

Irrigation Development Guidelines 2024

City of Kwinana



Document Control

Document ID: CM9 D19/60973					
Rev No	Date	Revision Details	Author	Reviewer	Approved
2013	29 Jan 2013	Initial document	TM	KH	DB
2013-B	21 Mar 2013	Updated preferred sprinklers & std. drawings	TM	KH	DB
2014	10 Jan 2014	Updated preferred controller, development process, design approval, water management & reformat	TM	KH	DB
2019	14 Oct 2019	Various updates	TM	KH, JG, JN	DB
2022	12 April 2022	Minor Changes, updated depth for main line & iron filter compound standard	TM	KC, KH, JN	
2024	17 April 2024	Changes to iron filtration requirements, changes to Bore discharge assembly, changes to pipework requirements, updates to Valving requirements, updates to sprinkler requirements	JM	JG, AF	DB
2024	8 August 2024	Minor rewording to meet City style guide, reformatting, attached reviewed drawing set.	JM	JG, AF	DB

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Introduction

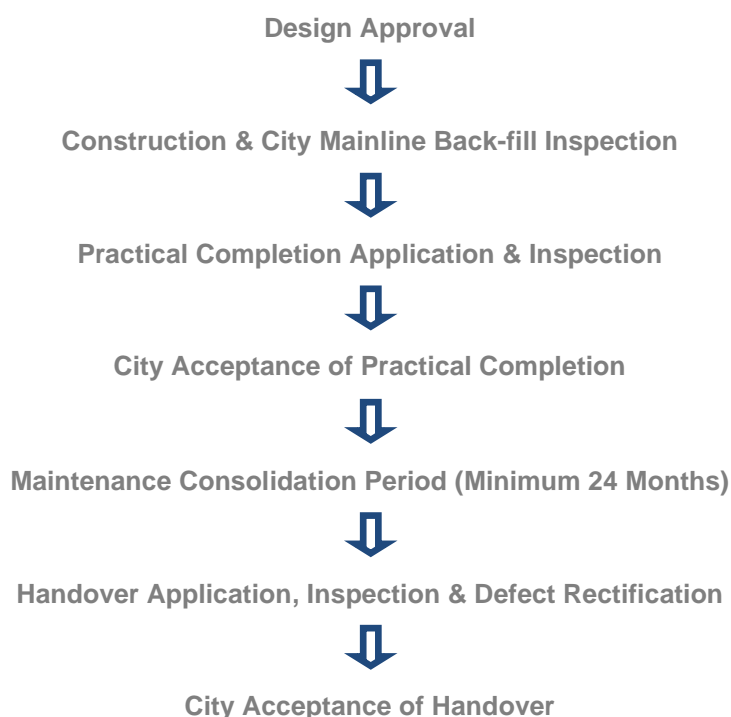
The following Irrigation Development Guidelines have been developed with the aim of ensuring the use of appropriate equipment, materials and workmanship in the design, installation and maintenance of irrigation systems within the City of Kwinana. The main objective of which is to reduce the risk of premature asset failure and the minimisation of maintenance requirements, representing optimal value for money for the City's ratepayers.

This Document outlines the City of Kwinana's development and handover process, guidelines on the design, supply and installation of irrigation assets, consolidation period maintenance expectations, as well as the requirements for the handover of these assets to the City.

1. Development & Handover Process

The City of Kwinana has a standard process and requirements for the handover of landscape and irrigation assets. These requirements are outlined in detail in the relevant sections of this Document as well as in the 'City of Kwinana Practical Completion and Handover Application Package', a document which must be submitted for every proposed landscape and irrigation handover.

In brief, the City of Kwinana's handover process is as follows:



2. Irrigation System Design

- 2.1. All irrigation system designs must be approved by the City of Kwinana as part of the development approval process, prior to commencement of installation. This includes all proposed equipment, materials and construction details for all facets of the proposed irrigation system.
- 2.2. The City of Kwinana encourages the provision of sustainable water use practices such as 'dry' winter tube-stock planting of landscapes where-ever possible, integrated monitoring and centralised irrigation control, storm/rainwater retention and recycled water use practices.
- 2.3. The City of Kwinana has a strong preference for planted areas, particularly in streetscape areas, to be non-irrigated 'dry' plantings. Ideally this involves tube-stock winter season planting with suitable plant species and appropriate soil amendments and additives (such as TerraCottem) to ensure successful establishment.
- 2.4. All turf areas must be irrigated, as shall feature planted areas in public open spaces, building grounds or entry statements where irrigation dependent plant species may be permitted.
- 2.5. All irrigation systems shall incorporate hydro zoning between turf, planted beds and trees. Active sportsground sites shall have separate zones for active and passive turf areas and shall not have any valve boxes located in, or within proximity to, the playing surface.
- 2.6. Any tree irrigation must be independently hydro zoned to allow decommissioning after two to three seasons without affecting the irrigation of turf and garden bed areas.
- 2.7. Valve grouping and station sequencing is to be geographically adjoining and chronological, wherever possible within acceptable matching of precipitation rates and target vegetation.
- 2.8. Design plans for irrigation systems shall contain details on the proposed sprinklers, valves, pipework, bore, cubicle, controller, electrical switch gear, filters and other components of the proposed irrigation system. Deficient plans will not be approved.
- 2.9. All irrigation systems shall provide efficient and adequate reticulation regardless of location, plant size or species. Irrigations systems shall perform >85% Coefficient of Uniformity and >75% Low Quarter Distribution Uniformity.
- 2.10. All bores must be fitted with an approved hydrometer and must meet the Department of Water and Environmental Regulation's acceptability requirements under the Rights in Water and Irrigation (Approved Meters), refer to Department of Water guidelines.
- 2.11. **The City of Kwinana will not accept Practical Completion of any irrigation system that has not had the mainline installation and back fill inspected**, at the time of works, as specified within this Document, by the City's Representative. It is the responsibility of the Developer to arrange this inspection.
- 2.12. All irrigation regimes will take into consideration the water requirements of the targeted plants and shall be subject to all water restrictions as indicated by the relevant Water Authority.
- 2.13. The watering window on any bore or irrigation system shall not exceed seven (7) hours per day and must occur within the hours of 2300 to 0600. Due to vandalism trends within the City, irrigation operation on Friday and Saturday nights is to be avoided where possible, particularly for streetscape stations.
- 2.14. Inline drip emitter hose type systems (commonly known as 'Drip-Eze' or similar) should be avoided unless deemed absolutely necessary and approved in writing by the City of Kwinana. Inline drip type systems will not be accepted in turf areas.

- 2.15. Where an approved inline drip hose type system is proposed, the garden design must consider suitable plant species and subsoil to allow the inline drip station/s to be decommissioned within a maximum of three seasons. The decommissioning of any such station shall not affect the remaining irrigation system.
- 2.16. Conventional poly pipe drip emitters, whilst not prohibited by the City, shall not typically be used within a system design unless specifically required and approved in writing by the City of Kwinana.
- 2.17. All irrigation assets must be designed, installed and maintained by suitably accredited and qualified irrigation contractors.

3. Requirements for Design Approval

- 3.1. Typically, the following items must be submitted to the City of Kwinana, in conjunction with the corresponding landscape design plans, for irrigation design plan approval:

Bore

- Plan detailing proposed bore location and maintenance access (bore equipment to be accessible by truck-mounted crane and be free of overhead obstructions)
- All bore detail plans, standard drawings and details, including bore hole diameter, casing and screen, pump, discharge assembly, proposed/known flow rates, operating pressures and water sample test results
- All proposed electrical details and drawings, including the control cabinet, irrigation controller, monitoring equipment, switch gear and VFD components
- Where an iron bacteria filtration system is required, all details including proposed manufacturer make and model, plant and compound detail drawings
- Current bore and mainline master plan for the sub-division area

Irrigation

- Water supply source information including bore name and location, where not located within the irrigation design area
 - Water supply flow rate with specified operating pressure at point of connection
 - Sleeve plans specifying location, diameter and type
 - Irrigation plans specifying the location of valves (including ID, diameter and flow rate), electrical pits, pipework (showing diameter) and all emitters
 - Schedule of emitters and valves outlining make, model, nozzle sizes, operating flow rates and pressure
 - Proposed schedule of stations outlining valves to be operated concurrently, including combined flow rate requirement, landscape type and precipitation rate, with peak watering window time to be specified
 - Valve groupings must be geographically adjoining, wherever possible, and station sequence to be geographically chronological
- 3.2. Standard installation detail drawings for sleeves, pipework, thrust blocks, isolation valves, flushing valves, air release valves, solenoid valves, pits and emitter connections Refer to Appendix 1 'Irrigation Drawing and Documentation Submission Checklist' for submission requirements. Deficient design plans or plans which specify un-approved equipment, materials or installation practices will not be approved.
 - 3.3. Refer to Appendix 2 'City of Kwinana Standard Irrigation Drawing Set' for typical details to be followed and submitted.

- 3.4. Proposed use of alternative water sources, such as stormwater retention or recycled water systems, shall have all relevant information including relevant authority approvals, relevant documentation and drawings for both construction and maintenance requirements, submitted to the City for approval.

4. Iron Bacteria Filtration

- 4.1. Where water analysis confirms that an unacceptable concentration of iron bacteria is present, as determined by the City of Kwinana, an iron bacteria filtration system shall be installed as part of the irrigation system. Water sample analysis report is to be provided at time of irrigation detailed design submission. **Sub-surface irrigation shall not be considered a solution to any anticipated staining.**
- 4.2. The media vessels must be sized in accordance with the respective iron content (Mg/L and flow rate) plus 20% tolerance for future proofing.
- 4.3. The iron filter must be included in any friction loss calculations and must achieve a post-delivery rate below 0.5Mg/L.
- 4.4. The iron system is to include the iron filtration unit, booster pump and associated electrical components, concrete pad and all backwash components. A post-filter pressure gauge is to be installed in the control cubicle.
- 4.5. The system is to be housed in an appropriate compound. The area surrounding the compound shall be planted to soften visual impact on the landscape.
- 4.6. The compound shall be of galvanised steel construction with a suitable slatted screen material and roof sheeting to be Colourbond or equivalent. Roof to be removable. Garden sheds, or similar type structures, will not be accepted.
- 4.7. Compound and soak wells to be accessible for a maintenance with adequate vehicle access.
- 4.8. **The City will not accept below ground compounds.**
- 4.9. The technical specification and design of any proposed iron bacteria filtration system and compound is to be approved by the City of Kwinana as part of the detailed design approval process.
- 4.10. The filtration system is to be maintained as per manufacturer recommendations during the maintenance consolidation period and, where appropriate, training provided to the City's representative at time of handover.
- 4.11. The filter controller must be electronic and allow backwash operation to be programmed to a set schedule, which is not to interfere with irrigation program schedules.
- 4.12. All backwash is to be contained within a suitable capacity soak well system or designated sump or swale as approved by the City's principal. Discharge to landscaped or natural areas will not be accepted. Backwash pits must have accessible lids and positioned so as to not impede maintenance access for future periodic cleaning. All backwash discharge areas must be capable of withholding twice the amount of water required to complete one full backwash cycle.
- 4.13. All as-constructed drawings, manuals, procedures and warranties must be electronically submitted to the City of Kwinana as part of handover application.

5. Bore Hole

Diameter

- 5.1. The diameter of the holes to be drilled shall be adequate for the installation of 200mm casings, including a 40mm annulus of gravel pack material surrounding the bore casing.

Materials

- 5.2. Production Casing must be 200mm Class 12 AS 1477 PVC, unless otherwise approved.
- 5.3. Screen Assembly must be 85/8" API standard duty stainless steel screens for 200mm bores. Aperture sizes shall be determined following analysis of sand samples during construction of each bore. Sand sampling and sieve analysis of the samples shall be undertaken for every bore. All screens shall have stainless steel base plates and suitable PVC or ABS casing to screen adapters.
- 5.4. Centralisers must consist of spring steel or plastic bow centralisers to fit a minimum 40mm annulus (as manufactured by Weatherford or Kwik-Zip).
- 5.5. Gravel pack must consist of washed, screened, and graded river sand, graded +1.6 mm – 3.2 mm

Bore Development

- 5.6. Following construction of the borehole and placement of the casing, screen and gravel pack material, the Contractor must develop the bore to a maximum yield of water, clean and free of suspended materials. Development of the bore shall be carried out using bailing, water jetting, air lifting and surging, chemical treatment or other such methods as may be found necessary by the driller for full and proper completion of development of the bore.

Test Pumping

- 5.7. On completion of bore development the Contractor must test pump the bore, including a multi-rate test and a constant rate test. Discharge rates and pump inlet depths to be tested and submitted with bore as-constructed documentation.
- 5.8. The pump used must be capable of providing sustained discharge at acceptable constant rates and from inlet depths as specified and must be capable of achieving various flow rates through discharge head regulation. The Contractor must provide a means of accurately measuring the flow rate.
- 5.9. A staged test of three different rates (provided by superintendent) each of 30 minutes duration will be required, followed by 30 minutes recovery. A constant rate test, nominally of 6 hours duration and at a flow rate provided, will then be required.
- 5.10. To facilitate water level measurements the Contractor must include with their testing equipment a pipe or tubing clamped to the side of their pump column, through which an electrical water level monitoring device can be inserted. The pipe or tubing must be free of kinks, joints etc which could hinder free movement of the water level measuring device.
- 5.11. Water level measurements must be made immediately prior to the start of each test, then during the test at the following times:
- 0 - 15 minutes: every minute
 - 15 - 60 minutes: every 5 minutes
 - 60 - 120 minutes: every 15 minutes
 - 120 - 600 minutes: every 30 minutes
 - >600 minutes: every 60 minutes

Water Analysis

- 5.12. The Contractor is responsible for obtaining an air free water sample just prior to the completion of the constant rate pumping test. The Contractor is also responsible for appropriate storage and delivery of the sample to a recognised laboratory within 24 hours of obtaining it, and for analysis of the sample.
- 5.13. Analysis must include a complete report on the quality and suitability of the water for irrigation purposes and include the following information:
- Appearance
 - Water PH
 - EC
 - Chloride
 - Sulphate
 - Total Nitrogen
 - Iron as Fe in solution
 - Total Phosphorus
- 5.14. Copies of water analysis reports must be submitted with detailed design and as-constructed documentation.
- 5.15. Elevated levels of Total Dissolved Salts (TDS) and Iron (Fe) must be discussed and appropriately resolved to the satisfaction of the City of Kwinana before installation commences.

