

Public Realm

Master Specification

PR-LS-C9 Irrigation

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Contents

Contents	3
PR-LS-C9 Irrigation	4
1 General	4
2 Referenced Documents	4
3 Abbreviations and Irrigation Terms	5
4 Design	5
5 Water Supply	5
6 Salvaged Materials	5
7 Setting Out and Checking of Work	5
8 Backflow Prevention	6
9 Trenching and Boring	7
10 Laying and Jointing of Pipes	8
11 Pipes and Fittings	9
12 Joints and Jointing Materials	10
13 Valves	10
14 Valve Boxes	11
15 Filters	11
16 Sprinklers	11
17 Drip Irrigation System	12
18 Thrust Blocks	12
19 Electrical	13
20 Control System	14
21 As-Constructed Drawings	14
22 Manuals and Documentation	14
23 Inspection and Testing	15
24 Maintenance (Defects Liability)	15
25 Hold Points	16

PR-LS-C9 Irrigation

1 General

- 1.1 This Part defines the requirements for the design, supply and installation of an irrigation system. Unless specified otherwise, the Contractor is responsible for:
- a) completion of the final irrigation design drawings;
 - b) connection to water supply points;
 - c) supply and installation of all components of the irrigation system;
 - d) programming, flushing, commissioning and testing of the system; and
 - e) ensuring that the system is fully functioning.
- 1.2 All clauses of this Part apply unless otherwise specified in the Contract Specific Requirements.
- 1.3 Where a specification differs between the Drawing and the Design Report, the Drawing shall take precedence.
- 1.4 If not specified in the Drawings or Design Report, the clauses in this Part shall be followed.

2 Referenced Documents

- 2.1 The work under the Contract shall comply with the following:
- a) Water Supply
 - i) AS 1628: Water supply - Metallic gate, globe and non-return valves
 - ii) AS 3500.1: Plumbing and drainage – Water services
 - b) Joints and Jointing Materials
 - i) AS 1195: Polytetrafluoroethylene (PTFE) skived tape
 - ii) AS 1646: Elastomeric seals for waterworks purposes
 - iii) AS 2129: Flanges for pipes, valves and fittings
 - iv) AS 3879: Solvent cements and priming fluids for PVC (PVC-U and PVC-M) and ABS pipes and fittings
 - c) Thrust Blocks
 - i) AS 2566.2: Buried Flexible Pipelines - Installation
 - d) Pipes
 - i) AS 1477: PVC pipes and fittings for pressure applications
 - ii) AS 2032: Installation of PVC pipe systems
 - iii) AS 2033: Installation of polyethylene pipe systems
 - iv) AS 2698: Plastics pipes and fittings for irrigation and rural applications – Polyethylene rural pipe
 - v) AS 4130: Polyethylene (PE) pipes for pressure applications
 - vi) AS 4809: Copper pipe and fittings—Installation and commissioning
 - e) Electrical
 - i) AS 3000: Electrical Installations
 - ii) SA Power Networks: Service & Installation Rules

3 Abbreviations and Irrigation Terms

Table PR-LS-C9 3-1 Abbreviations and Irrigation Terms

Abbreviation or Term	Definition
Control Valve	Control Valve
ELV	Extra-low voltage: Not exceeding 50 V a.c. or 120 V ripple-free d.c. (from AS3000)
GSM	Global System for Mobile Communications
Lateral	intermittently pressurised pipe work with outlets attached, downstream from control valves
LD poly	Low density polyethylene, Type 30 to AS 2698
LV	Low voltage: Exceeding extra-low voltage, but not exceeding 1,000 V a.c. or 1,500 V d.c. (from AS3000)
Mainline	pipes that are constantly pressurised during irrigation pipes that feed water to control valves
Station	output terminal of the automatic controller, valve or valve group
Submain	manifold of controlled pressure to feed laterals
uPVC	Unplasticised Poly Vinyl Chloride

4 Design

- 4.1 The Contractor shall design and submit detailed drawings showing the location and size of all controllers, pipes, filters, valves and a specification to the Principal prior to beginning construction.
- 4.2 Submission of design and specification shall constitute a **Hold Point**.

5 Water Supply

- 5.1 The location of the water service take off points shall be in accordance with the Drawings. The Contractor shall organise SA Water service connections at appropriate locations.
- 5.2 Unless specified otherwise, the Contractor shall connect the irrigation system to the water meter with new quick coupling valves and the appropriate connections and fittings.
- 5.3 If non-potable water is used, the Contractor shall install visual identification systems in accordance with SA Water requirements which includes all of the following:
 - a) lilac coloured pipe or lilac coloured striping;
 - b) lilac coloured sprinkler covers, valve covers and valve boxes; and
 - c) adequate signage indicating the use of non-potable water.

6 Salvaged Materials

- 6.1 Any existing irrigation components that are not required for the new system shall be decommissioned and abandoned in-situ in a condition that they do not present a safety hazard to others.
- 6.2 Any existing irrigation components that are required to be removed for the installation of the new system shall be exhumed, cleaned and returned to the Principal. Any excavations required shall be reinstated to finished grade.

7 Setting Out and Checking of Work

- 7.1 Setting out pipe
 - a) If the Contractor becomes aware of any discrepancy or ambiguity in or between the drawings, Specification and actual conditions on the site, it must notify the Principal as soon as practicable and before commencing work on the affected part of the Work. The Principal is not obliged to

make payment for additional work undertaken by the Contractor as a result of the Contractor's failure to comply with this Clause.

- b) The Contractor shall clearly identify the location of mainline and lateral pipe runs, using paint or pegs for approval by the Principal prior to trenching.
- c) In general, sprinkler and drip tube location is critical for uniform coverage, but variations in pipework may be approved to avoid obstacles.

7.2 Inspections

- a) The Contractor shall give 24 hours' notice for the Principal to make inspections at each of the following stages:
 - i) mainline & control valve set-out;
 - ii) sprinkler set-out;
 - iii) dripper set-out;
 - iv) mainline installation prior to backfill;
 - v) mainline & lateral flushing;
 - vi) mainline pressure test; and
 - vii) Final joint inspection
- b) Inspections of each of above shall constitute a **Hold Point**.

7.3 Connections to existing

- a) The Contractor shall make all necessary provision for exclusion of water from the pipes while connection is being made.

8 Backflow Prevention

8.1 The Contractor shall:

- a) install approved backflow prevention devices to all water supply points in accordance with AS 3500.1, and SA Water Regulations;
- b) only permit a person licensed to install and test backflow devices to install the backflow prevention devices;
- c) obtain all necessary permits and approvals from SA Water (special permission is required from SA Water to install back flow devices below ground);
- d) supply the Principal with a Certificate of Installation Compliance on completion of the installation of the backflow prevention device;
- e) at each meter site, install:
 - i) a double check backflow prevention device approved by SA Water 300 mm above the ground level adjacent to the water meter;
 - ii) double test cocks for maintenance and testing and SA Water approved isolating valves either side;
 - iii) a bronze Y - Strainer (to SA Water approval) immediately upstream of the backflow device;
 - iv) screwed bronze barrel union or flanges (to Australian Standards) on the inlet and outlet side of the check valve;
- f) use copper with copper fittings for all above ground pipe work with male and female threads made of dezincification resistance brass;
- g) install the base of the valve assembly on a minimum of 75 mm Class N20 concrete with a sleeve in the concrete to allow for the installation of the pipe work;
- h) wrap the section of copper pipe installed in the sleeve Denso Tape or equivalent; and
- i) install the backflow prevention device in an approved lockable vandal proof Colorbond cabinet or equivalent approved by the Superintendent.

