



# **Facilities Management Planning and Design Section**

## **PROJECT MANAGEMENT and DESIGN AND INSTALLATION STANDARDS MANUAL**

Section E Hydraulic Services Guidelines

Updated December 2007

**THE UNIVERSITY OF WESTERN AUSTRALIA  
PROJECT MANAGEMENT AND DESIGN GUIDELINES HANDBOOK  
SECTION E. HYDRAULIC SERVICES GUIDELINES**

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- E6** Details of Hydraulic Pits

## **SECTION E: HYDRAULIC SERVICES**

### **1.0 INTRODUCTION**

#### **1.1 Design Standards**

The design standards in the following section are provided to assist contractors, staff and consultants. These standards are to be applied with coordination of all other UWA handbooks, manuals and policies. Generally, the relevant Australian standards are to be complied with as a minimum unless the University requires that a higher standard be met. Any variations to the requirements are to be discussed, approved and authorised by the Senior Hydraulic Services Officer. Failure to consult appropriate managers and to obtain approval before work commences may result in costly rectification by others. All designs shall incorporate the users' requirements with approval of the Superintendent and UWA's Senior Technical Officer Hydraulics.

This is an ongoing working document which is subject to variation. It is the responsibility of the consultants, tenderers contractors and manufacturers to obtain latest edition which are available on request or via the University of Western Australia's web site.

Design and installations are to be provided for a projected 25 year life expectancy unless otherwise directed or approved.

#### **1.2 The University as Long-Term Owner**

The University has a vital interest in the quality of its built environment. The quantitative measure of this is life cycle costing which should be minimised as far as possible. The qualitative terms build ability and maintainability are equally relevant. What we build today we expect to live with for a long time.

The "as constructed" project must conform with established University building standards and represent the best possible value for money consistent with planning and financial restraints. It must also be easy to maintain, energy-efficient, easy to clean and environmentally and aesthetically acceptable, both internally and externally. It must also be buildable and the final form must be flexible enough to allow ready and inexpensive alterations.

Finally, to the maximum extent possible the end result must satisfy the user's requirements as detailed in the brief.

#### **1.3 Tenders and Quotations**

All tenders and quotations are to allow for any errors or omissions that may become evident where the intent has been implied.

Refer to 1.3.1.

Tenders and/or quotations that exclude any part of the documentation or intended scope of work shall be deemed to be non-compliant.

### **1.3.1 Regulations**

All plumbing work including but not limited to sanitary plumbing, industrial waste systems, property sewers, water supply and fire services and stormwater drainage shall be carried out in accordance with the Water Corporation Plumbing By-laws including all of the Authority's amendments to same and to the regulations of the Local Authority, FESA, The Building Code of Australia and to the satisfaction of the Superintendent.

All natural gas services work shall be carried out by an authorised installer possessing a current certificate of competency issued by AlintaGas and suitably endorsed in the relevant classes of work for this project.

All plumbing work, fire services and rainwater pipes and stormwater drainage shall be carried out by the skilled registered operatives under a currently fully licensed plumber, by the Water Corporation.

The Contractor shall provide and install everything necessary to comply with the relevant Authority By-Laws requirements and or conditions even though such requirements may not be shown on the Drawings or specifically mentioned herein.

### **1.3.2 Installation Requirements**

All installations are to include for any errors or omissions that may become evident where the intent has been implied. Installation shall include everything necessary to complete the project in accordance with documents, specific requirements of the UWA and UWA manuals/handbooks. Installation shall include all coordination related matters, authorities and other associated fees.

### **1.3.3 Supervision and Inspection of Works**

Provide a plumbing supervisor with seniority experience in the type of works to be constructed, to be in charge at all times and who is authorised to receive and act upon instruction. The nominated plumbing supervisor shall continue to complete the project the project once commenced, unless approved by superintendent and UWA Senior Technical Officer Hydraulics.

### **1.3.4 Water Corporation and Trade Waste Approval**

Plans must be submitted to the Water Corporation and have trade waste approval before release of final tender documents.

### **1.3.5 Applications and Permits**

Applications and permits must be submitted to the relevant Authorities (Water Corporation and Alinta Gas etc) before Commencement of work.

### **1.3.6 Design Considerations**

Consultants are to take account of all considerations including, although not restricted to, the following points in their design:

- Machinery and plant on roofs not permitted without approval
- Access to plant rooms and equipment must be considered at all times.
- Access to ridged roof plant rooms with hydraulic equipment must be large enough to accommodate an attic ladder.
- Flat deck roofs must be provided with cat walks to allow for access to and service of equipment. Refer to section in the Mechanical Manual.
- All cabinets, plant room doors etc with locks to be keyed to the UWA EMA key system and practical to maintain and replace plant access.
- Environmental and energy policies and/or requests including UWA's Environmental Sustainable development benchmark.
- Storm water to be retained on property where practical
- Chemical discharge data to be requested from UWA client for inclusion within design for industrial waste.

### **1.3.7 Excavation**

Prior to any excavation being started, request is to be made for the use of machine excavators, information required shall be the size, type and extent for machinery to be used. Machinery may only be used with permission of the superintendent and or Senior Technical Officer Hydraulics.

Prior to any excavation being started, check with the Superintendent and/or Senior Technical Officer Hydraulics for the location of any services likely to be encountered on the route. Refer to UWA Manual - In Ground Services.

### **1.3.8 Compaction**

Backfilling of excavations is to be certified by an engineer or to superintendent's satisfaction. Compaction shall achieve penetrometers reading of 8 minimum blows per 300mm. Backfill material shall be of clean, unpolluted soil. Refer to UWA Manual – In Ground Services.

### **1.3.9 Inspection**

The UWA Senior Technical Officer Hydraulics is to be contacted 48 hours prior to any testing and before backfilling and/or concealing commences and shall be invited to attend.

The UWA Senior Technical Officer Hydraulics shall reserve the right to carry out site inspections at his discretion with the presence of the plumbing supervisor on site. UWA Senior Technical Officer Hydraulics shall also be invited to witness all tests and all work prior to concealment.

### **1.3.10 Supervision and Inspection of Works**

The contractor shall provide a plumbing supervisor with seniority experience in the type of works to be constructed, experienced in carrying out major Campus

projects and to be in charge at all times and who is skilled and knowledgeable in construction safety and who is authorised to receive and act upon instruction.

#### **1.3.11 Notice**

A minimum of 48 hours notice in writing must be received by the Superintendent prior to connecting to, shutting down or modification of any existing services.

#### **1.3.12 The Superintendent**

The superintendent of the contract must be identified in writing when a contract or commission is awarded. The Superintendent may be the Project Manager, Architect, Consultant or other person depending upon the nature of the contract.

#### **1.3.13 Nominated Tenders**

Tenders are only accepted from the UWA preferred contractors' list or by approval of the Senior Technical Officer Hydraulics.

#### **1.3.14 On Commencement**

All commencement of work and /or design to have notice given to UWA Senior Technical Officer Hydraulics and provide on going progress reports.

### **1.4 Working Drawings**

#### **1.4.1 Approval of Working Drawings**

Contractors' working hard copy drawings must be submitted to the relevant Technical Officer for approval and comment. Consultants must include UWA requirements in instructions to contractors to amend or approve drawings for construction. A minimum of ten working days must be allowed for UWA comments and approvals.

#### **1.4.2 Submission of As-constructed Information on Project Completion**

Within four weeks of Practical Completion, FM require that consultants supply a range of information pertaining to the project in its completed state to the Project Coordinator.

Consultants are to allow for the provision of these under the scope of their fee agreements. Final payment of fees will not be authorised until all of the information has been received.

The information may be prepared by subcontractors, but it is the responsibility of the consultant to deliver it to the University and guarantee its reliability.

## **1.5 Consultants**

### **1.5.1 Consulting Appointment**

Senior Technical Officer Hydraulics to be involved and notified for the appointment of hydraulic consultant selection.

### **1.5.2 Brief**

On acceptance of the detail scope of works to be provided, Senior Technical Officer Hydraulics to sign off with return brief approval.

### **1.5.3 Design Meetings**

Preliminary and ongoing progress meetings to be held with Senior Technical Officer Hydraulics during the design and documentation period. Refer to working drawings, item 1.4.

### **1.5.4 Content**

Content of design and documentation to reflect hydraulic services manual accepting full UWA standards and Senior Technical Officer Hydraulics approval. Refer to working drawings.

### **1.5.5 Tender**

Prior to tender all design and documentation to be presented to Senior Technical Officer Hydraulics with full interpretation meeting prior to presenting for client approval.

## **1.6 Contract Administration**

### **1.6.1 Coordination**

Consultants to provide full coordination with other associated consultants and engineers to provide the required standards of completion.

### **1.6.2 Construction**

Ongoing site attendance for coordination meetings, site inspections and / or other requirements for the duration of the project to be provided as required. Number and extent of attendance to be itemised within fees.

### **1.6.3 Non-Engaged Consultant**

Where a hydraulic consultant is not engaged to carry out contract administration, all documented projects requiring contract administration shall be carried out by the Senior Technical Officer Hydraulics or an appointed representative.

### **1.6.4 Notification**

Site visits to include courtesy invitation for Senior Technical Officer Hydraulics to attend all inspections.

### **1.6.5 Instructions**

Instructions and variations are only to be accepted from the superintendent and/or representative.

## **1.7 Contractors Responsibility**

### **1.7.1 Coordination**

Hydraulics contractors to coordinate with other associated trades to achieve the full installation and commissioning of the project.

### **1.7.2 Variations**

All requests for information and variations to be directed to the superintendent and / or representative or Senior Technical Officer Hydraulics in the absence of an engaged superintendent.

### **1.7.3 Fees**

Installations shall include everything necessary to complete the project including and not restricted to paying all associate fees, levy's and taxes, and headworks.

### **1.7.4 As Constructed**

Provide as constructed drawings and manuals as required in 2.9. As constructed drawings to be forwarded to Senior Technical Officer Hydraulics with the absence of superintendent.

As constructed mark ups to be kept on site and made readily available at all times, completed as constructed drawings as within 2.9 to be forwarded to the superintendent at nominated completed stages throughout the project.

## **2.0 GENERAL**

### **2.1 Submission of As-constructed Information on Project Completion**

Within four weeks of Practical Completion, FM require that consultants supply a range of information pertaining to the project in its completed state to the Project Coordinator.

Consultants are to allow for the provision of these under the scope of their fee agreements. Final payment of fees will not be authorised until all of the information has been received.

The information may be prepared by subcontractors, but it is the responsibility of the consultant to deliver it to the University and guarantee its reliability.

Where consultant's services are not employed, the contractor shall be responsible for this section.

Documents include: Drawings - Specifications - Operational/Maintenance Manuals.

Consultants must provide accurate drawings of the completed project. These are designated "As-constructed" drawings in CAD format. The FM Drawing Office being a CAD based FM system require all graphical data to be correctly positioned and orientated in relation to the site plans. The electronic data shall be pictorially and dimensionally accurate. Not to scale drawing are unacceptable.

Drawings are not to include design notes, calculation or other information not directly associated to the hydraulic constructed installation.

### 2.1.1 Drawing Standards

All plans are to be provided with North up the page and drawn at a scale of 1:100 (actual CAD scale) including the site plan. Unless building plans are drawn to represent their site location angle, all plans are to be drawn normal to drawing sheet axes. Layers must be used to clearly identify elements within the drawings with like elements on the same layer to allow subsequent segregation of required data. Differing line styles are to be used to designate services. Continuous lines with text notes added to designate services are an acceptable alternative. Where symbol fonts are used to designate graphical items, the font libraries are to be included with the supplied data.

### 2.1.2 File Reference Numbers

FM Drawing Office uses an electronic drawing register that can be searched using various fields. The drawing/data is then retrieved by reference to a '**Registered Drawing Number**'.

Drawings provided by outside consultants are to have an FM Drawing Office '**Registered Drawing Number**' attached prior to *As Constructed* issue to UWA.

The format of the number will be: **123A123**

123- 3 digit UWA building asset number

A - Discipline reference A - Architectural M – Mechanical, Hydraulic etc.

123 - 3 digit Drawing number allocated by FM.

A group of numbers for each discipline (Architectural - Mechanical etc.) is to be obtained from the FM Drawing Office. 6488 1866.

### 2.1.3 Required Data Format

Drawings are to be supplied in **MicroGDS or AutoCAD** format. Any specific line - character style files and pen tables used to plot files are to be included. A text file is to be included that references Registered Drawing number to file title.

Three bound copies of all Specifications - Schedules - Operational manual are to be supplied.

They are also required in electronic format on CD.

These files are to be on a separate CD from any CAD data.

The format of the text files to be either text or PDF.

#### **2.1.4 Data Supply Process**

*Refer to flow chart (hereunder) for additional explanation.*

Architects/Consultants/Contractors are to supply to FM Project Manager: - paper copies of all final drawings and ONE unbound copy of specifications and manuals for “*As Constructed Approval*”.