6. Bore Pump, Motor & Discharge Assembly

General

- 6.1. Refer to 'Bore Head Detail' drawing (20_COK_STD_IRR_G_006) in Appendix 2 'City of Kwinana Standard Irrigation Drawing Set' in conjunction with this Specification.

Borehole Pump

- 6.2. Any borehole pump is to be submersible type and have both the pump-wet end and pump motor constructed from stainless steel.
- 6.3. The City of Kwinana's preferred borehole pump and motor, is outlined in Table 1 below:

TABLE 1: Preferred Pump and Motor			
Make	Type	Pump	Motor
Grundfos	Submersible	SP Series	MS Series

- 6.4. The selection of pump and motor size must be suitably matching the in-field irrigation system design parameters and provide duty of the nominated litres per second at the nominated total dynamic head length.
- 6.5. Any alternate proposed pump or motor must meet or exceed the technical specifications of the preferred equipment, to sole satisfaction of the City of Kwinana, and the installation of any such alternate equipment must be subject to the explicit written approval of the City.

Submersible Drop Cable

- 6.6. The submersible pump unit must be installed with a submersible electrical drop cable (Hydro firm or Eucahydro or approved equivalent) sized in accordance with the motor manufacturer's recommendations. This must terminate at the bore head with a metal

junction box, with a minimum of two metres of cable looped under the bore head within the bore.

Discharge Column

- 6.7. The pump and motor unit must be installed on 100mm threaded and coupled Class 18 PVC pump column with stainless steel sockets and two stainless steel safety cables, as per manufacturer recommendations or as approved by the City.
- 6.8. Where appropriate, the use of 80mm threaded and coupled Class 18 PVC pump column with stainless steel sockets and two stainless steel safety cables will be permitted, as per manufacturer recommendations or as approved by the City.
- 6.9. A 25mm PVC probe conduit is to be installed, terminating level with the top of the pump. The top end must terminate with a 25mm PVC Cat. 17-valve socket, screwed into the 25mm socket provided in the bore head discharge flange. The bottom of the drawdown tube is to be level with the top of the pump.
- 6.10. Column centralisers must be installed at the pump and at 12-metre intervals of column, to protect electrical cables and drawdown tube.

Bore Head & Discharge Flange

- 6.11. The pump and discharge column must be connected to the PVC flange on the bore casing and suspended in the bore casing by a matching hot dipped galvanised discharge flange and socket.

Discharge Assembly

- 6.12. All surface discharge pipe work must be hot dipped galvanised Schedule 40 ERW fabricated steel and fittings shall be butt weld flanged type.
- 6.13. The discharge assembly must include the following:
 - Arad Octave Stainless Steel range with floating flanges hydrometer. The meter is to be installed in a lockable box. An SD Systems data-node, cable and conduit must be installed from the hydrometer to the irrigation controller. Certificate of calibration to be submitted with as constructed documentation
 - Sniffer valve (minimum 1")
 - Sustaining pressure valve (if required)
 - 100mm (or 80mm) diameter dual flap check valve (Mission HVAC or equivalent)
 - 100mm (or 80mm) diameter epoxy coated cast iron butterfly isolation valve. A padlock keyed to the City's lock shall also be supplied to lock this valve in position
 - 100mm (or 80mm) diameter hot dip galvanised butt weld flanged test tee with blank matching flange
 - 100mm (or 80mm) diameter hot dip galvanised butt weld flanged s-bend discharge to a nominal 450-600mm below site ground level
 - All discharge assembly's and headworks must meet DWER compliance and requirements.

Mounting

- 6.14. The casing string and pump discharge assembly is to be supported by a concrete block with minimum dimensions of 750mm x 750mm with a depth of 600mm.
- 6.15. The top of the concrete block must finish 100mm above finished ground level.

- 6.16. All electrical conduits shall be set into the concrete block. Conduits attached over the surface of the block will not be permitted.

Circuit Breaker

- 6.17. A circuit breaker shall be installed as recommended by the manufacturer of the submersible motor.

Testing

- 6.18. The Contractor shall provide and set up all necessary test apparatus to determine the pumps capacity at the designed pressure.
- 6.19. The Contractor shall also provide any necessary equipment to dispose of water discharge during the testing.
- 6.20. The Contractor shall provide all testing documentation and reports to the City as specified in Section 13 of this Document.

7. Electrical Components

General

- 7.1. A standard City of Kwinana Irrigation Electrical Cubicle shall be installed at all sites having either a pump system or irrigation controller installed.
- 7.2. Refer to 'Electrical Cubicle Detail' drawing (20_COK_STD_IRR_G_001) in Appendix 2 'City of Kwinana Standard Irrigation Drawing Set' in conjunction with this Specification.
- 7.3. Electrical Cubicles shall be located to allow unobstructed access from a constructed road or car park and, wherever possible, orientated so as to ensure no direct water jet from surrounding sprinklers shall strike the cubicle.
- 7.4. All workmanship and materials shall comply with all current legislation, standards, codes, regulations and manufacturer recommendations as applicable.

Power Supply

- 7.5. The Contractor shall allow adequate ducting through the concrete plinth for entry to the cubicle of the supply cabling, together with two spare 50mm conduits with bends exiting towards the rear of the cubicle.
- 7.6. All underground conduits shall be heavy duty PVC, laid in straight lines in accordance with the manufacturer's instructions.

Control Cabinet

- 7.7. A control cabinet shall be installed to house all electrical equipment including automatic control, Variable Frequency Converter Drive (VFD) and Western Power metering.
- 7.8. The cabinet shall be installed in a location approved by the City on a concrete plinth (the top of which shall finish 100mm above final ground level).
- 7.9. The cabinet shall have nominal minimum dimensions of 1500mm high, 1050mm wide and 600mm deep.
- 7.10. The cabinet must have 2 doors if including VFD.
- 7.11. The cabinet shall be freestanding and lockable, with a 2-point locking or 3-point locking system and keyed to 2750 Western Power Key locking system.

- 7.12. The cabinet shall be weatherproof and constructed from heavy duty marine grade aluminium of minimum 2.5mm thickness with anti-graffiti coating applied to all external panels.
- 7.13. The cabinet door shall be lockable in its open position, to be resistant to wind, with the installation of either gas struts or solid link sliding arms at both the top and bottom of the door. The door shall be adequately rigid to be secure against unauthorised entry and resistant to vandalism.
- 7.14. Sufficient space in the top section of the cubicle shall be allowed for the installation of an irrigation controller, as specified, with the approximate dimensions of 400mm high, 400mm wide, and 180mm deep.
- 7.15. The cubicle shall include at minimum one (1) General Power Outlet (GPO) 15 amp with all wiring to be wired through RCDs.
- 7.16. The cubicle shall have an A3 holder inside.
- 7.17. Modem and relay cube to be located next to SDS controller on front panel.

Circuit Breaker

- 7.18. A circuit breaker shall be installed in the pump control cabinet, as recommended by the motor manufacturer.

Fault Indication on PLC Controller

- 7.19. PLC controller shall be programmed for run and fault conditions with run and have a visual display. The following fault/indication is required:
- Pump Running
 - Bore Low Level
 - Overload
 - High pressure
 - Low pressure
 - No flow fault for VFD

Variable Frequency Converter Drive (VFD)

- 7.20. The pump shall be controlled by a Variable Frequency Converter Drive (VFD), (otherwise known as Variable Speed Drive or 'VSD'), to vary the speed of the pump motor to maintain a constant set pressure within the mainline.
- 7.21. VFD equipment shall be Danfoss or Vacon Flow. Any alternate equipment must, to the written satisfaction and approval of the City, meet or exceed the specifications of the preferred units.
- 7.22. The VFD shall be sized according to the maximum rated amperage draw of the pump (not the nominal power consumption), as published by the pump manufacturer.
- 7.23. The VFD shall be installed with appropriate EMI/RFI filters.
- 7.24. The VFD shall be coupled to a 4-20mA signal pressure transducer connected to the pump headworks or mainline (downstream of any pressure sustaining valves fitted).
- 7.25. The VFD unit shall be fitted with an appropriate Sine Wave Filter as recommended and supplied by the manufacturer of the VFD.
- 7.26. The VFD shall be installed within a separate section of the cabinet and to the left side of reticulation cubicle. This section of the cubicle shall be separated from other electrical

equipment and connections, to allow access for programming of the VFD by licensed personnel only. A hinged escutcheon panel with remote VFD display to be supplied and fitted to the VFD section.

- 7.27. The VFD section of the electrical cubicle shall be fitted with an electric ventilation fan to provide adequate air flow ventilation. Ventilation fan to include:

- Low noise, AC slim line axial fan
- Removable dust filter
- Adjustable thermostat control
- Mechanical protection in the form of finger guards

Motor Starter

- 7.28. All necessary motor protection equipment and switchgear as specified by the motor manufacturer shall be installed, whether stated or not in this guideline document.
- 7.29. Both a 'run' light, 'trip/overload' light and reset button for the motor shall be installed and clearly marked within the electrical cubical.

Selector Switch

- 7.30. In addition to the main isolation switch, there shall also be an 'auto - manual – off' switch installed in the control cabinet. The selector switch shall be wired such that:
- The auto position allows for automatic start and stop of the pump unit by the irrigation controller
 - The off position provides for isolation of all pump controls
 - The manual position allows the pump to be controlled by separate on / off push buttons, independent of the irrigation controller

Pressure Switch

- 7.31. A high-pressure and low-pressure switch shall be supplied and installed in a separate enclosure within the cabinet, and associated equipment shall include a time delay and latching lockout relay, clearly labelled "high pressure" fault light, and a reset button. An SD Systems 'Data-Node' is to be connected from the pressure switch to the irrigation controller as a pressure fault input.
- 7.32. The pressure tube line to the pressure switch shall commence from the upstream side of the isolation valve in the pump discharge assembly. The tube line shall be approved for use in high-pressure installations, and only approved brass fittings shall be used with the tube.
- 7.33. A 0-1000kPa liquid filled pressure gauge must be installed. The gauge is to be connected to the pressure tube line, mounted in a prominent position within the cabinet and clearly labelled.
- 7.34. The high-pressure protection shall be operational in both the automatic and manual mode.
- 7.35. The independent second pressure line required for variable speed (Variable Frequency Drive) application is to be installed on the downstream side of the isolation valve in the pump discharge assembly. The tube shall be approved for use in high-pressure installations, and only approved brass fittings shall be used.
- 7.36. Where equipped with an iron filtration unit, there is to be an additional pressure gauge, clearly labelled, in the cubicle, with the pressure line to be installed on the downstream side of the filtration unit.

- 7.37. Current Western Power / Office of Energy regulations regarding installation of pressure switches, tubes, gauges, and other pressure equipment within the electrical control cabinet shall be strictly adhered to.
- 7.38. All electrical equipment is to be adequately protected from any potential source of water damage.

Low Level Probe

- 7.39. An approved two-wire low-level probe and probe relay shall be installed. The relay shall be installed in the pump cabinet, and wired with a lockout relay, clearly labelled "low level" indicator light and fault reset button. The bottom of the probe shall be positioned within the range of 0.5 to 1.0 metres of the top of the pump, within the 25mm PVC probe conduit. The low-level protection shall be operational in both the automatic and manual mode.

Ancillary Equipment

- 7.40. A suitable ammeter shall be installed. The maximum full load running current of the motor shall be marked with a red line on the face of the ammeter.
- 7.41. The switchboard shall include a single-phase GPO switch with RCD, and fuse block. All fuses for electrical control shall be HRC type. A pump run lamp shall be installed and operational in both the automatic and manual mode.
- 7.42. A lamp test button shall be installed to enable testing of fault indicator and pump run lamps.

Labelling

- 7.43. All equipment installed within the cubicle shall be identified with precise easy to read engraved labels. Labels shall be secured with screws or rivets and not glued.

Circuit Diagrams

- 7.44. As-built circuit diagrams must be electronically supplied to the City, showing all wire numbers, ratings and settings necessary for operation, maintenance and replacement of installed equipment.
- 7.45. As-built circuit diagrams shall also be presented on A3 size-drawing sheets, which must be laminated and placed in the cubicle.

8. Irrigation Controller

General

- 8.1. All irrigation systems shall have an approved irrigation controller, as specified, installed in the cubicle.

Preferred Irrigation Controller

- 8.2. The City of Kwinana preferred irrigation controller is outlined in Table 2 below:

TABLE 2: Preferred Irrigation Controller			
Make	Model	Type	Stations
SD Systems	SDS-50	Two-wire	48
	SDS-100	Two-wire	98
	SDS-50	Multi Core	48

	SDS-100	Multi Core	98
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- 8.3. Unless otherwise approved, SD Systems controllers shall be fully “SDS-Connect” equipped, including installation of a ‘SD-MDS Signal 4G/5G Modem’ and high gain 800 or better external antenna, as specified by SD Systems, to enable remote operation of the controller via central control and mobile device app/software.
- 8.4. SD Systems controllers must be used in conjunction with Bermad 200 Series solenoid valves fitted with SD DataCoils™, SD PumpNode™, hydrometer SD DataNode™, pressure fault sensor and SD Surge Arrestor lightning protection, which are all to be fitted and connected as standard equipment.
- 8.5. Use of multi-core wiring systems is not supported and must be specifically approved by the City. In such instances, the above SD Systems SDS controller shall still be the preferred controller with the addition of an SD Systems ‘RelayCube™’ module to allow multi-core wiring operation.