- j) Further to the requirements of Appendix 4 and Appendix 5, the following items shall be installed in hard drawn copper:
 - i) connection of the potable water meter to the backflow device;
 - ii) all pipe work from the potable water meter to the inlet-isolating valve; and
 - iii) the pipe from the isolating valve on the discharge side of the check valve to the irrigation main pipe.
- k) All copper pipe work shall comply with AS 4809.

9 Trenching and Boring

- 9.1 Trenches outside of sealed roads shall be constructed in accordance with Appendix 1 "Trench Details". Unless specified otherwise, pipes under sealed roads shall be placed in sleeves installed by boring in accordance with Part RD-EW-C3 "Boring".
- 9.2 If trenching of a sealed road is permitted it shall be constructed in accordance with Part RD-EW-C2 "Trench Excavation and Backfill".
- 9.3 Sleeves shall:
 - a) consist of minimum of Class 12 pressure pipe;
 - b) be installed at the normal depth required for the pipe so that no deviation in pipe level occurs; and
 - c) be 50 mm wider in diameter than the socket end of the pipe or connection to be sleeved or a minimum size of 50 mm in diameter.
- 9.4 Where pavers are present in driveways and footpaths, the Contractor shall minimise the number of pavers removed.
- 9.5 Where trenches are shared with other cables, conduit, pipes or detection tape, the Contractor shall ensure proper placement according to the specifications and drawings. If two pipes are installed in the one trench, they shall be placed apart at least by the greater of 50mm and the diameter of the smallest pipe.
- 9.6 Prior to any excavation around or near trees shall constitute a **Hold Point**.
- 9.7 Following completion of excavation and prior to the placement of any pipe, a **Hold Point** shall apply.
- 9.8 Pipes under sealed roadways shall have at least a minimum of 1000 mm depth of cover. In other locations, all mainline and lateral trenches shall have a minimum of 350 mm depth of cover. Where the minimum cover cannot be achieved (e.g. to avoid other services) the Contractor shall notify the Principal.
- 9.9 Where placing pipes in hot conditions, the Contractor shall take precautions to ensure that the pipes will not become excessively stressed by subsequent contraction of the pipe at lower temperatures.
- 9.10 Rock
 - a) Rock is defined as material that cannot be removed by a Class 2.5 Backhoe or Class 2 Excavator, as classified by the Civil Contractors Federation publication: "Plant Specs", available from: <http://www.earthmover.com.au/plantspecs>.
 - b) If the Contractor considers that it has encountered rock, it shall advise the Principal before proceeding with further excavation.
- 9.11 Alignment of Trenches
 - a) In general, trenches shall be aligned with surface visible items such as kerbs, plantings, sprinklers, or valve locations.
 - b) The Contractor shall peg all mainline and lateral paths and use string lines where instructed for straight line trenching. The trench shall not vary by more than one trench width from the string line.

- c) When there is a need to divert around obstacles, the trench shall be offset parallel to the first trench and 45 degree angles used to join the pipes. Deflecting the pipe will be allowed when the radius is not less than the recommended 130 times the nominal pipe diameter, or within the manufacturer's joint deflection tolerances. Abrupt changes in horizontal alignment shall be made only where specified bends are provided.
- 9.12 Directional Boring beneath Buildings, Gardens and other Places
- a) The Principal may direct the Contractor to directional bore under any existing path, road, building, tree, lawn, garden plot or similar. Trees required to be preserved shall be protected at all times and pipelines adjacent to or under such trees shall be laid without interference to the limbs and roots. The Contractor shall hand excavate past or directional bore under these trees and tree roots as required by the Principal.
- 9.13 Excavated material
- a) Excavated material shall be deposited in such a manner as to not obstruct any drain, roadway, footpath, right of way or building access and shall not be deposited against the wall of any building or fence.
 - b) Any excavated topsoil shall be kept separate from other material to allow for respreading at the completion of the trench. Where different types of material are excavated from the trench, the Contractor (where practicable) shall keep the best quality material separable for use as backfill where permitted by this specification
 - c) The Contractor shall remove surplus excavated materials from the site as soon as practicable. Excavated rock shall not be used for backfill.
- 9.14 Reinstatement of Paved Areas
- a) If a trench crosses a road maintained by the Commissioner of Highways, the pavement reinstatement shall comply with Part RD-PV-C6 "Reinstatement of Existing Pavements".
 - b) Other roads, footpaths, driveways and carparks shall be reinstated to the same condition that existed prior to the excavation. A reinstated pavement shall not be of a lesser standard and thickness than the existing pavement.
- 9.15 Reinstatement of Unpaved Areas
- a) In unpaved areas, the Contractor shall replace any topsoil that was present, level off the surface and remove stones, debris and other undesirable materials. The Contractor shall top up and re-compact any trench which subsides during the Defects Liability Period.
 - b) Unless specified otherwise, the Contractor shall seed all unpaved areas which have been disturbed by the work with a mixture comprising of the following:

75 %	Perennial Ryegrass
25 %	Kikuyu
 - c) The mixture shall be applied at a rate of 40 grams per square metre.

10 Laying and Jointing of Pipes

- 10.1 Pipes shall be laid complete with all valves and fittings in accordance with the Drawings.
- 10.2 No pipes or wiring shall be laid beneath a concrete, paved or bituminous driveway, footpath or roadway unless contained within a sleeve pipe. No joins in either wiring or pipes shall occur within, or in close proximity to the sleeved section.
- 10.3 Witness marks
- a) Where the use of witness marks are recommended by pipe manufacturers, they shall be marked on the pipe spigot and shall remain visible after making the joint.
- 10.4 Making joints and tolerances
- a) Pipes shall be laid by inserting spigots into sockets. Manual jointing only will be permitted, and excavation plant shall not be used to push pipes into socket. Tolerances and deflections shall

not exceed those defined by manufacturers and the appropriate Australian Standard. uPVC and poly pipe shall be cut square with a fine tooth saw or tube cutter, and burrs shall be removed prior to making joints.

10.5 Prevent dirt from entering pipes

- a) The Contractor shall ensure before laying pipes or fittings that they are free from dirt or foreign matter. All pipe ends left open overnight shall be sealed to prevent material ingress.

10.6 Flushing

- a) All pipes shall be purged at the maximum velocity that is possible, using whatever valving, pump or mains pressure is available. Flush repeatedly using start-up surges to move debris downstream. If the debris is a result of the Contractors installation, and purging using existing equipment is unsuccessful, the Contractor shall provide any other equipment necessary to purge pipes to the satisfaction of the Principal.
- b) The Contractor shall flush lateral pipe work through risers before connecting any drippers to ensure that the dippers do not become clogged.

11 Pipes and Fittings

11.1 uPVC pipes and fittings

- a) All uPVC pipes and fittings shall conform to AS 1477 and shall be installed according to AS 2032. Solvent weld joints shall be made using cement to AS 3879.
- b) All pipes shall be class 12 minimum. uPVC pipes less than 80 mm nominal diameter shall use solvent welded joints. All pipes of 80 mm or greater shall use rubber ring joints unless otherwise specified.
- c) All fittings shall be uPVC to class 18 and solvent weld jointed.
- d) When recycled water supply is utilised, all pipes shall be lilac coloured and all mainline and lateral trenches shall have lilac marker detection tape installed 250 mm below surface level. Mainline detection tape shall have stainless steel wire.
- e) Suitable fittings shall be used to prevent kinking in polyethylene pipes.

