Engineering and Works Services Standards and Specifications Section 9(b)

Landscape Irrigation System Specifications

The City of Busselton is committed to the sustainable use of water resources and maximising efficiency of its landscape irrigation systems. The purpose of this standard specification is to provide a concise point of reference for the design and installation of landscape irrigation systems and shall be referred to in the assessment for approval of development of public open spaces.

Revision No	Date	Section Amended	Prepared	Reviewed
A	December 2010	All	Engineering & Works Services	Parks and Gardens
B	June 2013	All	Engineering & Works Services	Parks and Gardens
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1 IRRIGATION SYSTEM SPECIFICATIONS

1.1 Introduction

The City of Busselton is committed to the sustainable use of water resources and maximising efficiency of its landscape irrigation systems. The purpose of this standard specification is to provide a point of reference for the design and installation of landscape irrigation systems and shall be referred to in the assessment for approval of development of public open space.

2 WATER SUPPLY

2.1 Water Source(s)

A suitable water source shall be identified and established prior to construction of any irrigation system. Vertical groundwater bores shall be the preferred source of water for irrigation.

Any use of water within a POS shall not be potable (scheme) unless economically sustainable within the development through a portion of the City's parks and gardens rateable income for that development and must include all other POS maintenance costs within the subdivision or development.

2.2 Water Allocations and Licensing

All groundwater usage shall be licensed as required by the Department of Water and shall detail specific lots and areas to be irrigated. A copy of this licence shall be provided to the City of Busselton along with proposed plans. This licence shall be provided along with details of past water usage and bore construction details as part of the "handover" process before being accepted and transferred into the name of the City of Busselton.

2.3 Flow Monitoring

All water sources (both groundwater and scheme water) shall have appropriate flow meters installed to monitor water usage. Further details relating to the specific requirements of flow meters are listed under Flow Meters within this document.

3 BORE CONSTRUCTION

Bores shall be located so as to give ample heavy vehicle access to allow for future servicing requirements (without the need for cranes to facilitate pump removal) and be located within the property boundaries. All bores shall be constructed to Department of Water requirements and conditions of licence.

3.1 Diameter and Depth

The diameter of the bore hole shall be adequate for the installation of the standard casing and gravel packing. Depth shall be as required and permitted by the Department of Water Licence to Construct or Alter Wells.

3.2 Verticality and Alignment

The bore shall be drilled and cased straight and vertical with a maximum out of vertical tolerance of 100mm per 30 metres of depth.

3.3 Drilling Method

Bores shall be constructed using either cable tool or mud rotary drilling as required. The driller shall collect drill cuttings at 1.0 metre intervals, or upon changes in the formation. Samples should be used to develop a documented profile of the soil strata levels. This documentation should form part of any development application to the City of Busselton.

3.4 Gravel Packing

The annulus surrounding the casing and screen shall be packed with a minimum of 50mm of suitably sized washed and graded sand from the static water level to the base of the bore hole. The annulus surrounding the casing shall be backfilled with drill cuttings from the surface to the static water level.

3.5 Casing

Bores shall be constructed using a minimum standard of 155mm Class 9 PVC. Where an artesian bore is being constructed, then casing should be constructed of Permaglass. Steel casing shall not be used.

3.6 Screen

Screen assemblies shall be constructed of 0.20 mm aperture, Stainless Steel screen. NOTE: Slotted PVC screens are not acceptable under any circumstances.

3.7 Test Pumping

Test Pumping shall occur upon completion of bore development and shall consist of a two (2) hour step test, followed by an 8 hours continuous water supply test using dedicated testing equipment. Test equipment must have capacity to pump at a rate equal to 150 % of irrigation design requirements. Throughout the test a log containing the following data shall be maintained:

- Reserve Name & Location.
- Bore Licence Number.
- Drillers Name.
- Date of Test.
- Bore casing diameter material.
- Diameter, mesh size, length and material of screen.
- Depth of bore to top of screen.
- Static Water Level prior to test.
- Pumping rate of water supply test.
- Drawdown from Static water Level at nominated continuous test rate.
- Depth to pump inlet.
- Water Level and flow rate readings during constant rate test as follows:-
    - 0 to 15 minutes - every minute.
    - 15 to 60 minutes -every 5 minutes.
    - 60 to 120 minutes - every 15 minutes.
    - 120 to 600 minutes - every 30 minutes.
    - > 600 minutes - every 60 minutes.

Results of these tests shall be forwarded to the City of Busselton and the Department of Water upon practical completion of bore construction.

3.8 Yield

Bores shall be constructed to provide a yield a minimum 30% greater than the requirements of the irrigation system they will be servicing.

3.9 Water Analysis

An air free water sample is to be taken at the completion of the water supply test for analysis (within 24 hours) by a recognised laboratory capable of performing relevant tests. Analysis shall include a complete report on the quality and suitability of the water for irrigation purposes and include the following information:

- Reaction.
- Appearance.
- Colour.
- Odour.
- Total soluble salts.
- Total Alkalinity (as CA CO3).
- Iron as Fe in solution.
- Free carbon dioxide (by calculation).
- Comments on the effect of water on iron and brass equipment and stain potential.
- Nutrient analysis.