The documentation will be checked by FM. Any discrepancies will be referred back for correction and the approval submission repeated.

The Project Manager will give written confirmation of approval.

Once approval has been given the Architect - Consultant - Contractor will supply electronic and printed data as noted above.

All data must match previously approved prints.

The data will be verified by FM and any discrepancies referred back to the Architect/Consultant. To conserve disk space files/folders may be compressed using “**WinZip**”.

Any queries about the above should be directed to the FM Drawing Office 6488 1866.

## **2.2 Identification of Services**

Identification of Hydraulic Services shall be:

- Painting of pipework
- Labeling of pipework
- Tagging and labeling of valves and equipment
- Indicator tile tag on ceilings locating concealed cleaning points on waste systems and valves locations

Provide permanent identification to all Hydraulic Services in accordance with AS1345. Identification shall be of applied durable proprietary labels or painted signwriting on background colours, as specified.

Prior to ordering and setting out of identification, provide samples for approval by the Superintendent.

## 2.3 Above Ground Pipes Service

Provide permanent identification to all Hydraulic Services. Pipe identification shall be applied durable proprietary labels at 12 meter maximum centers on exposed soffits and 6 meters in plant rooms, ducts ceiling and roof space and at pipes immediately upon entry through doors and hatches, of 'BRADY' or approved equal manufacture and style with labeling stating the type of service and together with directional flows arrows.

At ceiling tile/hatches provide ceiling indicator button identifying system waste cleaning point and valve location above.

All exposed services with laboratory areas are to be painted in accordance with UWA Policy and Painting clause as mentioned in specification.

## 2.4 Environmental & Sustainability

Sustainable design principles are to be applied in all building services. Hydraulic Services (HS) applications are guided by legislative requirements that need to be adhered to during design and implementation stages.

Embodied energy: HS uses a variety of material ranging from PVC to copper and it is important that the material selected for application is suitable, cost effective and has the least embodied energy content.

Energy: HS should consider energy efficiency with equipment required.

## 2.5 Water Efficiency

Water efficiency: This should be inherent within the particular service and all applications need to reflect best practices in water efficiency.

## 2.6 Material Considerations

Major considerations to selecting and installing hydraulic services

- Legislative and BCA requirements
- Life cycling costing
- Water and energy efficiency
- Hazardous materials
- Recyclability, reusability or disposal of material

## 2.7 Hydraulic Guidelines

- Irrigation not permitted from Mains Water. Supply existing areas of mains water use with other sources as practical
- Waterless urinals to be specified for new projects and recommended for refurbishments
- Installation of 6/3 liter cisterns to toilets where practical

- Metering of buildings and connections to Building Management systems for monitoring of water, sewer and waste, Natural Gas.
- Cold water only supplied to student toilets
- Recommend time flow taps at student hand basins with flow restrictors.
- Shower roses to be of 9 liter per minute maximum
- Taps in general to be provided with flow restricters
- Point of use hot water systems where practical to be installed
- Natural gas for storage hot water units where practical
- Practical assessment for solar hot water systems within new projects
- Assess the reuse of waste water and storm water within projects
- Storm water to be retained on site and directed back to the aquifers
- Storm water to be restricted from entering the river to prevent environment polluting
- Assess the installation of light liquid and solids arrestors prior to entering storm water system for the risk of polluting
- Where zip hydrotap units are installed, supply of chilled water is to be approved by the Senior Technical Officer Hydraulics.

## 2.8 In Ground Services

All inground Hydraulic Services shall be a 'BRADY' or approved equal B-721 Detectable Identoline Underground Line Warning Tape positioned 300mm below finished ground level. Loop the tape through valve boxes and pits.

Indicator wrapping shall be a minimum of 80mm wide.

## 2.9 Valves, Meters and Devices

All valves and meters and devices, whether below or above ground shall be identified by using 'BRADY' or approved equal manufacture and style round custom brass valve tags – 50mm dia secured to valve stem with 'BRADY' or approved equal brass chain. Engraving shall identify purpose and extend of control and shall correspond with 'As Constructed' Drawings information and schedules.

Unless otherwise specified, all items of mechanical and electrical equipment and each component shall be adequately identified by applied signwriting or tags as appropriate to identify function, extent control or purposes.

## 2.10 Signage – on Potable Water Outlets

The Contractor shall provide signage to all non-potable water outlets. Signage shall comply with AS3500.1 1992 Section 4 and be 'PRATT' or approved equal Safety signs PP7B 225mm x 300mm in size indicating "Non Drinking Water". Provide sample of signage prior to ordering. Fixing locations to be agreed on site with the Superintendent.

## 2.11 Painting of Hydraulic Services

SERVICE	BACKGROUND COLOUR	LETTERING	COLOUR	NOTES
	NAME			
	AS. 2700 No			
Air Pipework	Light Blue	C.A." __" Kpa	WHITE	
Cold Water (Non Potable)	Green	Cold Non Potable	WHITE	Direction of flow Chevron (arrow)
Cold Water (Potable)	Blue	Cold Potable Water	WHITE	Direction of flow
De-Ionised	Green	Deionised	WHITE	Direction of flow Chevron (arrow)
Potable Hot Water	Green	Potable Hot Water	WHITE	Direction of flow Chevron (arrow)
Drains	Black	Drain	WHITE	Hazard Identification ref. AS. 1345 cl.8.2. where appropriate

SERVICE	BACKGROUND COLOUR		LETTERING	COLOUR	NOTES
Electrical Conduits	Orange	X.15			
Electric Motors	Orange	X.15			
Fire Services	Red	Signal Red R.13	As Applicable	WHITE	
Motor Plinths and Inertia Bases	Charcoal	Dark Grey			
Natural Gas	Yellow Ochre	Sand Y.44	NATURAL GAS	BLACK	
Overflow (water)	Black		OVERFLOW	WHITE	
Pipe Supports and Hangers	Black				

SERVICE	BACKGROUND COLOUR		LETTERING	COLOUR	NOTES
Plant Room Floors	Bauxite by Berger	Biscuit X.42			
Stop or Emergency Stop Control Buttons	Red	Signal Red R.13			
Switchboards	Sand	Y.44	As Appropriate	BLACK	
Tube Conveyors	Light Blue	Aqua B.25	MESSAGE CARRIER	WHITE	
Vacuum	Light Blue	Aqua B.25	VACUUM	WHITE	Not for Medical Suction

### 2.11.1

### 2.11.2 Extent of Works

Paint Hydraulic Service pumps, valves, plant, pipes, brackets, clips and associated fitting for each services in the following locations:

- Plant Rooms
- Pump Rooms
- Boiler Rooms
- Pipes in visible spaces
- Pipe risers in fire escape equipment recesses
- External hydrants and taps
- Vent Pipes Above Roof

### 2.12 Protection

All pipework, plant, equipment, fixtures, valves, instruments etc, shall be protected against the entry of foreign matter and damage at all times. Any item the subject of this contract not considered to be in first class condition on completion shall be removed and replaced at the contractor's expense upon receipt of notice from the superintendent.

**Protection of pipework on columns in stores, loading docks and plant rooms, shall be covered with a purpose made heavy duty galvanised steel cover panel, securely fixed to the building structure.**

Height of cover panel shall be 2100mm.

Access openings in the panel shall suit components requiring service access.

### 2.13 Completion

#### 2.13.1 Completion Certificate

Prior to practical completion, certificates of satisfactory completion must be obtained from the:

- The Water Corporation certifying the suitability of the property sewer, sanitary plumbing, industrial waste system and the potable and non hot and cold water system and fire hydrant services and stormwater drainage
- AlintaGas certifying the suitability of the natural gas service installation
- FESA certifying the suitability of the fire hydrant, hose reel system and fire stopping of penetrations
- Local Authority Council certifying the suitability of the stormwater drainage system
- Suppliers / Manufacturers of fire stopping products, certifying installation compliance with manufacturer's specification
- Contractors Contract Certifications
- Radiological Council

And forwarded together with a complete set of 'As Constructed' Drawings and Manuals (outlined as follows) to the Superintendent before final payment will be made.

### 2.13.2 Progressive Authority Inspection Reports

The contractor shall provide during construction written Authority evidence stating:

- Sections of property sewer, sanitary plumbing and industrial waste systems and storm water down pipes tested by the Water Corporation Inspector prior to concealment.
- Sections of potable and non-potable hot and cold water systems and fire hydrant services tested the Water Corporation inspector prior to concealment
- Sections of the Rainwater pipe system tested and approved by the Superintendent prior to concealment
- Sections of the natural gas services installation tested by the installer prior to concealment
- Fire stopping of penetrations approved by the manufacturer and the WA Fire Brigades Board, prior to concealment.

### 2.13.3 'As Constructed' Drawings

Prior to practical completion and at progressive nominated stages, submit 'As Constructed' Drawings clearly showing variation from the intended design. These Drawings shall be kept on site in good condition and marked up progressively as variations occur and shall clearly show dimensional locations on all services and valves with their respective depths and invert levels which shall be plotted from fixed reference points while trenches and ceiling spaces are open prior to concealment.

Drawings are not to include design notes, calculations or other information not directly associated to the Hydraulic Constructed Installation.

**At the Contractors expense engage a licensed surveyor to survey, plot, certify and produce 'As Constructed' drawings of all inground services part of this contract, and merge the 'As Constructed' Drawings from the Forward Works phase into one total site set of documents. Drawings are to be drafted by the associated consultant. The consultant is to provide a consistent cost for the service provided to the tenders prior to tender close.**

During the progress of the works provide the 'As Constructed' Drawings for sighting by the Superintendent or his representative to ensure that all changes or deviations are being satisfactorily recorded.

Workshop Drawings and diagrams specifically prepared for this project shall be included in the 'As Constructed' set of Drawings.

Prior to forwarding to the University of Western Australia, drawing is to be submitted to the Senior Technical Officer Hydraulics for approval. All Senior Technical Officer Hydraulics comments and directions are to be acted on. Specifically prepare an overall site plan indicating the location of all isolating valves, switches, meters with their respective zone of control / monitoring indicated in different colours on the plan. These valves, switches and meters shall be tagged with numbering system that identifies the extent of control, size and service. Transfer this plan in laminated format and position in the main plant room and workshop. Transfer the valve, switch and meter data to the operating and maintenance manuals.

As per item 2.1.2 all drawings provided by outside consultants are to have an FM Drawing Office '**Registered Drawing Number**' attached prior to *As Constructed* issue to UWA.

The format of the number will be: **123A123**

123- 3 digit UWA building asset number

A - Discipline reference A - Architectural M – Mechanical, Hydraulic etc.

123 - 3 digit Drawing number allocated by FM.

A group of numbers for each discipline (Architectural - Mechanical etc.) is to be obtained from the FM Drawing Office. 6488 1866.

#### **2.13.4 Operating Instructions / Manual**

As soon as possible after the installation has been put to work, but prior to the system being handed over, the contractor shall in collaboration with the superintendent prepare a complete "Maintenance and Operating Instructions" manual for the complete installation. Then these instructions have been agreed to in detail bound and present the sets to the Superintendent.

All items the subject of his contract shall be covered by manufacturer's literature, comprehensively covering the installation, operating and maintenance instructions and warranties.

#### **2.13.5 Maintenance and Operating Instructions**

Provide professional quality prepared operating manual in the same quantities as the 'As Constructed' Drawings for each of the building areas in A1 size bound hard vinyl clad covers labelled on the outside face with the name of the project and store and titled 'Hydraulic Services Operating Manual for inclusion on the 'Building Dossier' as specified. The superintendent shall approve the lettering and format prior to producing these documents.

The flyleaf shall nominate the dates of Practical Completion and Defects Liability termination and shall bear the names and addresses of the:

- Project Hydraulic Services consultant
- Head Contractor
- Installing Sub-Contractors

The preface sheet shall bear the names, addresses and telephone numbers of emergency contract persons (for 24-hour contact) in the event of warranty attendance during Defect Liability Period.

The Manual shall contain (in order)

- Schedule resume of maintenance procedures.  
(Weekly/monthly/annually/seasonally/etc)
- As constructed drawing prints
- Risk analysis and outcomes
- Maintenance contracts
- Warranty for each item of equipment installed
- Operating and maintenance instructions for each item of equipment installed
- A brief and concise description of each of the systems included in these works – refer also to 'As Constructed' information required.
- Schedule resume of names and addresses for all suppliers of equipment
- Certificate of satisfactory completion from Authorities

The schedule of resume and maintenance shall include (but not limited to) such items as:

- Equipment (De-Ionized Plant, Process water plant etc)
- Water heaters and pumps general preventative maintenance recommendations
- Emergency shut down procedures
- Fire pumps and equipment

#### **2.13.6 Fire and Life Safety Maintenance Log Book**

Provide and coordinate everything necessary to contribute to the Fire and Life Safety maintenance Log Book. All maintenance and testing activities shall be recorded in this log book.

