

SECTION 30

ENGINEERING DESIGN REQUIREMENTS

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Version	Date	Authors	Summary of Changes
V1	02/07/18	Manager, Infrastructure Services	Removed from other sections and developed this section as part of the 2018 general review update

30.0 ENGINEERING DESIGN REQUIREMENTS

This document is a section of the James Cook University (JCU) Design Guidelines and is not to be read in isolation. Consultants and Contractors are required to comply with all sections of the JCU Design Guidelines.

This section is intended to reference the common basis for all engineering designs, however, the consultant shall remain responsible / liable for ensuring satisfactory performance of all works necessary for the complete installation and successful operation.

JCU owns, operates and maintains all infrastructure, services and all academic buildings on and within the Australian campuses. The RPEQ consulting engineer shall take a long term (whole of life) investment and maintenance decision strategy when designing the systems.

30.1 Approvals Required during Design

Approval shall be obtained from the JCU Estate Directorate, Deputy Director, Planning and Development in SD for the:

- Any changes to, or deviations from the requirements of these Design Guidelines except where specifically noted in each section.

30.2 Site Infrastructure Connection Approvals

The Manager, Infrastructure Services shall approve all connections to existing infrastructure, specific requirements are listed in each engineering/service section – xx.1.2. where xx designated the section number for each engineering discipline.

30.3 Non-Conformance Approvals

All project team members (for example Consultants, D&C Contractors, Principal Consultants, Internal/External project managers, subcontractors etc.) are responsible for delivering the project in accordance with the project brief, these guidelines, user group information and other contractual documents.

Where there are sound engineering reasons to deviate from these documents, a written non-conformance request is to be submitted to the Deputy Director – Planning and Development via the JCU Project Manager.

This could apply when the project involves aspects, scope, technologies, locations or other applications that are not specifically briefed or covered by the Design Guidelines, the non-conformance request will include clear information on:

- Technical Aspect that is not covered
- A range of options to address the issue
- Time and costs implications for each option
- Effect of the aspect on the design and on other trades
- Effects on users, maintenance, access, life of plant, energy efficiency, cost
- Effects on future re-allocation of the space / system etc.

- Recommended solution to the issue

A Non-Conformance register is to be maintained by the Principal Consultant and the details of each request plus the outcome are to be recorded.

30.4 Design Approvals

Irrespective of directions received from JCU, the Principal Consultant remains fully responsible for the design solution developed.

All engineering designs done for and on behalf of JCU require RPEQ certification, unless approved by the Manager, Infrastructure Services.

Form 15 Design Certification is to be obtained.

30.5 Schematic Design (SD) Report / Design Review

The Schematic Design (SD) report will give a high level understanding of the requirements for the project by setting up the high level design philosophy and providing JCU with comfort that the risk elements have been identified and understood – and that options have been developed, assessed and optimised ready for the detail design phase.

30.5.1 Report Content

- The drawing numbers and revisions the SD report is based upon e.g. Architectural, As Installed drawings etc.
- The applicable engineering scope of works for the project including design philosophy,
- Plans and sections of the building showing locations and dimensions of plantrooms, service risers/routes and cabinets, etc.
- Any changes to the design team from the tender submission, including CV's
- Details of coordination that has been undertaken with stakeholders, sub-consultants and other consultants
- Any Calculation Sheets
- List of Ecological Sustainable Development (ESD) opportunities as per Section 22 of these design guidelines
- Non-Conformance Register listing any deviations from Legislation, Standards, Codes, Guidelines or Project Brief.
- List of Assumptions, Boundaries (battery limits or tie-in points) and Specific Exclusions
- Proposed Drawing Register and Deliverables List
- Layout drawings showing any interfaces with existing services and structures including proposed services corridor/trenches.
- Investment Decision Report including Cost (Capex and Opex) and Schedule estimates, Lifecycle costs and indicating any areas of risk to the project delivery. This document to be resubmitted

based on feedback from the SD review and approved by the JCU Deputy Director – Planning and Development prior to commencement of Detailed Design.

- Outcomes and recommendations for safety in design, and design risk assessment workshops particularly responding to (or addressing) design elements which will limit liability
- List of proposed design development activities/milestone schedule and deliverables
- Additional as required in each engineering discipline section.

30.5.2 Submission Format

This information is to be submitted to the JCU Project Manager as an A4 colour PDF file with A3 drawing attachments, in hard and electronic format. The Consultant may be requested to deliver a presentation (in person or via VC) to JCU stakeholders and decision makers.