3.10 Casing Termination

On completion of bore development and test pumping operations, the bore casing shall be cut to 200mm above finished ground level and fitted with a galvanised steel, drilled Table E flange and a blank galvanised steel top flange with rubber gasket, to prevent unauthorised access to the bore. The bore casing shall be fitted with a casing clamp 200 mm to 300 mm below the flange. A concrete plinth shall be poured around the casing and shall finish level with the top of flange (200 mm above finished ground level). This plinth will form the base for the headworks assembly and consist of 20 mPa concrete poured to form a minimum 750 mm by 750 mm square and a minimum 600mm deep.

4 PUMPING SYSTEM

4.1 Pump

All pumps shall be vertical multistage or submersible type, of a size and brand approved by the City of Busselton.

- **Discharge Column**

For submersible pumps, the discharge column shall be sized to minimise losses and consist of Permaglass pump column with stainless steel fittings and two (2) stainless steel support cables. A 20 mm continuous Polyethylene probe conduit shall be installed, terminating level with the top of the pump(s). The top end shall terminate with a secure fitting, screwed into the 20 mm socket provided in the bore head discharge flange.

- **Drop Cable**

Hydrofirm, Eucahydro or Aflex EPR/PUR cable, terminating in the bore head metal junction box. Column centralisers shall be installed at the pump and at a minimum of 12 metre intervals of columns to protect electrical cables. The probe conduit (to be continuous 20 mm polyethylene), the pump cable and the drawdown tube shall be installed and clipped to the column at regular intervals. Allowances shall be made for any likely expansion or twisting of the pump column. The probe conduit shall be installed in such a way as to ensure that the two wire probe can be moved freely within the conduit for adjustment.

4.2 Headworks

For the purpose of this specification, the term headworks (Discharge Assembly) shall refer to the pipe work and associated components from the top of the bore casing through to the underground connection to the mainline.

- **Components**

The headworks or discharge assembly shall contain, as a minimum, the following key components:

- Water check valve of equal diameter as piping.
- Sniffer Valve (minimum 1”).
- Flanged test tee with matching blank flange of equal diameter to piping.
- Butterfly isolating valve (located after test tee).
- Artesian bores shall have a takeoff with valve to redirect artesian flow when servicing pump.

All above ground pipe work shall be constructed of hot dipped galvanized steel Schedule 40 ERW fabricated steel and be butt weld flanged type, unless otherwise stated. All butt weld elbows shall be of the long radius type. The complete assembly shall be as per attached diagram.

- **Junction Boxes**

Two galvanised metal, electrical junction boxes are to be installed opposite each other on the top of the first discharge assembly flange. One box is to be for the pump supply cables, the other for the probe and drawdown tubes. The pump electrical supply cable, 4 mm draw down tube and the two wire, low level probe wires, shall all pass through Heavy Duty Electrical Grade electrical conduits (minimum diameter 32mm), installed in the concrete plinth and terminating in the junction boxes. The probe wires, pump cable and draw down tube shall all pass through propriety glands or bushes installed in the junction boxes. Cables passing through plain holes will not be accepted. One junction box shall be equipped with a brass earth stud for the earthing of the assembly in accordance with Western Australian electrical requirements.

- **Pressure Take Offs**

A ¼ inch BSP tapping into the discharge pipe (near the point of connection to the mainline) shall be installed and connected to pressure tubing run to the electrical cubicle for attachment to relevant sensors.

4.3 Filtration

Any filtration systems shall be assessed individually at the time of submission for approval. The submission shall include detailed plans of the filtration system, including:

- Make.
- Model.
- Size.
- Layout.
- Service life.
- Servicing requirements/costs.

5 TANKS

5.1 Capacity

The stored volume of water shall be adequate to store one days water requirement for peak irrigation duty. The tank shall be no more than 2.3 meters in height.

5.2 Tank Construction

The tank shall be a COLORBOND ® 'Woodland Grey' walls and roof and galvanised steel water storage tank with food grade polyethylene liner. The tank and liner materials and construction shall be guaranteed for a minimum of 20 years by the tank manufacturer. Sound construction practices and procedures shall be adopted such that the fundamental criteria of stability, strength and serviceability are satisfied and that the tank is certified as such.
The tank shall be constructed on a concrete ring beam as per manufacturers' recommendations.

- **Materials**

All tank materials (cement, aggregate, reinforcing, metal sheets, liners, etc.) and materials supply (ready-mix concrete, admixtures etc.) shall comply strictly with the relevant Australian Standards.

- **Tolerances**

Contractors shall submit, with below mentioned calculations, achievable tolerances (plumb, plan dimension, position, level and member thickness) relevant to their proposed tank construction method. These tolerances shall be reviewed and agreed upon by the client prior to construction.

5.3 Design Parameters

The tank and roof shall be designed by a practicing registered structural engineer. These calculations shall clearly state all design parameters. The design engineer shall certify the tank after completion of construction. Such calculations shall be provided to verify that the design is appropriate for the prevailing climatic conditions at each site.

- **Stability**

The tank when empty and roof structure shall be stable when exposed to adverse wind conditions applicable to the site. If more than one is required then the base of each tank shall be at the same level as the other.
Note: For steel panel tanks of any size the minimum acceptable foundation shall be a circumferential concrete beam with the top outer surface of the beam levelled to shed drainage water away from the tank.

- **Strength**

The tank and roof structure shall be designed to withstand adverse wind or seismic conditions applicable to the site when either full or empty whichever is the worst case. The tank shall be covered with a self-supporting cone or

dome roof with vented cowl and minimum 15º pitched cone, (cone roof) constructed to ensure adequate run-off and prevent rubbish collection on roof. The roof shall be fitted with two square manholes (450mm x 450mm) with secure hinged or sliding lockable covers. Manholes shall be located over the float switches, and water supply inlet, and shall be fitted with suitable City of Busselton keyed standard locks. Two keys shall be provided with each lock.
The roof shall be bird and vermin proof, light and weather proof.