Lightening Protection

- 8.6. As per SD Systems manufacturer recommendations, an SD Surge Arrestor is to be installed every 300 meters or every 16 valves. Surge arrestors must be suitably located in valve boxes or cable pits and clearly indicated on irrigation drawings.

Alternative Controller Requirements

- 8.7. Any alternative controller proposed must, to the written satisfaction and approval of the City of Kwinana, meet or exceed the following specifications and features of the SD Systems SDS controller:
- 8.8. The controller must be compatible with the specified preferred valve, namely Bermad Two-Wire DataCoils™.
- 8.9. The controller must have the capacity for eight independent programs. Each program is to be fully independent of all other programs and have fertigation and individual pump per program capability. The controller shall be capable of a looping option on each program.
- 8.10. Individual pump starts shall be able to be connected anywhere along the Two-Wire cable.
- 8.11. The controller shall be capable of a 14-day watering calendar, true odd/even watering option, and cyclic watering day option. It shall have a minimum of four schedule starts per program.
- 8.12. The controller must be capable of being programmed to operate on a time, volume or precipitation basis for water application.
- 8.13. The controller shall be capable of operating matched precipitation zones in sectors. Each sector shall have the capacity to connect a moisture soil sensor. Each sector shall have the capability of operating on a time, volume or precipitation watering schedule.
- 8.14. The controller Two-Wire communication shall have near instant reporting of all valve and field-device status by the method of the field valves reporting back their real time status to the controller. The two-wire communication protocol shall continuously scan the sensors for status information.
- 8.15. The controller will have the capacity to connect up to 12 sensors of which 8 may be water meter counters at any position along the two-wire cable.
- 8.16. The controller will have the capacity to connect a moisture sensor to each program.

- 8.17. The controller shall have a minimum of 7 sensor inputs at the controller. These will include pressure sensors, digital water meter, high, low and intermediate pressure inputs and program start.
- 8.18. The controller shall be capable of being operated and monitored from a 4G/5G capable smart phone or tablet via Apps'. Apps' must have the ability to re-program the controller, interrogate logs, read flow rate & pressure.
- 8.19. The 4G/5G modem must support packet data. It must be capable of auto recovery, including detect and auto redial. It must also be remote AT Command configurable.
- 8.20. The controller shall have an RS232 serial port, USB port and Bluetooth capability for laptop programming.
- 8.21. The controller firmware shall be capable of being updated via the serial port or USB at the controller via a laptop computer and the PC central software.
- 8.22. The serial port and USB ports will be easily accessible from the bottom outside of the controller enclosure.
- 8.23. The controller shall allow DataCoil™ and DataNode™ address numbers to be assigned to the devices at the controller.
- 8.24. The controller design shall be modular and consist of plug-in PCB modules that consist of 3 PCB modules and a motherboard. It will be designed in such a manner that LEDs will indicate correct operating status of each module and easy replacement of the PCB modules on a DIY basis.
- 8.25. The controller enclosure shall have a clear front lid to enable observation of the display and LED indicators.
- 8.26. The controller shall be powered by a single fully weather sealed switch-mode power supply.

Shared Controller Use

- 8.27. In order to avoid interference between construction, consolidation maintenance and City maintenance operations on controller programs, three programs must be established prior to irrigation handover to the City:
 - Program 1: City of Kwinana stations
 - Program 2: Developer consolidation maintenance stations
 - Program 3: Developer construction stations

In addition, the Developer shall provide a schedule of stations outlining station numbers, locations, valve location and landscape type.

9. Pipe-works

General

- 9.1. Refer to 'Sleeve and Trench Typical Details' drawing (24_COK_STD_IRR_G_002) in Appendix 2 'City of Kwinana Standard Irrigation Drawing Set' in conjunction with this Specification.

City of Kwinana Inspection of Pipe-works

- 9.2. The City of Kwinana will not accept Practical Completion of any irrigation system that has not had the mainline installation and back fill inspected, at the time of works, as specified within this Document, by the City's Representative.

- 9.3. It is the responsibility of the Developer to arrange inspections as specified; namely:
- The relevant Council Officer shall be present at time of mainline backfill to inspect workmanship and compliance to the standards outlined in this document
 - No backfill of mainline pipeworks is to occur without the consent of the relevant Council Officer and shall only occur following an inspection
 - The Contractor shall provide the City with seven (7) days-notice of intent to backfill mainline pipeworks and confirm the inspection appointment a minimum of 24 hours prior to the inspection time

Excavation and Trenching

- 9.4. Wherever possible, piping shall be laid in parallel straight lines. The trench bottom shall be flat, firm, smooth and free from rocks. Care shall be taken so that no rocks, rubble or sharp objects are laid in contact with the pipe.
- 9.5. Under no circumstances will trenching, which runs parallel with the road, be allowed any closer than 600mm to the kerb. Unless otherwise approved, distribution lateral pipes running parallel to a road shall, generally, be a minimum of 1.0m from the kerb, with individual spur laterals to be utilised to connect each sprinkler on the roadside.
- 9.6. Wherever possible, piping shall be laid under softscape areas, with piping under areas to be concreted, asphalted or built on to be avoided in all instances.
- 9.7. It shall be at the City of Kwinana Representative's discretion whether excavated spoil is suitable for backfill.
- 9.8. Lateral clearance between any pipes in a common trench, including electrical conduit, shall be a minimum of 100mm.

Sleeves

- 9.9. PVC sleeves shall be installed under all hardstand surfaces for the installation of any mainline or lateral pipe. The sleeve shall be of Class 9 PVC SWJ and of the diameter noted in the relevant drawings.
- 9.10. Mainline sleeves must be a minimum of 150mm PVC to accommodate 80mm PVC mainline and 200mm PVC to accommodate 100mm mainline. Mainline sleeves shall accommodate the PVC Mainline only, any additional pipework (including solenoid cabling) to be ran in a separate sleeve.
- 9.11. Lateral sleeves must be sized to accommodate the lateral pipe so as to allow room to remove/replace if necessary. The lateral line sleeves shall accommodate the lateral PVC pipe only.
- 9.12. Conduit sleeves shall be a minimum of 40mm HD electrical conduit. The electrical (solenoid wiring) sleeve shall accommodate the electrical wiring conduit only.
- 9.13. Sleeves under roads must have 600mm minimum soil cover and the sleeve is to extend a minimum of 0.5m and maximum of 1.0m beyond the kerb line/hardstand edge.
- 9.14. Any sleeve installed via horizontal boring methods must not to be curved on any axis. Any necessary change in direction shall only be achieved by cutting of mainline pipes at level and the use of 45- or 90-degree elbow fittings.
- 9.15. All sleeves must be suitably temporarily blocked at both ends immediately following installation to prevent debris entry.

Mainlines and Electrical Conduit

- 9.16. Irrigation mainlines of 100mm NB size or larger, shall be PVC and manufactured in Australia to AS 4765, with a minimum pressure rating of PN9, and shall utilise the Rubber Ring method of Jointing (RRJ).
- 9.17. All mainlines of 80mm NB size must be uPVC manufactured in Australia to AS 1477, having a minimum pressure rating of Class 9, and shall utilise the Rubber Ring method of Jointing (RRJ).
- 9.18. The use of HDPE pipe for mainlines will also be accepted, where deemed beneficial, such as within ducts exceeding 6m in length, long radius arc or tree root zone applications.
- 9.19. All mainlines shall be installed in a trench which is free of debris and other large or hard objects which may damage or deform the pipe.
- 9.20. Electrical conduit for solenoid cabling to be no smaller than 32mm MD conduit to allow future cabling to be pulled through if necessary.
- 9.21. The base of the trench should be as uniform as possible relative to both grade (slope) and compaction so as to support the mainline pipes uniformly over their length and where practicable, the width of mainline trenches should be maintained at between 3 and 6 times the mainline pipe diameter.
- 9.22. Mainlines shall be installed to a minimum of 500mm soil cover and shall be bedded and backfilled.
- 9.23. Where mainlines must be installed under sealed driveways or other paved trafficable areas, they shall be installed within a PVC duct (sleeve) size as specified under the “sleeves” subheading.
- 9.24. Where mainlines must be installed under unsealed driveways or other unsealed trafficable areas, they shall be installed with a minimum soil cover of 600mm.
- 9.25. Mainline joints within sleeves will not be accepted, unless specifically approved by the City. Mainline pipes within sleeves exceeding 6 metres in length shall be high density poly pipe (continuous or butt welded), unless otherwise approved by the City.
- 9.26. Curves in PVC mainlines must be avoided in all instances and will not be accepted unless sufficiently justified, and approved, in writing, by the City. Where a mainline curve is deemed absolutely necessary, preference shall be for the use of HDPE pipe, however in the event of curved uPVC mainline being approved by the City, the following minimum radius arcs must be adhered to:

Size	Radius of Arc
80mm	24m
100mm	30m
150mm	45m

- 9.27. In addition, it is important that all joints in curved lines be thoroughly supported by compacted soil. No ‘Tapping Band’ connection will be permitted in a mainline curve, however, cast iron irrigation tees may be utilised for this purpose.
- 9.28. All Rubber Ring Joints (RRJ) must be installed in accordance with the manufacturer’s recommendations, including, but not limited to:
 - Chamfering of spigot
 - Use of recommended ring lubricant
 - Cleanliness during ring insertion
 - Pipe ‘witness mark’ to remain just visible

- Care to prevent over insertion of previous pipe joints by successive joint completion

Backfill and Compaction

- 9.29. The bedding, overlay and back filling of all pipe work trenches shall be accomplished with material previously excavated from the site trenches, provided it is free from rock and other hard objects, in accordance with AS 2032.
- 9.30. The City of Kwinana Irrigation Supervisor shall be present at time of backfill to inspect workmanship and compliance to the standards outlined in this document; no backfill is to occur prior to this inspection. **Practical Completion and/or Handover will not be accepted unless this inspection has occurred.**
- 9.31. The Contractor shall give the City's Irrigation Supervisor seven (7) days-notice of intent to backfill pipework and confirm the inspection appointment a minimum of 24 hours prior to the inspection time.
- 9.32. If the material excavated from the site trenches is unsuitable or insufficient to accomplish the bedding and back filling operation to the satisfaction of City's Irrigation Supervisor, then clean sand fill for this purpose is to be utilised.
- 9.33. The trench work shall then be compacted so as to minimise the future subsidence of the soil in the trench.

Laterals – PVC

- 9.34. All uPVC laterals shall be manufactured in Australia to AS 1477, having a minimum pressure rating of Class 9, and shall utilise the Solvent Weld method of Jointing (SWJ) being of the sizes as shown on the drawings.
- 9.35. All laterals shall be installed in a trench which is free of debris and other large or hard objects which may damage or deform the pipe, and the base of the trench should be as uniform as possible relative to both grade (slope) and compaction so as to support the lateral pipes uniformly over their length.
- 9.36. The lateral pipes shall be installed with 300mm minimum soil cover and shall be bedded and backfilled.

10. Fittings

General

- 10.1. Refer to 'Thrust Block Typical Details' drawing (20_COK_STD_IRR_G_003) in Appendix 2 'City of Kwinana Standard Irrigation Drawing Set' in conjunction with this Specification.
- 10.2. A minimum 300mm space between valves and joints
- 10.3. Cross stacking of fittings will not be accepted.

Cast Iron Fittings

- 10.4. All fittings of 80NB and larger, that must be used on the mainlines, with the exception of approved uPVC Bends and Tapping Bands, shall be of Cast Iron material with RRJ or flange connection, manufactured to AS 2280 or equivalent.
- 10.5. Where rubber rings differ from those of the PVC mainline, the installer shall exercise all due care to use the correct ring with the correct fitting. All RRJ fittings shall be thrust in accordance with this specification.

- 10.6. Any Cast Iron Flanged fittings shall be flanged in accordance with AS 2129 in British Standard Table 'E' configuration.

Thrusting Requirements

- 10.7. All the fittings on the uPVC mainlines jointed with rubber ring joints or glued require concrete thrust blocks to prevent movement of the pipeline when a pressure load is applied. The thrust block transfers the load from the fitting, around which it is placed, to the larger bearing surface of the solid trench wall.
- 10.8. A thrust block should bear firmly against the side of the trench and to achieve this, it may be necessary to hand trim the trench side or hand excavate the trench wall to form a recess. The thrust acts through the centre line of the fitting and the thrust block should be constructed symmetrically about this centre line.
- 10.9. In any event, concrete thrust blocks shall be installed to satisfy the intent as noted, and in accordance with the pipe & fitting manufacturer's recommendations.
- 10.10. Concrete shall be thoroughly mixed on the surface prior to installation. Dry concrete mix and water shall not be mixed in the trench.

Tapping Bands

- 10.11. Tapping bands (saddles) shall be utilised to facilitate the connection of lateral pipes, via a valve assembly, to the irrigation mainlines, which shall be of a type designed for use with PVC, having a tapping size corresponding to the size of the valve fitted.
- 10.12. Due care shall be taken in the installation of tapping bands and ensure that all holes are accomplished utilising a sharp and appropriately sized hole saw and ensure the inside of the pipework is free of debris prior to valve installation.

uPVC Fittings

- 10.13. The only uPVC pipe fittings which are approved for use on irrigation mainlines of 80mm and over, are RRJ long radius bends, being a one-piece fitting manufactured from pipe being a minimum of one (1) pressure class higher than the pressure class of the mainline to which they must be attached. The bend shall be thrust in accordance with this specification.
- 10.14. All uPVC fittings used in pipe laterals (downstream of solenoid valve) shall be manufactured to AS 1477 being designated as Class 18 pressure rating. Solvent Weld joints shall be accomplished in accordance with the pipe/fitting manufacturer's recommendations, including the application of both primer and solvent to all joints.