30.5.3 Design Review

Submit SD drawings / report and non-conformance register to JCU's Project Manager in full size hard copies (1) and on CD for a full design review in accordance with the project schedule, allow a minimum of 2 weeks for design review.

Inform the JCU's Project Manager as soon as possible if the drawings are going to be delayed for any reason.

Following receipt of the design review comments from JCU, respond formally with

- Acknowledgement that changes will be actioned, and
- List any areas where the design review comments require additional discussion and proposed manner of resolution.

30.6 Developed Design (DD) Report / Design Review

The DD report will provide the details of the accepted design option and design approaches. In addition to the updated documentation requested at SD, the following will be provided:

30.6.1 Report Content

- Full return brief for the applicable engineering discipline/service
- The drawing numbers and revisions the DD report is based upon e.g. Architectural, As Installed drawings etc.
- Provide detailed information of all existing site services, their re-use, refurbishment, relocation or removal
- Detail on existing site infrastructure and services locations with proposed connections for this project, HV network, CDC system, etc. including loads and consumptions as appropriate.
- Detail on any central plant being provided
- Detail on design approach for each type of system / area etc.
- Detail on special measures for spaces with additional requirements (eg PC2, PC3, laboratories etc)

- On each occasion where options were investigated, give reasons or supporting information for design choices,
- ESD Opportunities Register as per Section 22 of these design guidelines
- Updated Non-Conformance Register listing any deviations from codes, standards, legislation, guidelines or project brief.
- Updated Assumptions, Boundaries (battery limits or tie-in points) and Specific Exclusions
- Detailed Equipment List with sizes/specifications
- Detailed equipment layouts including dimensions for all access doors/hatches and showing provision to remove/maintain all items in excess of 50kg.
- Drawing Register and Deliverables list
- Updated and finalised Investment Decision Report including Cost (Capex and Opex) and Schedule estimates, Lifecycle costs and indicating any areas of risk to the project delivery. This document to be resubmitted based on feedback from the DD review and approved by the JCU Deputy Director – Planning and Development prior to commencement of Construction.
- Updated outcomes and recommendations for safety in design, and design risk assessment workshops particularly responding to (or addressing) design elements which will limit liability under mould issues in HVAC systems, temperature control and upper limit humidity control
- Risk Matrix for design methodology (i.e. n+1 where necessary)
- Areas of risk to the project during construction and commissioning
- List of construction activities/milestone schedule and deliverables, including construction and commissioning hold point/inspection/witness/approvals
- Finalised recommendations for preventative maintenance and list of critical spares on proposed equipment
- Additional as required in each engineering discipline section.

The consultant is required to acknowledge that changes requested in the design review process will be actioned, or to list any areas where the design review comments require additional discussion plus propose the manner of resolution.

30.6.2 Submission Format

This information is to be submitted to the JCU Project Manager as an A4 colour PDF file with A3 drawing attachments, in hard and electronic format. The Consultant may be requested to deliver a presentation (in person or via VC) to JCU stakeholders and decision makers.

30.6.3 Design Review

Submit DD drawings / report and non-conformance register to JCU's Project Manager in full size hard copies (1) and on CD for a full design review in accordance with the project schedule, allow a minimum of 2 weeks for design review.

Inform the JCU's Project Manager as soon as possible if the drawings are going to be delayed for any reason.

Following receipt of the design review comments from JCU, respond formally with

- Acknowledgement that changes will be actioned, and
- List any areas where the design review comments require additional discussion and proposed manner of resolution.

30.6.4 Developed Design JCU RPEQ Certification Schedule

The table in each engineering discipline section shall be completed by the DD Design Engineer, and submitted for confirmation.

30.7 Construction Contract Document Requirements

30.7.1 Specification Requirements

A concise, project specific specification shall be produced for each engineering discipline that

- Clearly identifies the scope of works
- Clearly identifies the project nature
- Clearly identifies Interfaces with other disciplines
- Calls into effect the requirements of these guidelines
- Does not contain excessive or spurious references to unrelated projects or unrequired works.
- Includes all performance requirements
- Requires relevant price breakup information from the contractor
- Requires contractor confirmation of equipment, scope, documentation etc.
- Calls up required service, maintenance details etc. in an acceptable Operating and Maintenance Manual format complete with preventative maintenance schedules.

