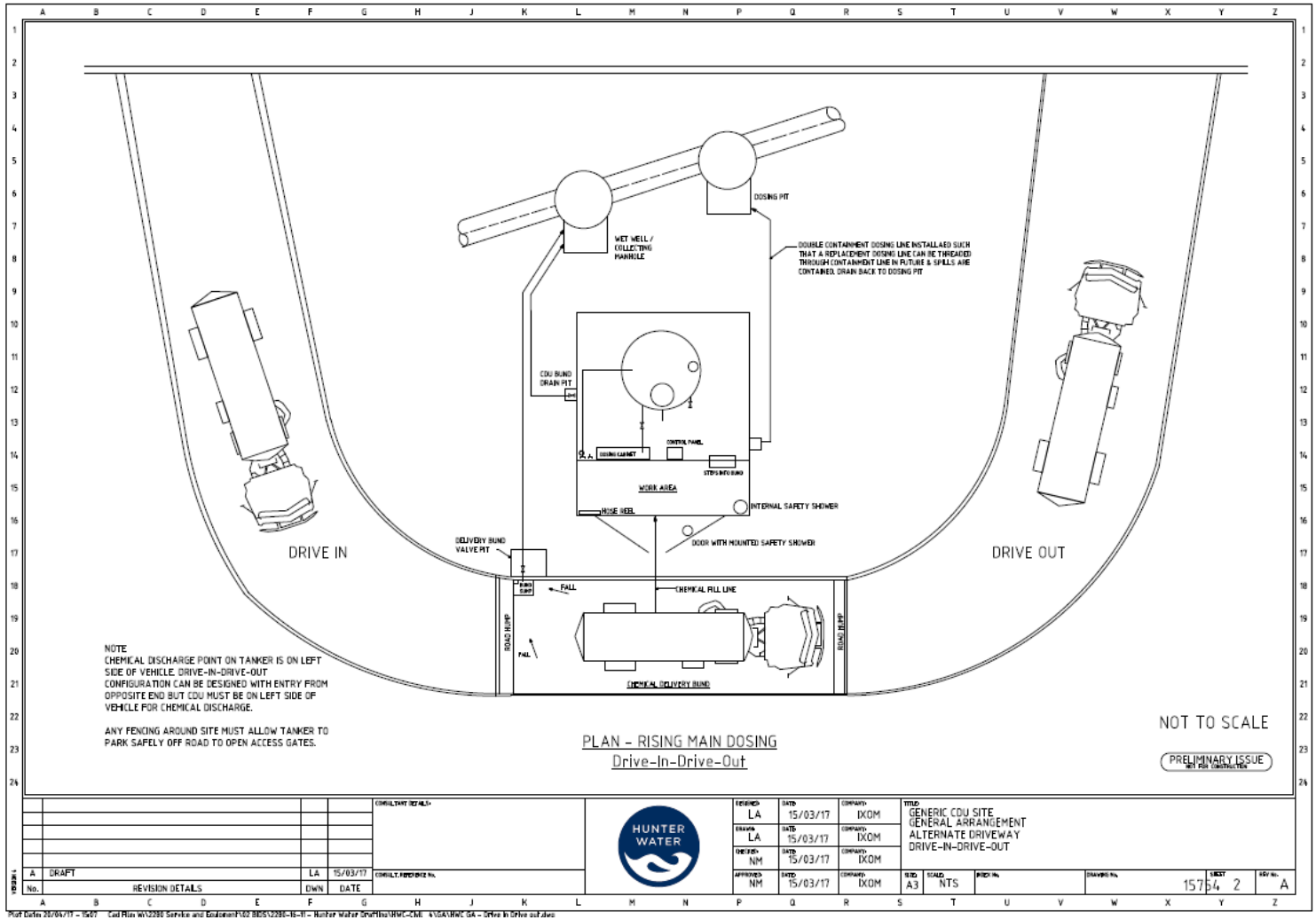
Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Standard Arrangements