11.2 Polyethylene pipes and fittings

- a) All polyethylene pipes shall be minimum PE100 and be PN12.5 for mainline pipe and PN10 for lateral pipe and use "compression type" joints in accordance with manufacturer's specifications.
- b) Polyethylene fittings above 63 mm diameter shall be electrofusion.
- c) When recycled water supply is utilised, all pipes shall be lilac coloured and all mainline and lateral trenches shall have lilac marker detection tape installed 250 mm below surface level. Mainline detection tape shall have trace wire.

11.3 Depth of cover to top of pipes

- a) The cover to the pipes shall comply with Table PR-LS-C9 11-1.

Table PR-LS-C9 11-1 Cover to Pipes

Location of Pipe or Pipe Type	Minimum Cover
under a sealed road	1.0 m
mainline pipework	450 mm
lateral pipework	350 mm
for PVC drip system submains	200 mm
LD poly drip tube	Laid on the surface and covered with mulch

11.4 Connections to existing pipework

- a) Connections to steel or copper pipe work and all valves shall be made using uPVC male thread adaptors for all sizes up to and including 50 mm. For all sizes above 50 mm refer to Clause 16.

11.5 High Density Fittings

- a) All high density fittings shall conform to AS 4129:2008.
- b) All polyethylene pipes shall be minimum PE100 and be PN12.5 for mainline pipe and PN10 for lateral pipe and use "compression type" joints in accordance with manufacturer's specifications.
- c) When recycled water supply is utilised, all pipes shall be lilac coloured and all mainlines shall have lilac marker detection tape installed 250 mm below surface level. Mainline detection tape shall have trace wire.

11.6 Copper Fittings

- a) Connections to copper pipe work shall be made by copper weld on fittings or optional compression fittings up to and including 50 mm. Connections of 80 mm diameter and above shall be made by weld type indicated in Clause 12 with bronze flanges fitted with suitable gaskets.

11.7 Galvanised Steel Fittings

- a) Connections to steel pipes shall be made with galvanised steel fittings. Galvanised barrel unions up to and including 50 mm diameter shall make all connections to valves. Connections 80mm diameter and above shall be made according to Clause 12 with screwed galvanised steel flanges conforming to AS 2129. All flanges shall be fitted with suitable gaskets.

12 Joints and Jointing Materials

12.1 Joints and jointing materials shall be in accordance with Table PR-LS-C9 12-1.

Table PR-LS-C9 12-1 Joints and Jointing Materials

Pipe Material	Pipe Size	Joint Type	Jointing Method	Standard
uPVC	All Pipes	Spigot and Socket	Solvent Material	AS 2033
uPVC	All Pipes	Screwed Fittings	Mechanical (PTFE Tape)	AS 1195
uPVC	All Pipes	Rubber Ring	Mechanical	AS 1646
Polyethylene	All Pipes	Screwed Fittings	Mechanical (PTFE Tape)	AS 4130
Polyethylene	All Pipes	Tita Fittings	Mechanical	AS 4129
Polyethylene	All Pipes	Stainless Steel Cobra Clamps	Mechanical	AS 4130
HDP Polyethylene	All Pipes	Spigot and Socket	Electrofusion	AS 4129

13 Valves

13.1 All valves and their installation shall comply with the relevant Australian Standards and SA Water requirements for their intended use.

13.2 No valve shall be used to terminate pipe work. A minimum length of 2.0 m shall be left between a valve and the end of a line. The end of the pipe shall be capped and anchored.

13.3 No valve shall be installed at the same depth as the pipe work. All valves should be installed close to the surface to allow for easy access and aid maintenance.

13.4 The number of the valve shown on the irrigation drawings shall be identified on the outside of the valve box on a 200 mm x 100 mm aluminium plate or similar approved.

13.5 Pressure Reducing Valves

- a) At each connection to the mains water supply a pressure reducing valve shall be used. The valve shall be of a type that will adjust to the flow requirements within a set limit and maintain a fixed pressure. Friction losses within the pipework shall be allowed for.

13.6 Shut-off Valves

- a) Isolating valves of the same nominal size as the supply pipe shall be bronze with screwed connections to AS 1628.

13.7 Gate Valves and Swing Check Valves

- a) Valves of the same size as the pipes in which they are incorporated shall be supplied, installed and tested.
- b) Each valve body shall be factory tested under a test pressure equal to 2,000 kPa. Copies of test certificates shall be provided to the Principal prior to their installation.
- c) Valves shall be constructed from bronze, cast iron or stainless steel with flanges or screwed connections. If required, an approved spring loaded check valve (non-return valve) shall be installed.

13.8 Solenoid Valves

- a) Solenoid valves shall be installed in accordance with Appendix 2 and Appendix 3 and shall be serviceable without removing the valve body from the pipeline.
- b) When non-potable water is being utilised, the valve shall have a lilac flow control handle in accordance with SA Water Requirements.

13.9 Drip Valves

- a) Drip valves shall be installed with a pressure regulator and filter assembly fitted downstream in a separate box to suit the flow required for the valve it is connected to.

14 Valve Boxes

- 14.1 All valves shall be installed in valve boxes of suitable size as to allow easy access for maintenance.

14.2 Valve boxes shall comply with the following:

- a) constructed from green high-density polypropylene, unless non-potable water is utilised;
- b) lockable and rectangular;
- c) set flush with the final grade;
- d) have metal detection tape attached underneath the lids;
- e) allow ready access to the hand wheels or control levers; and
- f) capable of withstanding being run over by motor vehicles of 3 tonne gross weight.

- 14.3 All valve boxes, excluding concrete boxes, shall be mounted on a concrete paving slab or bricks. Bricks shall be used to adjust the height of the boxes and backfilled with approved sand or 10 mm gravel aggregate to prevent contact with the pipe.

- 14.4 No part of the valve box shall rest on any pipe or fittings. Bricks and boxes shall be constructed so that the soil level inside the box remains lower than the bottom of the valve.

- 14.5 Isolating valve boxes shall allow ready access to the hand wheels or control levers.

15 Filters

- 15.1 The filter shall be installed in a separate valve box and shall have a 120 mesh screen.

16 Sprinklers

16.1 Type and Size

- a) Sprinklers shall be of the type and size specified on the Drawings.
- b) Pop-up sprinklers shall be installed to finished grade and perpendicular to the surface.

- c) Part circle sprinklers shall be adjustable. Where a part circle sprinkler is positioned adjacent to a hard edge (concrete path, paving etc) the body of the sprinkler shall be no more than 50mm from the hard edge.
 - d) All sprinklers shall be the stainless steel version of the model. Heads shall be set on compacted soil at finished ground level and be reset by the Contractor for a period of up to 6 months from date of Practical Completion if required.
 - e) The thread size of the riser shall be the same as the inlet thread size of the sprinkler. Sprinklers shall be installed on polyethylene 300 mm articulated risers using three threaded elbows. The Contractor shall install and adjust correct arc to each sprinkler to match site conditions.
- 16.2 Connection
- a) All sprinklers shall be installed to manufacturer's instructions. The Contractor shall mark out the position of each sprinkler before installation.
 - b) Sprinklers shall be installed within 100 mm of the designed location.
 - c) Marking out of the sprinkler positions shall constitute a **Hold Point**.