30.7.2 Drawing and Documentation requirements

Both Issued for Tender (IFT) and Issued for Construction (IFC) drawing and documentation will be required.

Drawings shall conform to Section 34 of JCU's Design Guidelines. Use JCU Title block and include JCU Drawing Number (obtain from JCU Drawing register).

30.7.3 Number of Copies

Unless briefed / agreed otherwise, the contract documents shall be provided in electronic (.pdf and native) format.

30.7.4 Contract Document JCU RPEQ Certification Schedule

The table in each engineering discipline section shall be updated by the CD Design Engineer and submitted for confirmation.

30.8 Commissioning and Handover Requirements

Requirements for commissioning are contained in each engineering discipline section.

Following commissioning, undertake a witness inspection of the operation. Ensure that the Consulting Engineer and JCU Manager, Asset Strategy and Maintenance and/or JCU Manager, Infrastructure Services (or representative) are present.

Specific requirements are contained in each engineering discipline section

Should re-inspection be required, the cost of consultants reinspections will be deleted from the contract sum.

30.8.1 Records to be provided

Minimum 2 weeks prior to practical completion provide

- All commissioning data as finalised
- Defects lists signed out and complete
- Additional requirements contained in each engineering discipline section

30.8.2 Defects Liability

Unless otherwise stated in JCU Conditions of Contract, the Defects Liability period shall be a minimum of 12 months from the date of Practical completion or acceptance of the systems by the Manager, Asset Strategy and Maintenance or representative. The Manager, Asset Strategy and Maintenance may require longer periods of warranty for key/critical equipment and this should be tested on a project specific basis.

During this period the contractor must attend to and rectify all faults, defects etc. at their cost including all parts, labour, commissioning and associated costs. Should an item repeatedly fail during this period, JCU may require warranty in relation to that item to apply from the date of latest repair / replacement.

30.8.3 Maintenance Requirements

All construction/ installation contracts shall allow for the performance of regular preventive maintenance of the works during the period of the defects liability period inclusive of all consumables (filters, oils, v-belts, etc.).

Such maintenance shall be in accordance with the manufacturer's instructions and the requirements of the Work Health and Safety Act, Standards or other applicable regulations, legislation, or codes of practice.

Maintenance records to be forwarded to JCU's Manager, Asset Strategy and Maintenance or Cairns Operations Manager (as appropriate) within 5 days of completion of maintenance.

30.8.4 Operating and Maintenance Manuals

Operating and maintenance manuals must be issued as Preliminary documents prior to Practical Completion. Any amendments must be made and final manuals issued within three weeks of Practical completion. Manuals must include as a minimum:

Specific requirements are contained in each engineering discipline section

Consultants shall provide a statement that maintenance manuals and as constructed drawings are correct to the best of their knowledge.

All lists shall be in a searchable format such as Excel.

Manuals must include as a minimum:

- Concise English description of the installation as a whole
- Concise English description of the each system
- Equipment list for all equipment and systems. This is to be in Excel spreadsheet and is to include the installed location of the equipment
- A minor assets list.
- A major assets list
- Supplier / Support list for all equipment
- Manufacturer's Literature for all equipment
- List of recommended critical spares
- List of Contractors and Subcontractors
- List of As-Constructed drawings
- All finalised commissioning data
- Form 16
- Recommended Service and Maintenance procedures
- Service and Maintenance Schedule
- Fault finding and reporting procedures
- Emergency Contacts for afterhours callouts and service during the defects period
- Defects lists signed out and complete, and warranties

Provide ONE hard copy of all manuals and "As Constructed" drawings plus electronic (.pdf and native) copies of all documents and drawings.

30.9 Design for project and future

A holistic approach shall be taken to any new or refurbishment design and the effect on the existing campus services and buildings shall be well understood.

All designs must consider how the project specific requirements and any additional areas served by systems serving the project areas (distributor/local road network, chilled water branches, stormwater discharges, etc.) will impact on the existing services, possible future fitouts / reworking of the project area, and future expansion such as master plan items, items advised etc. These impacts are to be clearly articulated in the design documentation.

Generally allow for 10-20% expansion in load within the infrastructure serving major projects, stand alone buildings and the like. This expansion capability must be provided in:

- Drinking and non-drinking water pipe mains and main branches (typically with additional blanked valves at strategic locations)
- Pumps
- Control panels (generally provide spare space for an additional 10% controls or 1 whole controller – whichever is greater, including fire panels)
- Riser spaces – pay particular attention to both space and accessibility. Minimise risk where necessary by providing spare ducts etc.
- Specialist infrastructure should be considered on a case by case basis e.g. RO water.

