THE UNIVERSITY OF WESTERN AUSTRALIA

The University of Western Australia

Design and Construction Standards

IRRIGATION SERVICES

J

DOCUMENT CONTROL

REVISION LOG

Current Issue

UWA Design and Construction Standards: Irrigation Services - J, Version 1.0 (September 2016)

Previous issues

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REVISION MANAGEMENT

It is envisaged that revisions to this document will be undertaken at intervals of not more than two (2) years.

ENDORSEMENT BODY

To be determined.

OWNER

Director, Campus Management

AUTHOR(S)

The Standards have been developed by Campus Management with the assistance of UWA staff, external consultants, contractors and colleagues from other education institutions.

CONTACT PERSON

Associate Director Capital Works, Campus Management

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Table of Contents

1 Introduction

1.1 PURPOSE

The UWA Design and Construction Standards (the *Standards*) outline UWA's expectations for its built forms in order to achieve consistency in the quality of the design and construction of those built forms. They are aligned with the UWA's *Campus Plan 2010* planning principles and UWA's requisites for aesthetic appeal, maintainability and environmental sustainability, while ensuring that there is sufficient scope for innovation and technological advancements to be explored within each project.

The Standards are intended for use by any parties who may be involved in the planning, design and construction of UWA facilities. This includes external consultants and contractors, UWA planners, designers and project managers as well as faculty and office staff who may be involved in the planning, design, maintenance or refurbishment of facilities. These Standards also provide facility managers, maintenance contractors and other service providers with an understanding of UWA services in order to assist in the maintenance and operation of facilities.

1.2 SERVICES

The UWA Design and Construction Standards for **Irrigation Services** (this document) are a part of UWA Design and Construction Standards set of documents (the Standards). The Standards are divided into the following service documents for ease of use, but must be considered in its entirety, regardless of specific discipline or responsibilities:

A Building and Architecture
B Mechanical Services
C Electrical Services
D Communication Services
E Hydraulic Services
F Security Services
G Fire Services and Fire Safety Engineering
H Structural Works
I Civil Works
J Irrigation Services (this document)
K Sustainability
L Vertical Transport

1.3 RELATED DOCUMENTS

1.3.1 University Documents

The Standards are to be read in conjunction with the following relevant University documents:

- UWA General Preliminaries Document
- UWA Specification for As-Constructed Documentation
- Relevant UWA planning and policy documents such as the *UWA Campus Plan*, *Commercial Masterplan*, *Landscape Vision* and *Integrated Infrastructure Strategy*, *University Policy on Alterations to University Buildings*, etc.
- Relevant UWA operational and maintenance documents such as preferred vendors lists, room data sheets, operational and maintenance manuals, etc.
- Other documents as referenced within the *UWA Design and Construction Standards*.

1.3.2 Relevant Legislation

The planning, design and construction of each UWA facility must fully comply with current relevant legislation, including but not limited to:

- Relevant Australian or Australian / New Zealand Standards (AS/NZS),
- National Construction Code (NCC),
- Occupational Safety and Health (OSH) legislation,
- Disability Discrimination Act (DDA),
- Accessibility Aspiration Design Factors, and
- Local council and authority requirements.

1.3.3 Manufacturer Specifications and Data Sheets

All installation must be carried out in accordance with manufacturer specifications and data sheets to ensure product performance over its intended life and so as not to invalidate any warranties.

1.3.4 Project Specific Documentation

Requirements specific to a particular project, campus or other variable, will be covered by project specific documentation, such as client briefs, specifications and drawings. These Standards will supplement any such project specific documentation.

The Standards do not take precedence over any contract document, although they will typically be cross-referenced in such documentation.

Extracts from the Standards may be incorporated in specifications, however it must remain the consultant's and

contractor's responsibility to fully investigate the needs of the University and produce designs and documents that are entirely 'fit for purpose' and which meet the 'intent' of the project brief.

1.4 DISCREPANCIES

The Standards outline the University's generic requirements above and beyond the above mentioned legislation. Where the Standards outline a higher standard than within the relevant legislation, the Standards will take precedence.

If any discrepancies are found between any relevant legislation, the Standards and project specific documentation, these discrepancies should be highlighted in writing to the Associate Director Capital Works, Campus Management.

1.5 DEPARTURES

The intent of the Standards is to achieve consistency in the quality of the design and construction of the University's built forms. However, consultants and contractors are expected to propose 'best practice / state of the art' construction techniques, and introduce technological changes that support pragmatic, innovative design.

In recognition of this, any departures from relevant legislation, or the Standards, if allowed, must be confirmed in writing by the Associate Director Capital Works, Campus Management.

Any departures made without such written confirmation shall be rectified at no cost to UWA.

1.6 PROFESSIONAL SERVICES

For all works, it is expected that suitably qualified and experienced professionals are engaged to interpret and apply these Standards to UWA projects. Works cannot be carried out by unqualified and unlicensed consultants or contractors.