11. Valving

General

- 11.1. Refer to 'Valve Typical Details' drawing (20_COK_STD_IRR_G_004) in Appendix 2 'City of Kwinana Standard Irrigation Drawing Set' in conjunction with this Specification.

Isolation Valves

- 11.2. Every solenoid valve and air release valve location (where used) shall be isolated from the irrigation mainline utilising an equivalent sized nylon ball isolation valve.
- 11.3. Mainline isolation valves will be required to be installed at the location shown in the drawings, and unless otherwise shown shall be of the cast iron gate (sluice) valve type with Table 'E' flanged connections conforming to Australian Standard AS 2638 having a stainless steel stem and gunmetal (bronze) trim and shall be installed in a vertical orientation being perpendicular to the surface of the ground in which they are installed.

Solenoid Valves

- 11.4. The City of Kwinana preferred solenoid valve is Bermad electric control 200 series, normally closed 24-volt, 50 Hertz solenoid operated diaphragm valves with flow control stem and manual bleed facility. Any alternative solenoid valve proposed or supplied must, to the written satisfaction and approval of the City, meet or exceed the specifications of the preferred product.
- 11.5. In conjunction with the City of Kwinana's specified preferred two-wire irrigation controller (SD Systems SDS-50/100), the Bermad electric control 200 series valves shall be fitted with DataCoil™ decoders. A durable, clearly legible, label is to be attached to every solenoid, identifying the assigned decoder number.
- 11.6. Valves shall be in accordance with the approved drawings and shall be installed utilising threaded fittings and a nylon ball isolation valve prior to solenoid valve inlet.
- 11.7. The installation Contractor shall undertake the flow (pressure) adjustment of all solenoid valves in accordance with the nominal operating pressure of the sprinklers attached to the particular solenoid valve.
- 11.8. All solenoid valves shall be installed in two (2) Rainbird VB Series '1419' model fibre reinforced valve box (or approved equivalent), ensuring adequate clearance to enable access to all valve features.

Flushing Valves

- 11.9. Manual flushing valves shall typically be a 50mm Philmac Ball valve, or approved equivalent, on a suitable diameter riser and housed in a '1419' model fibre reinforced valve box.

Air Release Valves

- 11.10. Air release valves shall be installed at high points in the mainline in the approximate locations as shown in the drawings, or as determined by site conditions, such that any trapped air in the mainline is able to be readily exhausted whilst minimising the risk of water hammer in the system.
- 11.11. Air/Vacuum release valves shall be 50mm diameter ARI non corroding valve inlet to be fitted with isolation ball valve.
- 11.12. Air release valves shall be installed in a '910' model fibre reinforced 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.

Conduits & Conduit Pits

- 11.13. All solenoid valve wiring shall be installed in the design specified conduit 32mm or larger, which shall be run in the same trench as the irrigation mainline and installed so as to maintain a minimum 100mm separation between the mainline and conduit.
- 11.14. P2 (600x285x570) conduit pits, with fibre cement lids, shall be installed at every change in conduit direction of 45 degrees or greater and at all junctions.
- 11.15. Conduit pits located in trafficable areas, or areas that are likely to experience vehicular passage, must be suitably trafficable.

Solenoid Wiring (General)

- 11.16. Where practicable, solenoid wiring from the valves to the controller shall be installed in one continuous (non-jointed) run. Where joints must be made in cable runs, they shall be undertaken in a conduit pit.

- 11.17. All underground electrical joints to the solenoid valves shall be accomplished using '3M' brand gel filled connectors Model 'DBY' or Model 'DBR', depending upon the number/size of cores to be joined. PVC tape shall NOT be used to insulate any connection.
- 11.18. All solenoid wiring within cable pits and valve boxes to have a minimum of 2m loop of spare cable, with wire joints serviceable outside of the valve box if required.
- 11.19. Two-wire system and all electrical connections must be as per preferred manufacturer (SD Systems) recommendations, as amended.

Multi-Core Solenoid Wiring (Specific Approval Required)

- 11.20. The use of multi-core wiring must be strongly justified, and specifically approved, in writing, by the Principal, prior to installation at any site.
- 11.21. Any approved multi-core wiring shall be of multi strand construction, of suitable cross-sectional area with HDPE insulation.
- 11.22. Where applicable, four (4) spare solenoid wires shall be installed with the entire route and extent of the mainline. Where the wires are installed with a ring main, there will be a total of eight (8) spare wires entering the electrical cubicle.

Valve Enclosures

- 11.23. All valves shall be housed in a heavy-duty valve box in accordance with the below;
- Solenoid Valves – To be housed using two (2) Rainbird VB Series '1419' fibre reinforced 590 x 490 x 310 rectangular valve box (or approved equivalent) with the bottom valve box lid removed.
 - Mainline Isolation Valves–Rainbird VB Series 10-inch circular valve box (or approved equivalent), 150mm PVC can be utilised to extend if required.
 - Any valve box installed in a trafficable area is to be of a suitably trafficable rating
- 11.24. All valve boxes will require an extension to the valve cavity, to a point where the valve box will bear upon the 'footing' and prohibit the entry of the surrounding soil into the valve cavity; spiral wound tubing shall not be used to form this cavity.
- 11.25. For circular valve boxes, the footing may be formed using standard sized clay bricks.
- 11.26. Valve enclosures shall be installed in softscape areas (excluding active playing surfaces), unless otherwise approved, in writing, by the City of Kwinana. Enclosures approved for installation within a hardscape shall have a suitably fastened lid.
- 11.27. Valve enclosures shall be installed so as the lid is flush with finished ground level.
- 11.28. P2 Cable Pit to be located every 45m and used at any change of direction along the conduit.

12. Sprinklers

General

- 12.1. Refer to 'Sprinkler Typical Details' drawing (20_COK_STD_IRR_G_005) in Appendix 2 'City of Kwinana Standard Irrigation Drawing Set' in conjunction with this Specification.

Sprinkler Selection

- 12.2. The City of Kwinana typically utilises sprinkler products from Hunter as outlined in Table 3 below. Any proposed alternative sprinkler must, to the written satisfaction and approval of the City, meet or exceed the specifications of the preferred sprinklers listed.

TABLE 3: Preferred Sprinklers		
Brand Name	Type	Series
Hunter	Pop-up gear drive	Stainless Steel 'I' series i-20-12 inch (plastic body)
	Pop-up fixed head	'Pro-Spray' series
	Pop-up tree bubbler	'Pro-Spray' series
Hunter	Side strips nozzle	'Pro- Spray fixed nozzle SS-series

12.3. Minimum height of any sprinkler in;

Garden - perimeter – minimum 150mm pop up height

Garden – internal – minimum of 300mm pop up height

Turf – minimum of 100mm pop up height

12.4. Minimum height of any gear drive sprinkler in;

Active playing surfaces – 150mm pop up height

Passive surfaces – 100mm pop up height

Sumps and gardens – 300mm pop up height (i-20-12-inch plastic body)

12.5. The pop-up height and head selection of pop-up spray sprinklers in garden beds must sufficiently account for spray clearance over the landscape design and selected plant species to be installed in the planted area. Effective spray coverage must be able to be maintained as the selected plant species mature.

12.6. **The City of Kwinana prohibits the use of inline dripper type emitter systems.** Should there be a specific and adequately warranted requirement for systems within a particular design, then prior approval, in writing, must be obtained from the City of Kwinana. Inline drip systems shall never be approved for use within turf areas.

12.7. Conventional poly pipe drip emitters, whilst not prohibited by the City, shall not typically be used within a system design unless specifically required and approved in writing by the City of Kwinana.

Sprinkler Spacing

12.8. The system designer and installer shall consider the effects of localised prevailing wind conditions with regard to optimal spacing of sprinklers. In any event, the maximum design spacing of sprinklers shall be in strict accordance with manufacturer recommendations and performance specifications.

12.9. All sprinklers adjacent to any hardscape shall be set 100mm off the hardscape edge, including any mowing kerbing. Gear driven sprinklers installed on road verges shall be offset 100mm from the back of the concrete kerb.

Connection

- 12.10. All sprinklers and gear drives shall be installed on polyethylene articulated riser assemblies in accordance with the base connection size of the sprinklers and the associated detail drawings for each site, with the top of sprinkler being flush or no more than 10mm below the finished level.
- 12.11. All tree bubblers shall be installed on 15mm Super-flex flexible riser tubing fitted with appropriate E-Z compression elbow connectors. No PVC lateral pipe is to be located within 1m of any tree root-ball; flexible tubing to be of sufficient length to spur from the PVC lateral to desired bubbler position within the root zone.
- 12.12. All sprinklers and tree bubblers shall be installed plumb, with the exception of sprinklers installed adjacent or on an embankment with has a gradient, above the horizontal, which is greater than the trajectory of the sprinkler head/nozzle. In the latter case, part circle sprinklers may be angled to avoid water erosion of the embankment.
- 12.13. Any sprinkler located against a road shall be supplied by a single spur lateral running perpendicular to the road. Distribution lateral pipes running parallel to the road must be a minimum of 1.0m from the kerb.

Matched Precipitation Rate

- 12.14. All sprinklers must only be grouped in accordance with the calculated precipitation rate of sprinklers. Only sprinklers with a matched precipitation rate shall be grouped to operate together on a valve section.
- 12.15. Similarly, only valve sections with similar precipitation rates may be grouped to operate as a station on the irrigation controller.
- 12.16. The maximum and minimum operating pressure of sprinklers in a system shall not vary by more than 10%.

Arc Selection

- 12.17. In all cases of diverse planting (turf, garden, temporary), the arc selection shall minimise over-spray onto paving and adjacent areas by utilising part circle spray head patterns to the perimeter of all such areas.

Nozzle Selection

- 12.18. Selection of sprinkler nozzles shall be in strict accordance with manufacturer recommendations and optimal performance specifications.
- 12.19. The designer shall consider the prevailing weather conditions when irrigation will be required to take place. Nozzles with higher flow rates, higher precipitation rates and lower angles of trajectory will perform significantly better in windier conditions.
- 12.20. In any event, low angle nozzles shall be utilised along the perimeter boundaries of the project property which abut any residential properties with a minimum 800mm offset from the property boundary, arced slightly over 180 degrees.

13. Drawings, O-Spec & As-Constructed Documentation

Drawings

- 13.1. The Developer shall provide 'as-constructed' plans showing the location and routes of all mainlines, conduits, solenoid valves, isolation valves, valve boxes, cable pits and sprinklers as well as all bore, cubicle, filtration, sleeve, valve, sprinkler and thrust block installation details. Refer to Appendix 1 'Irrigation Drawing and Documentation Submission Checklist' for all submission requirements.

- 13.2. All plans and as-constructed documentation is to be supplied in PDF and DXF/DWG, in MGA geo-referenced format, as applicable.

O-Spec

- 13.3. In addition to standard as-constructed documentation, The City of Kwinana also requires O-Spec format data submission for all assets, including irrigation assets. Details on this data format are available from <https://www.a-specstandards.com.au/>
- 13.4. Survey data is to be collected by a qualified surveyor with previous experience in the digital 'pick up' of irrigation systems.
- 13.5. O-Spec data is to be submitted at time of Practical Completion. No asset handover will be accepted by the City of Kwinana without prior submission of the corresponding O-Spec data.

Manuals

- 13.6. The Developer shall provide the City with Operation and Maintenance manuals for any bore to be handed over. The manual is to include the following information:
- Area title / bore ID
 - Installation contractor details including addresses, telephone numbers and contact names
 - Hydrometer make, model, serial number and installation date
 - As-constructed drawings
 - Electrical wiring diagrams
 - Date of bore commissioning, practical completion and details of warranty/guarantees
 - Site or system specific maintenance instructions
 - System specific fault-finding procedures
 - List of settings for protective devices
 - Full details of name brand, model, rating of pumps, including performance curves and configuration settings of the variable speed drive
 - Bore completion report, including copy of Groundwater Well Licence, Lithology, step flow tests, constant rate test, recovery test, water analysis etc
 - Previous history of maintenance on bore, filter and infield irrigation

14. Requirements for Practical Completion

General

- 14.1. Unless specifically approved for valid reason, the City of Kwinana will not accept practical completion of infield irrigation assets separately from the corresponding landscape area which the irrigation serves. Landscape and irrigation assets of a designated area shall be approved and transferred together, with the exception of bore equipment, which is processed separately.

Works Inspections Required Prior to Practical Completion Application

- 14.2. Developers are advised that the City of Kwinana will require a mainline pipework back-fill inspection during project works to enable acceptance of Practical Completion to take place.

Requirements for Practical Completion

- 14.3. The developer is required to submit a 'City of Kwinana Practical Completion & Handover Application Package' a minimum of 14 days prior to intended practical completion inspection. The application package outlines submission requirements, including:
- Details of installation contractor/s
 - Date of pipework backfill inspection by City Representative
 - Details of proposed consolidation period maintenance contractor/s
 - As constructed drawings
 - Itemised asset list
 - O-Spec data
 - Proposed date for PC inspection (minimum 14 days' notice)
- 14.4. A practical completion inspection must be undertaken, at which time the City shall compile a list of any defects. At its discretion, the City of Kwinana may engage a professional irrigation consultant to undertake the inspection of the irrigation works and provide a defects list.
- 14.5. The Developer shall be responsible for carrying out the remedial works as noted on the defect list.
- 14.6. At the discretion of the City of Kwinana, defect rectification re-inspection shall be undertaken by City staff, where applicable, prior to acceptance of practical completion.
- 14.7. A practical completion acceptance certificate will be issued by the City, with the Developer's maintenance consolidation period commencing from the date of acceptance.