#### **2.13.7 Instructing the Principal**

Prior to Practical Completion and before handing over to the Principal, instruct the Principal (or nominee) in the presence of the Superintendent and by practical demonstration all aspects of operation and maintenance and emergency shut down procedures. Hand to the Superintendent all copies of the operating manual.

#### **2.13.8 Individual Equipment Instructions**

One set of associated operating and servicing manual to be located within clear plastic sleeve adjacent to system equipment in a practical location.

#### **2.13.9 Redundant Services**

All services made redundant internal/external to be made redundant and made good. Existing redundant services located within any new project to be notified to the superintendent to determine its removal.

## **3.0 ACCESS TO UNIVERSITY BUILDINGS BY CONTRACTORS**

### **3.1 Normal hours**

Contractors required to work on campus during or outside normal business hours of 8.45am to 5.15pm are to report to the Security Office (north east corner - off Car Park 1) before they attempt to park their vehicles (refer to Appendix : Campus Map). This will enable the security staff to issue temporary parking permits if necessary and to arrange for buildings to be unlocked.

Contractors should notify the staff at the Security Office on arrival if they are going to do any welding and where they are going to do it. This will enable the security staff to make the appropriate arrangements to isolate the detectors on the fire indicator board. Failure to comply with this request will result in the company concerned being invoiced for the cost of the Fire Brigade call-out if a smoke detector is accidentally activated.

### **3.2 Entry to Restricted Areas**

Entry to restricted areas is to be arranged by the Superintendent who should have 24 hours prior notice.

### **3.3 Safety Considerations**

Refer to UWA Contractor Safety Handbook,  
<http://www.safety.uwa.edu.au/contractors?f=151720> ;  
and the UWA Contractor Safety and Health Policy  
<http://www.safety.uwa.edu.au/policies/contractor>

### **3.4 Refurbishments**

Unless specified, where refurbishment works are being carried out, existing redundant services are to be totally removed.

### **3.5 Samples**

Prior to the ordering of any item such as fixtures, equipment, taps, materials and/or workmanship, samples are to be presented on request from UWA Senior Technical Officer Hydraulics and/or superintendent.

The Contractor shall on request supply to the Superintendent samples of any item contained in the Hydraulic Services Contract, such fixtures, equipment, taps, materials and/or workmanship and such samples shall be approved in writing by the superintendent before the placement of orders for the appropriate equipment or installation work is carried out. Such samples subsequently to be retained by the Superintendent as criteria of the standard equipment workmanship or material to be supplied and any items not so complying may forthwith be rejected by the Superintendent and shall be replaced by the Contractor without cost to the Client.

Samples to be initially supplied shall be, but not limited to:-

- Taps and valves and meters
- Pipe material
- Floor grates
- Sanitary fixtures
- Valve box
- Workshop Drawings for purpose made fixtures and fittings and pumping systems and wiring diagrams
- Pipe, valves and equipment identification labels and tags
- Equipment identification labels and tags
- Equipment, plant and pumps, Data Sheets and Technical Manuals
- Insulations
- Sound attenuation products

### 3.6 Acoustic Attenuation of Hydraulic Services

Generally consult with environmental consultant for extent of acoustic attenuation scope.

#### 3.6.1 Extent of Acoustic Attenuation Work

**Sanitary Pipework** – Located in ceiling space above meeting rooms, offices and lecture theatres, or as directed.

**Rainwater Pipes** – Located in ceiling spaced of all areas. Note: RWPS in ducts need NOT be insulated.

**Fixtures** – Flushing Cisterns Valves – silent fill valves  
Flushing Cisterns – Acoustic Fixings for Cisterns shall be:  
Neoprene 'Rawnuts' type 6350 for M6 bolts with a square neoprene washer 25mm X 25mm X 6mm made from Mackay or approved equal M164 located between the cistern and the wall.

Pipework above or within offices, meeting rooms, lecture theatres or as directed shall have acoustic insulation provided. 50mm thick acoustic insulation with a minimum 5kg/m<sup>2</sup> loaded vinyl outer wrapping.

#### 3.6.2 Types of Attenuation

Sanitary pipework and rainwater pipes shall be lagged with a minimum of 4.5kg/m<sup>2</sup> loaded vinyl cast to 25mm acoustic foam – Pyrotek Soundlag 4525 or equal approved.

Bracket Fixing shall have Binder or equal approved 6mm thick BE150 noise attenuation pad between bracket and fixing.

Manufacturers' installation specification shall be adhered to.

### **3.7 Fire Stopping of Service Penetrations**

Install fire-stopping products around all service pipe penetrations through fire barrier elements, the likes of masonry floors, walls, ceilings and ducts. Products used shall be of approved manufacture, compatible to with materials being used in the installation.

Fire stopping shall conform to the Building Code of Australia and Local Council requirements. On request, provide certification for all product and installation.

- PVC / HDPE pipes – fire stop collars to the type and circumstance and combination product of water resistant and fire barrier gauging
- Metallic service pipes. Combination product of water-resistant and fire barrier caulking.

### **3.8 Floor Waste**

Floor waste to be discharge into sump of brick construction with minimum 3 bricks laid on edge effective depth. Finish at ground level with 250X250 floor waste box and grate. Refer to In Ground Service Manual.

## **4.0 SANITARY DRAINAGE**

### **4.1 Testing**

Every new below-ground property sewer, or section of an existing below- ground property sewer that has been replaced, shall be tested by either a water test or an air test.

### **4.2 Test requirements**

Test requirements are consistent with those in the National Plumbing and Drainage Code AS/NZS3500 and shall be adhered to at all times.

### **4.3 Overflow Relief Gullies**

Overflow relief gullies are intended to minimise the prospect of any sewer overflow from entering buildings. It is important that they be correctly installed.

### **4.4 Amendment of By-Laws**

By-laws have been amended in order to clarify requirements and came into effect on 1 January 1993 and apply in areas covered by the:

- Metropolitan Water Supply, Sewerage and Drainage By-laws 1981
- Country Towns Sewerage By-laws 1957

### **4.5 Overflow Levels**

There must be:

- a) At least 150mm level difference between the overflow level of a gully and the overflow level of the lowest internal sanitary fitting or fixture, and
- b) At least 75mm level difference between the overflow level of a gully and the surrounding ground surface.

These are the same requirements as outlined in the National Plumbing and Drainage Code AS/NZS3500. Co-ordination at design with architect shall be required/

#### **4.6 Internal Wet Areas**

Rooms with floor wastes, gullies, floor channels and bucket traps shall have a graded floor with a minimum of 25 mm to the gratings. All plant room floor waste outlets shall be a minimum of 100mm diameter. All floors are not to show risk of pooling. All internal grates to be installed as bronze non-slip using vinyl clamp rings and puddle flanges where applicable.

Details to be approved by Safety and Health Officer and Senior Technical Officer Buildings.

Non slip grates and covers to all areas.

Puddle flanges to be installed where possible for all floor areas including balconies except ground level.

#### **4.7 Plant Room Drainage**

All plant room drains to have a minimum of 100mm waste and grate and shall discharge to sewer. Plant room traps shall be charged via a solenoid and be connected to LAN and have a trap seal depth to suit mechanical consultant's requirements (i.e. may require deep seal). Plant room floors to grade without pooling to waste and grate.

#### **4.8 Acid Drains and Waste under Buildings**

Acid drains and waste under concrete slabs and in unreplaceable positions shall be of HDPE (high density polyethylene) installed to manufacturer's specifications.

#### **4.9 Acid Drains and Waste above Ground**

Above ground in replaceable positions may be of DWV PVC pipe if approved by Senior Technical Officer Hydraulics.

#### **4.10 Works Included in Supporting Trades**

- Electrical power supply to pump switchboards, hot water units, water boiling units, ice machines, dishwashers, chilled water units, autoclaves, process water pumps and de-ionised water pump systems and de-ionised water package and Fire Drencher Flow switched (Electrician).
- Connection and complete wiring by mechanical services sub-contractor to hydraulic services points requiring connection to Building Management Automation System BMAS (Mechanical) except where noted otherwise.

- Ceiling Access and access panels (Builder)
- Relaying Fire Drencher flow switched Fire Pump functions and alarms to Fire Indicator Panel (Electrician).
- Connection from gas service solenoid valve in laboratories to emergency stop button located at exit of each laboratory and stormwater isolation valve located in loading area to stop button located in secure loading area (stop button supplied by electrical sub-contractor)

## 5.0 SANITARY PLUMBING FIXTURES /Tap Ware/ Hot Water Units

Consultation with Senior Technical Officer Hydraulics required at commencement of each individual project to establish types of fixtures to be used and appropriately fit within cost estimations

### 5.1 Standards

The following Australian Standards apply:

- AS/NZS3500.0 - 1990 Part glossary of terms
- AS/NZS3500.1 - 1992 National Plumbing & Drainage Code Part 1
- AS/NZS3500.2 - 1990 Sanitary plumbing and sanitary drainage
- AS/NZS3500.3 - 1990 Storm water drainage
- AS/NZS3500.4 - 1990 Hot water supply systems

### 5.2 Common Equipment

For compatibility, share parts, servicing and maintenance reasons only one manufacturer type and style of equipment, valve, fixture or Plant shall be used throughout the project and be adhered to this manual or be approved by Senior Technical Officer Hydraulics.

- Sanitary fixtures
- Tapware
- Valves
- Pipe Systems
- Pumps and Switchboards
- Wiring, switches, LED's, globes
- Indicator labels and tags
- Painting and lettering
- Locks – keyed to Campus Master Key System

#### 5.2.1 Colour

Vitreous enamel fixtures are to be white. PVC fittings are to be a natural colour.

#### 5.2.2 Installation

Vitreous china fixtures are to be installed only after tiling has been completed and using appropriate sealant. All sanitary fixtures to be installed with individual

isolations. “Arco” right angle stops to be used or as approved by Senior Hydraulic Services Officer.

### **5.2.3 WC Pans and Cisterns**

Caroma Trident shrouded trap pans with Concorde mid-level surface mounted cisterns

Caroma water wafer induct cisterns are preferred

Silent flushers installed with approval from Senior Hydraulic Services Officer.

Sovereign 2000 Dual Flush with Care buttons preferred for disabled

Exposed cisterns to be connected with R/A Arco stop with hard drawn chrome plated copper connection.

Any change to be approved by Safety and Health Officer and Senior Technical Officer Hydraulics.

### **5.2.4 In-wall Cisterns**

Generally, in-wall cisterns are not to be fitted. Any exception must be approved by the Senior Hydraulic Services Officer.

### **5.2.5 WC Seats**

Caroma standard toilet seat (white)

Caroma Pedigree 11 Care for disabled installations

### **5.2.6 Urinals and Cisterns**

Waterless urinals. “Urimat” is the preferred installation, model ‘ECO’

Electronic solenoid flushing systems may be used if approved by UWA’s Senior Hydraulic Services Officer.

### **5.2.7 Hand Basin (wall-mounted)**

Caroma as approved by architect and Senior Hydraulic Services Officer.

Tap ware to be Galvin Engineering Laboratory.

40 diameter plug and washer.

Exposed water connections to be chrome plate hard drawn copper.

### **5.2.8 Vanity Basin**

Caroma Concorde 500, or approved equivalent - tap holes in fixture – 40mm dia plug and washer.

Student basins to be provided with Time Flow Pillar Taps.

Student and disabled basins to be provided with cold water only unless otherwise approved by Senior Technical Officer Hydraulics.

Exposed water connections to be chrome plate hard drawn copper.

### **5.2.9 Cleaner's Sink**

Stainless steel. Size 515mm x 405mm with chrome-plated bucket grating and strainer waste.

Galvin Stirling chrome wall set with 110mm swivel aerated outlet.

Hot water to be provided with 60°.

50mm diameter fixture trap required.

### 5.2.10 Drinking Fountain

Drinking fountains to provide ambient temperature only unless approved. Stainless steel unit wall-mounted or free-standing including filter as per 5.2.11 and approved by Senior Technical Officer Hydraulics. Arcus Oasis STW 34BJ is preferred. Disability provisions to be accessed by Senior Technical Officer Hydraulics and Disability Services Officer.

### 5.2.11 Water Boiling Units in Common Rooms

ZIP auto-boil, sized to cater. Other makes and models to be approved by Senior Technical Officer Hydraulics and Senior Technical Officer Electrical. Water boiling units are to be installed with Aqua-pure water filters AP115 opaque sump with AP117 filter cartridge. Under bench models to be approved by Senior Hydraulic Services Officer. Where zip hydrotap units are approved, energy savings timer to be set up at commissioning to suit users. Ambient cold water supply only unless otherwise approved by Senior Technical Officer Hydraulics.

### 5.2.12 Laboratory Sink

Units shall be custom-built to suit special requirements. PVC, polypropylene or 316 stainless steel sinks may be used.