17 Drip Irrigation System

- 17.1 Each dripline shall be flushed to remove dirt. Pressure reduction valves shall be adjusted so that the pressure is within the range of 80 to 120 kPa. All drip tube shall lie on the finished ground surface. Before covering any part of the drip system, a joint visual check by the Contractor and Principal shall be made for leaks before proceeding with planting and mulching.
- 17.2 Flushing and commissioning may be carried out in sections of the system. At the end of a section of drippers there shall be a flushing valve the same size as the pipe. If using an isolating valve attach a short length of hose to allow water to be directed on to the garden area during flushing. The downstream end of the dripline shall be fitted with an end stop.
- 17.3 The layout of drip tube prior to covering with mulch shall constitute a **Hold Point**.
- 17.4 Drip Irrigation Fittings
- a) All drip tube is to be held in place with "Asta" Stakes or equivalent as approved by the Superintendent at a minimum of 3 metre intervals. All poly fittings shall be Antelco SB (single barbed) or equivalent. All offtake fittings shall be "Antelco Expando" type (or equivalent) with appropriate rubber grommet and stainless steel "Cobra Clamps" or equivalent.
- 17.5 Drip Irrigation for Landscape Garden Beds
- a) Unless specified otherwise on the Drawings, the drip tube shall be "in line" drip tubes with the following lateral spacings:
 - i) Type 1: Landscape Bed - Laterals to be spaced at 0.5 m spacings.
 - ii) Type 2: Landscape Bed - Randomly run the drip tube to plants. Maximum run length of drip tube is not to exceed 120 m length. Placement of the tube shall be approved by the Principal.
- 17.6 Drip Irrigation for Trees
- a) Unless specified otherwise on the Drawings, trees shall be run on a separate station from landscape beds.

18 Thrust Blocks

- 18.1 Construction of anchor and thrust blocks shall be in accordance with Appendix 9 and AS 2566.2 at all changes in direction, where branches occur at blank ends and generally wherever an out of balance force is generated by the pressure and velocity of water in the main run pipe.
- 18.2 The design of the thrust blocks shall allow for loads to be encountered during testing. The allowable bearing pressure for the design of the thrust blocks shall be in accordance with manufacturer's

specifications and soil types. Concrete shall be poured against excavated faces in the trench which shall be free from all loose, soft or otherwise distributed material.

- 18.3 Concrete thrust blocks shall have a minimum volume of 0.025 m³. Polyethylene film 0.2 mm thick shall be placed between the pipe and the concrete. The concrete shall not encase more than half the diameter of the pipe and shall be cured for a minimum of 48 hours prior to testing.

19 Electrical

19.1 The Contractor shall:

- a) install all LV electrical wiring in accordance with AS 3000 and the Service Rules and Conditions of Supply of SA Power Networks;
- b) ensure all new LV electrical wiring is installed by an electrician who is licensed in South Australia for such work;
- c) arrange all required SA Power Networks connections and applications for supply for each service point; and
- d) provide a certificate of compliance to the Superintendent.

19.2 Earthing and lightning protection

- a) Where earths are required by inspectors or manufacturer's recommendations, copper earthing rods shall be installed so that resistance is less than 8 Ω to ground. If the manufacturer of the irrigation controller has lightning protection equipment as an optional extra, the Contractor shall supply and install all equipment recommended by the manufacturer to achieve stable and reliable operation.
- b) Where earth stakes are required, they shall be installed in compliance with AS 3000 and shall be present at the end of each decoder cable run, at each controller location and at no greater than 300m intervals along the cable run. Where possible install the earth stakes at the nearest valve box location to the required interval.

19.3 Solenoid Valve Wiring

- a) ELV wiring shall comply with the following:
 - i) all joints shall be made with 3M Direct Bury Splice DBR/Y-6 connectors or approved equivalent;
 - ii) a minimum of one metre slack of wire shall be provided at each solenoid valve to facilitate the removal of the coil when maintenance work is carried out;
 - iii) a single station shall be installed at each solenoid valve;
 - iv) where possible, cable runs shall be continuous between the controller and its destination;
 - v) cable joints can be made in 150 mm isolation valve boxes, provided they are accurately marked on "as constructed" drawings;
 - vi) all cable shall be polyethylene insulated and multi-stranded;
 - vii) "Common" wires shall be coloured black and minimum 2.5 mm²;
 - viii) "Active" cables shall be minimum 1.5 mm² with colour coding which does not change between the controller and the solenoid valve;
 - ix) voltage drop calculations for the "worst" loading shall be based on maintaining at least 20 volts to a nominal 24 volt AC solenoid valve coil;
 - x) expansion loops shall be provided at intersections, bends and pipe crossovers;
 - xi) each controller shall have its own cable and not be interconnected to another controller;
 - xii) underground wiring shall be installed in electrical uPVC conduit and any above ground wiring shall be installed in a galvanised steel conduit; and
 - xiii) if conduits are laid in the same trench as water pipes they shall be separated by a distance of 50 mm + $\frac{1}{2}$ water pipe diameter.

20 Control System

- 20.1 Actual locations of the controller shall be confirmed on site between the Contractor and the Principal and a **Hold Point** shall apply prior to installation of a controller on site.
- 20.2 The controller and necessary switch gear shall be housed in an approved cabinet as described in Appendix 10. The enclosure shall have vandal proof staple and hasps mounted at the top and bottom corners of the door plus a 3-point locking system with central handle and a mounting frame. The door shall have rubber seals and a stainless steel wire door stop.
- 20.3 Electrical control cable shall be copper (PVC insulated) or similar of sufficient size to allow long term operation of the control valves.
- 20.4 The Contractor shall make the connection to the controller and install the specified number of General Power Outlets within the control cabinet.
- 20.5 The Contractor shall install decoder wiring from the valves to the controller. All control cable above ground to the controller shall be installed within a conduit to AS 3000.
- 20.6 Unless specified otherwise, the Contractor shall program the controller.
- 20.7 Irrigation Controller
 - a) The Contractor shall install a controller of solid state design with sufficient stations and run times to adequately provide for the design.
 - b) The controller shall be fitted with a lithium or 9 volt battery to ensure that programming is not lost due to power failures.
- 20.8 ACC Decoder System
 - a) If specified on the Drawings, a Hunter ACC Series Decoder Controller and all necessary components shall be installed by the Contractor to the manufacturer's recommendations.
 - b) The Contractor shall ensure that each site has access to GSM communications and the necessary components, including GSM Sim cards to enable the Superintendent's operation of the Hunter Central Irrigation Management & Monitoring Software (IMMS) 3.0.

21 As-Constructed Drawings

- 21.1 Within two weeks of receiving the Certificate of Practical completion for the installation, the Contractor shall provide the Principal with a set of As-Constructed drawings accurately indicating all trench and wiring routes, sprinkler and solenoid valve locations and any other relevant information.
- 21.2 The As-Constructed information for the drawing shall be obtained using "Total Station" or GPS (to +/- 50 cm accuracy) survey, and shall be professionally labelled and include all and any variations from the original drawing.
- 21.3 As-Constructed drawings shall be provided in AutoCAD Release 2014 format.

22 Manuals and Documentation

- 22.1 For the whole system and for each item incorporated within it, the Contractor shall provide to the Principal the items listed in Table PR-LS-C9 22-1.

Table PR-LS-C9 22-1 Manuals and Documentation

Item	No. of Copies
Operating / maintenance instructions (including all set-points of all adjustable equipment) and schedules	3 copies, with one copy placed in a suitable holder in the control cubicle
Electrical wiring diagrams.	3 copies, with one copy placed in a suitable holder in the control cubicle
Each guarantee	One copy in plastic sleeves within a folder
Test records	One copy in plastic sleeves within a folder

- 22.2 The Contractor shall instruct a person nominated by the Principal on how to program the controller and other necessary day-to-day operations.