15. Consolidation Period Maintenance

- 15.1. The consolidation period for irrigation assets is a minimum of 24 months from the date of City of Kwinana acceptance of practical completion.
- 15.2. The City of Kwinana expects the Developer to engage a suitably qualified irrigation contractor or employee/s to undertake scheduled maintenance works on the irrigation system during the consolidation period. Expected maintenance works include:
- Scheduled irrigation system checks for adjustments and repairs during the irrigation season
 - Scheduled iron bacteria filtration maintenance as per system manufacturer recommendations (where fitted)
 - Strict monitoring of abstraction quantities in accordance with Department of Water and Environmental Regulation requirements, including, as a minimum, monthly hydrometer reading, analysis and watering schedule adjustments
- 15.3. In order to avoid interference between construction, consolidation maintenance and City maintenance operations on irrigation controller program/s, three programs must be established prior to any infield irrigation handover to the City:
- Program 1: City of Kwinana stations
 - Program 2: Developer consolidation maintenance stations
 - Program 3: Developer construction stations

In addition, the Developer shall provide a schedule of stations outlining station numbers, locations, valve location and landscape type.

16. Groundwater Management Expectations

- 16.1. Water-use efficiency and landscapes becoming unnecessarily irrigation dependent are priority concerns for the City of Kwinana during the Developer's maintenance consolidation period. In ensuring sustainability of the landscape and its water-use, the following shall be adhered to:
- Where-ever possible, all landscapes shall be installed during the winter period to minimise irrigation water requirements during establishment
 - Where installed during warmer months the landscape is not to be over-watered during establishment, with only the required amount of water to be applied considering the target landscape vegetation requirements
 - Irrigation times must be scaled back to standard run times immediately following any necessary establishment period. This ensures the landscape establishes an adequate (i.e. natural) root system, as opposed to becoming irrigation dependent shallow rooted
 - As a minimum, the Developer shall ensure that a monthly water budget irrigation schedule is implemented, whereby the irrigation run times are progressively increased then decreased over the irrigation season according to long term evapotranspiration (ET) rates.
 - Developers are encouraged to facilitate the use of the SD Systems remote activation capabilities by their contractors during system testing, maintenance and repairs to reduce unnecessary water usage

Integration of weather/ET/soil monitoring into the irrigation control is also encouraged to further improve water use efficiency

17. Requirements for Handover

General

- 17.1. The City of Kwinana will not accept handover of in-field irrigation assets separately from the corresponding landscape area which the irrigation serves, with the exception of bore equipment, which is processed separately.
- 17.2. The Developer is required to submit a 'City of Kwinana Practical Completion & Handover Application Package' a minimum of 30 days prior to intended handover inspection.
- 17.3. All drawings, O-Spec and as-constructed documentation, in accordance with Section 13 of this Document, is to have been supplied to the City.
- 17.4. A handover inspection must be undertaken, at which time the City shall compile a list of any defects. Reinspection of defect rectification (where applicable) is required prior to handover acceptance.
- 17.5. Following defect free inspection, the City of Kwinana will issue a certificate of handover acceptance and maintenance responsibility is then transferred to the City.

Handover of Bores & Groundwater Licenses

- 17.6. Handover of bores, associated filtration assets and groundwater allocation licenses will not be accepted by the City until such time as the City has already accepted handover of all infield irrigation infrastructure to be serviced by the bore.
- 17.7. Prior to the City having accepted handover all in ground irrigation infrastructure to be serviced by the bore, a shared maintenance cost agreement may be entered between the Developer and the City for the period of shared use. It shall be the responsibility of the Developer to arrange and establish any such agreement.
- 17.8. The Groundwater Well License (GWL) shall be transferred to the City of Kwinana in conjunction with handover acceptance of the bore assets. It shall be the responsibility of the

Developer to meet all requirements of the license transfer, including all fees, with the Department of Water and Environmental Regulation.

18. Warranties, Guarantees & Workmanship

- 18.1. The Developer is advised that guarantees and warranties for equipment, materials and workmanship shall be for a 12-month period commencing upon the date of the written acceptance of the irrigation works by the City of Kwinana.
- 18.2. The Developer shall warrant that the installation of all equipment supplied and installed was done so in accordance with standard industry practice and the equipment/material manufacturer's recommendations and specifications.

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Groundwater Consulting Services (2019), '*City of Kwinana Groundwater Operating Strategy 2019-24*', Groundwater Consulting Services, 8/47 Monash Ave, Como, PO Box 8323, South Perth, Western Australia

Hydroplan (2013), '*Bertram Road Irrigation Mainline Upgraded Installation Details; 12300-023-A*', Issued for tender 08.02.13, Hydro-Plan Pty Ltd, 11 Brodie Hall Dr, PO Box 1028, Bentley, Western Australia

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LD Total (2017), '*Living Edge POS 1*', As constructed 24.04.13, LD Total, 64 Mill Point Rd, South Perth, Western Australia

Signal (2018), '*SDS Series Instruction Booklet 2018*', Technical Irrigation Imports, 16 Mumford Pl, Balcatta, Western Australia

Total Eden (2018), '*Providence POS 6*', As constructed drawing, Total Eden, 6 Port Kembla Dr, Bibra Lake, Western Australia

Total Eden (2018), '*Wellard Sunrise POS 14*', As constructed drawing, Total Eden, 6 Port Kembla Dr, Bibra Lake, Western Australia

Appendix 1: Irrigation Documentation Submission Checklists

- A. Detailed Design Submission
- B. Practical Completion Application Submission
- C. Irrigation Handover Application Submission
- D. Bore Handover Application Submission

Appendix 2: Standard Irrigation Drawing Set

- | | |
|------------------------------|------------------------|
| A. Electrical Cubical Detail | (20_COK_STD_IRR_G_001) |
| B. Sleeve and Trench Details | (24_COK_STD_IRR_G_002) |
| C. Thrust Block Details | (20_COK_STD_IRR_G_003) |
| D. Valve Details | (24_COK_STD_IRR_G_004) |
| E. Sprinkler Details | (20_COK_STD_IRR_G_005) |
| F. Bore Headwork Detail | (24_COK_STD_IRR_G_006) |



