UNIVERSITY
OF WOLLONGONG
AUSTRALIA

Facilities Management Division / Maintenance

Hydraulic Services Design Standards
Version 6 – September 2019

Contents

UNIVERSITY OF WOLLONGONG AUSTRALIA

VERSION CONTROL SYSTEM

Section Modified	Description of Modification	Version	Organisation	Representative	Date
2.1; 2.4; 2.8	Change the term "Design Engineer" to "Designer"	1.01	Asset Technologies Pacific	Donny Yap	10/08/06
2.8; 2.9	Life Cycle Costings changed from Section 1.8 to 1.9	1.02	Asset Technologies Pacific	Tom Poyner	17/11/06
2.8	Section 1.8 Warranty added	1.02	Asset Technologies Pacific	Tom Poyner	17/11/06
Throughout	THE UNIVERSITY OF WOLLONGONG Logo added to	1.02	Asset Technologies Pacific	Tom Poyner	28/11/06
2.2	Add risk assessment activity to conceptual design process.	1.02	Asset Technologies Pacific	Tom Poyner	1/12/06
2.4	Insert OH&S reference link	1.02	Asset Technologies Pacific	Tom Poyner	1/12/06
2.7.13	Added rainwater tanks and pump to equipment listing	1.02	Asset Technologies Pacific	Tom Poyner	1/12/06
2.6.5.3	Added rainwater tanks to installation guidelines	1.02	Asset Technologies Pacific	Tom Poyner	1/12/06
2.7.10	Amended Urinal Schedule – Table 4	1.03	The University of Wollongong	Chris Hewitt	26/11/07
2.3.2	Potable water meter requirement added	1.04	The University of Wollongong	Chris Hewitt	2/9/09
Throughout	Full document review and update	2.0	McCallum PFCA	Robert McCallum	29/4/10
2.2	Minor clarification of campus and existing services provision requirements	2.1	McCallum PFCA	Robert McCallum	17/5/10
Throughout	Document updated to reflect name change from Buildings & Grounds (B&G) to Facilities Management Division (FMD) and rebranding logo	3	The University of Wollongong	Yvonne Butcher	8/3/2012
	Update to Equipment supplier information	4	The University of Wollongong	Yvonne Butcher	14/10/2013
Various	Hydraulic pump and metering requirements	5	The University of Wollongong	Mark Stephenson	7/07/14
Throughout	Full document review and update	6	McCallum PFCA	Robert McCallum	6/9/19

1 Design Process

This document provides an overview of the design process. The process shall be followed to achieve The University of Wollongong's desired outcomes.

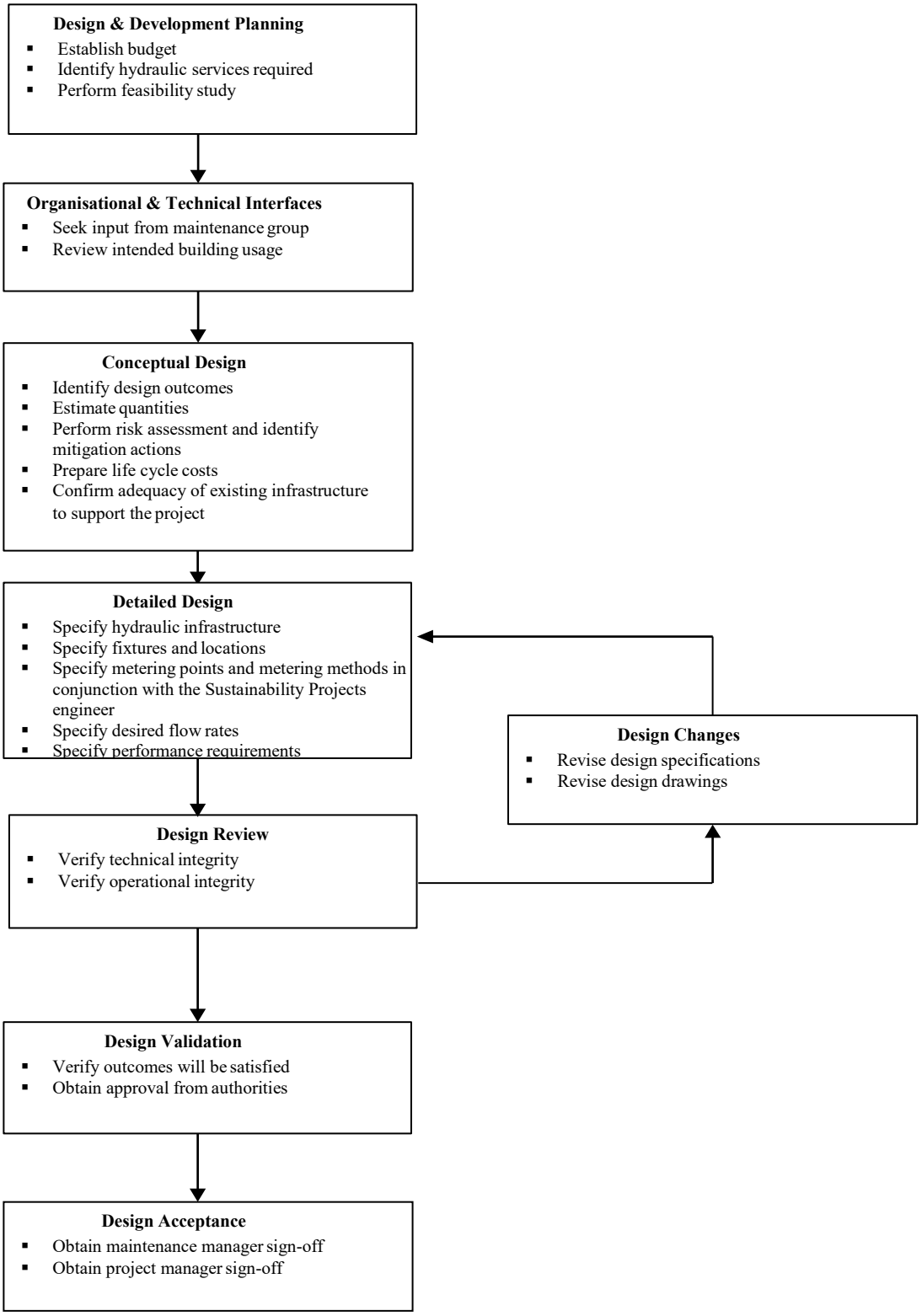

Figure 1 - Process Flow

2 Hydraulic Services

The hydraulic services involve supply, reticulation and fittings for the provision of water and gas. Following are the primary systems:

- Potable Cold Water Reticulation
- Potable Hot and Warm Water Reticulation
- Non-Potable Cold Water Reticulation
- Non-Potable Hot Water Reticulation
- Sanitary Drainage and Sanitary Plumbing
- Trade Waste Drainage
- Rainwater Harvesting Systems
- Stormwater and Subsoil Drainage
- Fire Hydrant Services
- Fire Hose Reel Services
- Fire Sprinkler Services
- Landscape Water Reticulation
- Natural Gas Supply
- Solar Hot Water Reticulation

2.1 Overview

This design standard outlines the functional, installation and technical requirements for hydraulic services at The University of Wollongong.