1.7 STRUCTURE OF DOCUMENT

This document is structured into 4 parts:

Part 1 Introduction (this Section)
Part 2 General Requirements – outlines the general requirements or design philosophies adopted at UWA
Part 3 Checklist for project team – checklist of items for consideration at various stages of a project
Part 4 Specifications (if applicable) – materials specifications and/or preferred lists for materials, processes or equipment used by UWA.

1.8 DEFINITIONS

For the purpose of this document, the following definitions apply:

Can: Implies a capability of possibility and refers to the ability of the user of the document, or to a possibility that is available or might occur.

May: Indicates the existence of an option.

Shall: Indicates that a statement is mandatory.

Should: Indicates a recommendation.

2 General Requirements

This specification describes the requirements for the design and construction of automatic irrigation systems at UWA sites, and is based on the following:

- The irrigation design shall be prepared by a Certified Irrigation Designer (CID), as certified by Irrigation Australia Ltd (IAL). The designer shall hold current certification in the Commercial Landscape Turf discipline and shall have at least three years design experience in designing similar irrigation systems.
- The irrigation design layout shall be as water efficient as is practical and shall avoid water wastage due to poor sprinkler uniformity, excessive nozzle pressure or spraying water on hard landscaped areas or building walls. Sprinkler DU, Hydrozones and pipeline velocities are nominated in this document.
- All UWA sites have an existing irrigation water supply and control system installed, which shall be used for any new irrigation works, subject to verification of suitability by the designer.
- Irrigation drawings shall be prepared in accordance with the *UWA Specifications for As Constructed Documentation*.

2.1 IRRIGATION WATER SUPPLY

Generally, the irrigation water supply will be provided by groundwater pumping directly from bores to the irrigation system.

The exception to this is at the McGillivray Sports Park site where the irrigation water supply is a combination of groundwater from on-site bores and treated wastewater from the Subiaco Waste Water Treatment Plant.

All new irrigation componentry for the McGillivray site shall be lilac coloured, in accordance with the Water Corporation and the WA Health Department requirements

Potable mains water or other sources, such as stormwater or wastewater from other process plants, shall only be used with prior approval from UWA.

The existing irrigation system at the Crawley Campus operates as a pressurised mainline with an operating set point of 500kPa and a maximum available flow rate of approximately 100L/sec at that pressure.

The irrigation network on the Crawley site is also used as a fire service for some buildings on the site. Any alterations to the irrigation mainline system must consider the effect on ALL of the functions of the irrigation / fire network.

For any irrigation works at the Crawley Campus, the following process must be adhered to:

- Approval must be obtained from UWA before isolating any section of the mainline for irrigation works. Any works on the mainline must be completed in an urgent manner and the mainline returned to full service with minimal delay. Only the section of mainline being worked on shall be isolated using the existing mainline isolating valves.

- Any work done downstream of the irrigation mainline, specifically for firefighting water supply purposes, shall be carried out in accordance with the *UWA Design and Construction Standards - Hydraulic Services* and *UWA Design and Construction Standards - Fire Services and Fire Safety Engineering* and relevant Australian Standards.

2.1.1 Flow Test

Prior to commencing any construction work and whenever specified for a given project, a pump flow test shall be conducted in accordance with Industry Standards where appropriate. Where a new meter is installed, a flow test shall be carried out within 7 days of the installation of the meter.

2.1.1.1 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 50kPa increments. The time of day and date of test will be included in the report and submitted to UWA prior to commencing any installation work.

2.1.1.2 Pump Performance Flow Test

Where required, (i.e., at a site where the irrigation mainline is not pressurised or where recent pump test data is not available), a pump performance test will be conducted on the existing pump which will be used to supply the proposed irrigation system. The flow will be recorded from 0kPa to shut off head in 100 kPa increments. Pumping water level (Bore) will be recorded at each pressure reading.

2.2 IRRIGATION PIPEWORK

2.2.1 PVC Pipe

PVC pressure pipe and fittings shall be installed in accordance with manufacturer's recommendations and the relevant Australian Standards.

All underground piping shall be uPVC piping manufactured in accordance with *AS 1477.1*.

mPVC, manufactured in accordance with *AS 4765* will be accepted in 100mm or larger in Class 12 and above.

The design velocity in the mainline shall not exceed 1.5m/sec during operation.

The size (mm) and class (PN rating) of the PVC pipe used shall be recorded on ‘as constructed’ drawings. Piping supplied and installed shall be in accordance with the following:

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.

Lateral Pipework

Lateral pipework installed on the downstream side of the solenoid control valves shall be a minimum of Class 9 solvent weld jointed PVC pipe, and the design velocity shall not exceed 2.0m/sec.

The total lateral line pressure loss within any given zone shall not exceed 10% of the sprinkler operating pressure.

2.2.2 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 laid in hot weather, precautions shall be taken to allow for the contraction of the pipe line.

Similarly, 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 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. When pipe laying is not in progress, open ends of pipe shall be closed by an approved means.

2.2.3 Pipe Sleeves

Where required under roadways or trafficable pathways, 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.