30.10 Design for Tropical Areas

JCU's campuses are located in a tropical environment. Particular care is required to ensure necessary measures are taken to prevent the formation of condensate on external or internal surfaces such as air conditioning units, pipework, ductwork, registers, ceilings, walls, windows etc. The design must specifically deter the growth of mould.

For this reason, the internal humidity levels within the building shall not exceed 70% under any circumstance with upper limit control of 65% RH.

30.11 Design for Cyclone Prone Areas

JCU's campuses are located in a cyclone prone environment. Particular care is required to ensure necessary measures are taken to ensure that all plant, equipment etc. (particularly external plant) is securely fixed, of suitably rated cyclone area construction and constructed in a manner to withstand such events.

30.12 Corrosion Prevention and Protection

JCU campuses are generally located in coastal areas. The prevention of corrosion must be considered in the design. Plant should be located under cover in conditioned plantrooms. Exposed plant should be avoided (except external condensing units, chillers and the like where included in the design).

External exhausts etc. should be constructed of non-corroding elements (PVC / Stainless steel etc.). Fixings should be stainless steel. Dissimilar metals should be electrically separated.

Pay particular attention to elements such as switchboards, control panels etc. which should be stainless steel where exposed to weather.

Identify additional service recommendations to mitigate or minimise corrosion where the particulars of the installation may produce corrosion in the installation.

30.13 Design for Maintenance

Where roof areas must be accessed for maintenance, suitable stairs, walkways, railings, fall protection measures etc. are to be provided. Take reasonable steps to minimise the amount of equipment etc. requiring servicing from roof areas. Roof mounted supply and exhaust fans are not permitted.

Ductwork inspection and cleaning must be facilitated through suitable location of services and careful co-ordination with other services and building elements. All ductwork shall be externally insulated to allow for easy cleaning and reduce the risk of mould and dirt build-ups.. Sisalation facing for internally insulated duct is not acceptable. Acoustic measures must therefore be addressed in design.

Internal insulation for supply ductwork in ceiling spaces is not permitted unless approved by the Deputy Director – Planning and Development.

Ongoing service and maintenance must be facilitated in the installation. Measures at least will provide minimum service access spaces, easily workable arrangements, clear unencumbered walkways of minimum 1,200mm.

In all cases mandatory clear access for electrical switchboards and the like is to be provided.

30.14 Locating Existing Services

All existing services for the project shall be identified and confirmed onsite in accordance with the requirements identified through JCU's Permit to Work system available on the JCU Website. Depending on the risk assessment outcome, once the permit has been issued - for any excavation in excess of 200mm - the services will need to be positively located through either potholing or GPR prior to any mechanical excavation.

30.15 Arrangement of Services

Take particular care with arrangement of in-ground and above ground service routes and ensure full co-ordination of the project services within the building envelope and with existing services. A particular requirement is the separation of mechanical services from electrical services. Ensure any mechanical plant which can cause condensation or water damage is not located above or in the same riser as the electrical services.

30.16 Services Trench

The design shall provide for the connection to existing infrastructure services. Co-ordination with stormwater drainage systems, potable water, fire water, non-drinking (irrigation/recycled) water, waste water, chilled water, electrical, communications, and mechanical services will be required to ensure that where ever possible common trenching of services is achieved.

All in ground services shall have traceable identification tape installed above the service as detailed in each engineering service section. All in ground services shall be co-ordinated and common trenched where possible. All in ground services shall be designed to suit the soil conditions as described by the geotechnical engineer.