23 Inspection and Testing

- 23.1 The Contractor is responsible for undertaking all testing necessary to verify that the system will perform to the intended level of service.
- 23.2 Following completion of the installation, the Contractor shall:
- a) complete several automatic cycles without fault;
 - b) test all components to ensure proper function;
 - c) pressure test the mainline and drip system;
 - d) check that the system complies with the Specification; and
 - e) ensure that all manuals and documentation specified under Clause 22 "Manuals and Documentation" are available.
- 23.3 Following completion of the above testing, the Contractor shall provide at least 24 hours notice to the Principal that the system is ready for the final joint inspection between the Principal and the Contractor.
- 23.4 Provision of the final joint inspection must constitute a **Hold Point**.
- 23.5 Mainline pressure test
- a) The Contractor shall run a successful pressure test in the presence of the Principal. The pressure test is deemed to be successful if after applying a pressure of 1,000 kPa to all mainline pipework, the pressure has not dropped over fifteen minutes, or leakage has not exceeded 0.2 l/hr. Pressure tests must not be performed earlier than 48 hours after pouring thrust blocks. Pressure testing may be done for separate sections of pipe-work.
 - b) Provision of the successful mainline pressure test in the presence of the Principal must constitute a **Hold Point**.
- 23.6 Final joint inspection
- a) Final joint inspection by the Principal and the Contractor may include:
 - i) checks for compliance with the specification;
 - ii) pop-up height/alignment;
 - iii) trench compaction;
 - iv) drip tube row spacing; and
 - v) lateral flushing.
 - b) If the system fails final joint inspection test, the additional costs reasonably incurred by the Principal as a consequence of the additional inspections may be deducted from the payment due to the Contractor.

24 Maintenance (Defects Liability)

- 24.1 All work required during the defects liability period including work of obtaining clearances and repair of damage to property becoming evident during the defects liability period shall be carried out before final certification and the defects liability period shall be extended accordingly.
- 24.2 During the maintenance period the Contractor shall attend to all emergency calls as quickly as possible. If during the maintenance period or summer the Contractor does not promptly attend to the emergency, the Principal reserves the right to engage others to rectify the problem and recover costs from the Contractor.

- 24.3 In the event of any defective work not being carried out within 2 working days (or shorter time if conditions are created that are hazardous to persons or the irrigated area) of the need arising, the Principal may have the same work carried out by others and the cost will be deducted from any moneys due to the Contractor under this Contract.

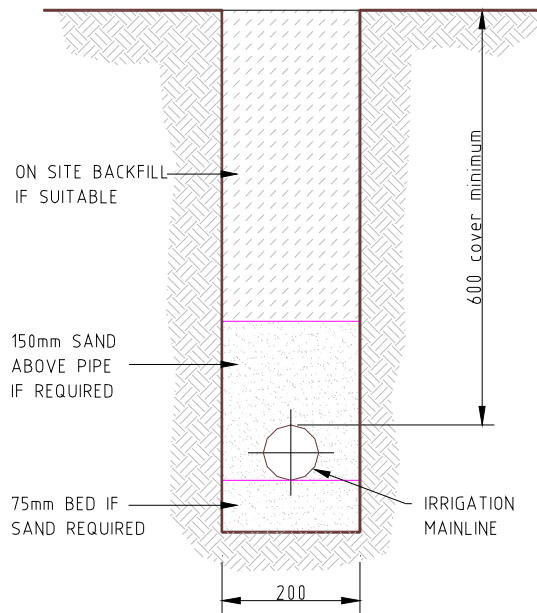
25 Hold Points

25.1 The following is a summary of Hold Points referenced in this Part:

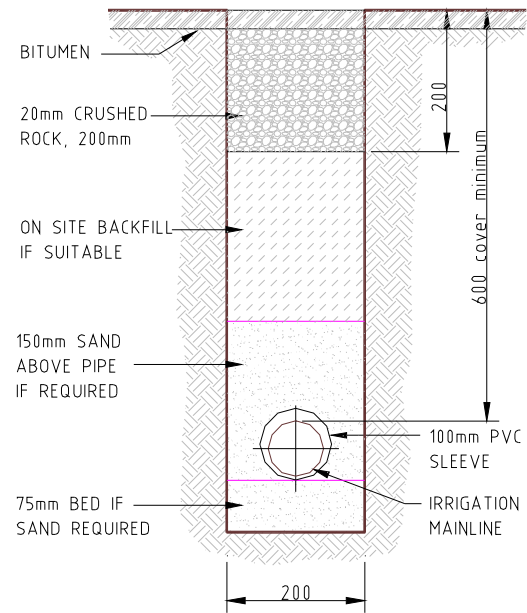
Table PR-LS-C9 25-1 Hold Points

Ref.	Hold Point	Response Time
4.2	Submission of a Design and Specification.	7 days
7.2(a)(i)	Inspection of mainline and control valve set-out.	24 hours
7.2(a)(ii) & 16.2	Inspection of sprinkler set-out.	24 hours
7.2(a)(iii) & 17.3	Inspection of drip tube set-out prior to covering with mulch.	24 hours
7.2(a)(iv)	Mainline installation prior to backfill.	24 hours
7.2(a)(v)	Mainline and lateral flushing.	24 hours
7.2(a)(vi) & 23.5(b)	Mainline pressure test.	24 hours
9.6	Prior to any excavation around or near trees.	24 hours
9.7	Following completion of excavation prior to placement of any pipe.	24 hours
20.1	Confirm location of controller on site.	3 days
7.2(a)(vii) & 23.4	Final joint inspection.	24 hours