2.2.4 PVC Pipe Fittings

All PVC fittings are to be manufactured in accordance with *AS 1477.2*, *AS 1477.5* and A*S 1477.6* and shall be compatible with PVC pipe. 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. 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:

Bends	Elbows to be RRJ 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/Gunmetal bands with SS bolts and nitrile rubber seal shall be used for pipesizes of 80mm or larger.
Reducers	Rubber ring jointed ductile iron, nylon coated.
Flanges	All flanges on any pipework, fittings, valves, etc., shall be in accordance with *AS 4087* and shall have a minimum pressure rating of 14MPA.
Flange to PVC Socket Connectors	All flanged connectors shall be RRJ ductile iron, nylon coated
Lateral Line Fittings	Lateral pipework fittings located downstream of solenoid control valves and shall be Class 18 moulded PVC fittings with solvent cement joints.

2.2.5 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.
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 *AS 1646*. The supply of pipe and fittings shall include a ring lubricant as recommended by the manufacturer of the pipe or fittings.

2.2.6 Low Density Polyethylene Piping

Low density polyethylene pipe (LDPE piping) shall not be used unless approved by UWA.

If approved to be used, then LDPE shall be manufactured in accordance with *AS 2698.1*.

All surface laid LD poly pipe shall be staked at maximum 3m intervals to minimise movement due to thermal expansion and contraction, or disturbances during planting.

2.2.7 LD Polyethylene Pipe Fittings

Refer *Section 4.1* of this document for approved LDPE pipe fittings. Tube clips shall be attached to all fittings.

2.2.8 HD Polyethylene Piping

HDPE pipe shall be Type PE100 conforming to *AS/NZS 4130*. UWA approval is required for the use of HDPE pipe for any irrigation system. HDPE pipework shall be installed in accordance with *AS/NZS 2033* requirements.

2.2.9 HD Polyethylene Joins and Fittings

Refer *Section 4.1* of this document for approved HDPE pipe fittings. All HDPE fittings shall conform to AS 4129. 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 or butt welding joins will be approved, provided all joints are carried out by qualified and experienced contractors in accordance with manufacturer's recommendations.

Butt welding and electrofusion welding installers shall have current accreditation certificate demonstrating competence in all the standard procedures covered in PMBWELD301A and PMBWELD311A or the equivalent current at the time. The welding supervisor shall have at least three years' experience in butt fusion welding. Butt fusion welders shall be familiar with the butt fusion method and equipment employed.

A copy of the accreditation certificates held by installation staff shall be provided to UWA upon request.

2.3 IRRIGATION EQUIPMENT

2.3.1 Sprinklers

Sprinkler type selected shall be commercial grade, quality sprinklers to suit the site conditions that prevail. Refer *Section 4.1* of this document for approved products list.

Sprinkler spacing shall not exceed 50% of the wetted diameter of the sprinkler as stated by the manufacturer in the most current performance chart available, for the sprinkler / nozzle / pressure combinations selected.

The sprinkler layout in large turf areas shall be configured in an equilateral triangular pattern wherever practical.

The distribution uniformity (DU) of any sprinkler, in a layout using spacings of 8m or greater, shall be a minimum 75% DU.

Zoning shall be designed to allow separate scheduling of hydrozones, e.g., passive turf areas to operate independently of active turf areas.

Other Hydrozones shall be:

- Active Turf and specifically the playing areas of sports fields
- Passive Turf
- Native gardens
- Exotic Gardens
- Trees
- Other areas, including “event” areas, i.e., specific areas on which social or other events may be held from time to time.

Part-circle sprinklers shall be used along all roadways, around buildings and along property boundaries. Over spray onto pathways shall be avoided.

Sprinkler nozzle design pressure shall be within the manufacturer’s recommended pressure for the particular sprinkler and nozzle combination. Generally, sprinkler nozzle pressures will be in the range of 200 to 450kPa depending on the product/model of sprinkler used. The sprinkler used shall be suitable for effective operation at the available pressure.

Sprinklers which operate on the same station shall be matched in precipitation rates.

As a general rule, part circle sprinklers shall be grouped on separate stations (zones) from full circle sprinklers.

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

All Sprinklers shall be fitted with check valves and shall be installed on rigid articulated risers, (ie no flex pipe), sized as per the sprinkler inlet.

Sprinklers shall be set 300mm off any paved surface or kerbing and 500mm off any building wall.

Sprinklers in lawn areas shall have a 100mm pop-up height and sprinklers in garden areas shall have a 150mm pop-up height.

All sprinkler flushing tops and old or surplus nozzles shall be removed from site, following the completion of installation

2.3.2 Mini Sprinklers or Micro Jets

Mini sprinklers and micro-jets shall not be used.

2.3.3 Bubblers

Refer *Section 4.1* of this document for bubbler type. Bubbler nozzles shall be installed on a 100mm pop-up or on a rigid riser set 300mm above ground level, as appropriate for the landscaped area. Rigid risers shall be installed on an articulated riser.

2.3.4 Spray or Rotary Nozzle Sprinklers

Pop ups with Spray or Rotary nozzle assemblies shall be fitted with check valves. Where spray nozzles are used, only fixed arc spray nozzles will be used and shall have matched precipitation between the various arcs.