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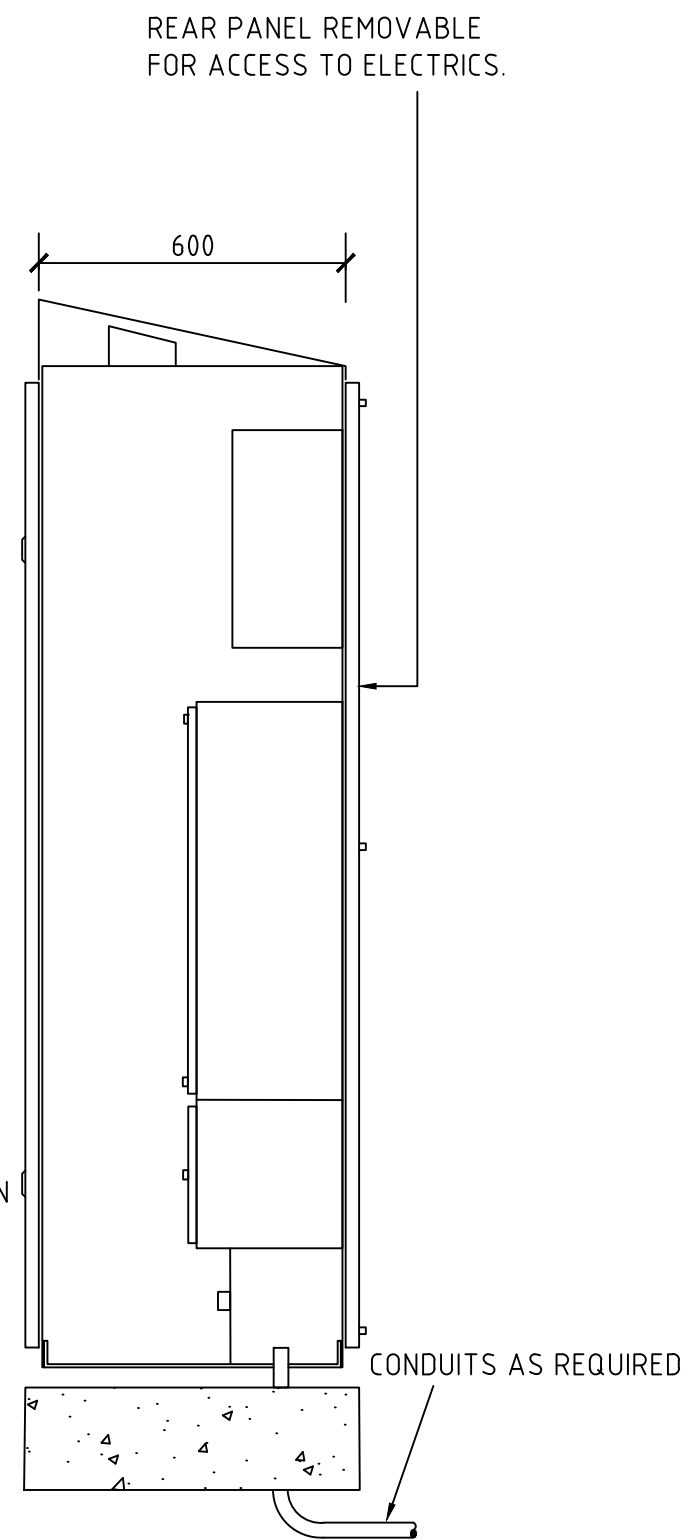
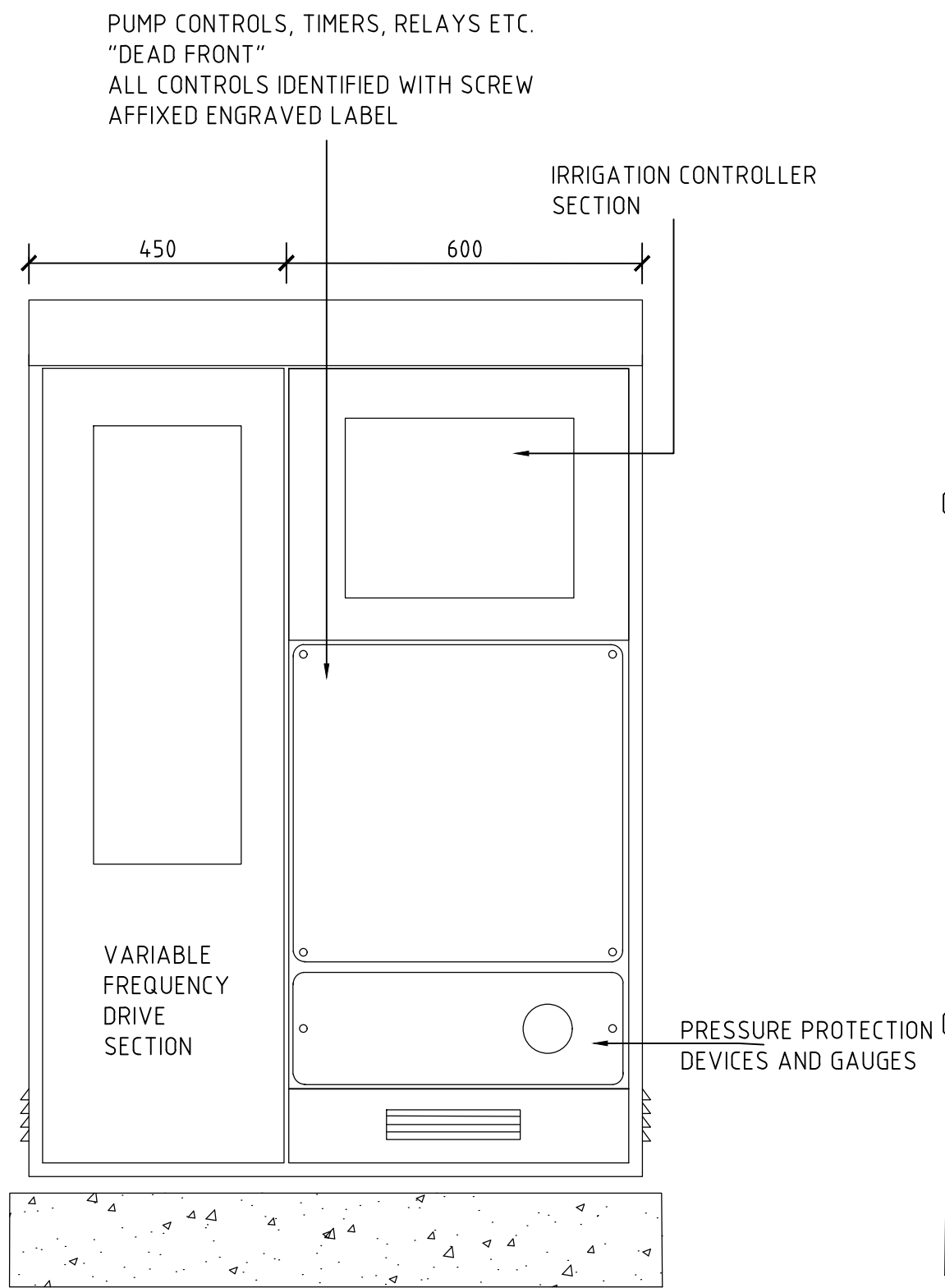
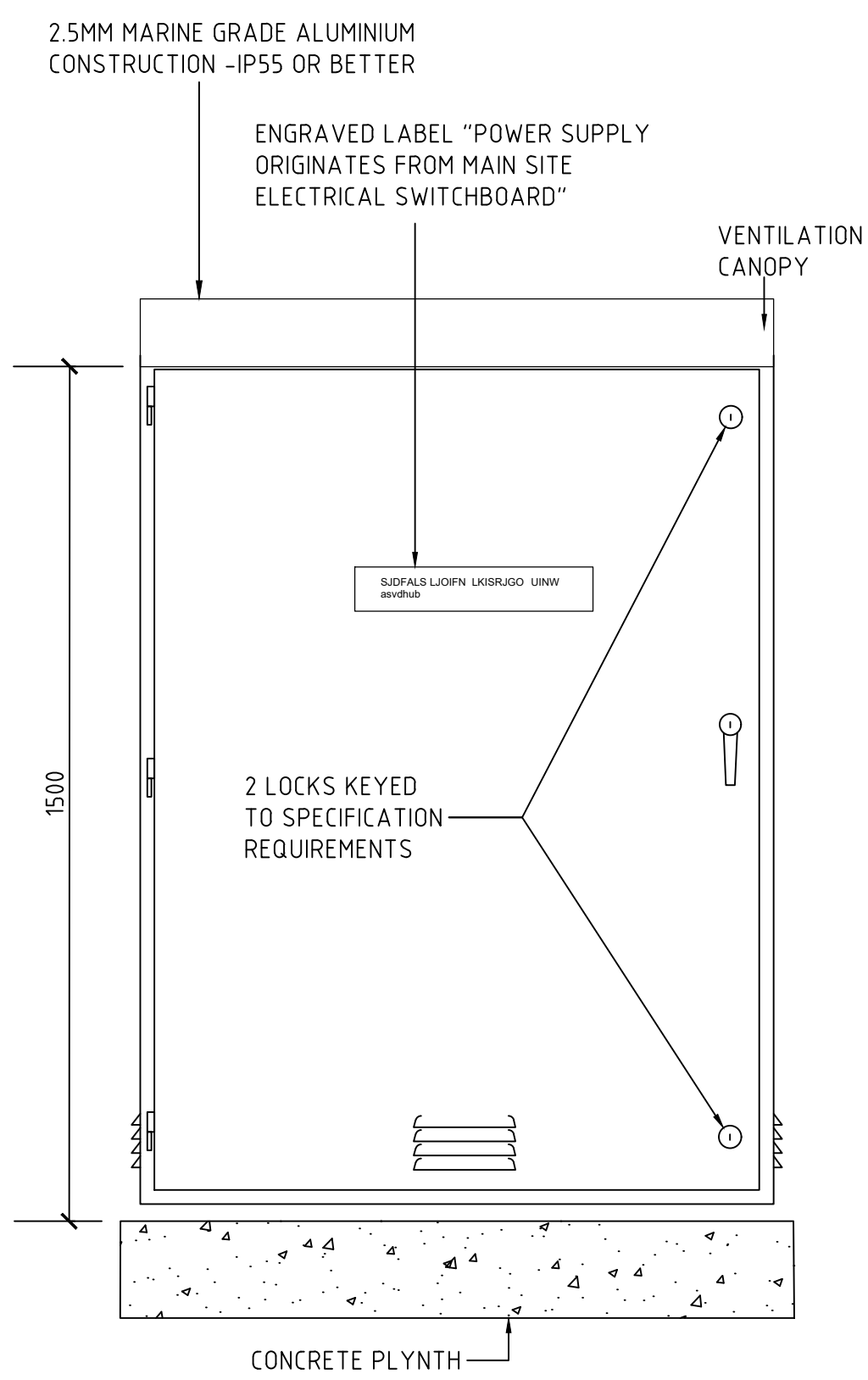
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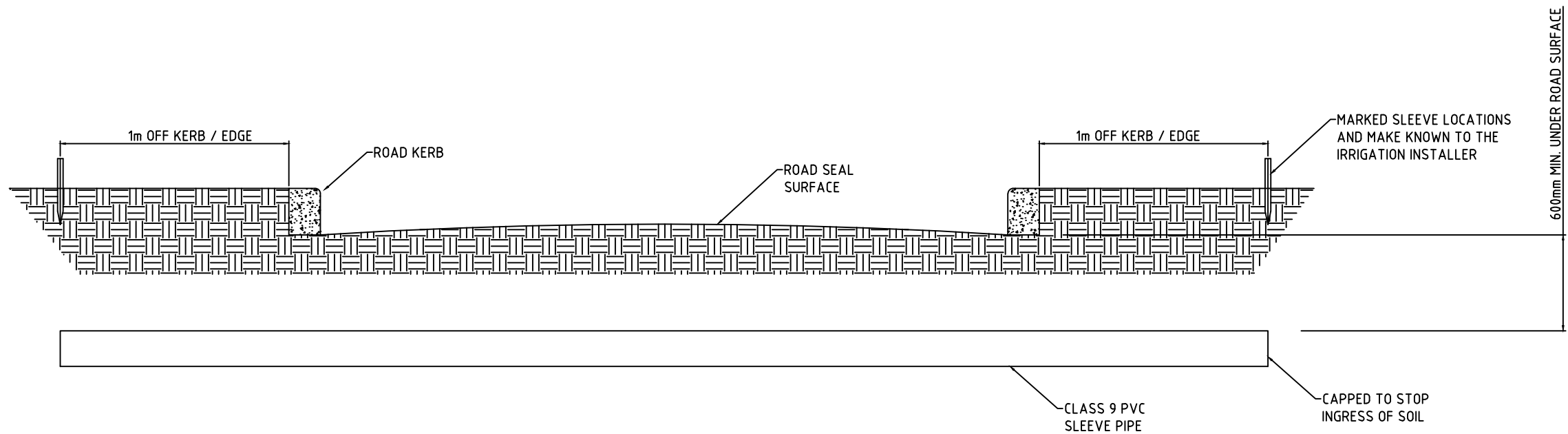
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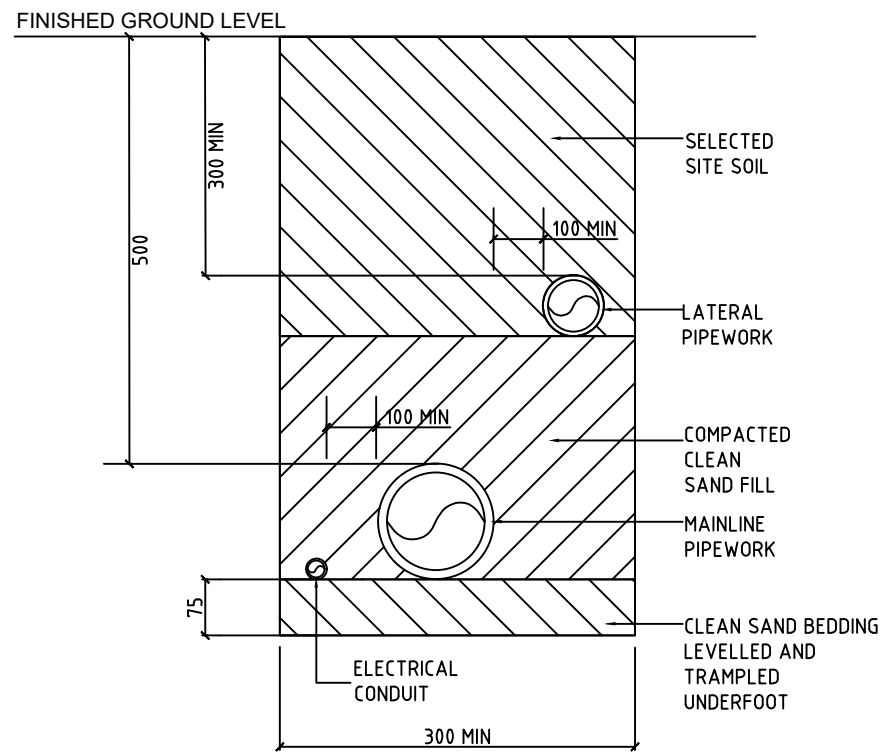


ELECTRICAL CUBICAL DETAIL
PUMP ELECTRICAL CUBICLE ("VFD" SECTION-as per specification)

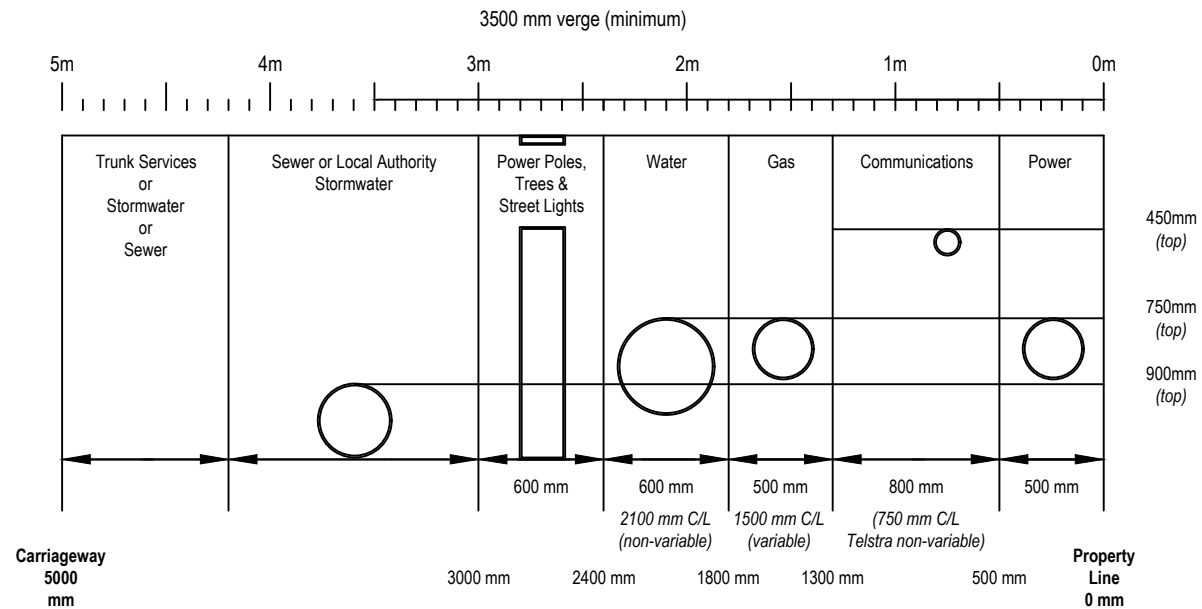
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								DESIGN	CHECK	TYPICAL DETAILS	
								T.M.	K.H.		
								DRAWN	DATE		
								T.M.	09/19		
								AUTHORISED (MANAGER ENGINEERING SERVICES)		FILE NO. DEPO-04	
						PHONE: (08) 9439 0200		ADDRESS: Cnr Gilmore Avenue and		DRAWING NUMBER	
						FAX: (08) 9439 0222		Sulphur Road,		20_COK_STD_IRR_G_001	
						EMAIL: admin@kwinana.wa.gov.au		Kwinana WA 6167		REVISION	
						WEB: http://www.kwinana.wa.gov.au				A	
								David Boccuzzi			
A	09/19	INITIAL ISSUE		T.M.							
REV	DATE	DESCRIPTION		DRAWN							



SLEEVE TYPICAL DETAIL
(DO NOT SCALE)



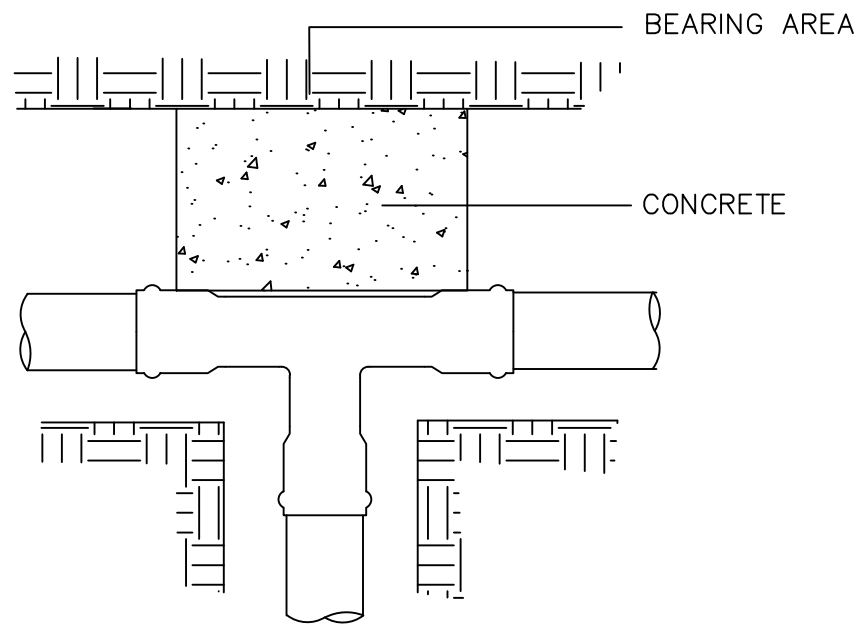
MULTIPLE PIPES IN COMMON TRENCH DETAIL
(DO NOT SCALE)