The designer shall use this design standard, relevant Australian Standards and National Construction Codes and other The University of Wollongong services design standards as appropriate (eg. Electrical, Mechanical, BMS) as the basis for the hydraulic services design. However it is incumbent upon the designer to ensure that the hydraulic services satisfy site specific operational, logistical and performance requirements and meet The University of Wollongong's demand requirements for hydraulic services for the facility.

Where appropriate and achievable, obtain local authority approvals during the design process. Include approval requirements into the final design documentation for the following items:

- Connection of services to mains;
- All trade waste discharges, including pits, arrestors and the like with copies of drawings & trade waste forms completed for issue to Sydney Water;
- All natural gas installations including applications, submissions and certifications to Jemena;
- Installation of fire hydrant services including applications to NSW Fire Brigade Fire Safety Branch for items of non-compliance;
- Any other approval by relevant authorities that may be required before construction can commence.

2.2 Existing Infrastructure Capacity

The Designer shall obtain from The University of Wollongong, the hydraulic services site drawings and any other pertinent information on system loadings available. The designer shall review the information and calculate and confirm that the existing infrastructure for water, fire, sanitary and gas services is sufficient to accommodate the likely increased demand on services due to the proposed project. If the services are deemed to be insufficient, then the University of Wollongong Project Officer is to be informed and possible rectification measures are to be proposed by the consultant for review and discussion.

Any required services amplification measures are to be coordinated with the University of Wollongong Project Officer.

2.3 Services Design Coordination

Refer to other Consultants drawings for coordination during the design period for the locations and number of items requiring hydraulic services connection. This includes but is not limited to Architectural, Mechanical, Electrical and Civil/Structural Services drawings. Connect hydraulic services to all items. Coordinate with other services to ensure all items to be installed fit in the intended location. Interconnect system elements so that the installations perform their designated functions.
Levels: Include spot levels, contour lines and ground profile lines on external services documentation.

2.4 Services Corridors

Where services corridors are available both external to the building and within the building, arrange the services to be within the services corridors and parallel with each other and with adjacent building elements.

2.5 Pipework Location, Documentation and Labelling

Where existing pipeline locations are identified during the project and are found to be either not indicated on existing the University of Wollongong services drawings or are in locations that differ from existing services drawings, the existing services drawings are to be 'marked-up' and issued to the University of Wollongong for alterations to their campus services plans.

New Pipelines and alterations to existing pipelines are to be indicated on the final project 'Work As Executed' drawings.

All new and altered underground services are to have detectable trace wire and service specific marker tape laid over them during construction for ease of future location and identification.

All new pipelines in all locations are to conform to AS 1345.

2.6 Existing Services

Locate existing services in the area of the proposed works in conjunction with the client and/or client's surveyor. Existing University of Wollongong's services drawings will be made available for review. These are diagrammatic and should not be deemed to be accurate. Accurate services locations are to be determined with the use of electronic detection equipment suitable for the task and physical 'potholing' by hand and viewing of services.

Indicate existing services on drawings and note which are to become redundant or be renewed or relocated.

2.7 External Items

All external plant and equipment required to be protected by the manufacturer is to be protected with a purpose made weatherproof (and where recommended, ventilated) colorbond enclosure of a colour selected by the University of Wollongong.

All exposed equipment and plant requiring electrical connection is to be IP rated.

2.8 Metering

Water and gas meters with pulsed outputs shall be installed to meter the water and gas supplies to each building and to high use specialist systems and areas as determined by the University of Wollongong. This includes (but is not limited):

- Potable water
- Non-potable water
- Reused water
- Harvested rainwater
- Rainwater tank levels
- Irrigation services
- Toilets
- Cooling towers
- Gas boilers
- Sub-meters for commercial areas in the building

- Sub-meters for different building levels or wings
- Other key specific supplies

The University of Wollongong shall be consulted to assess and approve the supplies to be metered, quantity and type of meters to be installed and all other metering requirements.

Water and gas meters are to be positioned in locations to ensure protection from physical damage, compliant ventilation and to be readily accessible for maintenance, manual meter reading, access to network reception and emergency access.

2.9 Safety in Design

Provide the University of Wollongong with a project specific Safety in Design report encompassing potentially unsafe items or installation practices. Nominate the risk involved, the level of risk and the design procedure undertaken in order to mitigate the risk. Nominate the final risk level following mitigation measures.

3 Functional Requirements

3.1 General

The hydraulic services design shall ensure efficient functionality and operational performance. Each of the functions specified shall be considered in terms of the specific building usage including minimum, average and peak demands. The availability of products specified and their cost effectiveness for long term maintenance is to be ensured.

Where the designer considers that an alternate equipment type is preferred to the equipment type specified in the design standard, the designer will advise the principal of the functional performance or cost benefit that will be achieved through the use of the alternate equipment type.

4 Water Pressure Control

4.1 Water Pressure Control

In general, maintain the campus water supply pressures on main risers within buildings.

Pressure control stations (if necessary) shall be included at the pipeline entry point to the building, at intermediate floor levels and prior to fixture and equipment connections. Generally, water pressures are to be maintained between 350Kpa and 650Kpa. Supply pressures above this shall only be made available to individual fixtures and equipment deemed by the manufacturer to be necessary. If necessary, include pressure control valves prior to temperature control devices to achieve the correct hot and cold water inlet water pressure ratio.

4.2 Potable Cold Water Reticulation

The potable cold water reticulation is to extend from the Authority water main or existing site water service to the proposed project location as necessary. Include pumping equipment if water pressures are determined to be insufficient to provide a suitable supply.

Where available, the potable water supply shall reticulate to the building and through the building via services corridors. Branches shall radiate off the main pipes to service all required connections via control valves.

Pipework shall be labelled “Potable Water” to ensure that future cross connection with other systems does not occur.

The potable water system shall include but not be limited to connection to all potable water fixtures, fittings, equipment, harvested roof water back up, hot water generation plant and mechanical plant as required. Connect to irrigation systems only if a harvested rainwater system is unavailable for connection.

Water meters with pulsed outputs shall be installed on potable and non- potable water supplies to each building and to high use specialist systems and additional areas as determined by The University of Wollongong. The University of Wollongong shall be consulted to assess and approve the supplies to be metered, the quantity of meters to be installed and all other metering requirements.

Backflow prevention valves are required to separate the potable water supply from non-potable water system supplies in accordance with Australian Standard requirements.

4.3 Water Heating Systems

Hot water heating systems include calculating and specifying the appropriate unit type for the installation. Submit details to the University of Wollongong for review and approval.