Refer *Section 4.1* of this document for spray and rotary nozzle sprinkler types.

2.3.5 Large Rotors

Refer *Section 4.1* of this document for rotor sprinkler types.

All sprinklers shall be fitted with check valves.

Sprinklers shall have stainless steel riser stems when installed in fresh ground with no established ground cover. Where the sprinklers are being installed in an established plant cover, stainless steel riser stems shall not be used.

All gear drive sprinklers shall be of a commercial grade and shall come with a minimum 5 year pro-rata warranty.

Gear drive sprinklers shall have rubber covers.

The distribution uniformity (DU) of any rotor sprinkler design layout shall be a minimum 75% DU.

2.3.5.1 Sprinkler Height and Adjustment

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

All sprinkler heads must fully retract when not in operation and non-drain valves must operate correctly to prevent line drainage.

Adjustment of sprinkler heights may be necessary after establishment of turf grass or subsidence of trenches.

2.3.5.2 Sprinkler Risers

Pop-up sprinklers with spray or rotary nozzles

All sprinkler bodies or rigid risers shall be installed on 15mm x 300mm rigid articulated risers (no flex pipe) which shall be installed to ensure that the riser is inclined at an angle of approximately 45^{o} to the horizontal.

Shrub heads

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

Pop-up 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 sprinkler's inlet thread size.

2.3.5.3 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. Arcs shall be set to avoid directly spraying onto building walls or hard landscaped areas.

2.3.5.4 Sprinkler Surrounds

Sprinkler surrounds shall only be used with approval from UWA. Where approved, sprinkler surrounds shall be 300mm x 300mm square concrete surrounds with a minimum thickness of 80mm to suit the appropriate sprinklers.

2.3.5.5 Spare Parts/Components

A complete set of any special tools necessary for the maintenance of each type and model of sprinkler used for any given project shall be provided to UWA. A quantity of other relevant spare components, particularly valves, valve boxes, sprinklers and nozzles, shall also be provided to UWA at the time of practical completion of the works.

2.3.6 Drippers

Drip irrigation shall not be used except with prior approval from UWA. Where approval is requested, the make, model flow rate, EU and FV of the proposed drippers, and the method of lateral installation shall be provided for UWA's approval. Dripper EU shall be 90% or greater and dripper FV shall be less than 20%.

2.3.7 Filtration

Where drip irrigation is approved, the system shall include a suitable 150 mesh screen filter, to be installed immediately downstream of the solenoid valve assembly.

Maximum headloss across the clean filter at the valve flow shall not exceed 1.0m. All filters up to 40mm will be fitted with a flushing tap and shall have a 1m length of hose attached to facilitate flushing.

Filters shall be installed to facilitate easy checking, flushing and filter element removal.

2.3.8 Pressure Regulating Valve

On sections of the system designed with drip irrigation, a 25m pressure regulating valve shall be installed. The regulator shall have a maximum operating pressure of 90m or greater. Adjustment of the regulator will be achieved by changing the internal spring.

2.3.9 Solenoid Control Valves

Refer *Section 4.1* of this document for solenoid control valve type to be used.

Pressure loss across the valve at the design flow shall not exceed 3.5m.

The system duty calculation shall allow for losses in the fittings immediately upstream and downstream of the valve.

Pressure regulated valves shall be used where required to ensure optimal operation of the sprinklers on each valve, without excessive misting.

The valve shall have a flow control stem and a manual bleed facility.

Install control valves with a tapping saddle, valve socket, Philmac ball valve (sized as per the solenoid valve) and 200mm of PVC pipe to connect to the mainline. Allow a minimum of 300mm of PVC pipe, sized as per the valve, downstream of the valve before connecting to the lateral pipework.

Flow control stems are to be adjusted to ensure optimal 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, providing it is practical to do so. Solenoid valves installed to service sprinklers in a playing field shall be located outside the perimeter of the playing area.

Battery operated solenoid valves shall not be used on Crawley campus.

2.3.10 Control Cables

Cabling and controls should be separate from the Electrical and Communications systems. Cabling installations (including containment) should match the standards nominated for the Electrical Services and all routes, depth of burial, pit positions and miscellaneous equipment should be coordinated with the requirements for the Electrical Services. Refer to *UWA Design and Construction Standards – Electrical Services*.

Solenoid valve control cables shall be multi-strand copper conductors sheathed in polyethylene or polypropylene suitable for direct burial. Refer *Section 4* of this document for cable type. Minimum cable sizes shall be:

Common Wires	2.5mm² conductor.
Active Wires	If less than 400m in total length, use 1.5mm² conductor If greater than 400m, use a minimum 2.5mm² 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 more than one wire of the same colour is used, all of the wires of the same colour shall be separately 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.

2.3.10.1 Installation and Handling

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

During hot weather, cables shall be 'snaked' into trenches to allow for contraction. A surplus loop of approximately 1m 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.

2.3.10.2 Wire Connectors

All solenoid cable joints shall be fitted with a crimp and sealed with a 3M DBRY connector. Alternative sealant kits shall not be used unless to meet the specific requirements of the equipment manufacturer.