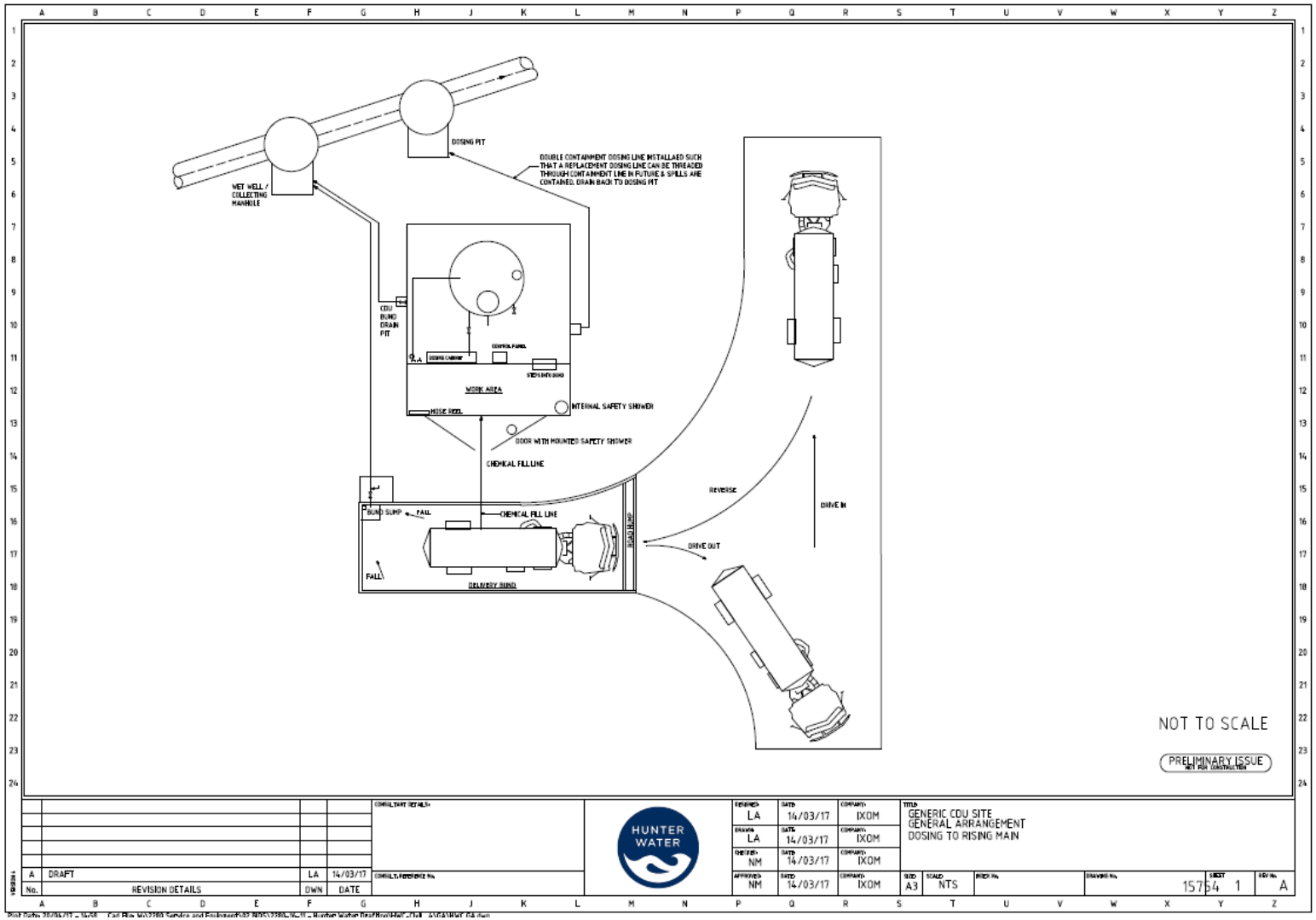
TBC – separate standard number with sheets etc	Layout	Generic network Ferrous CDU Site General Arrangement Reverse in (Steve Snitch – CDU - project)
TBC	Layout	Generic network Ferrous CDU Site General Arrangement Alternative Driveway Drive In Drive Out
TBC	Layout	Pits underground, leak detection underground pits, above ground leak detection, lids on pits
TBC	Layout	Double containment detail drawing
TBC	Layout	Injection quill detail (Snitch Anna Bay 9, also Tony neil)
TBC	Layout	Typical GA WWTW chemical – various (Farley, Dungog, Kurri, Cessnock etc)

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Appendix D: Typical Chemical Dosing System site layouts



Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.



Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Appendix E: Indicative Chemical Dosing System Arrangement

Drawing Number	Type	Description
TBC	Electrical	Truck unloading control panel
TBC	Mechanical	Truck unloading connection point and drip tray
TBC	Mechanical	Chemical dosing cabinet pipe layout
TBC	Mechanical	Chemical dosing cabinet
TBC	Mechanical/Civil	Chemical injection lance
TBC	Civil	Chemical injection pit
TBC	Civil	Buried double containment leak pit
TBC	Mechanical	Chemical storage tank

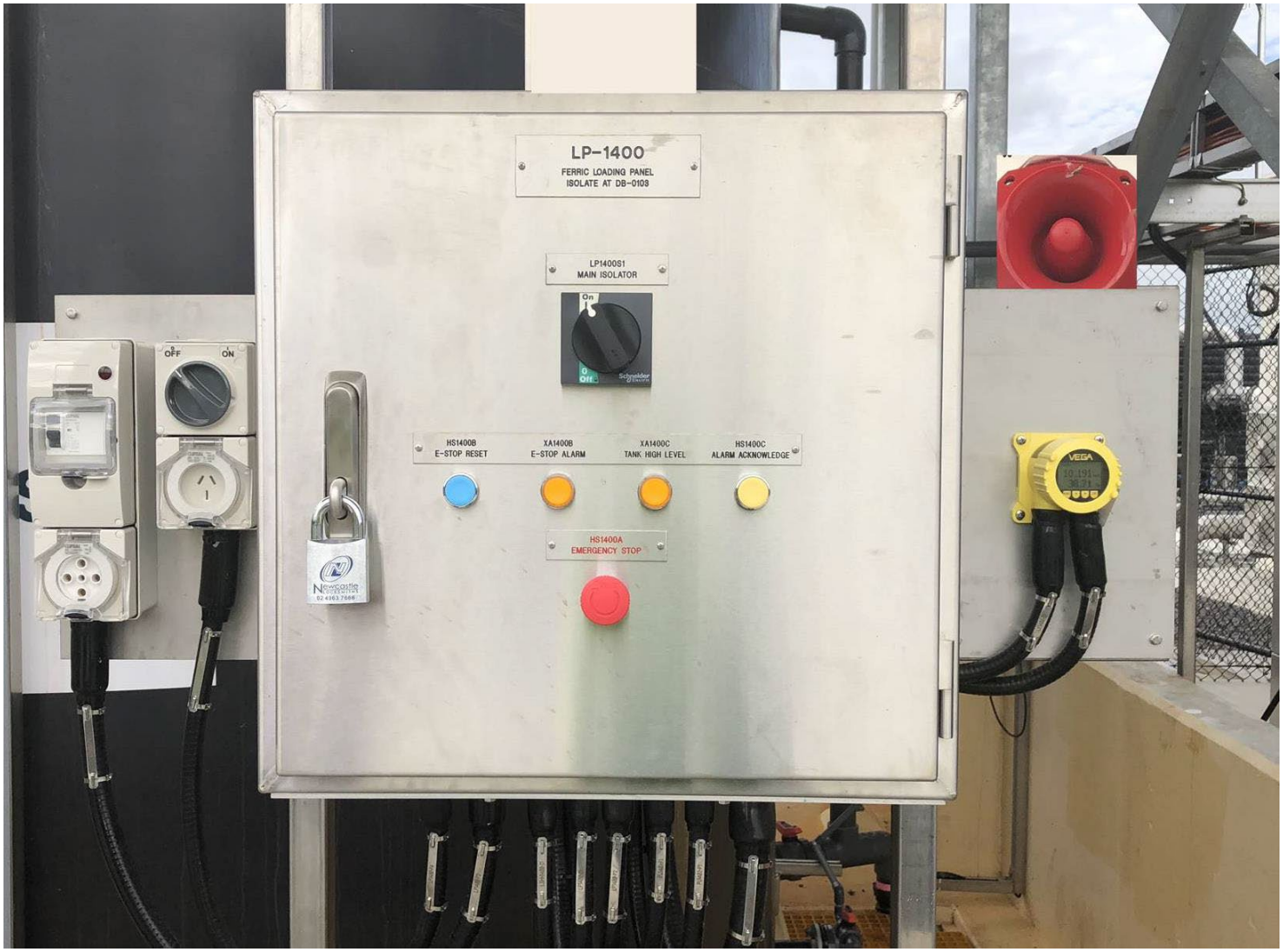
Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Appendix F: Indicative Chemical Dosing System Arrangements - Photos

1. Tanks nozzle reinforcing.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

2. Unloading control panel



Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.

Warning – This document is current at time of printing or downloading. It may be reviewed and amended prior to the noted review date at the discretion of Hunter Water Corporation.