- **Serviceability**

The completed tank, roof, accessories etc. shall satisfy the following conditions:

- Aesthetically acceptable.
- Provide and promote safe operational procedures and a safe general working environment.
- Be watertight up to the specified capacity level.
- Achieve the serviceable life without significant corrosion.

5.4 Tank Accessories

All tank accessories shall comply strictly with relevant Australian Standards unless specifically altered in this specification.

- **Access Ladders**

Access ladders to conform to the current Australian Standards.

- **Pipe Work**

All inflow and outflow pipe work shall be galvanised steel rated to 1600kPa.

- **Penetrations and Fittings**

Penetration through the tank walls or roof and the installation of other fittings and accessories shall be carefully programmed during construction so as not to prejudice the tank performance in any respect. Modifications or retrofit after construction will not be acceptable.
Water inlet and outlets up to 50mm diameter can be threaded joints, above this size Table 'E' stub flange joints.

- **Anti-Vortex Assembly**

A suitable anti-vortex assembly shall be fitted to the tank internal discharge assembly and constructed so as to not reduce the available storage.

- **Scour Outlet**

The floor of the tank shall be uniformly graded to a scour outlet, fitted externally with a 50mm diameter poly ball valve. The valve shall be housed below ground level in a lockable Model 1419 valve box.

- **Overflow**

The tank overflow pipe shall be installed and shall be of the same diameter as the fill pipe(s). The outlet pipe work will be piped to ground level with a ninety degree elbow directing water away from the tank.

The pipe shall be galvanised steel and shall be secured to the tank or to the ring beam at the base of the tank.

- **Level Control**

Level control shall be controlled by ultrasonic sensor or float switch only.

The settings shall be set to minimise fill pump cycling, maximize water storage, provide pump protection and prevent overflow of tank.

5.5 Site Preparation

For an area covered by the tank and a 2.0m wide perimeter around the tank, remove from or above the surface all rubbish, vegetable or organic matter, scrub, timber, stumps, boulders and the like.

- **Compaction**

Compaction the tank bearing surface to a minimum of 93% Maximum Modified Dry Density (MMDD). Non-cohesive soils compaction may be checked with a standard penetrometer suitably calibrated for the site. Soft spots to be removed and backfilled with uniform soil and compacted to 93% MMDD.

- **Rock**

If rock is encountered on site which is not uniform across the tank bearing area of which cannot be made effectively uniform and level (e.g. mass concrete), remove the rock to a depth of 500mm below the tank finished floor level and extending 500mm past the tank perimeter. Backfill the void with a uniform soil and compact to 93% MMDD.

- **Erosion**

The tank base shall be surrounded by an erosion barrier of graded blue metal extending 600mm from the edge of concrete ring beam.

5.6 Warranty and Serviceable Life

The tank and liner materials and construction shall be guaranteed for a minimum of 20 years by the tank manufacturer and shall have a minimum serviceable life of 30 years.

5.7 Fencing

Fencing should be considered in all tank installations.

6 ELECTRICAL WORKS

6.1 Power supply

A constant, underground, 415/240 Volt, 3-phase, 50Hz mains power supply for all cabinets associated with an irrigation bore and/or pump.

Where a cabinet is installed for the sole purpose of supplying power to an irrigation controller only an Un-metered Power Supply may be established.

This supply shall be maintained throughout the maintenance period and account ownership transferred to the City of Busselton as part of the Handover process of the site.

6.2 Electrical Cabinet/Cubicle

A standard City of Busselton Irrigation Electrical Cubicle shall be installed at all sites having either a pump system or irrigation controller installed. (refer to Cubicle Construction for these specifications).

- **Location**

Electrical Cubicles shall be located so as to allow unobstructed access from a constructed road or car park, facing away from main irrigated area and orientated so as to ensure no direct water jet from surrounding sprinklers shall strike the cubicle. Electrical cubicle shall be located within property boundary and no more than 20 metres from the bore or pump, to allow for connection of flow meters, etc.

- **Cubicle Construction**

All Cubicles shall be constructed to be totally enclosed, air insulated and manufactured from a minimum 2.5 mm thickness, marine grade aluminium alloy (Comalco 5152/H34 or equivalent) with all seams welded and ground smooth, finished with a orbital sanded finish and coated with transparent anti-graffiti paint.

It shall be rigidly constructed with dimensions to comfortably accommodate the necessary equipment (preferred size is 550 mm deep X 930 mm wide X 1200 mm high). Lockable door(s) shall be fitted, with captive stays (one top and one bottom of each door) that hold them open at 100 degrees against the prevailing wind. The internal side of the front door shall be fitted with a document holder. Doors shall be adequately stiffened to achieve rigidity and be fitted with two padlock lugs to enable the fitting of two Lockwood Night latches, fitted with City of Busselton Irrigation keys for access.

Cubicles shall be complete with a sun shield, raised at the front and sloping toward the rear with a ducted vent installed in the top of the cubicle with 20 mm clearance from the sun shield and shall not exceed 1800 mm in height, including base, sun shield and channel, unless approved by the City of Busselton.

Cubicles shall be equipped with wiring channels of ample dimensions and generous access for internal wiring. They shall be mounted on a galvanised

channel iron base, with gaskets, which are continuous and effectively exclude dust, secured in channels without the need for adhesive (including the door(s).