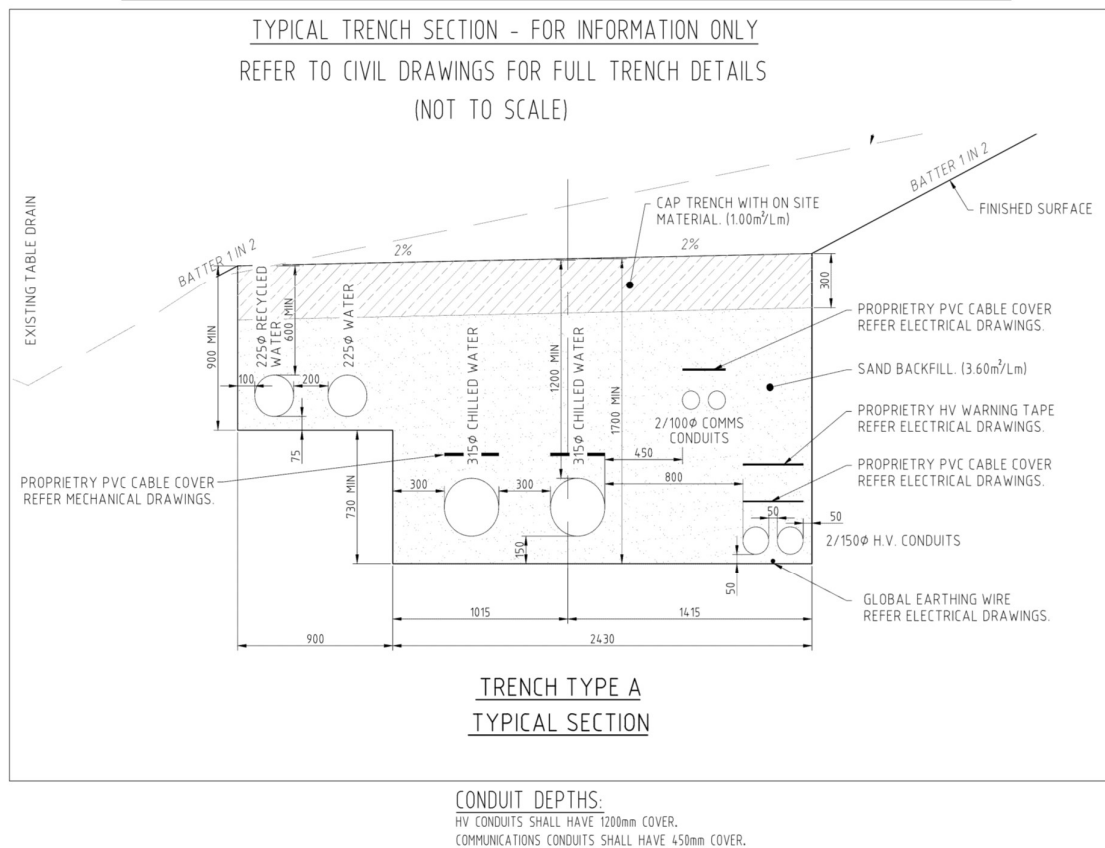
Services shall be identified by laying continuous PVC marker tape on the sand bed 300mm above the pipe. The marker tape shall be colour coded, magnetic and be printed with the identification of the contents of the pipe and/or conduits and direction of flow. Provide brass engraved markers cast into any hard landscaping or cast into concrete markers, as approved by the Manager, Infrastructure Services.

Provide identification of all pipes in accordance with AS 1345 for the Identification of Piping, Conduits and Ducts and AS 1318, Industrial Accident Prevention Signs.

"Safetyman" adhesive labels are an acceptable method. Provide flow direction arrows to all pipework at regular intervals (not exceeding 5m and at all connections)

All externally exposed pipework shall be fully painted in accordance with JCU's Colour Schedule, and colour standards shall be in accordance with AS2700.

Refer typical JCU common services trench detail below.



30.17 Safety in Design

Safety in design must be incorporated into the design of all new plant, buildings etc. In addition to legislated and briefed requirements, work closely with JCU Project Manager and keep the Deputy Director – Planning and Development, Manager, Infrastructure Services and Manager, Asset Strategy and Maintenance fully informed of installation, service and maintenance and access requirements.

Particular care must be taken to ensure that safe installation and service is inherent in the design. Generally any requirement for the use of Personal Protective Equipment (PPE) or protective measures (fall restraint systems etc.) should be avoided by design.

30.18 Heat Recovery / Energy Efficiency

JCU is committed to both minimising life costs of ownership and being environmentally responsible. Areas with high fresh air requirements (due to occupancy, operation, etc.) should be provided with enthalpy recovery from relief air. Similarly in areas requiring large exhaust of conditioned air, energy recovery from such exhaust is desirable.

CO₂ control of outdoor air ventilation rates can be utilised in conjunction with energy reduction strategies if room pressurisation is a key driver.

Under all ventilation demand strategies, the building shall remain under a positive pressure.

Systems shall be designed so that fans, pumps etc. are operating against modest pressures, whilst maintaining economy of installation (e.g. pipes are not excessively oversized etc.)