In plant rooms, locate hot water units on a 100mm high concrete plinth with width and depth dimensions suitable for the installation of safe trays under the units.

Nominate a safe tray in accordance with Australian Standards for all water heating units. Drain the safe trays to the sanitary drainage system.

Drain TPR valves from water heating units via a copper pipe of a size in accordance with Australian Standard 3500.4 to a tundish or other approved receptacle connecting to the sanitary drainage system.

4.4 Potable Hot and Warm Water Generation and Reticulation

Hot and warm water shall be provided by highly efficient gas fueled units, electric heat pumps, gas condensing boilers and/or electric instantaneous hot water systems unless otherwise indicated by the University of Wollongong.

Heat pumps shall be installed in well ventilated areas to allow optimal performance of the units.

Condensing boiler systems shall be designed to accommodate a return water temperature in accordance with AS/NZS 3500.4. They shall be installed with an adequate condensate drain to prevent corrosion and a condensate neutraliser to neutralise the condensate to pH7.

Where available, the potable hot water reticulation system shall extend from the central hot water plant via services corridors. Branches shall radiate off the main pipes to service all required connections via isolation valves.

Temperature control devices (Tempering Valves and approved temperature limited hot water units) for non-disabled ablution fixtures shall be provided to ensure compliant warm water temperatures are achieved.

Temperature Control devices (Thermostatic Mixing Valves) for disabled person usage shall be installed and commissioned to ensure temperatures are compliant with all Department of Health requirements. Thermostatic mixing valves are to be installed in lockable recessed proprietary stainless steel cabinets with appropriately sized drains to the sanitary drainage system. The entire installation is to comply with the Hosplan Code of Practice for Thermostatic Mixing Valves. (Refer to the University of Wollongong approved schedule of fittings and fixtures.)

Warm water to ablution fixtures in childcare facilities are to be provided with warm water via thermostatic mixing valves at a maximum temperature in accordance with all Department of Health requirements.

Thermostatic Mixing Valve cabinets shall be located on the same floor as the fixtures they area serving in locations that are readily accessible for inspection and maintenance without the need for ladders or scaffolding (1.5 metres to the base of the cabinet or lower). Do not install in false ceilings, ducts or other inaccessible areas. Coordinate locations and cover plate materials and colours with the project Architect to ensure building aesthetics are maintained.

Hot and Cold water supply pressures to all temperature control devices are to be within the ratio limits specified by the valve manufacturer. If necessary, use adjustable pressure valves to achieve this.

Pipework shall be labelled with ‘Potable Hot Water’, ‘Potable Tempered Water’ or ‘Potable Warm Water’ to ensure that future cross connection with other systems does not occur.

Where required by the University of Wollongong, solar water heating panels for heating water shall be provided and boosted with a gas plant to accommodate low radiation periods.

Where possible and if determined viable due to life cycle costing and subsequently agreed with the client, heat recovery from the mechanical plant shall be included.

4.5 Non-Potable Cold Water Reticulation

Where included on a project, non-potable cold water reticulation systems shall extend to the end use location via a services corridor where available. Branches with control valves at each level shall radiate off the main pipe to service all required connections via control valves.

Connections to the potable water supply shall be protected by approved Australian Standard backflow prevention methods using watermarked valves.

Pipework shall be labelled as “Non-Potable Cold” with the specific service name to ensure that future cross connection with other systems does not occur.

Water meters shall be installed on non-potable water supplies to each building and also to any high use specialist systems or areas within the building, or as directed by the University of Wollongong. Refer to Clause 2.4.8 for additional information.

4.6 Non-Potable Hot Water Reticulation

Hot and warm water shall be provided by highly efficient gas fueled, electric heat pumps, and gas condensing boilers and/or electric instantaneous hot water systems unless otherwise indicated by the University of Wollongong.

Heat pumps shall be installed in well ventilated areas to allow optimal performance of the units.

Condensing boiler systems shall be designed to accommodate a return water temperature in accordance with AS/NZ 3500.4. They shall be installed with adequate condensate drain to prevent corrosion and a condensate neutraliser to neutralise the condensate to pH7.

The non-potable hot water reticulation system shall extend from the central hot water plant via a services corridor where available. Branches with control valves shall radiate off the main pipe to service all required connections. Provide separate 'Non-Potable' hot water plant if necessary.

Pipework shall be labelled with 'Non-Potable Hot' with the specific service name to ensure that future cross connection with other systems does not occur.

Where specified, solar water heating panels for heating water shall be provided and boosted with a gas plant to accommodate low radiation periods. Where possible and if determined viable and subsequently agreed with the client, heat recovery from the mechanical plant shall be included.

4.7 Backflow Prevention Valves

Include the design of appropriate backflow prevention valves for property containment, zone containment and individual containment. Utilise types appropriate for the risk in accordance with Australian Standard and Sydney Water requirements.

In internal locations, nominate a stainless steel enclosure. (Recessed where possible). Include a drain of sufficient diameter between the enclosure and the sanitary drainage system.

4.8 Water Management System

Water saving devices shall be as specified by The University of Wollongong in the approved tapware, fixtures and appliances schedule. These shall include:

- Flow control devices.
- Minimum WELS 3 star rated water efficient appliances
- Do not specify 'waterless' urinals.
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4.9 Material

Potable Water supply systems are to be specified throughout the University in copper pipelines or high grade, readily available poly pipelines equal to 'Rehau' unless an alternative material is agreed with the University of Wollongong Project Officer. If an alternative material is proposed particular attention shall be made to ensuring that pipes are sized in accordance with the alternative materials internal bore.

Straight lengths of pipework shall be specified with uniform grades and without sagging. To accommodate directional changes, manufactured fittings in accordance with the pipe manufacturer's compatibility requirements shall be nominated.

Unions, flanges and isolating valves are required to facilitate ease of removal for maintenance purposes.

Separation must be maintained between copper pipes and fittings and other metal likely to cause electrolytic, galvanic or corrosive action. Junctions between dissimilar metals may only occur using purpose designed fittings manufactured for the specific metal types.

Joints shall be tight and leak proof and all burrs and obstructions shall be removed. The following jointing methods may be specified where considered appropriate and allowable by AS 3500.1:

- Compression fittings
- Silver braised slip joints
- Screwed joints
- Flanged joints
- Electro Fusion joints
- Solvent welded joints

Pipework shall not be embedded in concrete unless approved by the University of Wollongong project superintendent. Pipework approved to be embedded in concrete shall be continuous lengths, without fittings and shall not cross any movement joints or joints between two adjoining sections of reinforced concrete through which the reinforcing does not extend. As a minimum, the pipe shall be sheathed with 'Kemlag' prelag or University of Wollongong approved equivalent to allow lateral movement.