50mm fixture trap required.

All sinks to be provided with shop drawings and presented to superintendent prior to ordering.

CHECK WITH FACILITIES MANAGEMENT AND DEPARTMENT FOR SPECIAL REQUIREMENTS.

### 5.2.13 Valves and Seats for Hot and Cold Tap Fittings

Galvins or approved equivalent with brass jumper-valves with replaceable washers. Under no circumstances are any valves or taps to be fitted with plastic jumper washers unless approved by Senior Hydraulic Services Officer.

### 5.2.14 Laboratory Tap Fittings

To be colour-coded Galvins laboratory units or consolidated brass tapware made to University approval. All laboratory tap outlets to be supplied with a female 15mm BSP thread with a minidual check valve with a 15mm BSP removable tube nozzle and a 15mm BSP adaptor and aerator. Remainder of nozzles to be handed to Senior Technical Officer Hydraulics.

ALL wash up basins to have aerated faucets.

### 5.2.15 Laboratory Tap Colours (Tables A & B)

**Table A)**

SERVICE	BACKGROUND COLOUR		LABEL	
	NAME	AS.2700No	LETTERING	COLOUR
Compressed Air	Light Blue	Aqua B.25	CA" ___ KPa	WHITE
Laboratory Vacuum	Light Blue	Aqua B.25	VACUUM	WHITE

Pathological Suction	Red Gum	Red Gum R.53	PATHOLOGICAL SUCTION	WHITE
Nitrogen Gas	Pewter	N.63	NITROGEN	WHITE
Acetylene	Claret	R.55	ACETYLENE	WHITE
Oxygen	Black	-	OXYGEN	WHITE
Helium	Brown	X.54	HELIU,	WHITE
Carbon dioxide	Green/Grey	N.31	CARBON DIOXIDE	WHITE
Deionised Water	Green	Jade G.21	DEIONISED WATER	WHITE
Natural Gas	Yellow Ochre	Sand Y.44	NATURAL GAS	BLACK
Non Potable Water	Green	Jade G.21		
Potable Water	Blue	Atlantic	COLD POTABLE	WHITE
Carbogen	Green/Grey	N.32	CARBOGEN	BLACK
Argon	Blue	Peacock T.53	ARGON	BLACK
Nitrous Oxide	Blue	Ultra marine B.21	NITROUT OXIDE	WHITE

**Table B)**

Laboratory tap Colours SERVICE	TAP IDENTIFICATION	
	JOTUN COLOUR	JOTUN NUMBER
Air	Horizon Blue	PE 754134
Vacuum	Autumn red	PE 734120 SG
Nitrogen Gas	Notre Dame	PE 774201
Acetylene	Claret	PE 35057 SG
Oxygen	Gloss Black	PE 775197
Helium	Hamersley Brown	PE 784082 W
Carbon dioxide	Transformer Grey	PE 775242
Deionised Water	Cabana Green	PE 765098
Natural Gas	Primrose	PE 744161
Non Potable Water	Cabana Green	PE 765098
Potable Water	Atlantic Blue	PE 750226
Carbogen	Gloss Black – Transformer Grey	PE775197 PE 775242
Argon	Wizard	PE 754180
Nitrous Oxide	French Blue	PE 754187

### 5.2.16 Shower Fittings

Fixed rose must be water saving types where possible. All shower fittings must be approved by Senior Technical Officer Hydraulics.

### 5.2.17 Water Filters

Install “Cuno” pacific water filter equipment to all boiling water units and cold water drinking units and tea preparation areas. All other positions to be approved by Senior Technical Officer Hydraulics.

### 5.2.18 Safety Showers

Ashley type. Ceiling-mounted with pull handles. Note: Safety showers and eye washers to be approved by Senior Technical Officer Hydraulics and UWA Occupational Health and Safety Officer.

### 5.2.19 Hot Water

Hot water is not normally provided in student or disabled toilets except in cases where specially required. Approval by Senior Technical Officer Hydraulics is required. Hot water to cleaners sink and kitchen sink to be supplied at 60°. Where hot water is supplied in disabled toilets there shall be thermostatic control.

### 5.2.20 Electric Hot Water Systems

Large, small storage or instant hot water systems are not to be installed without prior consultation with Senior Hydraulic Services Officer. Point of use locations preferred. Eg. Stiebel Eltron DHB 12 or SNU.

### **5.2.21 Gas Hot Water Systems**

Preferred where gas is available. Instantaneous gas water heater to be Rinnai Infinity or approved by Senior Hydraulic Services Officer. Storage units to be either Rheem, Edwards or Hardie Dux. To be approved by Senior Hydraulic Services Officer.

### **5.2.22 Hot Water System Reliefs**

Hot water system reliefs are to discharge to a safe and easily visible position.

### **5.2.23 Inspection Pits (in situ) and Manholes**

Must be designed to meet standards of the Water Authority of Western Australia. Preferred with precast bases. All covers to be installed with minimum medium traffic duty covers with cast iron lite lift lids and/or grates. Refer to In Ground Services Manual.

### **5.2.24 Water Meters**

All new and refurbished buildings SHALL have water meters installed on the mains supply to the buildings. All water meters are to be fitted with pulse heads recording in litres and must be connected to the LAN. Position shall be approved by the Senior Technical Officer Mechanical and the Senior Technical Officer Hydraulics.

### **5.2.25 Supply Samples**

Supply samples of any non-standard fixtures and fittings for approval by the Senior Technical Officer Hydraulics and manager, planning and design.

## **5.3 Pipeline Ductwork and Electrical Identification**

All exposed hydraulic piping is to be colour-coded and labelled as per AS1345-1982, AS1169-1982 and AS/NZS2700-1985. Services located in building ducts, risers and ceiling spaces are to be labelled only. Services located in plant rooms (refer Appendix). To be painted unless otherwise approved from Senior Hydraulic Services Officer.

## **5.4 Cold Water Services**

For the following materials the service shall not show any leakage when subjected to a hydro-static test pressure of 1500kPa applied for a period of not less than 5 minutes; or as to manufacturer's specific requirements.

- Copper pipe
- Polybutylene
- Polyethylene
- Polypopylyene random

## **5.5 Insulation of Hot Water Services**

Hot water services requiring insulation shall be of closed-cell insulation 25mm wall. Insulation that requires painting to be painted with Aerocoat or approved by Senior Technical Officer Hydraulics.

## **5.6 Internal Wet Areas**

Refer to 4.6

## **5.7 Tap Outlets**

All potable outlets over sinks and basins to be fitted with standard aerators.

## **5.8 Charge Pipes**

To be approved by Senior Hydraulic Services Officer. Controlled by solenoid connected to LAN.

## **5.9 Valves in Ceilings**

Concealed isolation valves in ceiling shall have minimum 600mm x 600mm access panels with identification stickers.

## **5.10 Student and Wheelchair Access Toilets**

To have cold water only supply to basins. Standard knock on lever handle for wheelchair access toilet basin as approved by Senior Technical Officer Hydraulics and Disability Services Officer.

# **6.0 WATER SUPPLY, SEWERAGE AND DRAINAGE**

## **6.1 Australian Standards**

All materials to be installed as per relevant Australian standards and manufacturers specifications. On request the contractor shall provide manufacturers specifications and installation requirements to the Superintendent and Senior Hydraulic Services Officer.

## **6.2 Certification of Completed Work**

The requirements of the Water Corporation of Western Australia are to be adhered to. Consultants are to advise plumbers that the current by-law requirement for licensed plumbers to lodge a notice of intention to commence work and to certify compliance of complete work with the by-laws, will apply to all University projects. In certifying the work a licensed plumber is testifying that the work complies with the by-laws and that all of the required tests have been

carried out and proved satisfactory. Refer – 1.6

LICENSED PLUMBERS HAVE A CLEAR RESPONSIBILITY TO ENSURE THAT THEIR WORK ACTUALLY DOES COMPLY WITH THE BY-LAWS AND AS/NZS3500 PARTS 1 - 4 1992.

All plumbers should be well aware of the risks attached to non-conforming plumbing systems.

### **6.3 Pipeline Ductwork and Electrical Identification**

All exposed sanitary piping is to be colour-coded and labelled as Per AS1345 - 1982, AS1169 - 1982 and AS/NZS2700 - 1985.

Services located in building ducts, risers, and ceiling spaces are to be labelled as per the relevant standards.

Refer to Appendix.

### **6.4 Preferred Materials**

#### **6.4.1 Water Supply Pipes (in buildings)**

Water supply pipe to be of Type B copper tube or advised by Senior Hydraulic Services Officer.

#### **6.4.2 Concealed Water Supply Pipes (in ground)**

All copper pipe in ground to be Class B. 100mm and above - use poly-ethylene where practical.

Use medium-density polypipe up to 80mm for playing fields and open areas. Glued PVC is not permitted.

Associated valves, fittings and all copper pipe, 25mm and over, buried in the ground is to be wrapped in Denso tape.

#### **6.4.3 Isolating Valves on Branch Lines**

Above ground level valves shall be standard full-flow ball valves. Below ground-level valves shall be of stainless steel handle held on with a stainless steel nut. Where the valve is below ground level, a PVC sleeve riser will extend into the valve box.

The PVC sleeve to be supported on masonry blocks and allow free movement of the valve box over the sleeve. (Services shall not take the weight of valve box.)

#### **6.4.4 Exposed Water Supply Pipes (internal)**

For special cases use chrome plate finish or paint colour to indicate service in pipe as per AS/NZS2700 - 1985.

#### **6.4.5 Exposed Water Supply Pipes (external)**

Use copper and paint to match wall.

Note: Paint identification lettering to indicate type of service pipe. Stickers are not to be used externally.

#### **6.4.6 Sanitary and Soil Waste Pipes (above ground, external)**

Copper or cast iron with mechanical joints. Internal – PVC or HDPE with fire stop collars, copper or cast iron as discussed with Senior Hydraulic Services Officer.

#### **6.4.7 Silver Brazing and Jointing (Copper)**

Joints to be silver brazed using a minimum of 15% Silver Brazing Alloy. All other aspects of jointing to be as per manufacturers specification.

### **6.5 Preferred Fittings**

Use of fittings recommended by the University of Western Australia.

For example:

- Solvent joint fittings are appropriate for PVC lines only.
- Rubber rings for "Blue Brute" cast iron fittings and sluice valves will be Rislun nylon No. 11 coated to AS/NZS2280.
- Brazed copper, screwed-brass compression fittings should be used in the appropriate location.
- Deionised water taps are to be Galvins or approved equivalent, epoxy coated.
- Internal Deionised water pipe shall be polyethylene pipe fixed to unistrut or approved by the Senior Technical Officer Hydraulics.
- Floor waste grates to bronze non slip minimum 100mm Dia.

#### **6.5.1 Fixings**

All fixings to be of bolted variety. Nylon tappits shall not be permitted.

#### **6.5.2 Clipping**

Clipping and supporting brackets to of binder, Abbey or equivalent manufactured variety or approved by Senior Technical Officer Hydraulics. Clipping of all pipe work is preferred to be stand off wall brackets and provide acoustic qualities.

### **6.6 Water Storage Break Tanks and Expansion Tanks**

Water storage break tanks and expansion tanks shall be installed to Australian standards. A water meter shall be installed connected to LAN.

### **6.7 Insulation of Hot Water Pipe**

As per item 5.5.

### **6.8 Stormwater Drainage (AS/NZS3500 - 1990) and Downpipes**

The following are to be incorporated into stormwater drainage systems.

### **6.8.1 Box Gutters and Overflows**

Overflow shall have an equivalent area to downpipes. Refer to Australian standards.

BOX GUTTERS SHALL BE DESIGNED AND INSTALLED for 1 in 100 year rainfall intensity (200mm/Hr) and shall penetrate the wall (full cross section) and project over into an external rainhead with a relief overflow installed below the bottom of the box gutter.

### **6.8.2 Downpipes**

Downpipes to discharge over grated gullies of approved design and clip as per stormwater Australian standards. Refer to Inground services manual.

### **6.8.3 Stormwater Manholes**

Stormwater manholes are to be precast with built-in ladder rungs if they are deeper than 1200mm. Refer to In Ground Services Manual. Covers to be finished at ground level with grate.

### **6.8.4 Grated Channel Drains**

Grated channel drains are to be at least 150mm wide with grating at right angles to direction of fall towards drain. Bar spacing 19mm apart. Permeable paving to be assessed as an alternative.

### **6.8.5 Grates Over Inspection Pits**

Grates over inspection pits etc to be cast iron, heavy-duty safety grates. Minimum 600mm Diameter bicycle safe, raised 100mm, cast in concrete.

### **6.8.6 Surface Spoon Drains**

Surface spoon drains are to be wide and gently sloping to enable safe passage for pedestrians. Permeable paving to be assessed as an alternative.

