A Guide to Water Efficient Landscape & Irrigation

For Non Residential Facilities

water for all, forever WATER CORPORATION

Contents

Prepared by

Josh Byrne & Associates
Suite 10, 16 Phillimore Street,
Fremantle WA 6160
PO Box 1866
Fremantle WA 6959
www.joshbyrne.com.au

Welcome

This document has been prepared by Josh Byrne & Associates for the Water Corporation to assist existing non-residential facilities such as shopping centres, caravan parks, hospitals and hotels, in better understanding water efficient irrigation and landscape management practices. This document is primarily aimed at grounds maintenance staff and their site managers and will provide them with practical information for hands on maintenance advice and water efficient solutions.

It is important to note that a certified irrigation specialist should be engaged to undertake all new irrigation works or a comprehensive irrigation audit. Alternatively, for more comprehensive works, required personnel should consider completing an Irrigation Australia Limited's Irrigation Training Course. Refer to Irrigation Australia Limited for further information: www.irrigation.org.au.

Aims of this Document

The aims of this document are to:

- Provide an introduction to water efficient landscape management approaches.
- Increase awareness and understanding of those working at these facilities.
- Highlight common issues in landscape and irrigation systems seen in these facilities and provide a step by step approach to resolving these issues.
- Reduce unnecessary water use in non-residential facilities, reducing costs to customers.
- Reduce state wide pressures on water demands.

This document has been designed to encourage water efficiency in existing landscapes and small landscape upgrades, through simple, cost effective strategies which will also improve the overall amenity of landscape areas.

There are five key steps in helping you improve and maintain water efficiency in the landscape. These are listed below and described in more detail in this guide.

Step One: Understanding water use in the landscape
Step Two: Key ingredients in a water efficient landscape
Step Three: Understanding your irrigation system
Step Four: Assessing and improving an existing irrigation system
Step Five: Maintaining your irrigation system

Why Save Water?

Western Australia is facing a rising demand for water as a result of a drying climate and rapidly increasing population. In response the Water Corporation has embarked on a plan to secure a water future that is climate resilient, to ensure that sufficient water supplies are maintained, whatever the weather. This plan, known as Water Forever, outlines a portfolio of options to meet our future water demands including; reducing our water use, increasing water recycling and developing new sources.

In the interests of sustainability, our response to reduced rainfall must remain focused on the need for all sectors of our community to be more efficient in the ways we use water, and simply to use less. A suite of water efficiency programs and useful guiding documents, such as this one, have been developed, as an on-going strategy, to assist all sectors of the community, including homeowners and commercial businesses, to achieve this objective.

Save Water by Fixing Dripping Taps

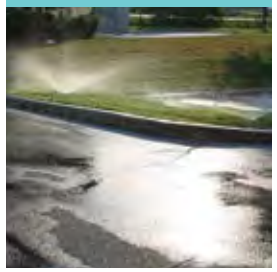
Common Problems – Simple Solutions

The problems listed below (with some associated images to the right) are commonly found in irrigation systems in non-residential facilities. Solutions to these problems are typically inexpensive, take minimal time and effort and can save a considerable amount of water. Solutions can usually be undertaken by on-site maintenance staff, rather than a specialist irrigation consultant.

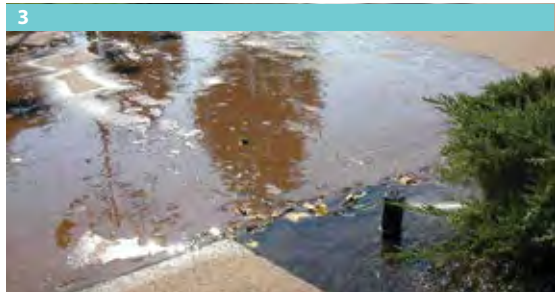
1. Overwatering
2. Incorrect programming of the controller/ non-compliance with sprinkler rosters
3. Broken or damaged pipes
4. Broken or damaged sprinklers
5. Mis-matched sprinkler heads
6. Malfunctioning solenoid valves
7. Broken/damaged taps/valves or leaking taps/valves

Information on how to fix these problems can be found in Step 4.

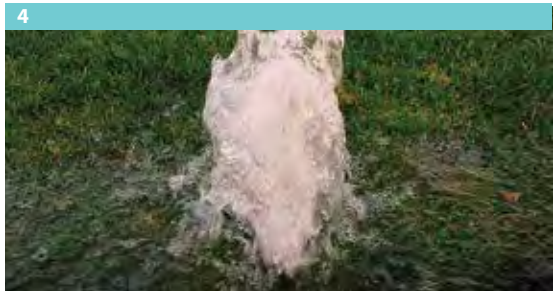
1


1


2


3


4


4


1


Step 1. Understanding Water Use in the Landscape

Understanding water use is the first step in improving water efficiency in the landscape. The following measures will help to monitor and reduce your water use, whether it's keeping a simple record of your meter readings, installing data logging equipment or prioritising water use in your landscape.

1.1 Reading Your Water Meters

To better understand your current water use you will need to obtain two meter readings; one from the main water meter and one from a sub meter, which should be connected exclusively to your irrigation system.

A water meter simply measures the volume of water entering a facility or property. It is the best tool to accurately measure water use.

The **main water meter** is commonly located close to the boundary of the property and is connected to your scheme water supply line. It measures the total water usage for the whole facility. This is the same water meter that is read in order to calculate your water bill.

Under the Department of Water requirements, commercial bore water users must install a primary meter to monitor and record their water use.