4.10 Control Valves

Control valves shall be designed to provide local isolation of a water service without interference to other areas. In general, one (1) valve should be provided to control the water service to each bathroom, laboratory or major water end-use (e.g. cooling towers). One (1) valve is also to be provided to control the water service to each floor of a building or other user group designated defined area, and one (1) valve should also be provided at the perimeter of a building to control the water service to the entire building. Include control valves to isolate fittings. Mini control valves are required to all fixtures and appliances.

Install valves in inconspicuous locations such as below sinks and basins and other locations approved by University of Wollongong and the project architect. Do not install in locations where a ladder is required for access to the valve.

Do not install in false ceilings, in underground pits and other difficult to access locations.

4.11 Fittings

Taps shall be copper alloy and be dezincification resistant. Control valves shall be:

- Loose jumper valve type with 'O' ring seals fitted to the spindle.
- Constructed of suitable materials and have suitable methods of connection.
- Fitted with unions on each side to facilitate ease of removal for maintenance.

Balancing valves shall be:

- Tagged with valve number and setting of the valve.
- Installed adjacent to a gate valve.
- Bronze construction.
- Include unions on each side to facilitate ease of removal for maintenance.

Laboratory taps shall have a universal seating action.

4.12 Thermal Insulation

Specify all scale, rust, grease and debris to be removed from pipes prior to insulating.

Thermally insulate all hot, tempered and warm water pipework including 'poly' pipes. Insulate cold water pipework exposed to the risk of condensation.

As a minimum, 25mm thick black nitrile foam is to be used in ducts, ceiling voids, roof spaces, and undercroft and carpark areas. 20mm black nitrile foam is to be used in stud walls.

Foil lining is to be used for all insulation not within walls.

Metal Sheathing is required for protection of insulation where exposed to weather and where subject to mechanical damage. Includes valves on sheathed pipework.

'Kemlag' sheathed pipework is to be used to form an insulation barrier to all hot and cold water pipework concealed in masonry wall chases.

4.13 Inground Control Valves

- For external, in-ground control valves, include a 200mm diameter PVC riser with a cast iron lid marked with the service identification letter flush with the final surface level.

- In-ground valves on water supply and fire mains and branches greater than 50mm diameter are to be resilient sealed gate valves.

4.14 Tap and Valve Heads

Vandal proof heads: If available, include vandal proof or anti-tampering devices for the designated types.

Metal heads and handles: Include brass fittings or suitably bush to prevent electrolysis and growth.

Install tapware handles, and indicators (with Lettering) in the colour noted.

Install tapware handles, and indicators (with Lettering) in the colour required by the New South Wales Health Department.

Hot Water (>43.5deg.C) - Colour – RED -Indicator Lettering – "H"

Warm Water - Colour – YELLOW-Indicator Lettering – "W"

Cold Water - Colour– BLUE-Indicator Lettering – "C"

4.15 Painting and Services Equipment

General

If exposed to view, new services and equipment including in plant rooms are to be painted, except chromium, anodised aluminum GRP, UPVC, stainless steel, non-metallic flexible materials and normally lubricated machined surfaces. Repaint proprietary items only if damaged.

4.16 Finishes

Piping

General: All exposed piping, fittings, supports, traps, Floor waste covers and Sealed Floor Waste covers (unless individual items are specified otherwise) are to be finished as follows:

In internal locations such as toilet and kitchen areas: Chrome plate copper piping to AS 1192 service condition 2, bright.

4.17 Services Trenches

Excavate for underground services, to required lines, levels and grades. Generally make the trenches straight between personnel access ways, inspection points and junctions, with vertical sides and uniform grades.

Keep trench widths to the minimum consistent with the laying and bedding of the relevant service and construction of personnel access ways and pits.

Where necessary for safe working, include shoring and timbering in the trench as the work proceeds. All shoring and timbering shall be withdrawn after installation of services.

If under road boring is required in lieu of trenches, a suitably qualified subcontractor is required.

Service trenches are to be backfilled as soon as possible after the service has been laid and bedded, if possible on the same working day. Backfill is to be in layers ≤ 150 mm thick and compact to the density which applies to the location of the trenches to minimise settlement, and so that pipes are buttressed by the trench walls.

Fill stones not greater than 25 mm occurring within 150 mm of the service, or other materials as required for particular services or locations. Well graded, inorganic, non-perishable material, maximum size 75 mm. Under roads and paved areas and within 4m of buildings: coarse sand, controlled low strength material or fine crushed rock.

In topsoil areas, complete the backfilling with topsoil for at least the top 50 mm.

In reactive clay, in sites classified M, H or E to AS 2870, impervious material where trenches fall towards footings.

Remove, including saw cutting of concrete and asphalt surfaces and/or reinstate existing surfaces removed or disturbed by trench excavations to match existing and adjacent work.

4.18 Vibration and Noise Suppression

Fix pipe risers at each floor level with brackets completely isolated from the building structure. Use 25 mm thick mineral wool molded pipe insulation faced with 450 sisalation and with a metal pipe collar between the sisalation and the pipe bracket or approved equivalent method.

Downpipes are to be acoustically isolated from the main structure by using pipe insulation or gasket rubber at fixing points.

Rainwater Pipes that are present in ceiling spaces or walls adjacent to habitable areas are to be separated from those areas by a sound attenuation system having minimum sound rating Rw + Ctr not less than 40. Lag pipes as necessary with 4.5 kg/m2 loaded vinyl insulation with foam decoupling layer and ensure minimum 70 mm air gap around pipe to face of plasterboard.

Noise associated with hot and cold water supply pipework is typically structure borne. Ensure isolation from the building structure is achieved.

Isolate pipes, fittings and fixtures from building structures, especially lightweight partitions, by means of resilient sleeves, mounts and underlayment's.

Allow for water hammer arrestors where lines connect to the building, to individual floors within the building and where appliances are equipped with quick closing valves.

Use flexible connectors to vibrating appliances such as pumps, chillers, etc.

Use resilient supports for soil and waste water pipes at floor penetrations. There should be no solid connection between soil and waste pipes and the floor slabs or walls.

Where vertical pipes are installed in ducts adjoining habitable rooms are to be insulated as per the requirements in the following paragraph.

Drainage Pipes that are present in ceiling spaces or walls adjacent to or within areas deemed to be noise sensitive by The University of Wollongong are to be separated from those areas by a sound attenuation system having minimum sound rating Rw + Ctr not less than 40. Lag pipes as necessary with 4.5 kg/m2 Loaded Vinyl insulation with foam decoupling layer and ensure minimum 70 mm air gap around pipe to face of plasterboard.

5 Water Supply Pumps

5.1 Water Supply Pumps

Use single pump units only.

Specify the pump, motor and pressure vessel package to maintain the pressure at the pump discharge between the maximum and operating pressures. Factory assemble on a steel base. Include the following.