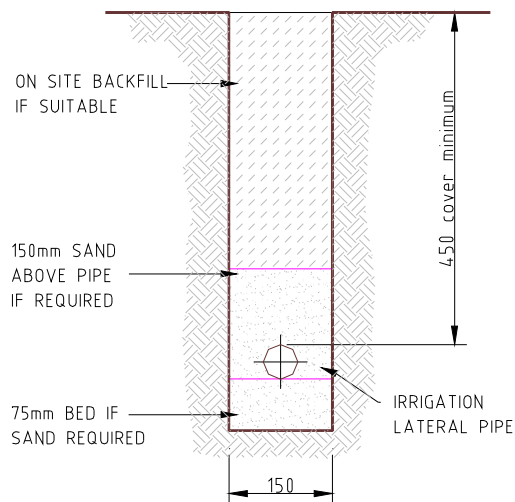
Appendix 1: Trench Details



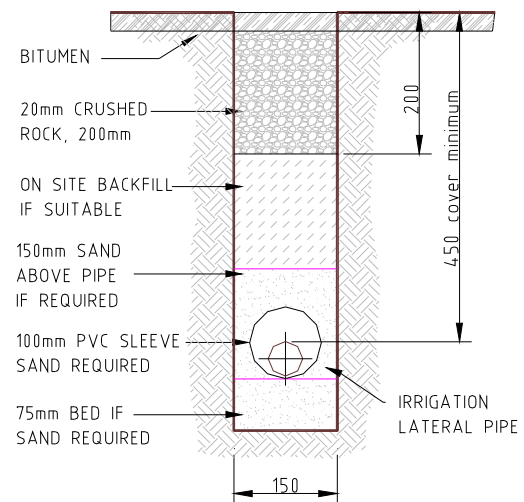
TYPICAL MAINLINE TRENCH DETAIL
NOT TO SCALE



TYPICAL MAINLINE TRENCH DETAIL
UNDER SEALED SURFACES
NOT TO SCALE

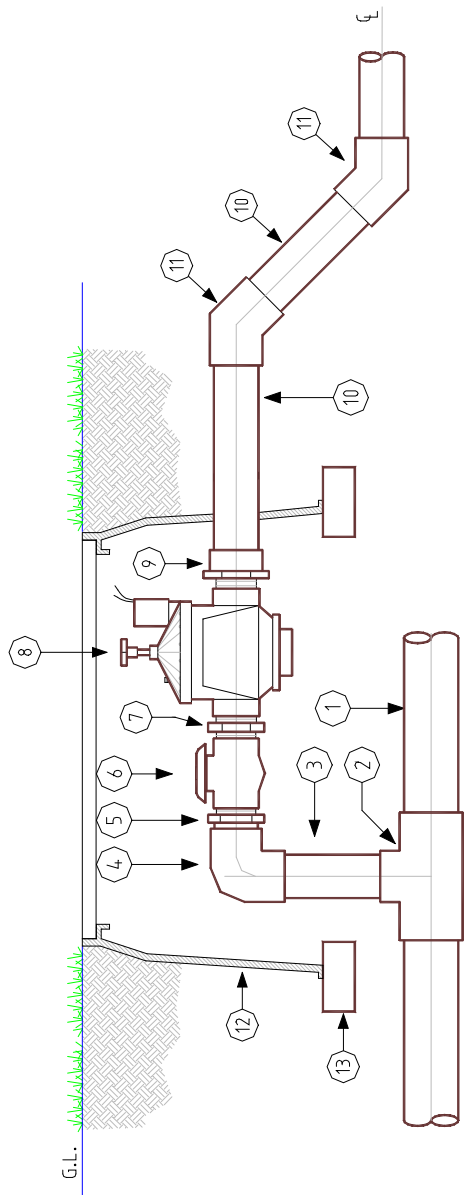


TYPICAL LATERAL TRENCH DETAIL
NOT TO SCALE



TYPICAL LATERAL TRENCH DETAIL
UNDER SEALED SURFACES
NOT TO SCALE

Appendix 2: Solenoid Valve 50mm – Typical Installation Detail



1. 80mm CLASS 12 uPVC MAINLINE

2. 80x50mm CAT.19 TEE

3. 50mm CLASS 12 PVC RISER

4. 50mm CAT.13 90° ELBOW

5. 50mm CAT.2 VALVE ADAPTOR

6. 50mm BALL VALVE

7. 50mm NIPPLE
8. 50mm SOLENOID VALVE

9. 50mm CAT.17 VALVE SOCKET

10. 50mm CLASS 9 PVC PIPE

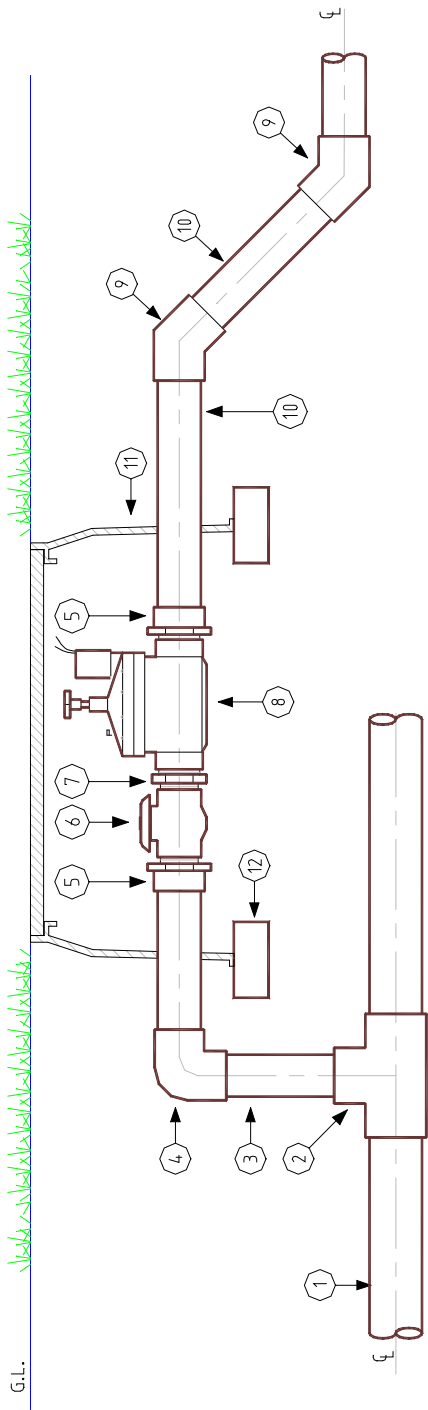