### **6.8.7 Surface Collection Pits**

Surface collection pits details to be submitted for the approval of the Senior Hydraulic Service Officer. Refer to In Ground Services Manual.

### **6.8.8 Agricultural Pipes**

Must be laid well below finished floor level to prevent seepage. Ensure membrane is properly laid before pouring of concrete and backfilling.

Note: All pipes must connect to drainage outlet.

### **6.8.9 Pipe Clamps and Saddles (fixing and penetrations)**

All pipe supports are to be installed as per Australian standards. All insulated lines on flow and return services e.g. hot water - cooling etc shall be binder B1000 series or similar with Senior Hydraulic Service Officer approval. Copper pipe clipped to binder channel shall have neoprene inserts AS/NZS1170 Earthquake Protection Code PT4. Installation to provide for expansion and contraction.

### **6.8.10 Pipe Penetrations**

Services requiring movement or insulation through walls and floors shall be sleeved with sheet galvanised iron or PVC pipe. (Sleeves may be knocked out of concrete.) Penetrations through floors shall be installed with approved sealant to make water proof.

All services travelling through walls and/or floors between fire rated compartments to be fire rated with approved fire collars with certification to be provided on request.

### **6.8.11 Anular Clearance**

The space between the pipe or the insulation sheathing and the wall or floor sleeve shall be filled with insulation or an acoustic seal. The acoustic rating of the seal shall be equivalent to the partition through which the pipe passes.

Where pipe passes through fire walls or floors, the space between the piping (or sheathed insulation) and the sleeves shall be sealed with fire rated seal of rating equal to that of the wall as approved by all local authorities.

## **6.9 Valve Covers**

### **6.9.1 Cast Iron Flushing Point Cover**

Ball valve and sewer inspection / cleaning access within paved areas to be provided with cast iron flushing point cover positioned at FGL with 100mm clearance from support. Riser shall have minimum 50mm clearance from underside of cover. Refer to In Ground Services Manual.

### **6.9.2 Conical Cast Iron Path Cover**

Sluice valves within paved areas to be provided with conical cast iron path covers positioned at FGL with 100mm concrete support. Riser shall have minimum 50mm clearance from underside of cover. Refer to In Ground Services Manual.

## **6.10 Backflow**

### **6.10.1 Standards**

The following standard applies - AS/NZS3500.1- 1992.

The University has installed reduced pressure zone devices downstream of north and south boundary meters, protecting contamination of the Water Corporation's main water supply (containment).

Downstream throughout the campus, RPZDs are being installed on all buildings (where practicable) with laboratories or hazards, creating a non-potable water supply downstream of this device (zone protection) protecting the water service upstream to the containment RPZD, (potable) which shall service potable areas as is toilets, lunchrooms, showers, drinking fountains etc.

All internal laboratory faucet outlets (including eye washers) etc. in laboratory areas etc. shall have mini dual check valves fitted (individual protection). Laboratory doors shall have a universal non-potable sticker on all doors (200mm x 200mm) and all laboratory taps shall have a smaller sticker (80mm x 80mm) as per University standards.

Eye wash safety shower to University specifications. Refer to the Senior Hydraulic Service Officer and to the Safety and Health Office for position.

### **6.10.2 Backflow Prevention Devices**

Prior to starting any design work relating to potable and non-potable water supplies in new or refurbished buildings, the hydraulic consultant or contractor must confer with the Senior Hydraulic Service Officer to determine how the backflow is to be installed. Failure to clarify University requirements on backflow could result in expensive alterations later in the contract.

All new or modified mains water systems are to have backflow prevention devices installed in duplicate. FEBCO 825 YA series is the preferred option or FEBCO P25 series with light pattern unions (Yankee couplings) between test cocks and the RPZD.

### **6.10.3 Backflow Rating**

All laboratories and dark rooms etc to be classified as high hazard.

Buildings containing laboratories etc to be zoned protected (hot and cold) valves to be installed in duplicate to the Senior Technical Officer Hydraulics.

### **6.10.4 Backflow Testing**

Testing is an integral part of the required installation, servicing and maintenance procedure for backflow prevention valves. Backflow valves are to be tested prior to commissioning, immediately after servicing and at end of 12 months defects liability period.

### **6.10.5 Isolations**

Isolation Valves shall be provided to all services supplying individual laboratories eg. Fume cupboards and departmental equipment.

### **6.10.6 Non Potable Signage**

All laboratory tap sets are to have University approved non-potable stickers above or near fittings and on laboratory doors.

### **6.10.7 Makeup tanks**

Water supply to makeup tanks to be non-potable where practical. Hose cocks to be installed in plant rooms in lieu of fast fill to makeup tanks.

## 6.11 Metering

All buildings to be provided with a meter connected to BMS measuring supply with additional meters located as directed by Senior Technical Officer Hydraulics.

## 7.0 TEST REQUIREMENTS

### 7.1 Standards

Test requirements are consistent with those in the National Plumbing and Drainage Code AS/NZS3500. Contractors and consultants are to ensure that all tests are undertaken in compliance with the code AS/NZS3500.

### 7.2 Sanitary Plumbing

Sanitary plumbing installations shall comply with the following when tested:

- a) The respective sections of any soil pipe, vent pipe or above ground drain shall be free of leaks when subjected to:
  - hydrostatic test to flood (overflow) level; or
  - air test to 30kPa for a minimum period of three minutes
- b) The discharge pipe, through which sewage is pumped to the sewer, shall be free of leaks, when subjected to a hydrostatic pressure equal to twice the shut-off head (head at which flow becomes zero) of the pump or, if a relief valve is fitted, twice the pressure at which such valve operates.
- c) Sanitary fixtures of all kinds shall be tested by subjecting them to normal use. After each relevant test, the residual water seal in the trap of the fixture concerned, and in the trap of any other fixture connected to the same system of discharge pipes, shall retain a water seal depth of not less than 70mm when maximum pressure is applied within the chamber.

### 7.3 Sanitary Drainage

Every new below-ground property sewer, or section of an existing below-ground property sewer that has been replaced, shall be tested by either a water test or an air test.

### 7.4 Overflow Relief Gullies

Overflow relief gullies are intended to minimise the prospect of any sewer overflow from entering buildings. It is important that they be correctly installed.

Amendment by-laws were made by the Board in order to clarify its requirements. They came into effect on 1 January 1993 and are the same requirements as outlined in the National Plumbing and Drainage Code AS/NZS3500. The by-laws apply in areas covered by the:

- Metropolitan Water Supply Sewerage and Drainage By-Laws 1981

- The Country Towns Sewerage By-Laws 1957

The by-laws require:

- a) At least 150mm level difference between the overflow level of a gully and the overflow level of the lowest internal sanitary fitting or fixture, and
- b) At least 75mm level difference between the overflow level of a gully and the surrounding ground surface.

## 7.5 Cold Water Services

- a) Service shall not show any leakage when subjected to a hydrostatic test pressure of 1500kPa applied for a period of not less than five minutes or to manufacturer's specifications.
- b) Flexible jointed installation (i.e. rubber ring joints) however shall not show any leakage when subjected for a period of not less than 15 minutes, to whichever is the greater of the following hydrostatic test pressures:
  - mains pressure or
  - not less than 700kPa

When pressure test is carried out, it may be necessary to disconnect and cap the water service to isolate it from fixtures and appliances which may be damaged by the test pressure applies. The water service shall be isolated from the Authority's water main when testing is carried out.

## 7.6 Hot Water Services

Hot water systems shall be tested prior to commissioning as follows:

- a) The completed hot water reticulation, excluding the storage container or water heater, shall not leak when tested with water at ambient temperature at a pressure of 1500kPa for a period of not less than 30 minutes or to manufacturers' specifications. Prior to testing, the heating medium shall be isolated. It may be necessary to disconnect fixtures, appliances and valves in order to prevent damage during testing.
- b) Testing shall be carried out on all pipework prior to its being concealed in ducts, chases or trenches.
- c) The complete system (including valves, pumps and other equipment) shall be tested under normal working conditions for a period of not less than 48 hours. The system shall be checked visually for leaks.
- d) All drain pipes from expansion control valves, and temperature/pressure relief valves, shall be tested with water to ensure that they are unobstructed and are open to the atmosphere.
- e) All vent pipes shall be tested with water to ensure that they are unobstructed and open to the atmosphere.
- f) All domestic hot water outlet temperatures to be certified as operating at 46 degrees C maximum temperature by the contractor.

Note: This is a statutory requirement.

## **8.0 GAS**

The University of WA has a ring main reticulated at 15kpa. JT is the general design requirements that branch lines extend into each building at 15kpa reducing pipe size as far as practical prior to reducing line pressure to design requirements. A single isolation valve shall be installed immediately adjacent to each individual building located in a cast iron cover. The associated cast iron cover shall be labelled identifying the building and shall be painted yellow. Isolation valve shall be positioned in a clear and easily visual position.

### **8.1 Installation**

In general, all gas installations shall conform to AS1596-1983, AG601-1990, AG501-1984 Gas Standard Regulations 1983.

### **8.2 Underground Gas Lines**

For natural gas services in the ground, external to buildings, all pipes and fittings are to be Type 2 modified UPVC Class 100 to AS1464.

#### **8.2.1 Valves**

All valves to be AGA approved. Valves up to 50mm to be full flow. Ball valves (with stainless steel handle held on to spindle with a stainless steel nut). Valves above 50mm to be AGA-approved butterfly valves with key handle.

#### **8.2.2 Valve Covers**

Isolating valves on branch line shall be covered with Cast Iron Valve Box. Refer to In Ground Services Manual. Where the valve is below ground-level a PVC sleeve riser will extend into the valve box. PVC sleeve to be supported on masonry blocks and allow free movement of sleeve in the valve box.

### **8.3 Internal Gas Lines**

#### **8.3.1 Internal Pipework**

All internal and exposed-to-air gas pipes and fittings will be seamless copper tube Type B to the standards previously described.

#### **8.3.2 Labels**

All internal gas lines are to be labelled in building risers and ceiling spaces. In rooms they are to be painted to Superintendent's instructions.

#### **8.3.3 Meters**

All new and refurbished buildings are to have gas meters installed. Meters will have pulse heads fitted which read in M3/H and are connected to the LAN. Meter preferred is "Elster" Turbine.

### **8.3.4 Design Pressure**

All buildings will be supplied with medium pressure gas. The gas pressure will be reduced through a gas regulating valve and an over-pressure shut off valve (OPSO). OPSO valves to be housed within the building in a position approved by Alinta Gas.

### **8.3.5 Quarter Turn Turrets**

Consolidated brass quarter turn turrets. Any other type of valve must be approved by the Senior Technical Officer Hydraulics, in writing before installation. Turrets are to be colour-coded as per AS/NZS2700.

### **8.3.6 Laboratory Tapware and Fittings**

Laboratory fittings to be coated AS/NZS2700.  
Laboratory tapware to be Galvin Engineering or approved by Senior Hydraulic Technical Officer.

### **8.3.7 Ball Valves**

Brass ball valves (with handle held onto spindle with a nut). All ball valves are to be full flow. No other type will be accepted.

## **9.0 FIRE SERVICES**

### **9.1 General**

Fire services are to comply with the requirements of AS/NZS3500-1-1992, Section 6, and the:

- authority responsible for the control of fires
- applicable building regulations
- Insurance Council of Australia or Insurance Underwriters as appropriate
- relevant authority responsible for water supply

### **9.2 Standards**

In addition the following Australian Standards apply:

- AS/NZS3500-1-1992 Section 6
- AS2419-1 Fire hydrants
- AS2441 Hose reels
- AS2118 Sprinkler service
- AS2941 Pumps
- AS1345 Identification

### **9.3 External Fire Hydrants**

External fire hydrants to be dual head and have valve support by means of dual post.

## 9.4 Isolation Valves

Isolation valves 100mm and larger shall be Norcast Rislan "Nylon II" coating as standard.

## 9.5 Fitting and Tee points

Fitting and Tee points on PVC services to be Rislan "nylon II" powder coating as standard.

## 9.6 Valves in Buildings

Valves in buildings shall be installed in a removable and maintainable position.

## 9.7 Fire Hydrant Valves and Reels

Fire hydrant valves and reels shall be Galvins Engineering.

## 9.8 Fire Service In Ground

Fire Services in ground to be Poly Ethylene where practical.

## 10.0 IRRIGATION WATER SUPPLY

The irrigation water supply for the proposed systems will be provided by one or more of the following sources, as specified in the project specification for each project.

- Groundwater Bore.
- Water Corporation potable mains.
- Other as nominated.

The irrigation network on the Crawley site is also used as a fire service for some buildings on the site as well as the groundwater pre-cooling system for the Molecular and Chemical Sciences building. Any alterations to the irrigation mainline system have to consider the effect on ALL of the functions of the irrigation network.