Cubicles shall have weather lips, bowed at the top and ventilators which provide the cooling requirements (particularly to the starting equipment) and have a minimum protection rating of IP 55. Bottom vents shall be fitted with deflector plates and screened with fly wire mesh.

Construction should be such that access to internal wiring by dismantling the escutcheon and cover plates is readily possible without the removal of the door(s).

- **Base**

Cubicle shall be secured with 316 stainless steel "Chemset" anchor bolts to a concrete plinth, min 20 Mpa strength. The top of the plinth shall be set
100 mm above finished ground level and extend a minimum of 600 mm below finished ground level. The top of the plinth shall extend beyond the cubicle by at least 100 mm on all sides and shall angle away so as to prevent the accumulation of water against the base of the cubicle.

Conduits shall be installed in the concrete base so that they enter the cubicle behind the control panel. Additional spare conduits, two X 50 mm, and, two X 25 mm, shall be installed and fitted with long radius bends. Conduit stubs shall be extended at least 100 mm beyond the concrete plinth and terminate within a cable pit.

- **Rain Gauge Pole**

All electrical cabinets associated with irrigation control shall have a Medium Duty Galvanised Steel Pole installed between a minimum of 2 metres and a maximum of 20 metres from the cubicle. This pole shall be installed so as to minimise access to the rain gauge and be free from obstruction in the area and maximise rain fall exposure.

6.3 Electrical Components

- **Switch Board**

The cubicle shall contain a minimum of:

- Main Switch.
- Supply and Other Circuit Fuses.
- Motor Starter.
- Two (2) General Power Outlets (GPO).
- An Irrigation Controller as per below Specifications.
- Ammeter.
- Western Power Corporation Meter Panel.
- A Mainline Pressure Gauge.
- Hour Meter.
- Bore pumps are to have a minimum of the following protection:
- High & Low pressure.
- Phase Failure Relay.
- Motor Manufacturer's Recommended Overload Relay.

- Low Water Level Detected By Two Wire Probe in Bore.
- Programmable Logic Controller (PLC) shall be used for all fault

- **Control Panel**

The control panel shall be suitable for a prospective fault current of 9kA and accommodate all control and monitoring equipment for the operation of the irrigation pump and controller. The minimum standard for internal wiring is V75 stranded (1.5 mm2). All connections to the internal wiring shall be to a terminal strip, numbered to correspond with a schematic diagram. One laminated copy of the "As Constructed" wiring diagram is to be placed in the document holder placed inside the cubicle door and one additional copy is to be handed to the Superintendent. Wiring shall be neat and unobtrusive, cleated in vertical and horizontal runs and installed without any interposed joins.

A labelled terminal strip (able to accommodate three valve wires) is to be provided, for the termination (and bridging if required) of the field valve wiring. This terminal strip is to be wired to the controller outputs. Labelled terminal strips are to be provided for the rain switch and low level probe terminations. Cubicles associated with pump systems shall be fitted with fault indicator lights (which must indicate in bright sunshine), reset button(s) and manual off/auto switch.

The ammeter shall be a minimum of 70 mm square and shall have a red line to indicate the full load current of the pump motor. The scale shall be such that the full load current shall be approximately at the middle of the scale.

- **Motor Starting Equipment**

A Western Power Corporation approved soft starter capable of 12 starts per hour or a variable speed drive is to be installed to start the pump(s). Where more than one pump is required then the variable speed drive shall be of the cascading type. The starter and contactors shall:

- Be selected for electrical utilisation category AC3.
- Have auxiliary contacts, as required, to provide the specified control and interlock functions.
- Be equipped with auxiliary contacts of a minimum rating of six Ampere. If it is impractical to include the required auxiliary contacts on the main contactor, an auxiliary relay may be installed
- Be provided with a pump rated circuit breaker.
- Comply with the requirements of Australian Standard Specifications as appropriate for contactors, starters, overloads, relays and so forth.

Contactors, timers, relays and ammeter are to be housed in a dust proof enclosure or be protected by a well fitting escutcheon panel to the superintendent's satisfaction. The escutcheon panel shall be fabricated and aluminium hinged as per attached diagram (8.2). It shall be fitted with at least two lifting handles. It shall be provided with cut-outs which expose only toggles and dollies.

- **Fault Current Limiters**

Fault current limiters shall be incorporated, where necessary, to limit the prospective fault

current to a value within the capacity of the equipment being protected and be clearly labelled "Fault Current Limiters," together with the make, type, rating and catalogue number of the limiter on the label.

- **Circuit Breakers**

Miniature over current circuit breakers, if required, shall be a minimum of 6KA rated and comply with the requirements of AS 3111 and/or AS 2184, as applicable. They shall be DIN rail mounted and fitted with suitable covers, if required by the Superintendent.

- **Residual Current Devices**

Residual current devices shall be installed and shall comply with AS 3190 and have a sensitivity of 30 mA.

- **Switches and Isolators**

All switches and isolators shall comply with AS 3133, class M or X as applicable and be suitable for their intended use and be mounted in accessible positions. Contacts shall have a minimum 10 Ampere rating.

- **Voltage Transformer**

A 240 Volt to 24 Volt transformer is to be provided to power the controller and other equipment as required. Transformers shall be a minimum rated 100VA and be double wound type with an earth screen interposed between the primary and secondary windings. They shall be enclosed, A - N type with coils either vacuum impregnated using varnish to BS 2778 or resin encapsulated. All transformers shall be acceptable by the controller manufacture for both type and location.