11. 50mm CAT.10, 45° ELBOW

12. VALVE BOX

13. BRICK SUPPORT FOR VALVE BOX

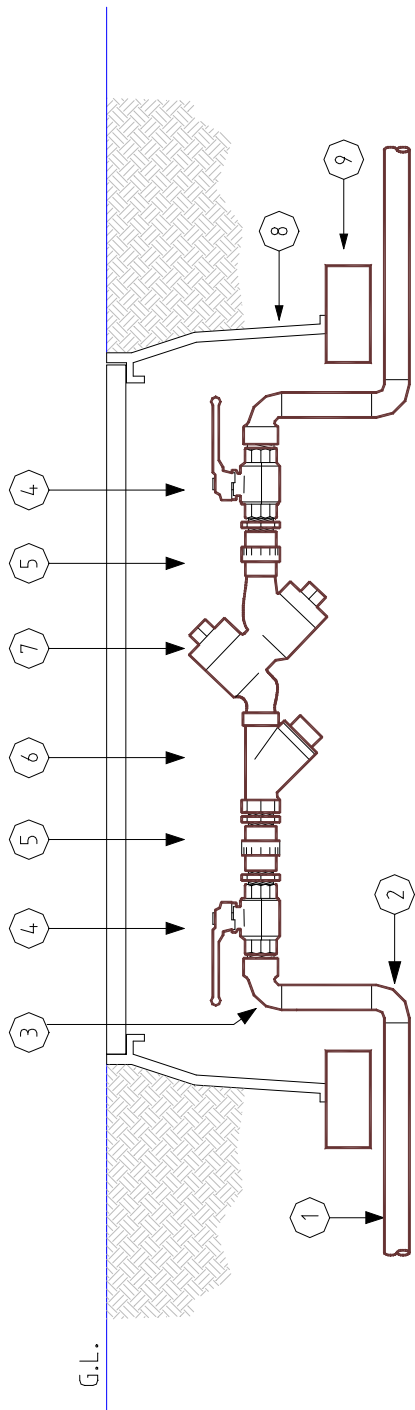
SOLENOID VALVE
TYPICAL INSTALLATION DETAIL
NOT TO SCALE

Appendix 3: Solenoid Valve 25mm – Typical Installation Detail



SOL ENOID VALVE
TYPICAL INSTALLATION DETAIL
NOT TO SCALE

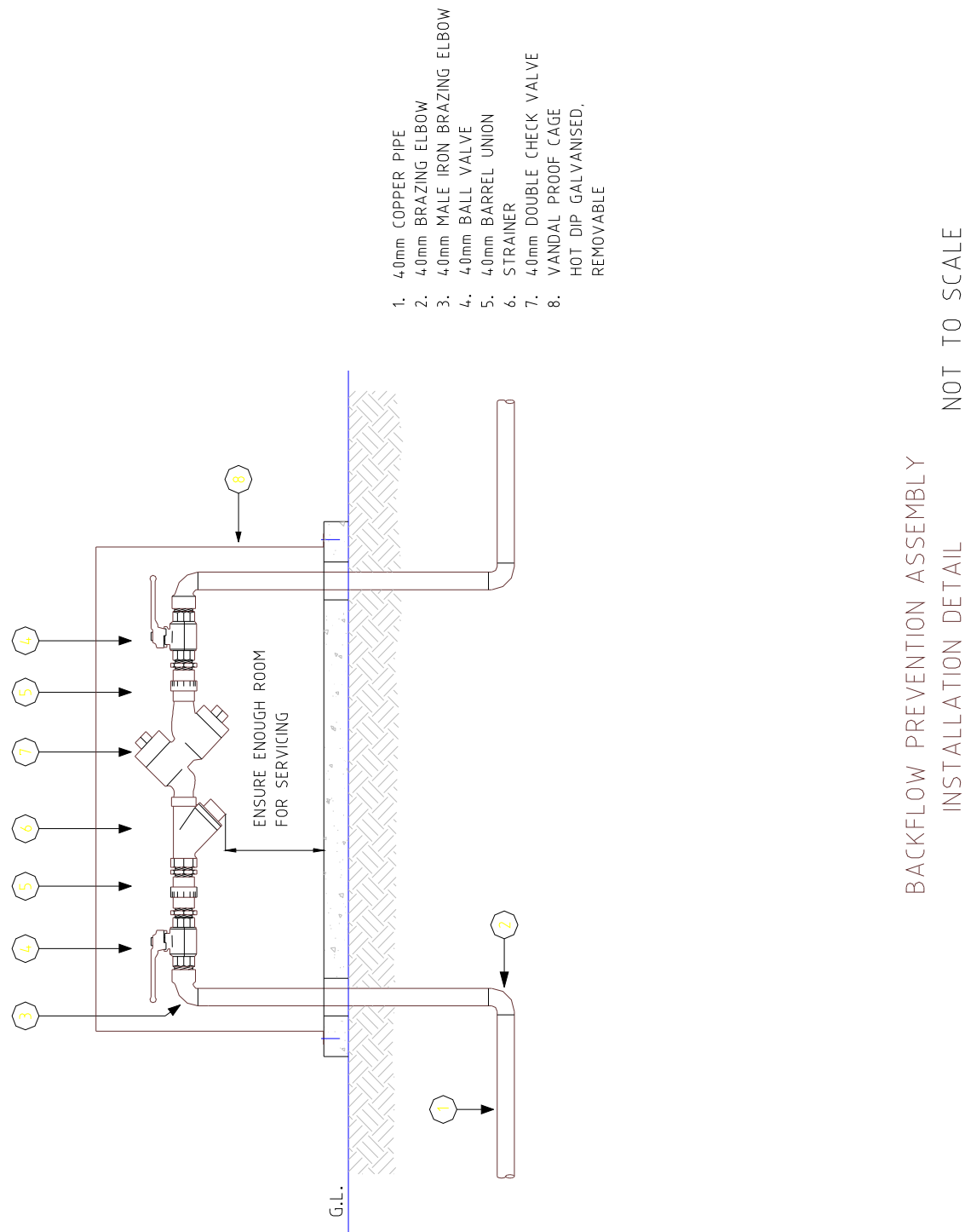
Appendix 4: Backflow Prevention Assembly – Below Ground



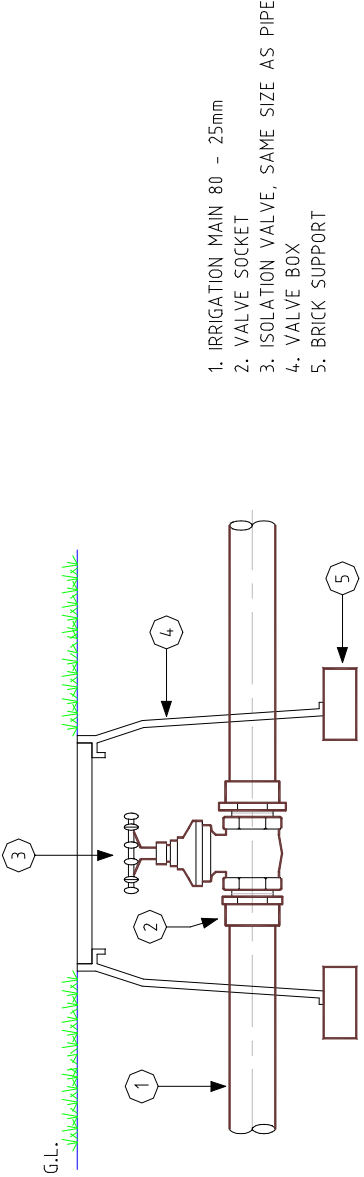
- | | |
|---------------------------------|--|
| 1. 40mm COPPER PIPE | 6. STRAINER |
| 2. 40mm BRAZING ELBOW | 7. 40mm FEBCO 805Y OR SIMILAR DOUBLE CHECK VALVE |
| 3. 40mm MALE IRON BRAZING ELBOW | 8. VALVE BOX |
| 4. 40mm BALL VALVE | 9. BRICK SUPPORT |
| 5. 40mm BARREL UNION | |