## 10.1 Flow Test

Within the time given in the project specification and where called for in the project specification for any given site, and prior to commencing any construction work, the Contractor shall conduct a flow test as specified in the project specification. Where a water meter has not been installed at the time of contract award, the Contractor shall conduct a flow test within seven (7) days of the installation of the meter.

### 10.1.1 Mains Water Flow Test

The flow test shall be conducted after installation of, and downstream of, the master valve and the backflow prevention device.

The test shall be conducted from fully open to shut off point in 50 kPa

increments. The time of day and date of test will be included in the report to be submitted to the Superintendent's representative for approval prior to commencing any installation work.

### **10.1.2 Pump Performance Flow Test**

Where required in the project specification a pump performance test will be conducted on an existing pump. The flow will be recorded from 0 kPa to shut off head in 100 kPa increments.

Pumping water level (Borepump) will be recorded at each reading.

## **10.2 Setting Out**

The arrangement and general details as shown on drawings are essentially diagrammatic and must be applied to circumstances as found on site. It shall be the irrigation contractor's responsibility to report to the Superintendent any deviations between the drawings, specifications and the site. Failure to do so prior to the installing of equipment and resulting in the replacing and/or relocation of equipment, shall be done at the irrigation contractor's expense.

The irrigation contractor shall mark out the location of each run of pipes, sprinkler heads and valves prior to trenching. Before installation is started in any given area, the Superintendent shall check all locations and give his approval. All marking and setting out shall be as directed by the Superintendent.

Pieces of PVC pipe will not be acceptable as marking pegs and the irrigation contractor shall allow in his tender for the supply and use of white painted timber pegs, degradable paint or marker flags as provided by equipment wholesalers. All marking devices shall be removed on completion.

Location of all sprinkler heads, solenoid valves, etc. shall be marked on the construction drawing upon completion of works until recorded on the 'As Constructed' drawings.

## **10.3 Hold Points**

The following are specified hold points. The irrigation contractor shall contact the Superintendent before proceeding beyond these hold points. A minimum of 24 hrs notice shall be given to the Superintendent, of the hold point being reached.

- After flow testing a Water Corporation main supply connection point and before proceeding with installation.
- Following a bore or borepump flow test and before ordering a new pump.
- Following pegging of mainline route around the site, and before commencing trenching.
- Following pegging of the sprinkler layout on the playing field and before commencing trenching.
- Following mainline installation and thrust block installation before back filling.

## **10.4 Existing Irrigation Systems & Associated Equipment**

The Contractor shall repair immediately any existing systems not within the area of modification, damaged whilst constructing the new system. These works shall be at the Contractors expense. Any valves and sprinklers within the area of modification that will not form part of the new system shall be removed by the Contractor and returned to the UWA Grounds Maintenance Area or as otherwise instructed in the Project Specification or by the Superintendent.

Existing sprinkler heads shall be removed by the Contractor and given to UWA Grounds Staff. The Contractor shall operate the existing system, prior to disconnecting any equipment, to identify, mark and remove any existing heads. Any pipes, sprinkler heads (all types) and valves shall remain at UWA as part of UWA property.

The Contractor shall remove all obsolete and disused electrical cabinets, connections, pumps, discharge pipework and any other equipment as requested by the Superintendent, from site, unless otherwise specified in the project specifications for each project.

Ideally, this equipment shall be removed during the construction period, but if not it shall be removed within 7 days of the date of Practical Completion.

Failure to do so will result in the Superintendent making alternative arrangements for the removal of any such equipment and deducting the cost from the contract sum payable to the Contractor.

Old bores which are being replaced shall be backfilled and capped in accordance with Water and Rivers Commission requirements.

Old Wells which are no longer required shall be demolished and back filled by the Contractor after removal of all pipework and pumps.

Wells and bores shall be demolished to the extent that they do not provide a hazard for future use, cultivation and maintenance of the area.

## **10.5 Pipework**

### **10.5.1 PVC Pipe**

PVC pressure pipe and fittings shall be installed strictly in accordance with manufacturer's recommendations and the relevant Australian Standard Code of Recommended Practice.

All underground piping shall be uPVC piping manufactured to Australian Standard 1477.1 - 1988. Tenderers shall state in the product schedule the make of piping to be used.

mPVC to AS4765 2002 will be accepted in 100mm and 150mm sizes of class 12 and above.

uPVC and mPVC shall not be mixed within the mainline run on any one site.

The type of PVC pipe used shall be recorded on the 'as constructed' drawings. Piping supplied and installed by the irrigation contractor shall be in accordance with the following:

**a) Mainlines and Sub-mains**

All mainline and sub-mains pipework shall be a minimum of Class '12' pressure rating.

Pipes of 80mm or larger shall be joined using rubber ring gaskets. Pipes up to and including 50mm shall be solvent welded joints.

**b) Lateral Pipework**

Lateral pipework installed on the down stream side of the solenoid control valves shall be a minimum of class 9 solvent weld jointed PVC pipe.

**10.5.2 Installation and Handling – PVC pipe**

Joining of the lengths of pipe on the surface shall be permitted provided care is taken in the handling of the assembled pipework.

When piping is being laid in hot weather conditions, precautions shall be taken by the irrigation contractor to allow for the contraction of the pipe line. Partial backfilling only will be permitted during hot weather conditions unless the irrigation contractor takes other necessary steps to contract the line.

Similarly, those necessary precautions shall be taken to prevent excessive expansion and movement of the pipework once installed.

Cutting of the pipe shall be done in a neat workmanlike manner with the use of a fine tooth saw, tube cutter, etc. The cuts shall be square and all burrs shall be removed.

The inside of pipes shall be kept free from dirt and debris and when pipe laying is not in progress, open ends of pipe shall be closed by an approved means.

**10.5.3 Pipe Sleeves**

Where required, sleeves are to be set at a minimum of 600mm and a maximum of 1000mm below finished, sealed or paved level.

Pipe sleeves shall be Class 9 uPVC SWJ sized to suit.

**10.5.4 PVC Pipe Fittings**

All PVC fittings supplied and installed by the irrigation contractor are to be manufactured AS1477.2-1990, AS1477.5-1988 and AS1477.6-1989 shall be

compatible with PVC pipe produced in accordance with the Standard. PVC fittings shall be manufactured to Class '18'.

Changes of direction of pipework shall be with standard fittings, excessive bending of the pipe shall not be permitted. The "crossing" of fittings shall under no circumstances be allowed. All outlet branches of tees shall be installed in the horizontal plane.

Fittings supplied and installed in underground pipework shall be in accordance with the following:-

**Mainline and sub-main up to 50mm diameter:**

Standard Class 18 moulded PVC fittings, solvent cement jointed.

**Mainline fittings 80mm diameter or larger shall be as follows:**

Bends	Elbows to be ductile iron, nylon coated.
Tees	All tees to be rubber ring joint, ductile iron nylon coated
Tapping Bands	Single branch and cross tapping bands shall be screwed bronze for pipe sizes of 80mm or larger.
Reducers	Rubber ring jointed ductile iron, nylon coated.
Flanges	All flanges on any pipework, fittings, valves etc shall be ductile iron, nylon coated.
Flange to PVC Socket Connectors	All flanged connectors shall be RRJ cast iron, nylon coated.
Lateral Line Fittings	Lateral pipework fittings located downstream of solenoid control valves shall be Class '18' moulded PVC fittings with solvent cement joints.

### 10.5.5 Pipe Joins – PVC

Solvent cements	Solvent cements supplied shall be in accordance with the manufacturer's recommendations for the climatic conditions that prevail during the installation of the system. Joint failure due to incorrect application of cement shall be the irrigation contractor's responsibility.
Priming fluid	Priming or cleaning fluids shall be as recommended by the pipe manufacturer. Priming fluid shall be used on all PVC SWJ pipe joins.
Rubber rings and lubricant	Rubber rings supplied for pipes and fittings shall comply with Australian Standards AS1646 - 1992. The supply of pipe and fittings shall include a ring lubricant as recommended by the manufacturer of the pipe or fittings.

### 10.5.6 LD polyethylene piping

Low density polyethylene pipe (LDPE piping) manufactured to AS2698.1-1984 shall be supplied in sizes as shown on the approved drawing.

All surface laid LD poly pipe shall be staked at maximum 3m intervals to minimise movement due to thermal expansion and contraction, or disturbance by Horticultural Staff.

### 10.5.7 LD polyethylene pipe fittings

LDPE pipe fitting shall be Wingfield barbed fittings or approved equivalent. Tube clips shall be attached to all fittings.

### 10.5.8 MD polyethylene piping

MDPE Polyethylene pipe shall be Type 80 of sizes and class shown on the drawing.

### 10.5.9 MD polyethylene fittings

HDPE pipe fittings shall be Plasson or an approved alternative. Tapping bands shall be secured with a minimum of 4 bolts and branch outlets shall have a stainless steel reinforcement ring. Securing bolts shall be Grade 416 stainless steel.

Flange connectors shall be pre-drilled and fitted with a hot dipped galvanised backing ring.

Use of electrofusion joint fittings will be approved provided all joints are carried out by experienced workmen in accordance with manufacturer's recommendations.

## 10.6 Sprinklers

All sprinklers at any paved surface or kerbing shall be set 300mm off the edging and 500mm off any building wall. Sprinkler spacing stated shall not be exceeded unless written permission is given by the Superintendent.

Sprinklers shall be to meet the type, performance and quantities as required by the project.

Where part circle sprinkler heads are installed on the same valve as full circle sprinklers, the part circle head will be fitted with reduced nozzle sizes to achieve an approximate matched precipitation with the full circle heads.

All sprinkler flushing tops and old or surplus nozzles will be removed from site by the irrigation contractor.

## 10.7 Mini Sprinklers or Micro Jets

Where mini sprinklers or jets are specified on the drawing they shall be mounted on stakes with a 4mm rigid riser with 0.5m of 4 mm micro tube attaching the sprinkler to LD Poly.

## 10.8 Bubblers

Pop-up bubblers shall be Toro adjustable flood bubblers fitted to Toro 570Z bodies.

Bubblers on fixed risers shall be Toro 500 series adjustable flood bubblers.

## 10.9 Spray or Rotator Head Sprinklers

Sprinklers shall meet the performance shown on the drawing.

Spray head and bubbler sprinkler assemblies shall be Toro 570Z assemblies fitted with built in stem pressure regulators, and the sprinkler shall be fitted with an anti drain valve. Only fixed arc spray nozzles will be used and shall provide matched precipitation between the various arcs. Rotator nozzles will be used as indicated on the drawings.

Hybrid sprinkler body / nozzle combinations will not be accepted. The exception to this is where Nelson Rotator nozzles are specified, in which case a Toro 570Z body will be used.

## 10.10 Large Rotors

All rotor sprinklers shall be Hunter I-20, I-31, I-41 with performance as specified on the drawings. All sprinklers shall be fitted with drain valves. Sprinklers shall have stainless steel riser stems.

### 10.10.1 Sprinkler Height & Adjustment

All sprinklers shall be installed as per the manufacturer's instructions and installed with their tops set to finished ground level.

The irrigation contractor shall be responsible for ensuring all sprinkler heads fully retract when not in operation and non-drain valves operate correctly to prevent line drainage.

Any changes to the height of sprinklers caused by subsidence of trenches shall be rectified by the irrigation contractor.

The irrigation contractor shall allow for returning to site after establishment of turf grass and adjust sprinkler heights where necessary.

### 10.10.2 Sprinkler Risers

Pop-up sprinkler heads All pop-up sprinkler heads shall be installed on rigid articulated risers (no flex pipe) which shall be installed to ensure that the riser is inclined at an angle of approximately 45° to the horizontal.

Spray heads Spray head sprinkler risers shall be 15mm x 300mm articulated risers and fittings. Flexible risers will not be accepted.

Shrub heads Shrub heads shall be mounted on 600mm rigid poly riser and articulated riser as above, riser to extend 300mm above ground level.

Rotor sprinklers Sprinkler risers shall be articulated type of sufficient length to ensure that the riser is inclined at an angle of 45° to the horizontal. Riser diameter shall be equivalent to the sprinklers inlet thread size.

Rotor sprinklers shall be fitted with anti theft risers.

### 10.10.3 Sprinkler arc patterns

All part-circle sprinklers shall have their arc patterns set to give the required coverage under the site wind conditions that prevail.

### 10.10.4 Sprinkler surrounds

Sprinkler surrounds shall be 300mm x 300mm square concrete surrounds with a minimum thickness of 80mm to suit the appropriate sprinklers. Surrounds shall be installed where indicated on the drawings.

### **10.11 Spare Parts/Components**

Tenderers shall allow in their tender price for the supply of a complete set of any special tools necessary for the maintenance of each type and model of sprinkler and a quantity of spare components as listed in the Schedules.

### **10.12 Drippers**

Drippers shall be a minimum of 24L/hour, or as nominated on the drawing. All drippers at trees shall be installed on a ring of 19 mm LDPE laid around each tree.