- Control panel: Mount the control panel in a suitable position, as close to the pumps as possible. Degree of protection IP54 or better.
- Alarm bells: Mount on an external wall. Provide bells which can be muted.
- Warning lights: Mount on the control panel, to indicate the following:
    - Pump failure.
    - Supply pressure low.
    - Power on.
- Selector: Provide manual pump selector for on/off control of the pump.
- Cut-out circuit: Provide an over-riding automatic cut-out circuit with manual restart which operates when discharge pressure falls below the stated limit.
- Isolating switches: Provide a lockable isolating switch next to the pump motor.
- Overload: Provide necessary thermal overload protection.
- Voltage free BMCS interface connections to be provided in the pump control panel
    - Low discharge pressure
    - Pump faults
    - Potable water supply enabled

5.2 Hot Water Circulating Pumps

Hot water ring main systems are to include circulating pumps on the return pipelines adjacent to the hot water generation plant. Calculate system heat losses and specify appropriate duty in-line circulator pump and motor with bronze housing and stainless steel or corrosion-resistant interior fittings.

Standard: To BS EN 1151

After hours control: Specify a time clock.
Changeover: Provide an automatic changeover facility at 12 hours between pumps.

6 Sanitary Drainage Systems

6.1 General

Sanitary drainage pipework is to accept the discharge from all fixtures and outlets. Connections to sanitary fixtures shall be by jointing methods appropriate to the pipework and fixture. All WC pans shall be connected via 100mm pan collars.

The sanitary system shall extend via services corridors where available to connect to the existing sanitary drains either on site or in the street as necessary.

Where available, the sanitary plumbing services shall be installed in dedicated hydraulic services corridors throughout the building.

Use aerial drainage and single stack systems for above ground sanitary drainage installation.
If unable to utilise a single stack system in the above ground drainage design, a single stack modified system is to be used employing either relief, group and branch vents as necessary or Australian Standard approved pressure equalising valves.

Minimise the number of vent penetrations through the roof material where possible by designing vent manifolds to connect multiple vents and using Air Admittance Vents in locations allowable by AS 3500.2.

Vents are to be adequately supported where they are installed at high level above trafficable roofs. Locate vents a minimum of 6 metres from mechanical services air intakes.

Where a graded drain connection to the sites sanitary drainage connection point cannot be achieved and the University of Wollongong project manager agrees that all possible options to achieve a gravity system have been exhausted, specify a one piece pump station with integral valve chamber, a single pump, controls and ancillary items. Size, locate and vent the pump station in accordance with Australian Standard and Sydney Water requirements. Connect the pump station control panel to the University asset monitoring system.

Include an in-line macerator prior to the pump station. Ensure a suitable pit with easy access is installed to enable routine maintenance to the macerator.

6.2 Pipework Material

The standard sizes to be employed shall be 100mm and 150mm in DWV grade pipeline. Solvent Cement joins shall be constructed in accordance with AS 2032.

Note: Chemical and high temperature wastes (>60□C eg: autoclave discharge) are considered to be trade waste and are not compatible with AS 2032 approved pipelines.

6.3 Access Chamber Lids

Access chamber lids for manholes, pits and sumps installed in finished surface areas such as paved, exposed aggregate, concrete, vinyl or similar must be fitted with a lid suitable to accept the material proposed and be fitted with a brass rim flush with the nominated surface level.

Clear-outs are bolted trap screws and are to be finished flush with the finished floor/surface area. In trafficable areas nominate cast iron items. In internal areas nominate chrome-plated brass screwed items. In external areas where not subject to loading, nominate UPVC items.

6.4 Floor Waste Assemblies

Riser pipes to floor wastes are to be a minimum of 100mm diameter. Floor wastes are to be manufactured from metal and the grate is to be either.

Chrome Plated or Polished Nickel Bronze. Floor wastes for vinyl flooring areas shall be a ‘Vinyl Clamp’ type. Floor wastes located in Kitchen areas are to be fitted with a stainless steel mesh basket made specifically by the manufacturer of the floor waste. Include ‘Grate-Seal’ foaming inhibitors or approved alternative to all floor wastes.

Grated Drains located in Kitchen and bar areas are to be Stainless Steel with Wedgewire Grate and are to be fitted with a removable stainless steel mesh basket outlets made specifically by the manufacturer of the floor waste.

7.0 Trade Waste Drainage Systems

7.1 General

Where included on a project, a trade waste treatment and drainage system shall be provided for facilities such as laboratories, food preparation areas etc. as deemed necessary by Sydney Water.

The trade waste plumbing system shall extend from the trade waste drainage system through a dedicated services corridor where available. Above ground systems shall be either aerial drains or a single stack system where possible. If unable to utilise a single stack system in the above ground trade waste drain design, a single stack modified system is to be used employing relief, group and branch vents as necessary.

Vents are to be adequately supported where they are installed at high level above trafficable roofs. Locate vents a minimum of 6 metres from mechanical services air intakes.

Use only air admittance vents approved for use in chemical systems in trade waste systems.

Liaise with Sydney Water to determine the appropriate size and type of trade waste apparatus to be used for the installation. Vent all trade waste arrestors separately to atmosphere.

Determine with the user group the temperature, quantity and the chemical analysis of the trade waste discharge and specify the correct pipeline material, treatment type and apparatus size for the contaminants to be treated prior to entering the Sydney Water sewer system.

Locate trade waste treatment apparatus in locations that are easily accessible to standard liquid trade waste removal trucks carrying standard length hoses and for ongoing maintenance requirements.

Aid the University of Wollongong with registering the system on the Sydney Water ‘Wastesafe’ electronic tracking system for grease trap cleaning and liquid waste transportation and disposal.

7.2 Pipework Material

Pipes and fittings for above ground waste and ventilation systems and underground drainage shall be to Australian Standard approved requirements. Use polypropylene vulcathene or heavy duty polyethylene pipelines and fittings.

Pipework and fittings are to achieve chemical and temperature resistance to the appropriate issued manufacturers charts.

All jointing between pipes and/or fittings shall occur with an approved electro fusion jointing system in accordance with the manufacturer’s procedures and instructions. Jointing with adhesives or solvent cements is not permitted.

Provision shall be made for thermal expansion and contraction. Proprietary stress relief units are to be used to cater for expansion and contraction. Compression fittings are not acceptable.

Thermal expansion fittings shall be included in the following positions:

- In all vertical waste stacks at which fixtures are connected. They shall be fitted adjacent to and above the junction at each floor level.
- In vertical vent pipes where a branch vent is fitted.
- In graded and vertical vent pipes where the distance between fixed points is greater than 1.2m and less than 6m an expansion joint shall be fitted to the downstream end of the pipe.

When encased in concrete, waste pipes are to be sleeved in a larger diameter pipe or wrapped in ‘Abelflex’ (or equivalent material) so that the waste pipe is neither restricted nor abraded when subjected to thermal expansion movement.

All underground installations of polypropylene mechanical jointed pipes and fittings shall be surrounded by a minimum of 75mm of free running coarse sand.

All polypropylene pipes passing through floors or walls shall be protected by a minimum thickness of 15mm of suitable flexible material in the annular space and have a fire rated collar where necessary.