- **Pump Circuit Breaker**

Motor Pump Circuit Breakers shall be thermal type and provided in each phase and as approved by the motor manufacture for the protection of the motor in its installed situation. Circuit Breakers shall be compensated for ambient temperature and if of the adjustable type, have a minimum adjustment from 70 to 105% of full load current.

- **Push Buttons**

Push button units shall be rated for their intended duty and be of the same manufacture and pattern throughout. They shall be of dust proof and oil tight pattern, of robust construction and have dust tight gaskets fitted where they protrude through panels. If required, they shall have corresponding on/off buttons mounted adjacent at a convenient position on the front of the panel. All push buttons shall be fitted with self aligning, double break butt type contacts.

- **Indicating Lights**

Run and Trip/Overload lights shall be an LED type that can be clearly viewed from a wide angle and be grouped in a uniform manner with respect to the push buttons. Run lights shall be Green in colour and operate when the pump is running. Trip/Overload lights shall be Amber in colour and operate due to:

- high temperature.
- earth leakage.
- more than 12 start attempts.
- motor overload.
- any other electrical fault.

Alternatively a touch screen interface can be used that has the same indicators as described above.

- **Controller**

The City controller shall be housed within the electrical cabinet and be hard wired with its own isolation switch. The controller shall be located at eye level to enable easy viewing. The inputs/outputs shall be direct connected to the controller.

- **Fans/Heaters**

All cubicles are to be provided with a cooling fan. The fan shall be of the sandwich type and be sized to be able to expel the volume of air in the cubicle at least four times per hour. The fan shall be installed directly under the top vent and shall be thermostatically controlled. Cubicles exposed to condensation shall have one Helois 70 watt, anti condensation heater, per $2m^2$ located near the bottom of the cabinet and thermostatically controlled.

- **Surge Suppression**

All equipment shall be designed, suitable for withstanding any over-voltage which might develop in the installation, be equipped, where necessary, with suitable non-liner resistors (surge diverters) to attenuate the effects of over voltages and comply with the relevant Australian Standards.

- **Interference**

The installation shall also include equipment, if necessary, that limits voltage fluctuations and harmonics. All equipment shall be designed not to emit electrom agnetic interference, or shall be equipped with electrom agnetic interference suppression. If necessary, equipment shall be equipped with radio frequency filtering (RFI) to ensure that radio and television reception is not interfered with near the site.

- **Earthing**

The earthing of the installation shall be arranged for the Multiple Earthed Neutral system, comply with Australian Standards wiring rules AS 3000 and any additional requirements of the Supply Authority. Earthing shall be by Copper weld earth electrode driven to a depth of 2.5 metres in a FC4 main earth pit or similar, installed outside the cubicle and preferably in the wetted zone of the sprinklers. It shall have copper earthing conductors and bond all metallic water pipes and so forth within 2.5 metres of the installation. Earthing shall also effectively earth all metallic escutcheons, doors and so forth and incorporate an earth busbar or link(s), sized to suit all earth conductors.

- **Cable Pits**

Cable pits shall be provided where straight conduit runs exceed 100 metres in length, or at changes in direction of a conduit run. Pits shall be of plastic construction with steel covers with lettering Electric Cables or similar. Where pit is being located within a path or similar, the lid shall be recessed to accommodate the surrounding material. The pit shall have two 50 mm diameter (minimum) drainage holes drilled in the bottom and be set level and flush with finished ground surface.

- **Labelling**

All electrical components shall be labelled as to their designation and function. Labels shall be manufactured from Traffolyte or similar material, fitted to the front of each panel and secured to the equipment using at least two chrome plated, round head screw fixings which will permit ready replacement. Labels shall be machine engraved with minimum three (3) mm high characters. Danger labels shall be red lettering (6 mm min.) on white background. Main Control Labels shall be black lettering (6 mm min.) on white background.

- **As Constructed Drawings**

The Contractor shall provide two sets of As Constructed drawings of all control and protection circuits together with all information necessary for the operation, maintenance and replacement of equipment. Plans should include the conduit allocation and direction of all conduits. One set of these documents shall be housed in the door pocket, one set handed to the Superintendent at handover.

An electronic version in DXF or DWG will also be required at handover preferably on a CD.

- **Operation**

The bore motor can be manually started by selecting Manual position on the selector switch. In order for the bore motor to be controlled automatically by the irrigation controller, the “Auto” position must be selected. A key lockable isolation switch shall be installed to permit future “tagging” during repairs or maintenance.

7 IRRIGATION SYSTEM

7.1 Design

City of Busselton Irrigation systems shall be designed to utilise the key components as identified in this specification in order to ensure uniformity with other City of Busselton irrigation systems and to minimise costs associated with spare parts, etc.

For active reserves systems shall separate main playing areas and surrounds to allow for more efficient watering practices and for solenoid valves to be located off the main playing surfaces.

All irrigation designs shall be carried out by a Certified Irrigation Designer – Landscape.

- **Efficiency**

Irrigation systems shall be designed so as to maximise the coefficient of uniformity to enable optimal watering efficiency. The theoretical DU% shall be 75% or greater. The theoretical distribution uniformity DU% shall be supplied as part of all irrigation plans submitted.

Systems shall be capable of meeting plant water requirements by operating only between the hours of 10 pm and 6 am, for a maximum of five (5) days per week, where practical. Licensing requirements currently dictate no watering is to occur between the hours of 9 am and 6 pm daily.