### **10.13 Filtration**

On sections of the system designed with drip irrigation a suitable 150 mesh screen filter shall be installed immediately downstream of the solenoid valve assembly with the arrangement shown on the drawing.

Maximum headloss across the clean filter at the valve flow shown will be 1.0 metre. The maximum working pressure of the filter will be at least 80 metres. All filters up to 40 mm will be fitted with a flushing tap and shall have a one metre length of hose attached to facilitate flushing.

### **10.14 Pressure Regulating Valve**

On sections of the system designed with drip irrigation a 20m pressure regulating valve shall be installed as detailed on the drawing. The regulator shall have a maximum operating pressure of 90 m or greater. Adjustment of the regulator will be achieved by changing the internal spring.

### **10.15 Solenoid Control Valves**

The Solenoid control valves used in the system design shall be Bermad 200 series. Alternative valves as will not be accepted, except for Emflow valves if nominated on the drawings.

The valve shall have a flow control stem and a manual bleed facility and valve shall be available in both angle and globe configuration.

Tenderers shall offer solenoid valves which meet the type, performance and size shown on the drawing.

The irrigation contractor shall install control valves with a valve socket and 200mm of PVC pipe to connect to the mainline.

Flow control stems are to be adjusted to ensure proper sprinkler operation. All threaded joints of control valves and associated fittings shall be thread seal taped to prevent leakage.

All solenoid valves shall be installed in turf areas, not in garden areas  
Battery operated solenoids shall not be permitted to use on Crawley campus..

**Battery operated solenoid control valve controllers shall be Hunter SVC controller valves or approved equivalent, with the ability to select days to water on or off for each day of the week, installed complete with a high quality 9V alkaline battery.**

Battery operated solenoid control valves shall be programmed by the Contractor to suit the requirements within the regulations as laid down by the Water Corporation to meet any water restrictions which may be in force at the time.

Battery operated valves shall be installed in a 1419 valve box. The valve box lids shall be fitted with a gravoply label attached to the top surface of the lid with 4 stainless steel self tapping screws. The label shall read follows:

*“Battery Operated Valve. Change battery in January each year”.*

### **10.16 Low Voltage Cables**

Solenoid valve control cables shall be Tyflo multi-strand copper conductors sheathed in polyethylene or polypropylene suitable for direct burial. Cable sizes shall be:

Common Wires	2.5mm <sup>2</sup> conductor.
Active Wires	Less than 400 metres in total length, using 1.5mm <sup>2</sup> conductor if longer than 400 metres using a minimum 2.5mm <sup>2</sup> conductor, or larger if required to ensure reliable operation of the solenoid valve.

A different colour of active wire shall be used for each solenoid valve with an individual cable being installed to each valve. Common wire shall be green. Spare wires shall be terminated in a 910 Valve Box. Spare wires at the terminal strip at the controller shall be bunched, taped and labelled as “spare wires”. The number and location of spare wires shall be nominated on the ‘as constructed’ drawing. Valve one shall be connected to station one on the controller, etc. Where the first station on the controller is ‘0’, it shall not be used. Where more than one wire of the same colour is used, all of the wires of the same colour shall be identified. The irrigation contractor shall use ‘Z’ type cable number ferrules, sized to suit the wire used, for wire number identification. Numbers shall be attached to the cable at both the controller and valve ends of the cable for all valves. Numbering must be secure and accurate.

#### **10.16.1 Installation and handling**

Care shall be taken at all times when laying cables not to drag, skin, kink, etc. any wires. Cables shall be neatly bundled and taped at approximately 6 metre intervals.

During hot weather cables shall be ‘snaked’ into trench to allow for contraction. A surplus loop of approximately one metre in length shall be neatly looped and placed alongside each solenoid valve to allow for future servicing.

The wire colours or numbers shall be recorded during the construction process to simplify compiling the valve wiring chart for the 'as constructed' drawing.

Wiring for the remote fault indicator lamp panel for pump faults shall be a minimum of 1.5mm 7 core multi core, sized to suit the run length required.

#### **10.16.2 Wire Connectors**

All solenoid cable joints shall be fitted with a crimp and sealed with a King One-Step connector, or 3M DBY connector. Alternative sealant kits shall not be used unless authorised by the Superintendent.

Wire connections to solenoid coils and joints in cables shall only be carried out by competent and experienced tradesmen.

The Solenoid wire shall be taped to the lateral pipework adjacent to the valve and the wire shall be looped in the valve box to allow flexibility in future maintenance works.

Ends of multi-strand wires shall be stripped by the use of correct size wire stripping pliers. Similarly only approved crimp pliers shall be used on crimp sleeves.

It is important that all joints be absolutely waterproof so that there is no chance of leakage of water and corrosion build-up on the joint. The specified sealant kits shall be used on ALL cable joints.

The number of in-ground joints shall be kept to an absolute minimum. The irrigation contractor shall utilise his cable drum lengths and off-cuts in a manner that will permit continuous cable runs from the controller to solenoid coils. Any cable joints not located at solenoid valve coils shall be made in an approved electrical cable pit and recorded on the 'As Constructed' drawings.

All cable joints shall be to the approval of the Superintendent. Pairing of cables shall only be made at the controller or the adjacent terminal strip.

#### **10.16.3 Conduit**

Cables shall be installed in LD conduit with cable pits at all changes in direction. All conduit for low voltage (24 V AC) control wires shall be a minimum of 25mm LD conduit.

#### **10.16.4 Cable pits**

Cable pits shall be installed at all changes of direction or at 100m intervals along long continuous runs of wire/conduit.

Cable pits shall be constructed as per the installation drawing, using a Havestock Litelift ductile iron cover. Refer to in ground services manual.

### 10.16.5 Spare wires

Spare wires shall be terminated in a 910 valve box and the number and location of spare wires shall be nominated on the 'as constructed' drawing. All spare wires shall be terminated in a DBY connector/s and marked "SPARE WIRES" using a fade proof marker pen. All spare wires shall be white.

### 10.17 Controller

The irrigation contractor shall supply and install an Irritrol MC irrigation controller within the pump control cabinet or in a location as nominated on the drawing.

The controller shall have the station capacity as called for on the drawing or project specification, as a minimum number of stations. The station output terminals on the controller shall be labelled starting from the number 'one'.

The controller shall be installed in accordance with the manufacturer's published instructions for the model of controller offered.

The same model controller shall be offered for all sites within the contract, with the station capacity sized to meet the needs of each specific site.

The irrigation designer shall provide a valve table guide for use when grouping valves and programming controller.

Pairing of valve cables shall only be made at the controller or an adjacent terminal strip.

Where solenoid field wiring terminates at a terminal strip within the, and different coloured wiring is used between the terminal strip and the irrigation controller terminals (e.g. multi-core), a label shall be attached to the controller indicating that:

**"Solenoid wire colours shown on the controller are internal wiring only. For field wiring colours, refer to terminal strip."**

The Controller shall be set by the irrigation contractor, for the station run times to provide 100% of peak requirement in January. The irrigation contractor will adjust the percentage to suit the climatic conditions at the time of Practical Completion.

Back up batteries shall be installed in all controllers.

Unused stations on the controller shall be bridged to the last active station. Valve one shall be connected to station one on the controller. Where the first station on the controller is '0', it shall not be used.

## 10.18 Valve Boxes

MDPE valve boxes without pipe portals shall be supplied, with overlay style lockable lids with stainless steel locking bolts. Valve boxes shall have minimum dimensions in accordance with the following models: refer to in ground services manual.

Super Jumbo	To be fitted to all in ground filter assemblies and scheme water connection points.
Model 1419-12	To be fitted to all solenoid valves and flushing valves.
Box	To house all isolation valves.

Carson Brooks or HR products tested valve boxes which meet the above specification are acceptable for 1419, Super Jumbo and 910 valve boxes. The valve box lid shall clearly identify the box as being either Carson Brooks or H-R Products.

All valve boxes shall be installed on at least one course of unmortared bricks or similar and allow servicing of valve without removal of the valve box.

All valve boxes located within ovals, parkland or assembly areas shall be buried with the top at 150mm below ground level. The precise location of the valve box shall be marked on the 'as constructed' drawing.

Buried valve boxes shall be fitted with a galvanised steel plate 80mm x 100mm permanently attached to the underside of the lid.

Valve boxes with pipe access holes shall not be used, unless the access hole is required for the installed configuration for any given valve.

Valves shall be centrally located within the valve box and the valve shall be clearly exposed within the valve box. All excess sand and soil within the box will be removed by the irrigation contractor.

Adequate clearance shall be provided between the top of the valve and the valve box lid underside.

A layer of gravel, (approximately 50mm thick) shall be laid across the base area covered by the valve box.

## 10.19 Isolation Valves

Isolation valves shall be installed at junctions of mainlines as shown on the project drawings. Price for installation of valves shall include the installation of valve boxes. Access to valve assemblies located below the bottom of valve

boxes shall be provided by the installation of a short piece of 250mm nominal diameter PVC 'Ribloc' pipe or equivalent.

Isolation ball valves installed on the inlet to solenoid control valves and on mainline up to 50mm diameter shall be stainless steel ball and stem and handle ball valves.

On 80mm and above mainline size use ductile iron resilient seated valve with spindle cap. Valves shall be configured for 'clockwise turning' to close and the top of the spindle cap shall have an **embossed arrow indicating the direction to turn for closing**. **Note: Non conforming valves shall be replaced at the irrigation contractor's expense.** Valves shall be configured for flange mounting and shall be enclosed in a valve box as specified.

The irrigation contractor shall supply one 665mm valve actuating key with 'T' handle for each site for use with the valves. Where the spindle caps are different sizes on any given site, a valve actuating key will be provided for each size of cap at that site.

The irrigation contractor shall allow for adjusting valve box heights after the re-establishment of turf.

## 10.20 Air/Vacuum Release Valves

Air release valves shall be installed at high points in the mainline in the approximate locations as shown in the drawings, or as determined by site conditions.

The precise location shall be subject to the approval of the Superintendent. Air/Vacuum release valves shall be 50mm diameter ARI or Nelson non corroding valve inlet to be fitted with isolation ball valve. Refer to drawings and project specification.

Air release valves shall be installed in a Model 910 valve box with top of valve box set at ground level. A 50mm ball valve shall be located immediately beneath the air valve and the ball valve shall be left in the open position.

## 10.21 Flow Meter

Where called for in the project specification, an appropriate flow meter will be installed. The assembly shall be installed in a 1419 valve box and shall be supplied with a remote display, to be housed in the control cabinet which has the ability to record and display the following information.

- Flow Rate in L/sec.
- Re-settable cumulative flow volume.
- Non re-settable cumulative flow volume.

The remote display shall be installed in the pump control cabinet.

## 10.22 Backflow Prevention

Scheme water is not to be used unless approved by UWA Senior technical officer hydraulics. Where scheme water is used in the irrigation system, a suitable backflow prevention device shall be installed by the Contractor. This shall be to AS3500 and the local plumbing inspector's requirements. Devices considered as appropriate are dual check or double check backflow valves as appropriate or air gaps as specified in the Australian Standard when used for tank filling. The maximum velocity across the backflow valve shall not exceed 2.2 m/sec.

The Contractor shall connect to the existing Water Corporation main with the installation of a Water Corporation approved gate valve, master solenoid valve and backflow prevention device. The connection point will be at the approximate location shown on the drawing.

Where the Australian Standard and local codes permit, the backflow assembly shall be located below ground in a jumbo valve box.

Where the assembly is located above ground a lockable removable galvanised cover will be fitted.

## 10.23 Bolts and Nuts

All bolts, nuts and washers shall be in accordance with AS1110, AS1111 AND AS1112 and hot dipped galvanised in accordance with AS1214. Bolts, nuts and washers shall be of similar material.

Washers shall be fitted to all bolts and shall be tapered where necessary to give the heads and nuts of bolts a satisfactory bearing surface. The threaded portion of each bolt shall project through the nut by at least one full thread and not more than a distance equal to the bolt diameter.

## 10.24 Rain Shut Off Devices

Where called for in the project specification a Hunter Mini-Click-C (½" female threaded inlet) rain shut off device shall be securely installed in a position to minimise the potential for vandal damage while remaining accessible for servicing. The mounting plate for the device shall be made using non corrosive material and shall be configured to allow easy adjustment of the mini click device. All wiring shall be enclosed in electrical conduit and shall be connected to the control system via a manual bypass switch. The mini-click shall be adjusted to activate after rainfall events exceeding 5mm.

## 10.25 Testing, Commissioning and Maintenance Specification

### 10.25.1 General

The Contractor shall undertake all necessary testing, commissioning and maintenance of equipment installed with the irrigation systems. Examination and

testing shall be carried out by the Contractor as an integral part of the work under the Contract.