Wire connections to solenoid coils and joints in cables shall only be carried out by a qualified installer, experienced in installing irrigation control system wiring. 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. 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 approved by UWA or its representative. Pairing of cables shall only be made at the controller or the adjacent terminal strip.

2.3.10.3 Conduit

All 24V solenoid control wiring shall be installed in MD (grey) electrical conduit, with a minimum of 25mm diameter. Cable pits are required at all changes in direction.

Any wiring, other than control wiring, shall be installed in conduit of the appropriate colour for the cabling being carried.

2.3.10.4 Cable Pits

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

Refer *Section 4.1* of this document for cable pit types.

2.3.10.5 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 connector/s and marked “SPARE WIRES” using a fade proof marker pen. All spare wires shall be white.

2.3.11 Controller

The irrigation system on the Crawley Campus is controlled using the UWA Building Management and Control System (BMCS). For the Crawley and Nedlands sites, BMCS controllers are located in:

- Octagon Theatre
- Human Movement Building (2 controllers)
- James Oval
- Art Gallery
- Nedlands

There are stand-alone proprietary controllers located at University Hall and Park Avenue sites. (i.e., not connected to the BMCS). All other UWA sites have existing stand alone controllers which shall be used for any new works, providing that the controller has the available capacity (ie spare stations). Ithe event that an existing controller does not have the required capacity, the make and model of the replacement controller shall be approved by UWA.

In the event that a new controller is required at the Crawley Campus, the controller unit shall be supplied by

UWA. Installation shall be by the Contractor. Each existing controller is programmed to operate the solenoid valves connected to the controller using a conventional multi-wire system between the controller and the valves.

Consult UWA with regards to availability of spare controller stations and solenoid wiring at the nearest controller.

Additional control wires for the operation of the new system may be required.

Provide a valve table guide when grouping valves and programming controller.

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

Liaise with UWA to operate new valves for testing and flushing.

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

2.3.12 Valve Boxes

Irrigation valve boxes installed in soft landscaped areas shall be Rainbird VB series valve boxes without pipe portals. Valve boxes 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:

- VB Super Jumbo Valve Box - to be fitted to all in-ground filter assemblies and mains water connection points.
- VB standard Valve Box - to be fitted to all solenoid valves and flushing valves.
- VB 250mm Round Valve Box - to house all isolation valves.

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.

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 shall be removed.

Where extra depth is required, the VB standard extension valve box shall be used.

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

In ground conditions which are not free draining sand, a layer of gravel, (approximately 50mm thick) shall be laid across the base area covered by the valve box.

GPS co-ordinates shall be provided on the as-constructed drawings for the location of all new valve boxes.

2.3.13 Isolating Valves

Isolation valves shall be installed at junctions of all mainlines. The location of all mainline isolating valves is critical and shall be approved by UWA.

Isolation ball valves installed on the inlet to solenoid control valves and on mainlines up to 50mm in diameter shall be Philmac ball valves.

On mainlines of diameter 80mm or greater, ductile iron resilient seated valve with spindle cap shall be used. 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. Valves shall be configured for flange mounting and shall be enclosed in a valve box.

A 665mm valve actuating key with 'T' handle shall be supplied to UWA.

Valve box heights shall be adjusted by the contractor, as required after the re-establishment of turf.

2.3.14 Air / Vacuum Release Valves

Air release valves shall be installed at high points in the mainline or as determined by site conditions. The exact location shall be approved by UWA.

Air / vacuum release valves shall be 50mm diameter ARI or Nelson non corroding valve inlet to be fitted with isolation ball valve.

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.

2.3.15 Flow Meters

Water meters are installed on all bores. Where a new water supply is established, or where there is a need to monitor / record the flow of irrigation water to supply a specific area, an appropriate electromagnetic flow meter shall be installed. The flow meter shall be installed in accordance with the manufacturer's straight pipe requirements. The assembly shall be installed in a jumbo valve box and shall be supplied with a remote display, to be housed in a suitable cabinet, and which has the ability to record and display the following information:

- Active Flow Rate in L/sec.
- Re-settable cumulative flow volume in kL or m^3.
- Non re-settable cumulative flow volume in kL or m^3.

All water meters are to be connected to the BMCS. Consult with UWA (Building Operations) regarding provision of BMCS connection.

2.3.16 Backflow Prevention

Mains water is not to be used as an irrigation water supply unless specifically approved by UWA.

Where mains water is used, a suitable backflow prevention device shall be installed in accordance with *AS 3500* and Water Corporation requirements. The maximum velocity across the backflow valve shall not exceed 2.2m/sec.

The backflow device and associated components shall be installed by a licensed plumber, authorised to do the work.

Connection to a Water Corporation main shall be with a Water Corporation approved gate valve, master solenoid valve and backflow prevention device. The connection point will be recorded on the as-constructed 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.

2.3.17 Bolts and Nuts

All bolts, nuts and washers shall be in accordance with *AS 1110*, *AS 1111* and *AS 1112*. They shall be hot dipped galvanised in accordance with *AS 1214*. 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.