- **Stations**

Irrigation systems shall be designed so as to ensure a single use for each station, for example:

- turf only.
- gardens only.
- tree bubblers only.

Each individual station shall be designed for the use of one single method of delivery, i.e. one type of sprinkler, no mixed stations shall be accepted.

NOTE: Tree bubblers are intended to be used for newly planted trees up to a maximum of two years from practical completion before being phased out due to establishment of the planted trees. All tree bubblers shall be installed as separate stations. Under no circumstances are tree bubblers to be installed as part of a sprinkler line.

- **Format**

Proposed Irrigation System plans shall be submitted to the City of Busselton in both hard copy and electronically utilising CAD based software. As Constructed Irrigation System plans shall also be provided within three months of the practical completion date of the specific site.

7.2 Sleeves

Piping to be installed under existing or future roadways or pathways shall be installed within PVC sleeves and be constructed of SWJ PVC Pipe. Wiring conduits shall not be installed within the pipe sleeve and shall be run separately. PVC sleeves shall be of a size at least 30% larger than the outside diameter of the pipe coupling to be installed within the sleeve, continue a minimum of 600mm past the finished edge of the roadway or pathway and be of a minimum depth of from finished ground level. Any such sleeves shall be clearly marked and identified on As Constructed plans.

7.3 Mainlines

For the purpose of this specification the term Mainline shall refer to all pipe work and associated fittings up to but not including the Solenoid Valve Assembly.

- **Mainline Pipes**

All underground mainlines shall be constructed of a minimum of Class 12 uPVC Piping. Piping of 80mm size or larger shall Class 12 PVC RRJ (Rubber ring joint) as a minimum. Piping up to and including 50mm in size shall be Class 12 PVC SWJ (Solvent weld jointed). All mainlines shall be jointed strictly in accordance with the manufacturers specifications.

Where mainline cross roads or the front of residential lots the mainline shall be constructed of a minimum of PN12.5 MDPE pipe. The pipe shall be butt welded.

- **Mainline Fittings**

All PVC mainline fittings up to and including 50mm in size shall be Class 18 moulded pre-fittings and be solvent cement jointed. PVC mainline fittings 80mm or larger in size shall be as follows:

- Bends: All Bends or elbows shall be Rubber Ring Joint, Ductile Iron.
- Tees: All tees are to be Rubber Ring Joint, Ductile Iron.
- Reducers: All reducers to be concentric, Rubber Ring Joint, Ductile Iron.
- Flanges: Flanged connectors are to be Rubber Ring Joint, Ductile Iron or PVC with galvanised backing ring. All Flanges are to be pre-drilled Table E Flanges.

MDPE fittings shall all be butt weld fittings.

- **Mainline Isolation Valves**

Mainline isolation valves shall be installed at all significant changes in direction and every 500 metres on straight lines. Isolation valves shall be Ductile Iron, resilient seated gate valves (with spindle and configured for clockwise turning to close valve) and be of equal size to the mainline in which they are installed. Where mainlines are 50mm or smaller isolation valves shall be Philmac nylon ball valves of equal size to the mainline in which they are installed. All valves shall be installed within a valve box and marked as required by this specification.

- **Air Release Valves**

Air release valves shall be fitted at end of lines and at identified high points in the installation. When installed on mainlines up to and including 50mm the valve shall be a 1” Philmac dual action Air Release valves. For mainlines 80mm and larger air release valves shall be 2” Philmac dual action air release valves.

All air release valves shall be installed as per attached diagram utilising brass tapping band, Philmac

nylon isolating ball valve and Philmac nipple. All valves shall be installed within a valve box and marked as required by this specification.

- **Thrust Blocks**

Concrete thrust blocks shall be installed on all Rubber Ring Joint fittings and as required on mainlines, including:

- Elbows,
- bends,
- reducers,
- tees,
- end caps, and
- isolation valves.

Thrust blocks will not be required for "self straining" fittings such as those fitted "inline" and tapping bands. Thrust blocks shall be constructed symmetrically about the centre line of the fittings and shall be placed so as all pipe joints are accessible for inspection and/or repair. Pipe, fittings and cabling shall be covered with a protective membrane of plastic sheeting when adjacent to concrete surfaces.

Thrust blocks shall have minimum dimensions of approximately 600mm by 600mm by 600mm and with all sides being either formed or placed against undisturbed soil faces to ensure clean edges. Concrete shall be minimum 20 mPa and be thoroughly mixed prior to installation. Dry concrete mix and water shall not be mixed in the trench.

- **Installation requirements**

Mainlines shall be installed so as to ensure a minimum of 450mm soil covering between the top of the mainline and the finished soil surface, with the exception of pipes under roadways and playing fields, where the minimum covering depth shall be 600mm.

Pipes shall be laid into trenches having a continuous, firm and relatively smooth base, free of rocks, rubble or sharp objects. When installed in areas that cannot meet this requirement the pipe shall be bedded onto and covered with a minimum 100mm layer of sand to avoid any pipe contact with rocks, rubble or sharp objects. Trenching shall be straight and of a width sufficient to enable a minimum of 100mm space between any additional pipes installed within the same trench. Under no circumstances shall separate pipes touch within the trench.

All trenches shall be filled with the excavated soil and be plate compacted after filling to minimise any potential subsidence in the future. No debris (off cuts of pipe, etc.) shall be buried in trenches during the construction of the site.