Identify the appropriate trade waste arrestor for the project in conjunction with Sydney Water. Indicate the arrestor in the appropriate location and vent accordingly.

8.0 Stormwater Drainage

8.1 Rainwater Harvesting Systems

The rainwater system where required includes the supply and installation of above and in-ground pipelines connecting from non-trafficable roofs via sealed downpipes and drains to the rainwater harvest tanks. Include the rainwater harvest tanks and the 'first flush apparatus prior to the tanks. The final tank locations and types are to be agreed in conjunction with the University of Wollongong and the architect. Where necessary or desirable by the University of Wollongong, include harvested rainwater pumps and controls and reticulation of rainwater pipelines to irrigation points, toilet cisterns, wash-down taps and washing machines. Connect to other fixtures, fittings and plant where directed.

Conduct calculations to determine the appropriate size of the rainwater harvest tank using the Annual Rainfall Index and the size of the roof area to be harvested. Issue to the University of Wollongong Project Officer for approval.

The rainwater harvest drainage systems shall drain to a rainwater harvest tank via sealed downpipes and in-ground pipelines. Where required and/or specified, the harvested rainwater shall be disinfected and filtered by a non-potable water treatment plant prior to re-use.

Use backflow prevention devices to separate the potable and harvested rainwater supplies in accordance with Australian Standard 3500.1 requirements.

The system is to be provided with an adequate bypass connection to the potable water supply 'back-up' for use in the event of maintenance to the water harvesting or treatment processes and during periods of dry weather. Acoustic insulation shall be provided to drainage that is reticulated within habitable spaces in buildings.

8.2 Rainwater Tanks

All above ground rainwater tanks shall be Colorbond steel tanks in a colour approved by the Project Officer following consultation with the University of Wollongong Senior Management. All tanks are to be fitted with a strainer and overflow. A level reinforced concrete slab of minimum thickness 120mm shall be used as the foundation for rainwater storage tanks.

Below ground tanks shall be purpose made tanks suitable for underground installation. Tanks shall be engineered (if necessary) by a structural engineer to confirm their capacity to withstand the forces of an underground installation. Incorporate 'anti floatation' measures where sub-surface water is possible. Extend access openings to be flush with finished surface levels and ensure all tanks are watertight.

Comply with all Workcover requirements for access and confined spaces. Lids are to be appropriate to the location where the tanks are to be installed, such as capacity to hold loadings or have landscaping or paving installed over.

Confirm tank locations are acceptable with the project Architect, the University of Wollongong Project Officer and project Structural Engineer. Take all measures necessary to install in a location devoid of existing services. Alternatively, where services exist, design the diversion of existing services around the tank.

Consideration is to be given to the potential reuse of the tank overflow (eg: direct the outlet to existing harvesting systems, ponds, irrigation systems etc.)

Water meters with pulsed outputs shall be installed on all non-potable water supplies fed from the harvesting system as determined by the University of Wollongong.

Pulsed output tank level meters shall be installed on each harvesting tank to monitor the water level in the tank as determined by the University of Wollongong.

The University of Wollongong shall be consulted to assess and approve the tanks and the non-potable supplies to be metered, the quantity and type of meters to be installed and all other metering requirements.

Refer to the preferred Rainwater reuse pumping system in the equipment schedule.

Catchment areas such as trafficable roofs and upper floor podiums may be contaminated. Discharge from these areas shall continue to ground level and connect directly to the stormwater discharge system. Runoff from these areas is only to be captured, treated and reused for irrigation purposes where directed by the University of Wollongong.

8.3 Stormwater Drainage

As a minimum 100mm DWV Grade piping shall be used. Larger sizes are to be used where determined by calculations. Pipes are to be laid to uniform gradients falling to the outlets using straight between required changes to direction. They are to be properly supported with water-tight joints aligned flush at internal surfaces and with spigot ends pointed in the direction of the flow.

All necessary fittings including junctions, branches, inspection and cleaning openings, expansion joints shall be provided.

Drainage lines shall be laid to meet Australian Standard Authorities requirements for levels and gradients. Concealed downpipes shall have a clearout at surface level in the stormwater line within 5 metres of the building.

Additional inspection openings shall be provided as required by the regulatory authority and relevant Australian Standards.

Where existing ground conditions are unsatisfactory, pipework shall be bedded on pipe bedding material of 150mm of blue metal or sand as per Australian Standards. Standard size sewer grade pipes of 100mm, 150mm and 225mm shall be used.

Jointing shall be by solvent cement or rubber rings to AS 2032. Construction shall be to AS 2032.

8.4 Pit Covers

All stormwater pit grates are to be of cast iron material. They are to be lightweight in non-vehicular traffic areas and heavy weight in areas where vehicular traffic may occur. (AS 3996)

9.0 Fire Services

9.1 Fire Hydrant Services

The fire hydrant system shall extend from the existing on-site fire service system to service an individual hydrant system for each building.

Incorporate a fire hydrant booster valve assembly at each building. Locations are to comply with AS 2419.1

In addition to obtaining a Sydney Water ‘Statement of Available Pressure’ for the campus water main supply, conduct a physical onsite fire system flow and pressure test adjacent to the proposed building to establish existing system fire flow capabilities in accordance with Australian Standard testing requirements. Utilise the results to design a system in accordance with AS 2419.1.

Where existing system water pressures are insufficient, in an Australian Standard compliant location specify a diesel fueled fire booster pump, include pump connections, associated valves, piping, exhausts, insulation, ventilation and ancillary items as necessary for a fully operational compliant installation. Include a jacking pump where necessary to achieve compliant system flows and pressures. Install storz fittings on all hydrant outlets to comply with NSW Fire Brigade requirements.

Include the installation of a pressure gauge in a visible location adjacent to the entry of the building. The gauge is to be compliant with the requirements of AS 2419.1. External Underground pipelines are to be in HDPE with electrofusion joints.

All fire hydrant flange bolts and galvanised or copper risers to be wrapped in Denso to stop corrosion.

9.2 Fire Hose Reel Services

Fire Hose Reels are to be installed in buildings as nominated in the current version of the National Construction Code.

For combined potable water/fire hose reel systems, do not design control valves to be located between the buildings water sub-meter and the fire hose reels. Include locking control valves at meters noting the installation of the fire hose reels within the building with signage to National Construction Code requirements.

Where system water pressures are unable to provide the minimum required water pressures and flows, include a single booster pump. (Dual booster pump systems are not preferred by the University of Wollongong).

9.3 Fire Sprinkler Services

The fire sprinkler system shall extend from the existing campus combined fire hydrant/fire sprinkler fire service and shall be piped through the building via a sprinkler valve set. The system is to be designed in accordance with the current applicable version of AS 2118.

If the supply service is deemed as being unsatisfactory to supply the water to Australian Standard requirements for the fire hydrant and fire sprinkler systems to operate simultaneously, design an on-site water storage system complete with Automatic Fill Valves for storage 'top-up'. Include sprinkler pumps as necessary to ensure the required system flows and pressures are met.