BACKFLOW PREVENTION ASSEMBLY
INSTALLATION DETAIL NOT TO SCALE

Appendix 5: Backflow Prevention Assembly – Above Ground

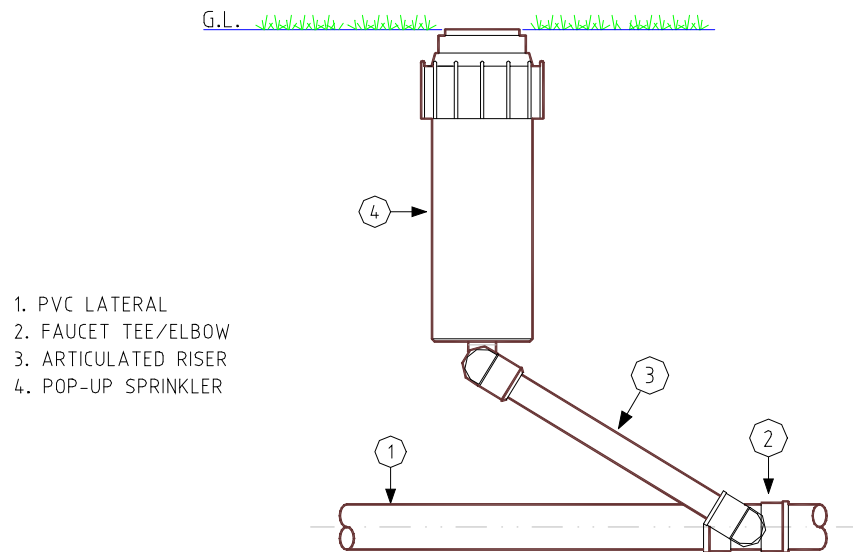


Appendix 6: Isolation Valve – Installation Detail



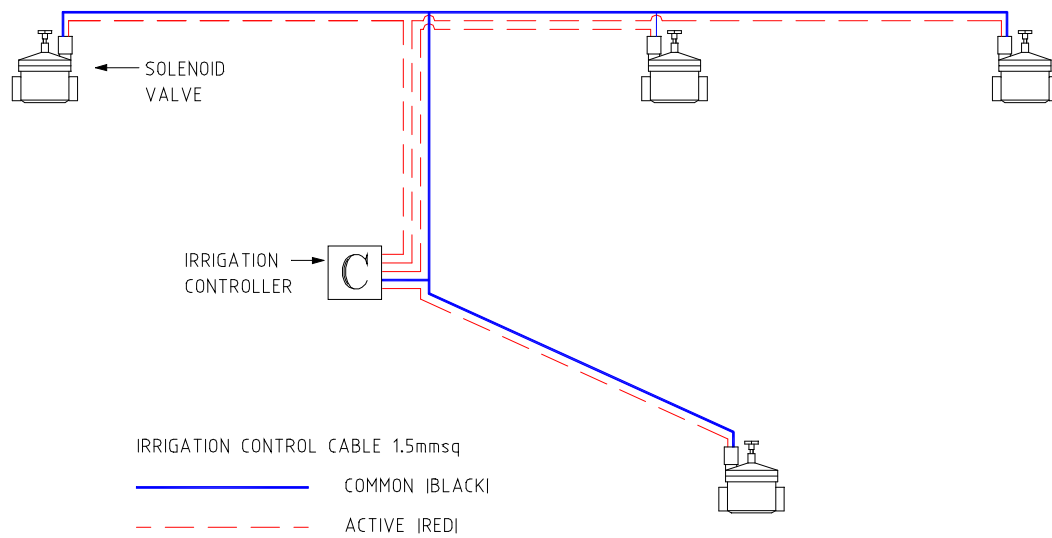
NOT TO SCALE

ISOLATION VALVE INSTALLATION DETAIL

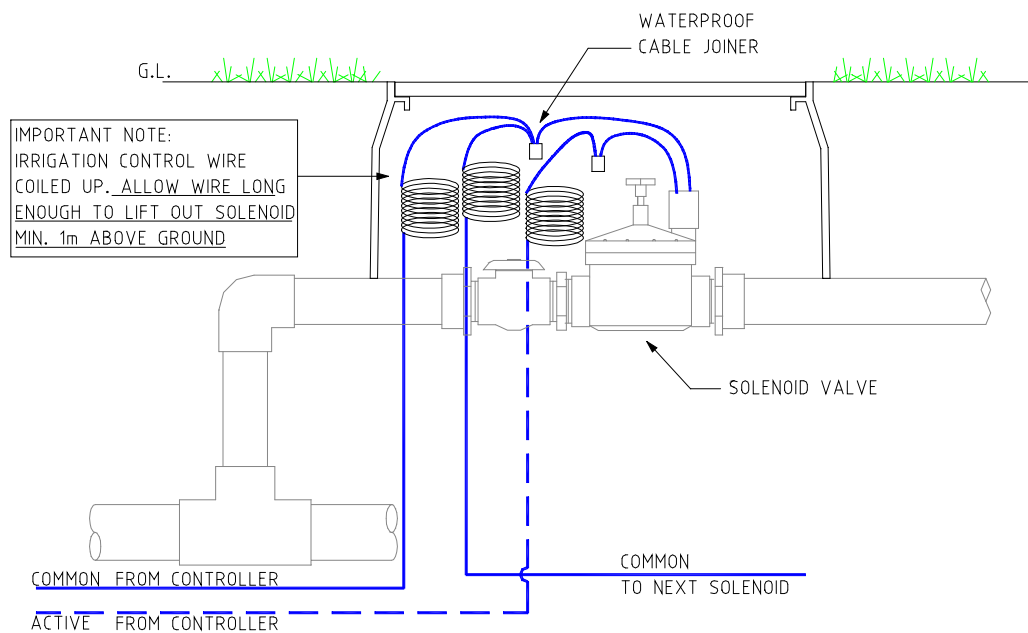
Appendix 7: Pop Up Sprinkler – Typical Installation Detail

POP-UP SPRINKLER
TYPICAL INSTALLATION DETAIL NOT TO SCALE

Appendix 8: Irrigation Control Wiring - Solenoid Valve Connection Detail

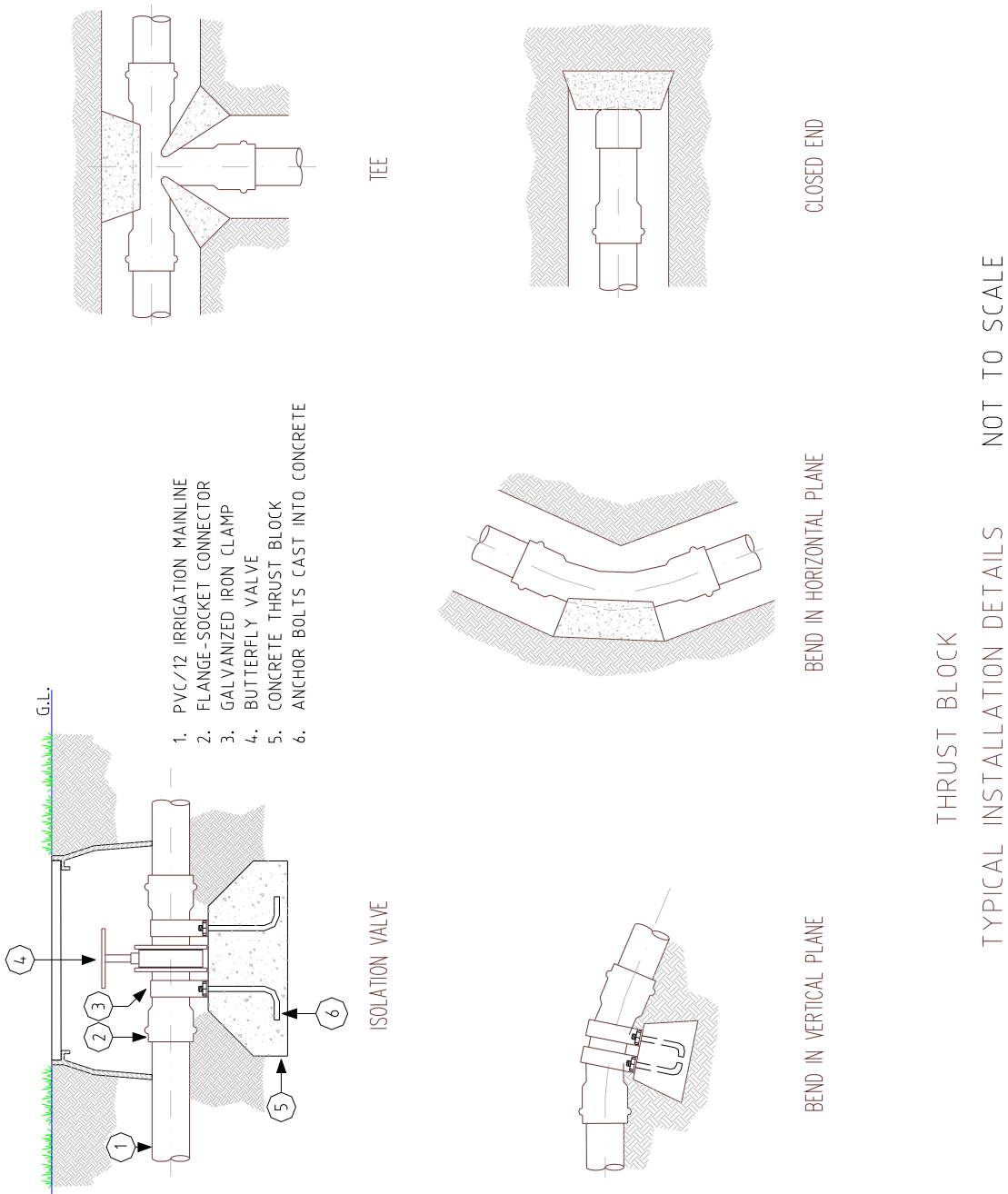


IRRIGATION CONTROL WIRING SCHEMATIC



SOLENOID VALVE CONNECTION DETAIL NOT TO SCALE

Appendix 9: Thrust Blocks



Appendix 10: Irrigation Control Enclosure