7.4 Cabling

Field wiring of all irrigation systems shall consist of conventional multi wire systems and include a minimum of two spare cables or ten percent of the total number of stations, whichever is greater, run from the controller to the furthest point of each mainline.

Two wire decoder systems can be utilised only with the express written consent of the City of Busselton.

- **Size and Type**

All low voltage (24 Volt) solenoid control valves shall be Tyflo multi-strand copper conductors sheathed in polyethylene suitable for direct burial. Minimum cable sizes shall be:

- Common Wires - 2.5mm2 conductor.
- Active Wires < 400m - 1.5mm2 conductor when cable run is shorter than 400 metres.
- Active Wires > 400m - 2.5mm2 conductor when cable run is longer than 400 metres in order to ensure reliable valve operation.

A different colour cable shall be used for each active wire, with an individual cable being installed to each valve. Common wires shall be black, spare wires shall be white. At each solenoid valve a minimum 1.5 metres loop of both common and active wires shall be installed neatly within the valve box to allow for future works.

Cabling shall be run in appropriately sized conduit in conjunction with mainline installation. Care should be taken to place conduits 100mm away from mainline. Where cabling is not run in conjunction with the mainline it shall be installed within PVC conduit as per conduit specifications. Two wire systems must use a minimum of 4 mm two wire cabling at all times.

- **Connections**

All field wiring cable connections, including solenoid valve connections, shall be made within a marked valve box using 3M DBY or DBR direct bury splice kits. Spare wires shall also be terminated using the same direct bury splice kits.

- **Junction Boxes**

All cable joints or end of cable runs shall be made within a clearly marked and identifiable cable pit and shall have a minimum of 2 metres of spare cable looped neatly within the pit. These pits shall be identified on the As Constructed plans.

7.5 Solenoid Valve Assembly

Solenoid valve assemblies shall be comprised of the following components: tapping band; polyethylene nipple(s); solenoid isolation valve; electric solenoid valve; PVC valve socket; and minimum of 300mm PVC pipe immediately after the valve.

Bronze Tapping Bands shall be used to connect Solenoid Valve Assemblies to the mainline and shall be of equal size to the valve to which they will

connect. Solenoid Isolation Valves shall be Philmac nylon ball valves of equal size to the solenoid valve.
Connections between valves and tapping bands shall be made using threaded polyethylene nipples. All threaded connections shall be sealed with the use of PTFE Thread sealing tape. Electric solenoid valves shall be normally closed 24 Volt (AC), 50 cycle, Bermad 200 series (including flow control) or Bermad 400 series only, and shall include a manual bleed facility.

A minimum of 300mm PVC pipe of equal size to the valve, shall be jointed to a PVC valve socket (Cat 17) to allow for future servicing requirements. Solenoid Valve assembly shall be installed as per attached diagram.

7.6 Valve Boxes

All valves, including:

- mainline isolation valves
- air release valves
- flushing valves
- solenoid isolation valves
- solenoid control valves

shall be installed within a lockable valve box.

Mainline Isolation, flushing & air release valve boxes shall be Model 910 Valve Box (or approved similar). Solenoid Valve valve boxes shall be Model 1419- 12VBOL (or approved similar) without pipe portals and with overlay (T-Lip) style lockable lids with stainless steel locking bolts.

Valve Boxes shall be installed so as to have the overlay style lid finishing flush with the final soil level and shall ensure valves are readily accessible for servicing without removal of box as per the attached diagram. All valve boxes shall have a metal plate installed on the underside of the lockable lid to facilitate future locating requirements. The valve box shall be placed on a minimum of 2 courses of un mortared bricks and have a minimum of 50mm gravel located under the valve assembly.

7.7 Lateral Lines

For the purpose of this specification, lateral lines shall refer to all pipelines and associated fittings downstream from the Solenoid Valve Assembly, up to but not including, the sprinkler and its riser.

- **Pipes**

Lateral lines shall be constructed of a minimum of Class 9 uPVC Piping. All joins in pipe work and fittings shall be by Solvent Weld Joint (SWJ) and shall be constructed strictly in accordance with the manufacturer's specifications. This includes the cleaning of all sized joints with approved primer prior to joining.

- **Fittings**

All lateral line fittings shall be Class 18 moulded pre-fittings and be solvent cement jointed, in accordance with manufacturer's specifications. Any excess solvent cement shall be wiped clean from pipes and fittings.

- **Installation Requirements**

Lateral Lines shall be installed so as to ensure a minimum of 300mm soil covering between the top of the lateral line and the finished soil surface, with the exception of playing fields, where the minimum covering depth shall be 450mm.

Pipes shall be laid into trenches having a continuous, firm and relatively smooth base, free of rocks, rubble or sharp objects. When installed in areas that cannot meet this requirement the pipe shall be bedded onto and covered with a minimum 100mm layer of sand to avoid any pipe contact with rocks, rubble or sharp objects.

Trenching shall be straight and of a width sufficient to enable a minimum of 100mm space between any additional pipes installed within the same trench. Under no circumstances shall separate pipes touch within the trench. All trenches shall be filled with the excavated soil and be plate compacted after filling to minimise any potential subsidence in the future.

7.8 Sprinklers

In order to maintain a standardised irrigation network across the City of Busselton this specification provides a standard range of sprinklers to be utilised when designing irrigation systems. Any use of sprinklers outside of those listed may be approved with the express written consent of the City of Busselton at the time of assessment. Sprinklers shall be full circles where required and adjustable or part circle on edges. Adjustable sprinklers (adjusted to full circle) shall not be installed where a full circle sprinkler is required.