In multi storey buildings each floor shall have its own flow switch to activate an alarm and shall be directly wired to the main fire indicator panel. Pumps, indicators and valve tampers switches etc. shall be illuminated on the main fire panel and connected to the BMCS as appropriate.

Sprinkler heads are to be selected and specified based on the sprinkler location, the hazard being protected, The University of Wollongong Insurance requirements, National Construction Code and Australian Standard requirements, aesthetic appeal and environmental conditions.

Install jacking pumps on all buildings containing fire sprinklers.

10.0 Landscape Irrigation

10.1 Landscape Water Reticulation

Include hose taps and isolation valves for the connection of irrigation systems. Include AS3500.1 compliant backflow prevention devices to provide separation of potable and non-potable water supplies in accordance with Australian Standard requirements.

The landscape water reticulation shall utilise moisture sensored drip or sub- surface irrigation, suitably signposted as being 'non-potable' water.

Refer to the University of Wollongong 'Landscape' design standard for clarification and additional requirements.

A 'Work As Executed' plan of the landscape irrigation pipework system is to be provided to the University of Wollongong upon completion of the system installation.

10.2 Locations

All new buildings are to have a hose-cock outlet with isolation valves every 60 metres along perimeter walls or as directed by the projects landscape architect.

Refer to the University of Wollongong Landscape Design Guide for clarification of requirements.

Water meters with pulsed outputs shall be installed to monitor the supply to hose taps and other devices used for irrigation purposes. The University of Wollongong shall be consulted to assess and approve the systems to be metered, quantity of meters to be installed and all other water metering requirements.

11.0 Natural Gas Reticulation

11.1 General

The entirety of the natural gas service shall be designed in accordance with AS 5601.

The natural gas service is to include connection to the site gas supply. Determine the pressure of the natural gas main to which the supply is being connected. Design the appropriate size main regulator set and meter set for the building. Establish the correct gas inlet connection pressure for each appliance or plant item from manufacturer's information. Include second stage regulators as necessary to achieve the appropriate pressure reduction for the equipment. Liaise with all other consultants and the University of Wollongong to supply low pressure fixture supply pipelines from the meter/regulator set to all items of equipment requiring connection. Include all required safety items in accordance with AS 5601.

Gas meters with pulsed outputs shall be installed to monitor the total supply to the building and high use specialist systems and additional areas as determined by the University of Wollongong. The University of Wollongong shall be consulted to assess and approve the loads to be metered, quantity of meters to be installed and all other metering requirements.

11.2 Item Locations

Gas pipes passing through walls, floor beams and columns shall be fitted with purpose made metal or plastic sleeves with 12mm annular clearance and shall be packed fire rated sealant to AS 4072.1 where applicable.

Fittings shall be manufactured and comply with AS 5601 and AGA and ALPGA "Approved Appliances and Components".

Pressure shall be regulated by the installation of regulators manufactured AGA and ALPGA "Approval Appliances and Components" and installed to AS 5601. Regulators are to be installed at the property boundary, at the building, at each zone and at each appliance as appropriate.

Control valves shall be installed to control and cut off gas flow in accordance with AG 601. Control valves shall be manufactured in accordance with AGA and ALPGA "Approved Appliances and Components".

Gas services shall be in accordance with AS 5601 and installed by suitably qualified personnel. Where appropriate, specify nylon mains in ground. Include 'ball' type control valves.

Gas meters are to be positioned in locations to ensure protection from physical damage, compliant ventilation and to be readily accessible for maintenance, manual meter reading and emergency access.

Assess the projects overall design risk in conjunction with the design team and the University of Wollongong Project Officer.

Include a solenoid valve on the main building supply pipeline to enable the entirety of the building supply to be isolated via a 'panic' button installation arrangement within the building. Liaise with the project Electrical engineer to facilitate this operation. Interface the solenoid valve with the F.I.P. if required by the relevant codes and standards. Locate the 'panic button' in conjunction with The University of Wollongong Project Officer.

Flues shall be included as follows:

- Coordinated with the project Architect to ensure aesthetically acceptable.
- Suitable dual skin stainless steel flues shall be fitted to individual appliances when available.
- Flues shall comply with AS 5601.
- Terminate flues individually through the roof fabric or wall face with approved cowls. Fan forced flues may discharge horizontally through the building external walls where approved by the University of Wollongong project officer and project architect.
- Flue sections exposed externally (including the cowl) shall be in 316 stainless steel

12.0 Emergency Eyewash And Shower Systems

12.1 General

Emergency eyewash and shower systems are to be independently supplied from the outlet of the building meter assembly via a dedicated pipework system to each required eyewash and/or shower. The control valves at both the meter and at the system branch pipe are to be locked open and labelled with permanent 'non-fade' tags noting 'Emergency Eyewash and Shower System – Do Not Isolate.'

The entire system including required flows and pressures at emergency eye wash and shower outlets is to comply with AS 4775 – Emergency Eyewash and Shower Equipment.

13.0 Equipment

13.1 General

All plant equipment, fixtures and tapware proposed for the project are to be listed and issued to the University of Wollongong for review prior to specifying or installation.

13.2 Environmental & Sustainability

The material used for the system shall be environmentally considerate such as polybutylene, polypropylene or cross-linked polyethylene.

13.3 Fixtures and Tapware Unlikely to be accepted

Cube Electronic Urinal Series
Any sensor flush Urinals where the sensor is in the pan
Any waterless Urinals
Schell Petit Timed Flow tapware
Broen Thermostatic Mixing Valves

13.4 Fixtures and Tapware Likely to be accepted

Zip FlushMaster Standard WS003
Caroma Torres Wall Hung Urinal
Caroma Invisi Series Toilet Suite
Enware Aquablend 1500 Thermostatic Mixing Valves
Thornthwaite Rada 215bk

13.5 Manufacturers Likely to be accepted (Depending on the item)

Enware
Caroma
Hansa
Zip

13.6 Pipe type Unlikely to be accepted

Rubber ring joint type pipes including 'Blue Brute'.

13.7 Warranty

The designer shall ensure that all components are supplied with the following minimum warranty periods:

System/Equipment	Warranty Period
Piping	5 Years
Electronic Tapware	12 Months
Manual Tapware	5 Years
Basins	2 Years
Instant Boiling Water Units	12 Months
Instant Chilled Water Units	12 Months
Showers	5 Years
Cisterns/Pans	2 Years
Valves & Flow Restrictors	5 Years

14.0 Standards

The design shall comply with the latest versions of all relevant codes and standards in force at the time of specification. Where the designer considers a standard to be inappropriate to the circumstances, the designer shall advise the principal and seek direction. Table 1 below contains a list of the relevant codes and standards.