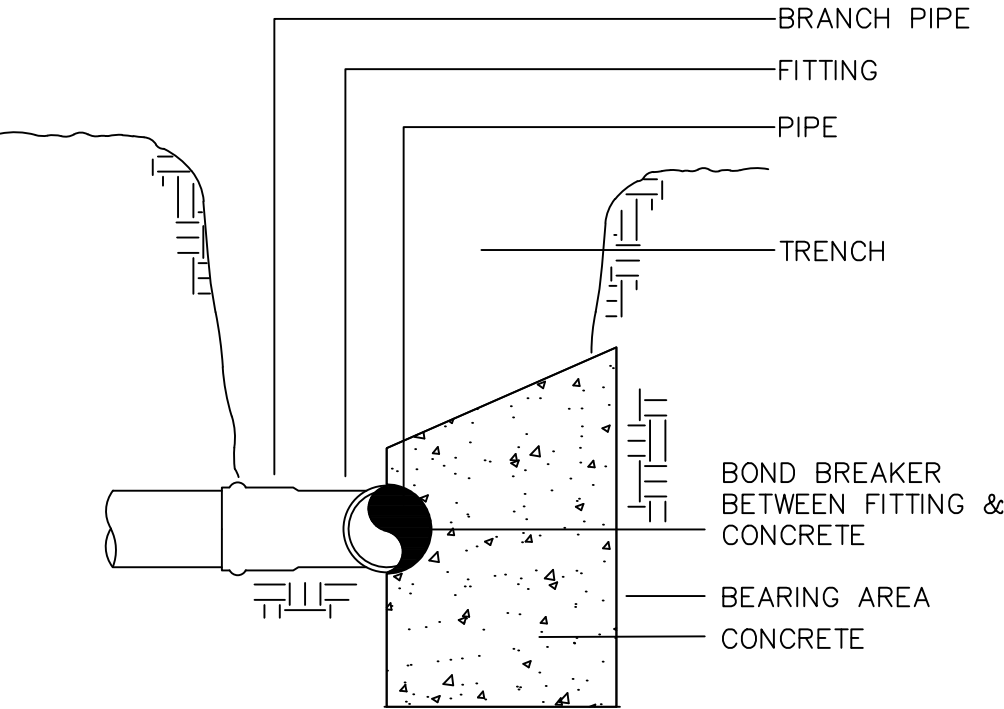
TYPICAL SERVICES OFFSET DETAIL
(DO NOT SCALE)

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						STANDARD IRRIGATION DRAWINGS	DESIGN: T.M. CHECK: K.H.	
							DRAWN: T.M. DATE: 09/19	
							AUTHORISED (MANAGER ENGINEERING SERVICES)	FILE NO. DEPO-04
								DRAWING NUMBER 24_COK_STD_IRR_G_002
								REVISION A
A	09/19	INITIAL ISSUE		T.M.		PHONE: (08) 9439 0200 FAX: (08) 9439 0222 EMAIL: admin@kwinana.wa.gov.au WEB: http://www.kwinana.wa.gov.au	ADDRESS: Cnr Gilmore Avenue and Sulphur Road, Kwinana WA 6167	
REV	DATE	DESCRIPTION		DRAWN			David Boccuzzi	

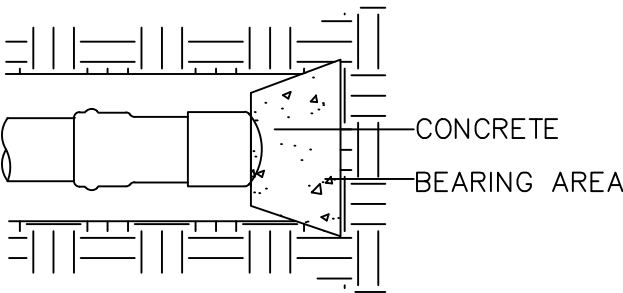
PLAN VIEW OF PIPE TEE PIECE



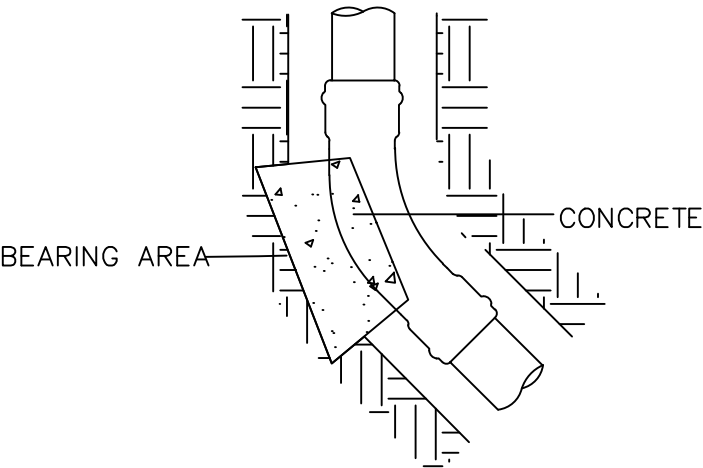
SECTION VIEW OF PIPE TEE PIECE



PLAN VIEW OF PIPE END CAP



PLAN VIEW OF PIPE ELBOW

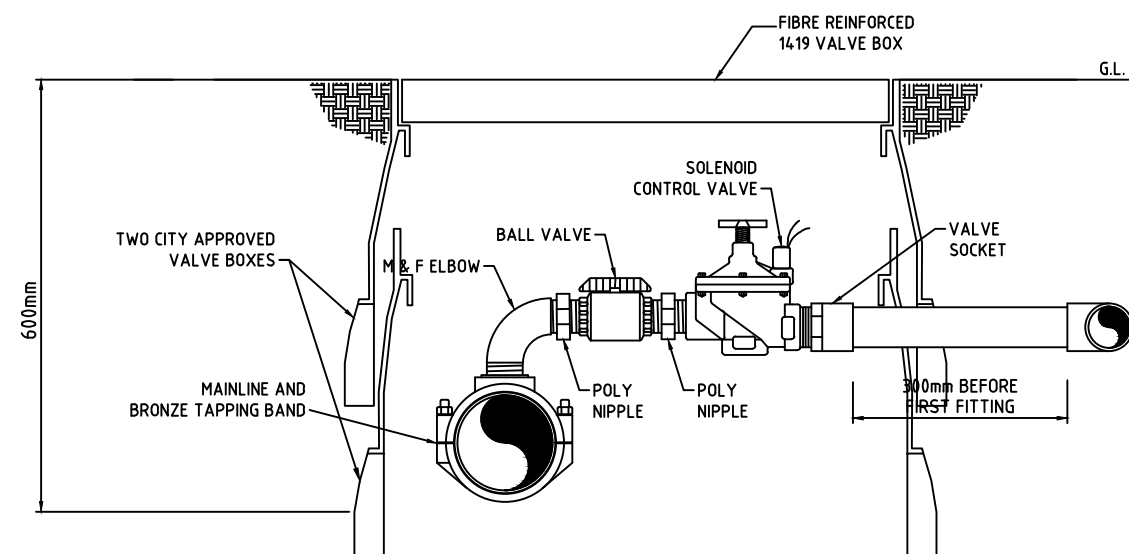


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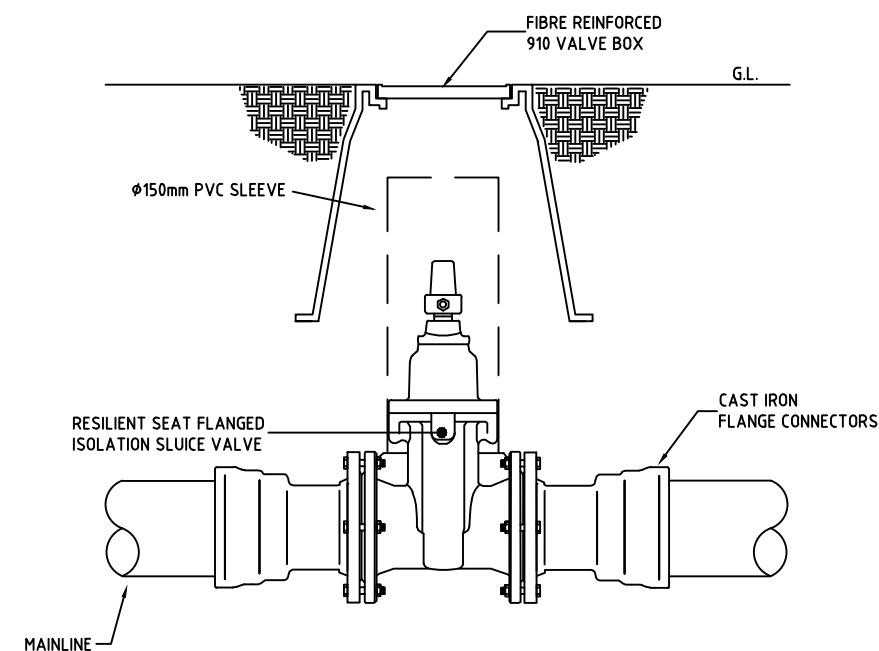
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BLOCK DIMENSIONS SHALL BE SUITABLY SIZED TO SUIT INDIVIDUAL PIPES AND FITTINGS USED AS RECOMMENDED BY MANUFACTUER

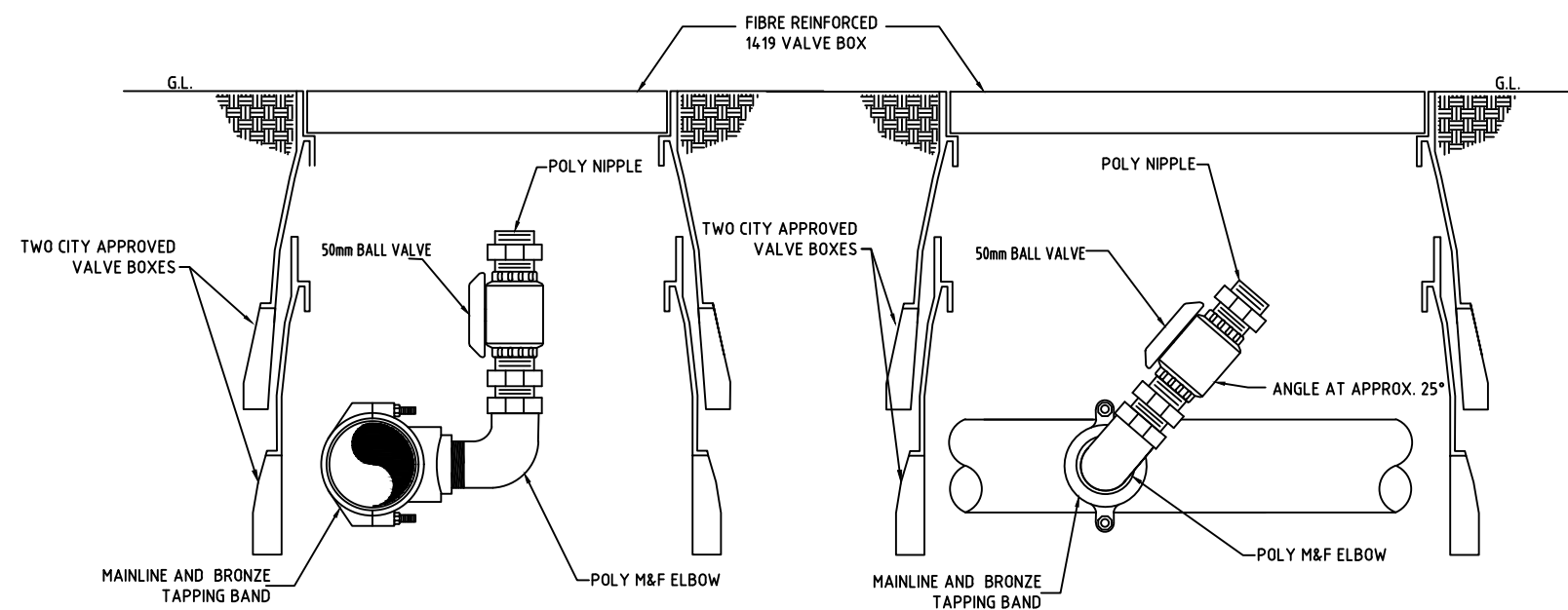
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							DRAWN T.M. DATE 09/19	FILE NO. DEPO-04
						PHONE: (08) 9439 0200 FAX: (08) 9439 0222 EMAIL: admin@kwinana.wa.gov.au WEB: http://www.kwinana.wa.gov.au	ADDRESS: Cnr Gilmore Avenue and Sulphur Road, Kwinana WA 6167	DRAWING NUMBER 20_COK_STD_IRR_G_003
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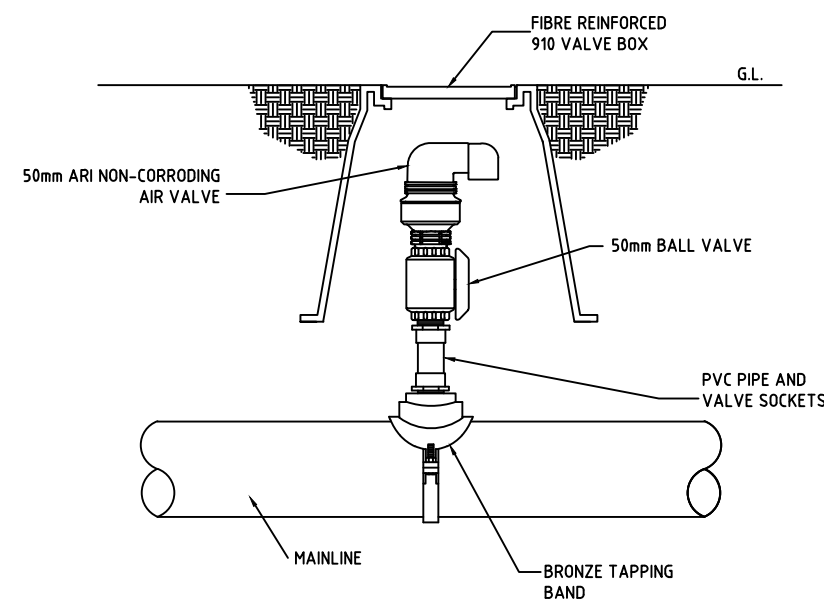
SOLENOID VALVE DETAIL
DO NOT SCALE