2.4 SITE REQUIREMENTS

2.4.1 Setting Out

The arrangement and general details shown on design drawings are essentially diagrammatic and must be adjusted to suit the site conditions. The location of all existing in-ground services should be verified to coordinate the layout of new services prior to commencement of trenching. The Contractor shall report any deviations between the drawings, specifications and the site. Any replacement or relocation of equipment resulting from a failure to highlight deviations shall be at the Contractor's expense.

The Contractor shall mark out the location of each run of pipes, sprinkler heads and valves prior to trenching. Before installation, all marking and setting out shall be inspected by UWA or its representative.

Sections of PVC pipes will not be acceptable as marking pegs. White painted timber pegs, degradable paint or marker flags provided by equipment wholesalers shall be used. 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 and recorded on the 'As Constructed' documentation.

2.4.2 Inspection Points

The Contractor shall contact UWA before proceeding with the following:

- After flow testing of a Water Corporation main supply connection point and before proceeding with

installation

- Following a bore or borepump flow test and before purchasing a new pump
- Following pegging of mainline route, and before commencing trenching
- Following pegging of the sprinkler layout and before commencing trenching.
- Following mainline installation and thrust block installation before back filling.

A minimum of 24 hrs notice shall be provided.

2.4.3 Existing Irrigation Systems and Associated Equipment

Where an existing system is being replaced or upgraded, the existing sprinkler heads or valves shall be removed and returned to UWA, unless otherwise instructed. Operate the existing system, prior to disconnecting any equipment, to identify, mark and remove any existing heads. Any obsolete pipes, sprinkler heads (all types) and valves shall remain the property of UWA, unless otherwise instructed.

Remove all obsolete and disused electrical cabinets, connections, pumps, discharge pipework and any other equipment, unless otherwise instructed.

This equipment shall be removed during construction, otherwise not more than 7 days after practical completion.

2.4.4 Trench Construction

2.4.4.1 Alignment

Trenches shall be excavated such that the piping can be laid in parallel straight lines.

Use any necessary alignment devices or string lines to ensure accuracy and straightness of trenches.

Parallel trenches within 600mm of road kerbs shall not be permitted. All sprinklers installed along the road edge shall be offset so as to have minimal disturbance to the road base.

Lateral pipework for part-circle sprinklers shall be installed 600mm off road edges with a branch off at each sprinkler location.

2.4.4.2 Common Trenching

To allow for the installation of different pipes within the same trench, the width shall be sufficient to provide a minimum of 100mm separation between each pipe.

2.4.4.3 Depth

Trenches shall be excavated to a sufficient depth to provide a minimum of 500mm of soil cover over the mainline, 450mm over the PVC lateral pipework in turf areas and 300mm over laterals in non-turf areas. The exception is

piping buried under roadways, which shall be buried to a minimum depth of 600mm below the existing surface.

The trench depth shall also provide for the placement of approximately 100mm of clean bedding material into the bottom of the trench. In areas where the soil conditions of the trench bottom do not require a bedding material, the depth of trench shall be reduced by the thickness of bedding deleted.

2.4.4.4 Trench Bottom

The trench bottom shall be continuous, firm, relatively smooth, and free of rocks, rubble or sharp objects. The pipe shall be uniformly and continuously supported over its entire length.

Where required on site the trench bottom shall be undercut and filled with approved bedding sand.

2.4.4.5 Width

The trench width shall be sufficient to provide adequate room for joining the pipe in the trench, if this is necessary.

2.4.4.6 Road Crossings

Where required, use horizontal under-road boring methods where pipework crosses roadways or paths and provide appropriate sleeving.

2.4.4.7 Reinstatement of Existing Surfaces

Should it be necessary to excavate where piping is required to pass under made surfaces, it shall be the irrigation contractor's responsibility to make good this surface. A high quality of finish is required.

2.4.5 Backfill

Provide all necessary equipment for the backfilling, compaction and levelling of all trenches and removal of surplus spoil.

Provide all necessary labour and equipment for the transporting of the material to the trench site and its placement.

2.4.5.1 Pipe Embedment

Place suitable underlay and overlay sand to provide an embedment of 100mm thick (minimum) between the pipe and any unsuitable material. Supply all necessary sand for embedding pipes.

All pipe embedment material shall be selected and placed carefully to avoid rocks, rubble or sharp objects from being in contact with the pipe.

2.4.5.2 Final Backfill

After the placement of pipe embedment material, the balance of backfill material shall be with material excavated from the trenches.

Should the soil excavated be unsuitable for use, the irrigation contractor shall supply clean sand (as advised by UWA or as defined in the Australian Standard) for the final backfill.

Remove all surplus material from site.

Excessive subsidence of trenches after the completion of the works shall be rectified. Where additional top dressing or fill sand is required, only recognised sand suitable for top dressing of turf shall be used. Such sand shall be free of any extraneous matter. Brickies sand will not be accepted.

Trenches shall be plate compacted at the end of each day. All trench edges shall be raked and left with a high quality finish.

Trenches backfilled with final material shall be plate compacted.