30.19 AQIS / OGTR / Authorities

Where AQIS / OGTR / Federal Drug Administration or other requirements apply, the designer must fully address these requirements, and provide all information to allow JCU to inform these bodies and pass certification.

30.20 Noise & Vibration Control

Design the Hydraulic systems to eliminate transmission of noise and vibration from hydraulic equipment to the building structure, spaces and users.

Reciprocating or rotating equipment shall be isolated from structure and other systems by vibration isolators. Where necessary seismic restraint type shall be used.

Pipework shall not be rigidly mounted to building structure. Ensure that hangers are arranged to accommodate thermal expansion, transient loads and conditions whilst maintaining isolation.

Penetrations shall incorporate sealing methods (whether they be acoustically rated, fire rated, weather rated etc) that do not provide a vibration bridge from services to structure.

30.21 Design Sound Levels for Spaces

Ensure noise levels comply with the requirements of Section 18 of these Design Guidelines, specifically Table 18.1.

All pipework shall be isolated from spring-mounted equipment by flexible pipework with a flexibility to match the deflection of the equipment spring mountings. Expansion and vibration in pipework shall be taken up by appropriately designed and approved changes of direction or expansion loops.

Take particular care to avoid tonal components, whistles, rattles etc. Avoid intrusive noises such as machinery start and stop characteristics. Generally allow VSD or soft starting.

30.22 Insulation

In all cases pipe insulation is to comply with the requirements of the NCC latest edition Section J for thermal properties for the relevant climate zone.

30.23 Plant Rooms and Equipment Locations

Generally plantrooms and the like shall not be located immediately bordering noise sensitive spaces (e.g. plant room backing on conference rooms and the like). Wherever possible, plant-rooms shall be stacked above one another in multistorey buildings. The below are the minimum requirements:

- Service Access to be shown
- Plant room drawings must include service clearance zones, travel paths for maintenance and the like.
- Provision for expansion
- Provision for cleaning and maintenance
- Plant room lighting. For building with essential power all plantroom light shall be connect to this supply.
- External Plant Deck lighting

30.24 Interfaces with BMS

Allow for in the design all required interfaces from hydraulic equipment & control panels to JCU's BMS, as specified in JCU Design Guideline Section 23. This includes but not restricted to:

- All Water Meters
- External building and street lighting for control by the sitewide time schedule and PE cell, where available.
- Pumps – signals for pump run/stop, pump fail & high/low level alarms
- Gas – signals from gas control panels for gas on/off & emergency shut down

30.25 Metering

Water metering will be provided to all new buildings or to buildings undergoing refurbishment or extensions. The meters shall be an electric digital full flow meter and be capable to be connected to JCU's BMS as per JCU Design Guideline Section 23.

Sub-meters will be provided for the following:

- All tenancies
- Inlet supply and discharge of cooling towers
- Irrigation systems
- Rain water pump outlets connected to fixtures
- Inlet supply and outlet supplies to water polishing plant i.e. Reverse Osmosis
- Trade Waste Discharge

30.26 Roof & Roof Access

A safe permanent means of access to the roof shall be provided and shall fall under the Architectural design. This would include safety hook on points and safety guide wires for use during maintenance of the roof and roof drainage systems. The preferred pitch of the roof is 5-7 degrees. If any of these items have not been addressed in the Architectural design the hydraulic engineer shall bring this to the attention of the Deputy Director – Planning and Development at time of SD and confirmed at each milestone.

30.27 Identification of Equipment / Services

Confirm the plant numbering sequence with JCU Deputy Director – Planning and Development prior to Contract Documentation. Prefix equipment with building number.

Equipment Labels shall be 3 layer laminated plastic coloured to Australian standards fixed by stainless steel screws (approved adhesive fixings may be used to plastic accessories). Labels shall be sized to suite the importance and application and must be uniform for similar items. Minimum letter size is to be 3mm and 0.3mm line thickness.

Labelling shall be provided to all items to give clear indication of direction of flow and service purpose. Labels shall be colour coded to comply with AS1318.

Underground pipe work shall have traceable warning tape placed 75mm above the pipework, colour coded, magnetic and be printed with the identification of the contents of the pipe and/or conduits and direction of flow. Warning tape is to be manufactured from polypropylene with 316 stainless steel trace wire imbedded to enable location detection complying with AS2648. The width of the marking tape shall be equal to the diameter of pipe it is protecting up to 400mm.

Above ground pipework identification shall be in accordance with AS1345 to identify piping, conduit and ducts.