MAINLINE ISOLATION VALVE DETAIL
(SIZED SAME AS MAINLINE) DO NOT SCALE

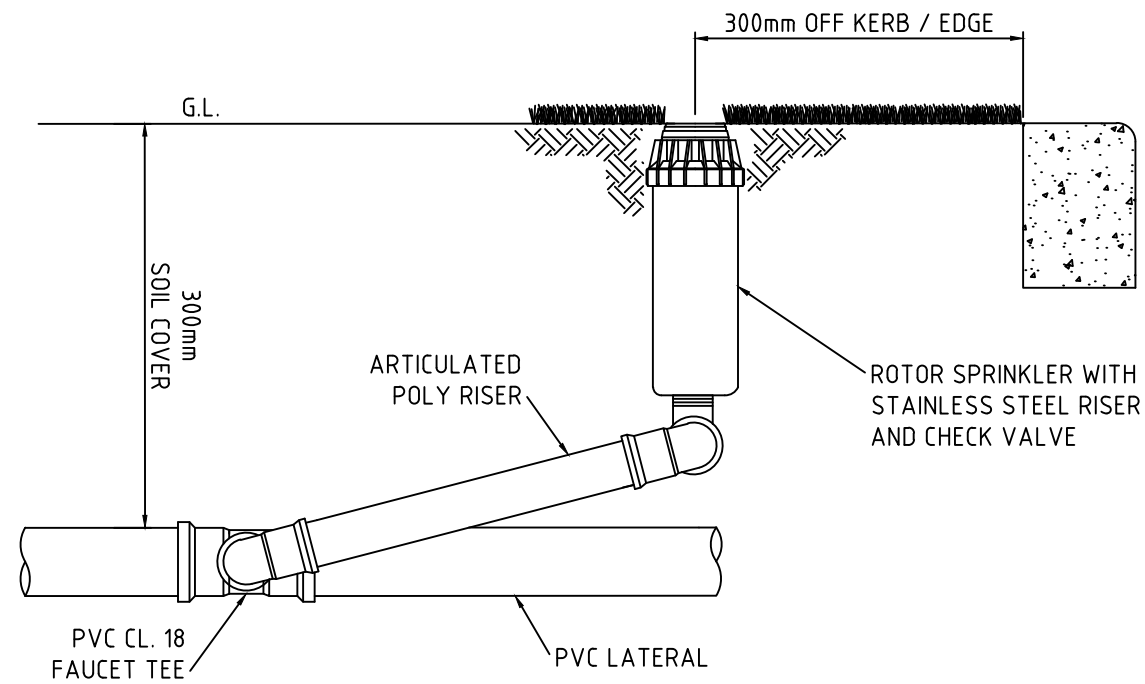


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DO NOT SCALE

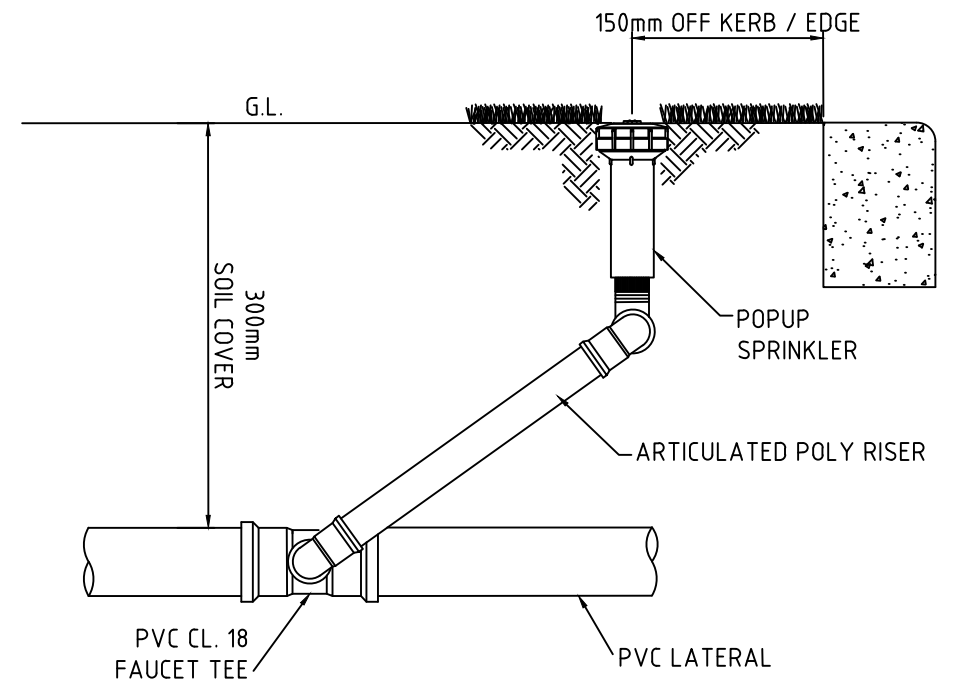


MAINLINE AIR RELEASE VALVE DETAIL
DO NOT SCALE

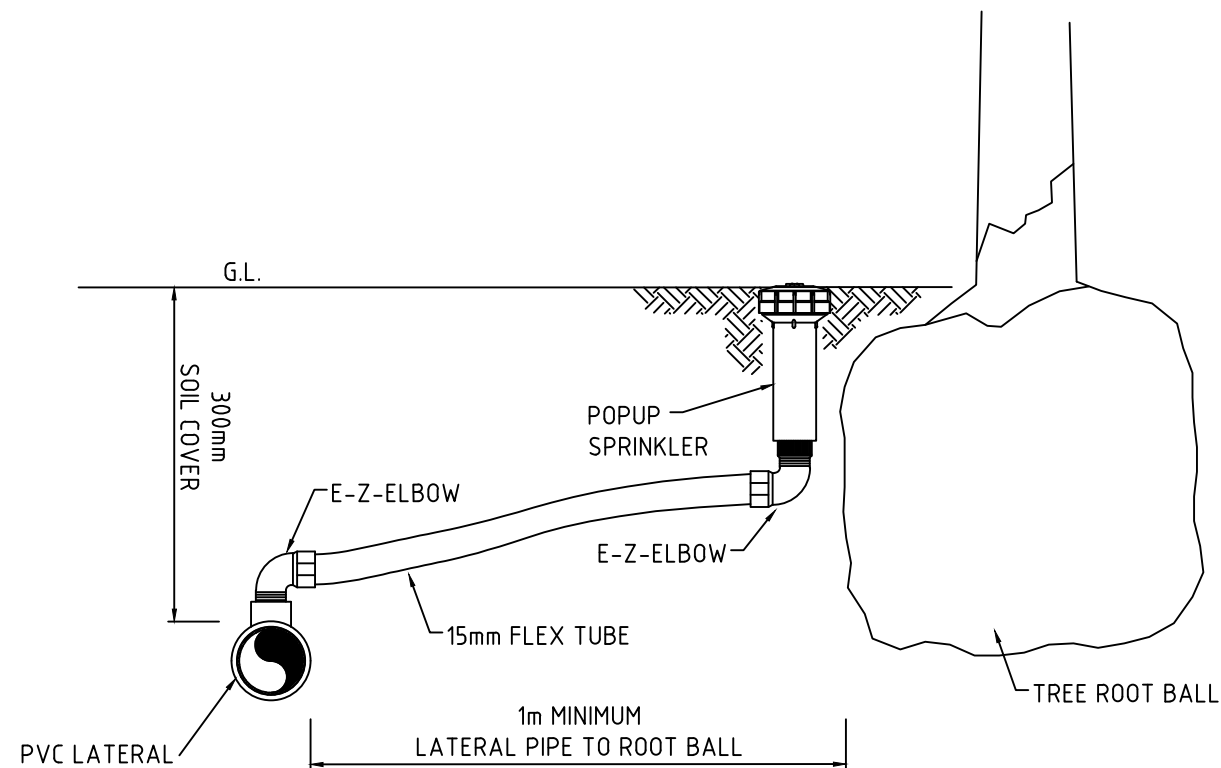
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TYPICAL ROTOR SPRINKLER INSTALLATION DETAIL
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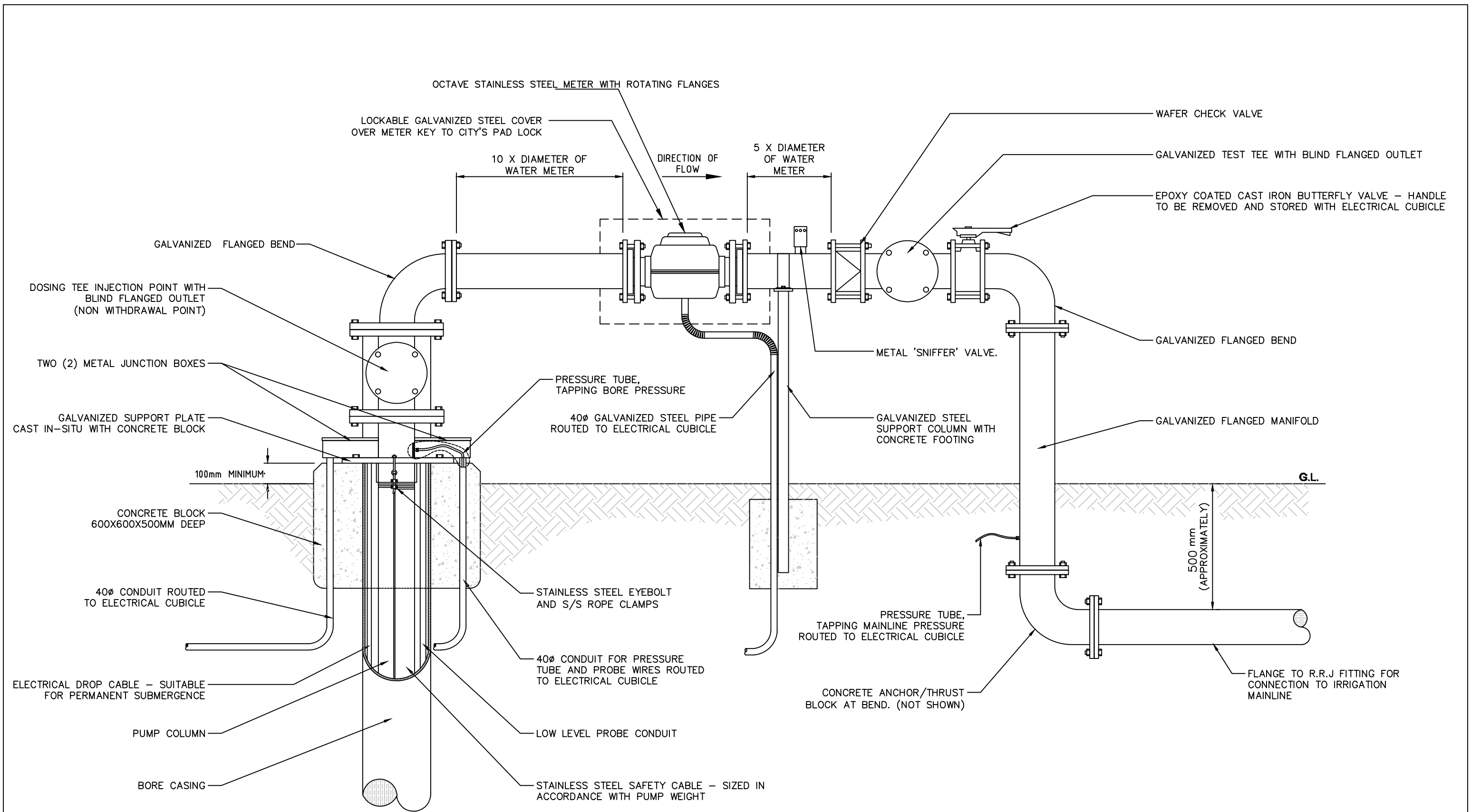


TYPICAL POPUP SPRINKLER INSTALLATION DETAIL
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TYPICAL TREE BUBBLER INSTALLATION DETAIL
NOT TO SCALE

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BORE CASING SIZE		DISCHARGE ASSEMBLY SIZE	
100mm		50Ø	
155mm		80Ø	
200mm		100Ø	

- NOTES:
1. ALL CABLE AND CONDUIT ENTRIES INTO JUNCTION BOXES TO BE SEALED.
 2. WATER METER TO BE INSTALLED IN ACCORDANCE WITH CITY OF KWINANA GUIDELINES AND DWER REGULATIONS.
 3. BORE CASING TO BE 200mm UNLESS OTHERWISE AGREED AND APPROVED BY THE CITY OF KWINANA PRINCIPAL.
 4. FINAL PIPE SIZE TO BE CONSIDER THE REQUIRED FLOW RATES, AND BE APPROVED THE CITY OF KWINANA PRINCIPAL.
 5. DRAWING TO BE READ IN CONJUNCTION WITH CITY'S IRRIGATION SPECIFICATIONS & BORE CONSTRUCTION SPECIFICATION DOCUMENTS.
 6. MODEL MUST BE APPROVED BY DEPARTMENT OF WATER AND ENVIRONMENTAL REGULATIONS (DWER) IN ACCORDANCE WITH THE PATTERN APPROVAL DOCUMENTATION.

				ASSOCIATE CONSULTANT:		PROJECT:		SCALE: N.T.S. (A3)		DRAWING TITLE: BORE HEAD WORKS TYPICAL DETAILS	
						STANDARD IRRIGATION DRAWINGS		DESIGN: J.M. CHECK: J.M.			
						PHONE: (08) 9439 0200 ADDRESS: Cnr Gilmore Avenue and Sulphur Road, Kwinana WA 6167		DRAWN: J.M. DATE: MAR 24		FILE NO. DEPO-04	
						FAX: (08) 9439 0222		AUTHORISED (MANAGER ENGINEERING SERVICES)		DRAWING NUMBER 24_COK_STD_IRR_G_006	
						EMAIL: admin@kwinana.wa.gov.au		David Boccuzzi		REVISION A	
						WEB: http://www.kwinana.wa.gov.au					
REV	DATE	DESCRIPTION		P.K.		DRAWN					
A	MAR 24	INITIAL ISSUE									