### **10.25.2 Warranties**

The Contractor shall obtain and undertake the warranty of all materials and workmanship in accordance with the following:

Bore pump and motor	2 year from date of practical completion
Electrical cabinets, controls and equipment	1 year from date of practical completion
Pipe, fittings, valves and other components associated with all pipework.	1 year from date of practical completion.
Gear drive sprinklers	5 years
Workmanship and all installations	1 year from date of practical completion.

The Contractor shall provide written guarantees for all equipment and works supplied or carried out. Manufacturer's guarantees in excess of one year shall be provided to the Superintendent for the Principals records at practical completion.

The Contractor shall be required to complete a Quality Assurance Compliance form, prepared by HydroPlan (Form No. HP44-16).

### **10.25.3 Pump and electrical systems testing**

The Contractor shall allow for returning to the site upon completion of all works and carry out running tests in the presence of the Superintendent to ensure all switches, settings and protection devices etc. are operating as specified, prior to practical completion.

Testing of all new pump installation shall be undertaken by the Contractor at the completion of all installations to verify performance against the design data pump flow. Tests shall record flow and pressure readings at 100kPa increments up to shut off head, and the flow at design pressure.

### **10.25.4 Flushing**

Prior to Testing, the system or parts thereof shall be thoroughly flushed with clean water to remove dirt and debris which may have entered the pipework during installation.

When flushing, the Contractor shall flush only one valve or one controller station at a time to avoid pumping the bore at an excessive discharge rate.

The Contractor shall make good any surface eroded by water during flushing operations.

If during the system installation, sand, soil, dirt or debris enters the pipework of these parts of the total system previously installed, the Contractor shall flush out and clear any blockages caused in that pipework.

### **10.25.5 Practical completion**

Practical completion of the systems shall not be given until all components and works are satisfactorily tested and commissioned by the Irrigation Contractor, training on the system operation is given to the Principal's nominated representative and all project completion documentation is satisfactorily completed and given to the superintendent.

The Practical Completion hand over inspection shall include the following personnel:

- The Principal or Representative
- The Superintendent's Representative
- The Facility Manager or Regional Manager (Maintenance)
- The Contractor's Project Manager

Practical Completion for the Contract shall be given when the Works have been completed at all sites included in the Contract.

The Contractor shall ensure that the Irrigation Systems are programmed to operate automatically as soon as possible during/following installation to ensure rapid recovery of plant growth.

The Contractor shall ensure that the system is operated automatically, to suit prevailing climatic conditions until the date of Practical Completion of the Contract, when UWA will take over responsibility for operation of the system.

### **10.25.6 Commissioning**

It is the Contractors responsibility to pre-commission the system before requesting the Superintendent for Practical Completion.

The Contractor shall complete the pre-commissioning checklist and submit to Superintendent to verify that pre-commissioning has been completed, prior to Practical Completion inspection.

In the event that a second inspection is required, the Contractor will pay for the Superintendents attendance at the Superintendents standard hourly rate.

### **10.25.7 Training**

The Contractor shall allow to provide a minimum of three separate training sessions for the system operators. The Contractor must allow for the fact that the automatic system is new to the site and the responsible staff will take some time to familiarise themselves with the system operation. The level of support will vary depending on the experience of the operator. The training sessions shall cover the following as a minimum:-

- System walk through to show location of;
- Mainline.
- Connections to existing system.
- Location of all solenoid valves and isolating valves.
- Different sprinkler heads used and precipitation rates.
- Sprinkler operation and adjustments.
- Solenoid valve operation, maintenance, and adjustments.
- Controller programming, auto run procedure, manual run procedure.
- Operating of pumps and any limitations.
- Description of pump fault indicators and testing procedure.
- Description of pump control safety settings and location of switches.
- Emergency shut down procedures and system start up procedures.
- Routine maintenance requirements.
- Contract names/numbers for ongoing support during the D.L.P.

The Contractor shall cover the above points during an initial training session within seven (7) days of the date of Practical Completion, followed by a second session when the 'as constructed' drawing and operator manuals are presented.

#### **10.25.8 Maintenance**

During the period of the Contract, the Contractor shall effect immediate repairs to any component failure or malfunction, including damage resulting from the activities of other Contractors working on the site.

#### **10.25.9 Defects liability period**

The Contractor shall be allowed to return to site as often as is required during DLP to adjust the following:

- Sprinkler head heights.
- Valve box heights.
- Trench subsidence.
- Sprinkler arc settings.

The Contractor shall allow for a minimum of three site visits during the defects period, plus a final inspection visit. The final inspection visit shall be conducted within 30 days prior to the date of final completion.

The Superintendent may vary the number of visits required, depending on the date and season of commissioning of each system.

The Contractor shall nominate the proposed dates (week commencing) of DLP visits on the DLP checklist (Schedule O) at the time of Practical Completion and provide a copy of the Schedule to the Superintendent's Representative. A copy of the checklist will be given to the superintendent at the time of the site visit.

The following shall be checked at the time of each visit.

- Check all valves servicing the new works are fully operational.
- Check all sprinklers are popping up and rotating, record quantity of faulty sprinklers.
- Check for trench subsidence and fill as necessary to maintain level with the adjacent surfaces.
- Adjust sprinkler arcs as required.
- Check and record operating pressures.
- Check pump operation and amperage readings, record amperage readings and pump run hours at each visit.
- Check and test pump safety switch operation and settings.
- Check and tighten all electrical connections.

The Contractor shall respond with a site visit within 24 hours of being advised of a problem by the Maintenance Staff during the DLP.

The Contractor shall have adequate resources to provide this level of service. Any work during Maintenance visits which falls outside the Scope of DLP obligations shall be charged by the Contractor in accordance with the Schedule of Rates.

The Contractor shall provide a report to the Superintendent within 14 days of each visit, showing the status of each of the above items and readings taken.

#### **10.25.10 Pump switch gear safety settings**

The Contractor shall set the safety switch settings of the pump and record these on the 'as constructed' drawings. Settings shall include:

- High Pressure Cut Out setting in kPa and Time Delay. Contractor to ensure that the high pressure set point is below the shut off pressure of the pump installed, as measured at the point of connection of the high pressure take off.
- Low Pressure Cut Out setting in kPa and Time Delay.
- Tank water level probe settings for;
  - start filling
  - stop filling
  - low level cut out
  - minimum level when irrigation pump can restart.
  -

The Contractor shall provide details of all tank water level probe settings as part of the system 'as constructed' detail.

#### **10.25.11 Final inspection**

The Contractor shall be required to attend a final inspection meeting during the last four weeks of the defects liability period at a time to be advised by the Superintendents Representative. Others to attend shall be as per the list for Practical Completion Inspection.

**10.25.12 Pre-commissioning check list**

The Contractor shall pre-commission the system and complete the following check list before requesting Practical Completion Inspection. A completed checklist shall be submitted to the Superintendent.

Item	Description	YES	NO	N/A
1	Verify That the layout was pegged out and full coverage achieved prior to commencing installation.			
2	As Constructed detail was marked up daily during construction.			
3	Draft 'As Constructed' drawings have been prepared for submission at PC Inspection.			
4	All trenches backfilled, compacted and level.			
5	All sprinkler heads set with tops set level with finished grade.			
6	All valve boxes set with tops level with finished grade.			
7	Solenoid control valves installed centrally within valve box and clearly exposed within the valve box.			
8	Sprinkler nozzle pressure tested and recorded at the system furthest point and two intermediate points from the pump/meter.			
9	Sprinkler coverage checked and a minimum head to head coverage achieved throughout the site.			
10	Sprinkler arcs set to cover required areas only.			
11	Pump operating pressure in kPa and flow (L/sec) recorded for each controller station. Provide list of readings with the pre-commissioning check list.			
12	Controller programmed to meet the ground staffs' requirements.			
13	Old equipment removed from site.			
14	Existing services including, phone, power, gas, water, tested and integrity verified.			

Contractor \_\_\_\_\_ Signed \_\_\_\_\_

Date \_\_\_\_\_

## **11.0 CONNECTION TO EXISTING SERVICES**

### **11.1 Liaise with Relevant Trades**

Facilities Management will determine a suitable programme, outlining the agreed times and dates when connection to and/or diversion of existing services is to take place. Produce the programme for review by all involved in the work to be undertaken.

Include costs for carrying out of such works out of normal working hours including weekends. Such works shall take place during periods of low flow or demand.

### **11.2 Hand Digging Excavation**

Hand digging excavation around and near within 1 metre of existing services shall be carried out. Machines shall NOT be used unless approved by Facilities Management.

### **11.3 Notice**

Give 24 hours notice to Facilities Management prior to exposing the existing service, so that Technical Officers may inspect its condition and instruct on any remedial action required to safeguard its integrity.

## **12.0 MECHANICAL PLANT ROOMS (Refurbished and New)**

### **12.1 Drains**

Drains are to be located as near as possible to the centre of the plant room. The waste line from this drain must run to Sewer.

### **12.2 Drain Charging Line**

The plumbing contractor is responsible for the drain charging line and solenoid valve. 24 volt DC.

### **12.3 Building Management System**

TAC will be responsible for connecting the drain charging solenoid to the BMS.

### **12.4 Plant Room Penetrations**

Where services, ducting, pipe work and electrical conduits penetrate the plant room wall they must be sealed.

## 12.5 Plant Room Floors

To grade towards waste and grates without pooling.

## 12.6 Plant Room Painting

Valves, pipes, conduits and other associated installations in plant rooms to be painted as per appendix unless approved by Senior Hydraulic Services Officer.

## 13.0 DRAWING SPECIFICATION

### 13.1 Documents

Documents include: Drawings-Specifications - Operational/Maintenance Manuals.

Consultants must provide accurate drawings of the completed project. These are designated "As-constructed" drawings in CAD format. The FM Drawing Office being a CAD based FM system requires all graphical data to be correctly positioned and orientated in relation to the site plans. The electronic data shall be pictorially and dimensionally accurate. Not to scale drawing are unacceptable.

### 13.2 Plan Drawing Standards

All site plans are to be provided with North up the page and drawn at a scale of 1:100 (actual CAD scale) including the location plan. Unless building plans are drawn to represent their site location angle, all plans are to be drawn normal to drawing sheet axes. Layers must be used to clearly identify elements within the drawings with like elements on the same layer to allow subsequent segregation of required data. Differing line styles are to be used to designate services. Continuous lines with text notes added to designate services are an acceptable alternative. Where symbol fonts are used to designate graphical items, the font libraries are to be included with the supplied data.

### 13.3 File Reference Numbers

FM Drawing Office uses an electronic drawing register that can be searched using various fields. The drawing/data is then retrieved by reference to a '**Registered Drawing Number**'.

Drawings provided by outside consultants are to have an FM Drawing Office '**Registered Drawing Number**' attached prior to *As Constructed* issue to UWA.

The format of the number will be: **123A123**

123- 3 digit UWA building asset number

A - Discipline reference A - Architectural M - Mechanical etc.

123 - 3 digit Drawing number allocated by FM.

A group of numbers for each discipline (Architectural - Mechanical etc.) is to be obtained from the FM Drawing Office. 9380 1866.

### 13.4 Approval Process

*Refer to flow chart (hereunder for additional explanation)*

Architects/Consultants/Contractors are to supply to FM Project Manager 2 paper copies of all final drawings and ONE unbound copy of specifications and manuals for "As Constructed Approval".

The documentation will be checked by FM. Any discrepancies will be referred back for correction and the approval submission repeated.

The Project Manager will give written confirmation of approval. Once approval has been given the Architect - Consultant - Contractor will supply electronic and printed data as noted above.

All data must match previously approved prints. The data will be verified by FM and any discrepancies referred back to the Architect/Consultant. To conserve disk space files/folders may be compressed using "WinZip".

Any queries about the above should be directed to the FM Drawing Office 6488 1866.

### 13.5 Drawing Format

Drawings are to be supplied in **MicroGDS or AutoCAD** format. Any specific line - character style files and pen tables used to plot files are to be included. A text file is to be included that references Registered Drawing number to file title.

### 13.6 Text Data Format

Word Document format on CD. These files are to be on a separate CD from any CAD data. The format of the text files to be either text or pdf.

### 13.7 New Buildings

In new buildings, or where other installed systems have not been previously documented for the building three bound copies of Operations and Maintenance Manuals including Manufacturer's Equipment, Commissioning and Balancing, and Controls Data.

## 13.8 Existing Systems

Systems installed or upgraded in Buildings where other systems have been previously documented in an Operation and Maintenance Manual: - Equipment, Commissioning, Balancing and Control Data to update the existing Building Manual is required together with revisions to existing drawings, where appropriate, to show whole systems on one drawing or set of drawings.

Manuals are to be presented in an electronic format, in PDF and Word format. Manufacturer's data and drawings can be attached electronically, but if they are not available in this form, clear scanned copies will be accepted.

1 CD's of the Operation and Maintenance Manuals are required.

1 CD's of As Constructed Drawings

1 sets of hard copies of the As Constructed Drawings