Issuing Body	Document Number	Title
Standards Australia	AS MP78	Manual for the assessment of risks of plumbing products
Standards Australia	AS 1172	Water closets
Standards Australia	AS 1260	PVC-U pipes and fittings for drain, waste and vent application
Standards Australia	AS 1271	Safety valves, other valves, liquid level gauges and other fittings for boilers and unfired pressure vessels
Standards Australia	AS 1357.1	Valves primarily for use in heated water systems
Standards Australia	AS 1428	Design for access and mobility
Standards Australia	AS 1432	Copper tubes for plumbing, gas fitting and draining applications
Standards Australia	AS 1628	Water supply - Copper alloy gate, globe and non-return valves
Standards Australia	AS 1851.2	Maintenance of fire protection equipment - Fire hose reels
Standards Australia	AS 1851.3	Maintenance of fire protection equipment - Automatic fire sprinkler systems
Standards Australia	AS 1851.4-1	Maintenance of fire protection equipment - Fire hydrant installations
Standards Australia	AS 2032	Code of practice for installation of UPVC pipe systems
Standards Australia	AS 2118	Automatic fire sprinkler systems
Standards Australia	AS 2129	Flanges for pipes, valves and fittings
Standards Australia	AS2419.1	Installation of fire hydrant systems
Standards Australia	AS 2941	Fire hydrant pump sets
Standards Australia	AS/NZS 1221	Fire hose reels
Standards Australia	AS 2441	Installation of fire hose reels
Standards Australia	AS/NZS 2845	Water supply - Backflow prevention devices

Issuing Body	Document Number	Title
Standards Australia	AS 1056	Storage water heaters
Standards Australia	AS/NZS 3350.2.35	Instantaneous water heaters
Standards Australia	AS 3500	Plumbing and drainage (set)
Standards Australia	AS/NZS 3662	Water supply - Water efficient mains pressure shower spray heads
Standards Australia	AS/NZS 3666	Air handling and water systems of buildings - Microbial control
Standards Australia	AS 3688	Water supply - Copper and copper alloy body compression and capillary fittings and threaded-end connectors
Standards Australia	AS/NZS 3718	Water supply - Tapware
Standards Australia	AS/NZS 3982	Urinals
Standards Australia	AS 4032	Water supply - Valves for the control of hot water supply temperatures
Standards Australia	AS 4130	Polyethylene (PE) pipes for pressure applications
Standards Australia	AS 4775	Emergency Eyewash and Shower Equipment
Standards Australia	AS/NZS 4936	Air admittance valves (AAVs) for use in sanitary plumbing and drainage systems
Standards Australia	AS 5200	Technical specifications for plumbing and drainage products
Standards Australia	AS/NZS 6400	Water efficient products - Rating and labelling
Standards Australia	AS RUL PL	Rulings to plumbing and piping systems standards (Ruling to AS 3500 set)
THE UNIVERSITY OF WOLLONGONG	OHS064.9	WHS Consideration for Design http://staff.The University of Wollongong.edu.au/content/groups/public/@web/@ohs/documents/doc/The University of Wollongong017017.pdf

Table 1 - Codes and Standards

14.1 Minimum Performance Standards

The minimum performance standards as outlined in the documents specified in Section 9.1 and 9.2 shall apply. In addition, the services shall be designed to meet or exceed the following:

<table>
<tr><th>Functions</th><th>Performance Requirement</th></tr>
<tr><td>Hydrant Design Rates</td><td>Minimum of 250kPa at all hydrant outlets (700 kPa for pumped systems). Where new hydrants are added, the effect on all hydrants in the system shall be checked.</td></tr>
<tr><td>Hose Reel Design Rates</td><td>Minimum 19.8 litres/min at 210 kPa at the nozzle of each fire hose reel.</td></tr>
<tr><td rowspan="3">Type of Backflow Protection</td><td>Individual Backflow Protection: Protection provided at the water connection to a fixture or appliance.</td></tr>
<tr><td>Zone backflow Protection: Protection provided at the connection to specified sections of a plumbing system within a building or facility.</td></tr>
<tr><td>Containment Backflow Protection: Protection provided in the property service connection to the property boundary.</td></tr>
<tr><td>Hot Water Reticulation Insulation</td><td>Insulate with expanded PVC black nitrile foam in sleeve form. Branch Lines
– 13mm wall thickness minimum
Main Flow and Return Lines – 25mm wall thickness minimum</td></tr>
<tr><td>Copper Tubing</td><td>Minimum AS1432 Type B pipe thickness/construction</td></tr>
<tr><td>Polyethylene Pipe</td><td>Minimum SDR 17 for pressurised applications Minimum SDR
26 for non-pressurised applications</td></tr>
<tr><td rowspan="2">Pipe Supports</td><td>
<table>
<tr><th>Pipe</th><th colspan="2">Horizontal or Vertical Pipe</th><th colspan="2">Graded Pipe Material</th></tr>
<tr><th></th><th>Internal</th><th>External</th><th>Internal</th><th>External</th></tr>
<tr><td>Copper</td><td>1.8m</td><td>0.9m</td><td>1.8m</td><td>1.8m</td></tr>
<tr><td>UPVC 40-50mm</td><td>1.0m</td><td>1.0m</td><td>2.0m</td><td>2.0m</td></tr>
<tr><td>UPVC 65-150mm</td><td>1.2m</td><td>1.2m</td><td>2.5m</td><td>2.5m</td></tr>
</table>
</td></tr>
<tr><td>Insulated Pipe: Support by the pipe directly and/or by using timber ferrules, not by the insulation.</td></tr>
<tr><td>Faucets, Cocks and Outlets</td><td>Water Supply – Copper Alloy Screw-Down Pattern Taps
Dimensions, dezincification resistant copper alloy, pressure tested to 20 MPa chrome plated on brass finish with vandal proof or anti-tampering devices.</td></tr>
<tr><td>Water Conservation Measures</td><td>Dual flush toilet cisterns to water closets.
Push button taps.
Ceiling recessed infrared urinal flushing systems.
Faucet flow aerators.
Water efficient showerheads.</td></tr>
<tr><td>Fixture Outlet Flow Rate Requirements</td><td>Basins WELS 4 Star (minimum) Sinks
WELS 4 Star (minimum) Showers
WELS 3 Star (minimum)</td></tr>
<tr><td>Water metering</td><td>All buildings, separate floors and major plant items are to have individual potable and non-potable, pulse output water meters installed with the capability to provide series consumption data for toilets, showers, irrigation, cooling towers, blackwater and grey water re-use etc.</td></tr>
</table>

Functions	Performance Requirement
Gas metering	All buildings and space heating equipment total are to be fitted with gas meters, complete with pulsed outputs to provide series data for gas consumption.

Table 2 – Additional Performance Standards

The hydraulic systems shall be designed to achieve the following service lives:

System	Lifetime
Pipework	50 years minimum
Valves	20 years minimum
Fixtures including taps, basins, pans and urinals	15 years minimum

Table 3 – Minimum Lifetime