In previously compacted areas, the compaction density and type of backfill shall be equal to the surrounding material.

All trenches will be subject to penetrometer testing before final acceptance.

2.4.5.3 Clean Up

The setting out and finish of the works is required to be of a high standard. Surfaces should be finished and cleaned to the same standard as that prior to commencing work.

This will include raking and compaction of all trenches.

All surplus or unsuitable spoil accumulated during the installation process shall be removed from the site.

2.4.6 Thrust Blocks

Thrust blocks shall be constructed in accordance with the pipe manufacturer's installation instructions and shall be constructed symmetrically about the centre line of the fitting.

The pipe or fittings shall be covered with a protective membrane of PVC when adjacent to concrete.

Concrete shall be thoroughly mixed on the surface prior to installation. Dry concrete mix and water shall not be mixed in the trench.

The use of quick set cement for thrust blocks will not be permitted.

Concrete thrust blocks shall be poured on site. Size and location shall be determined on site and shall suit the ground conditions. Thrust blocks shall have minimum dimensions of approximately 600 x 600 x 600mm.

Thrust blocks shall be installed on all RRJ mainline fittings, including elbows, bends, reducers, tees and isolation valves. 'Self straining' take-offs, such as tapping bands for air valves and tees to solvent welded branches for sub-mains, shall be excluded.

Thrust blocks shall be placed such that the pipe joint will be accessible for inspection and repair.

Concrete for thrust blocks shall be placed against undisturbed soil faces. All sides of thrust blocks not in contact with undisturbed soil shall be formed.

2.5 TESTING, COMMISSIONING AND MAINTENANCE

2.5.1 Warranties

The minimum warranty of all materials and workmanship shall be in accordance with the following:

- 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

2.5.2 Flushing

Prior to testing, and before instyalling sprinkler nozzles, 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.

Flush one valve or one controller station at a time to avoid pumping the bore at an excessive discharge rate.

Make good any surfaces eroded by water during flushing operations.

2.5.3 Testing

Upon completion of the works, testing of all switches, settings and protection devices shall be carried out in the presence of UWA.

Testing of all new pump installations shall be carried out at the completion of the installation 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.

Where bore pumps are being tested, the pumping water level (PWL) shall be recorded at each flow increment.

2.5.4 Practical Completion

Practical completion of the irrigation works shall not be given until:

- All components and works are satisfactorily tested and commissioned
- Training on the system operation has been provided to UWA
- All project completion documentation is satisfactorily completed and provided to UWA.

The irrigation system shall be 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 can operate automatically, to suit prevailing climatic conditions until the date of Practical Completion.

2.5.5 Training

A separate training session for system operators shall be provided. The level of support and training will vary depending on the experience of the operators and the sophistication of the equipment installed. The training shall cover the following as a minimum:

- System walk through to show location of:
    - Mainline and any new isolating valves
    - Connections to the existing system
    - Location of all new solenoid valves
- Different sprinkler heads used and precipitation rates
- Sprinkler operation and adjustments
- Solenoid valve operation, maintenance, and adjustments
- Controller programming
- Routine maintenance requirements
- Contract names/numbers for ongoing support during the DLP.

Two training sessions may be required, an initial session within 7 days from the date of Practical Completion and a second session when the Operations and Maintenance Manuals have been submitted.

2.5.6 Defects Liability Period

The contractor shall return to site during DLP, as often as is required to adjust the following:

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

The Contractor shall allow for a minimum of one site visit 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 contractor shall provide a DLP checklist at the time of each DLP visit.

The following shall be checked at the time of the 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 the system operating pressure.

2.5.7 As Constructed Drawings

As constructed drawings shall be provided in accordance with the *UWA Specifications for As Constructed Documentation*. One set of A1 paper drawings shall also be provided to UWA Grounds.

2.5.8 Pump Switch Gear Safety Settings

The safety switch settings of the pump system shall be checked and recorded in 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
- Where a storage tank has been supplied, 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, given as mm from the top edge of the tank wall, as part of the system 'as constructed' detail.