- **Size and Type**

The following gear driven sprinklers shall be utilised as required:

- Rain Bird
  - 5505
  - 6504
  - 7005
  - 8005
- Hunter
  - I-20 ultra
- Hunter I-20 Ultra Series.
  - I-20: 10 cm pop up (Full Circle or Adjustable) sprinkler (Stainless steel riser).
  - I-20-HP: 30 cm pop up (Full Circle or Adjustable) sprinkler.

The following spray type sprinklers shall be utilised in smaller areas as required:

- Rain Bird 1800 series
  - 1804-SAM: 100 mm pop up sprinkler.
  - 1806-SAM: 150 mm pop up sprinkler (No side inlet).
  - 1812-SAM: 300 mm pop up sprinkler (No side inlet).

and be fitted with U series nozzles.

Flood Bubblers shall be utilised for tree bubblers and installed on a 15mm riser and set 50mm above ground level.

All sprinklers shall be fitted with non-drain valves. Sub surface or drip irrigation may be utilised in garden bed areas only and with the approval of The City of Busselton.

- **Risers**

All Sprinklers shall be installed on adjustable articulated risers of equivalent diameter to the inlet thread size of the sprinkler. Length of the articulated risers shall be sufficient to ensure the riser is inclined at an angle of 45º to the horizontal when installed. Funny pipe (Olsen EZ-EL or similar) may be used for tree bubblers only, as required and shall at no time be utilised for gear driven or spray type sprinklers.

- **Height and Adjustment**

Sprinklers shall be set with the top of the sprinkler being set flush with finished ground level, as per manufacturer's specifications. Sprinklers should also be set straight to the vertical alignment, except when installed on significant slopes where the sprinkler shall be set halfway between the vertical and the angle of the slope on which it is installed. When installed beside roadways, footpaths or any other built structure, spray type sprinklers shall be installed to be 150 mm from all edges and gear drive sprinklers 300mm from all edges. Sprinkler arcs shall be adjusted to ensure minimal overspray onto nearby roadways or fixtures occurs. Sprinklers may be over adjusted to allow for prevailing winds as the site requires.

8 IRRIGATION CONTROL SYSTEM

The City of Busselton operates a centrally controlled Irrigation network to monitor its irrigation operations throughout the City. All new systems installed by the City, or to be taken over by the City (e.g. new developments) are to be constructed as per the following specifications. Practical completion dates shall not be considered effective until the controller is connected to the City of Busselton Irrigation network.

8.1 Controller

The City of Busselton operates Rain Bird MaxiCom2 and IQ2 central control systems. The controller used must be compatible with the MaxiCom2.

The controller shall include inputs for all required components to fulfil the required specifications as detailed below.

The controller shall be capable of operating the maximum number of stations plus 2 spare stations and shall be housed with the electrical cabinet as per this specification.

In the case of large subdivisions that intend to operate as a single supply, multiple site irrigation system the RainBird Site Control could be used at the discretion of the City of Busselton.

8.2 Communications Equipment

The City of Busselton control system uses GSM technology. The GSM modem shall be as supplied by Rain Bird. All communications equipment shall be installed neatly within the cabinet and secured, so as to ensure no loose cabling or other components within the cabinet.

8.3 Sensors

All Irrigation control systems shall include the following sensors to be installed and connected to the controller:

- Pressure Transducer – to be installed within the cabinet to pressure tubing from the mainline (as per head works specifications).
- Rain Sensor – Rainbird Rainguage 100mm to be installed on galvanised steel pole and set 4 metres above ground level.
- Current Transducer – to be installed within the electrical cabinet.

8.4 Flow Meters

All water sources shall be fitted with a flow meter, connected to the irrigation controller for reporting to the City of Busselton Irrigation network. This flow meter shall meet the requirements of the Rights in Water and Irrigation (Approved Meters) Order 2009 and be of equivalent size to the mainline at the point of discharge from the pump. Flow meters shall be installed as per manufacturers recommendations with an isolating valve and testing tee installed. The flow meter shall have a pulse output at 1000L per pulse.

In the case of the water source being pumped into a tank or reservoir and then pumped into the irrigation system an additional meter is to be installed.

8.5 Lightning Protection

All irrigation systems shall be constructed to include lightning protection systems as follows:

- Antenna Lightning Protection CSP-BNC-M/F.
- Inline Lightning Protection SD-240V-1PH-40KA.

8.6 Central System Connection

Upon commissioning of all irrigation systems it shall be compulsory to allow for connection of the site to the City of Busselton Irrigation (Maxicom2) network and that all functions, including communications and reporting, are fully functional and verified by the City of Busselton. Practical completion dates shall not be considered effective until connection to the central system is completed. This connection is to be maintained throughout the contractors' maintenance period prior to hand over to the City of Busselton.

9 Commissioning

9.1 As Constructed Plans

As Constructed Irrigation System plans shall be provided to the City of Busselton within three months of the practical completion date, in both hard copy and electronically in DWG file format. A copy of the As Constructed electrical plans, bore construction details and flow test results shall also be supplied at this time. Upon handover to the City of Busselton, these drawings are to be resubmitted on request to the City of Busselton.

9.2 Training

Site specific training, relating to any particular areas of maintenance shall be supplied to City of Busselton upon request at the time of handover to the City. An example of this may be a specific filtration system or other such component of the irrigation system to which the City of Busselton staff may not be familiar with.