3 Checklist for Project Team

Activity	Responsibility	Stakeholder(s)	Timeframe
Irrigated area and Hydrozones confirmed	Irrigation Consultant	CM (Grounds)	Gate 3 Planning
Irrigation water source flow/pressure/quality and availability has been verified and confirmed	Irrigation Consultant	CM (Grounds)	Gate 3 Planning
Capacity of the control system to accommodate the proposed works has been verified and any discrepancy has been resolved.	Irrigation Consultant	CM (Grounds)	Gate 3 Planning
Sprinkler grouping/valving have been calculated with flow rates (L/sec) and precipitation rates (mm/hour) established for each group/valve.	Irrigation Consultant	CM (Grounds)	Gate 3 Planning
Provision for BMCS for controllers, valves and pressure sensors, etc.	Irrigation Consultant	CM (Building Operations)	Gate 3 Planning
All approvals required have been received and documented	Irrigation Consultant / Contractor	CM (Capital Works)	Gate 5 Construction
Authority to access restricted or difficult areas of UWA sites has been obtained.	Contractor	CM (Grounds)	Gate 5 Construction
Controller programmed to meet UWA requirements	Contractor	CM (Grounds)	Gate 5 Construction
All trenches backfilled, compacted and level.	Contractor		Gate 5 Construction
All sprinkler heads set with tops set level with finished grade.	Contractor	CM (Grounds)	Gate 5 Construction
Solenoid control valves installed centrally within valve box and clearly exposed within the valve box.	Contractor		Gate 5 Construction
Sprinkler nozzle pressure tested and recorded at the system furthest point and two intermediate points from the pump/meter.	Contractor	CM (Grounds)	Gate 5 Construction
Sprinkler coverage checked and a minimum head to head coverage achieved throughout the site.	Contractor	CM (Grounds)	Gate 5 Construction
Sprinkler arcs set to cover required areas only.	Contractor	CM (Grounds)	Gate 5 Construction
System operating pressure in kPa and flow (L/sec) recorded for each controller station	Irrigation Consultant / Contractor	CM (Grounds)	Gate 5 Construction

Activity	Responsibility	Stakeholder(s)	Timeframe
Provide list of readings with the pre-commissioning check list.	Irrigation Consultant / Contractor	CM (Grounds)	Gate 5 Construction
System testing and commissioning has been completed	Irrigation Consultant / Contractor	CM (Grounds) / CM (Capital Works)	Gate 6 Handover
Site has been left tidy and all construction debris removed	Irrigation Consultant / Contractor		Gate 6 Handover
Project completion documents have been submitted to UWA for approval	Irrigation Consultant / Contractor	CM (Capital Works)	Gate 6 Handover

4 Specifications

The table below nominates the standard products used by UWA. New irrigation systems shall utilise products from this list unless otherwise agreed with the UWA. In the event that any particular product is not readily available for a particular project, an alternative shall be submitted for consideration.

Item	Make	Model
Piping		
LDPE fittings	Philmac barbed fittings or approved equivalent	
HDPE fittings	Vinidex or an approved equivalent	Compression, Eletro-Fusion or Buttweld fittings
Sprinklers		
Gear drive/Rotor sprinklers	Hunter	PGP, i20, i25, i40
Spray body for spray or rotary nozzles	Toro	Toro 570Z-4 or 570Z-6 with bottom entry, and all with 570CV.
Rotary Nozzle type	Hunter	Hunter MP rotator nozzle
Spray Nozzle type	Toro	Toro Fixed arc matched precipitation nozzles, no adjustable arcs
Bubblers	Toro	Toro adjustable flood bubbler on 570Z-6 body or Toro 500 series bubbler on rigid riser
Solenoid Control Valves and Covers		
25mm	Bermad	200 series
40mm and 50mm	Bermad	200 series or 100 series
80mm and larger	Bermad	400 series
Valve boxes in soft landscaped areas	Rainbird	VB series, Models 10inch round, Standard and Super Jumbo
Valve boxes in hard landscaped areas		Refer UWA for construction details
Control wiring		Multi-core, multi strand copper conductor wiring.
Solenoid valve control cables	Tyflo	
Cable Pits in soft landscaped areas	Burdens	IDS P2 Cable Pit with unmarked concrete cover
Cable Pits in hard landscaped areas		Refer UWA
Wire joiners	3M	DBR/Y
Water Meters	Emflux	Electromagnetic flow meter with remote readout display

Abbreviations

BMCS	Building Management and Control System
CID	Certified Irrigation Designer
CM	Campus Management
DFES	Department of Fire and Emergency Services
DLP	Defects Liability Period
DU	Distribution Uniformity (of Irrigation Sprinklers)
EU	Emission Uniformity (Drip emitters)
FV	Flow Variation (Drip Emitters)
GPS	Global Positioning System
LD	Low Density
LDPE	Low Density Polyethylene
MD	Medium Density
HD	High Density
mPVC	Modified Poly Vinyl Chloride
PN	Pressure Numbers (ratings)
PVC	Poly Vinyl Chloride
PWL	Pumping Water Level
RRJ	Rubber Ring Joint
SWJ	Solvent Weld Joint
uPVC	Unplasticised Poly Vinyl Chloride
UWA	The University of Western Australia

References

AS 1110	ISO metric hexagon bolts and screws - Product grades A and B
AS 1111	ISO metric hexagon bolts and screws - Product grade C
AS 1112	ISO metric hexagon nuts
AS/NZS 1214	Hot-dip galvanized coatings on threaded fasteners
AS/NZS 1477	PVC pipes and fittings for pressure applications
AS 1646	Elastomeric seals for waterworks purposes
AS/NZS 2033	Installation of polyethylene pipe systems
AS 2698	Plastics pipes and fittings for irrigation and rural applications
AS/NZS 3000	Electrical installations
AS 3500/NZS	Plumbing and drainage
AS/NZS 4087	Metallic flanges for waterworks purposes
AS/NZS 4130	Polyethylene pipes (PE) for pressure applications
AS/NZS 4765	Modified PVC (PVC-M) pipes for pressure applications

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