Sub meters measure water usage for different parts of large non-residential facilities, for example, irrigation, cooling systems or individual tenancies. The sub meter for irrigation will measure the total water usage used for irrigating the landscape. If there are different irrigation take off points servicing different irrigation systems across the site, each of these will need a separate water meter to capture the water being used.

Reading Your Irrigation Water Meter as part of Regular Monitoring

1. Check your water meter regularly and record the reading on the fortnightly and seasonal Irrigation Assessment Checklist (Appendix 8-10).
2. Provided the controller settings haven't changed, the meter readings should indicate a similar volume of water use over a specific period.
3. An increase in water use will likely be due to a leak, burst fitting or a flat battery caused by a power outage.
4. A decrease in water use will likely be due to faulty wiring or a solenoid valve.

Using Your Sub Meter to Detect Leaks

1. Record the sub meter reading.
2. Turn off the irrigation system, making sure all taps and valves are closed. Make sure the irrigation system is switched off for a full hour.
3. Return after the hour and record the water meter reading. If the numbers have increased, then there may be a leak in your irrigation system.

How to Read Your Irrigation Sub Meter

1. Check you have the correct water meter which is linked to your irrigation system by switching on the irrigation and see if the meter numbers increase.
2. Read the white numbers on black dials. These represent the number of kilolitres of water you have used. Note: 1 kilolitre = 1000 litres. Water charges are based on the number of kilolitres used.
3. Record your reading on the fortnightly irrigation checklist (Appendix 8), along with the date and time of your reading.
4. Compare this reading against previous readings for a total volume used between readings.

Water Meters

1.2 Data Logging

Monitoring water use via water meters can be made easy through the use of data logging devices that automatically record the time and volume of water use events. This information can be retrieved and analysed to help detect leaks or variations in water flow which may indicate a problem with the irrigation system. It can also be useful for determining the normal volumes used by an individual station over a set period of time.

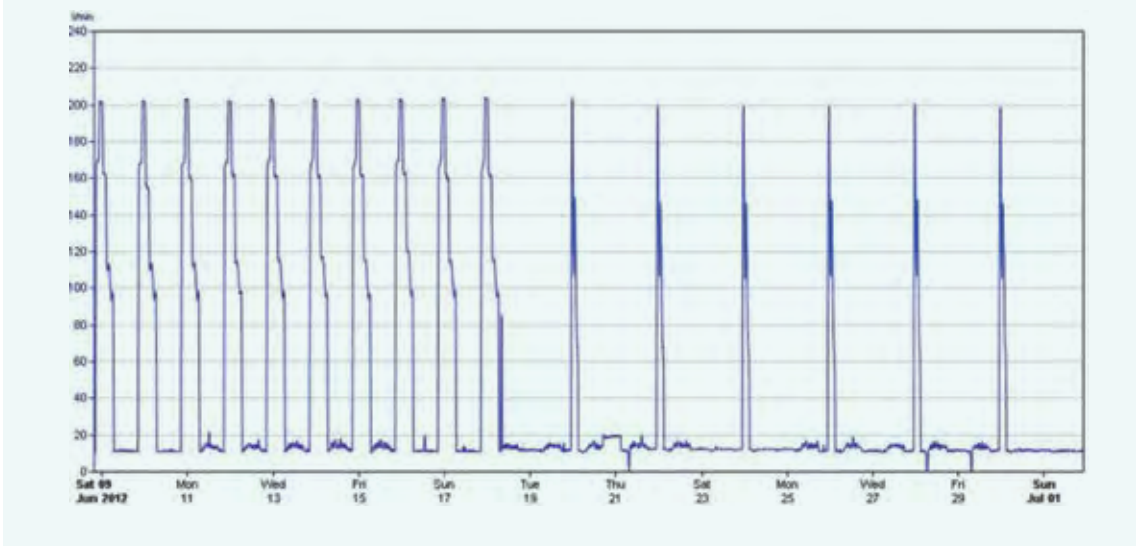
For example the graph on the right shows the water use profile of a non-residential facility in the North West. The large spikes indicate water use for irrigation and shows the system had been set unintentionally to irrigate daily. The customer also used this information to review run times. By reducing irrigation to every second day (as per the North West sprinkler roster) and adjusting run times at essentially no cost, the average water use of the site dropped by 68 percent.

The logging also highlighted a leak of around 12 litres a minute. The combined savings in water use will reduce the customer's water bill by around $50,000 per year if maintained for a whole 12 months.

There are different types of data logging equipment on the market ranging from simple, battery operated models, where data is manually accessed periodically, through to more sophisticated systems that have remote access capability. Basic models cost only a few hundred dollars and will soon pay for themselves in saved time and peace of mind.

For more information on data logging options contact the Water Efficiency Projects Branch.

Graph 1: Data Logging Water Use Profile of a Non-residential Facility in the North West



Data Logger

Data Logger

1.3 Prioritising Water Use

Hydrozoning

The second step in achieving water efficiency in your landscape is to apply hydrozoning principles.

Hydrozoning simply involves classifying areas on the basis of the water needs. To ascertain which areas require more water depends on the level of human contact it recieves or it's visual importance. Within these areas, plants with similar water needs should be grouped together and serviced off similar irrigation stations.

For example, a landscaped entry statement will be viewed by the public more than say a planting bed in a service yard. To keep the entry statement up to a presentable level, it will need to be irrigated more than the service yard planting bed and, as a result, should be classified as a primary hydrozone. The service yard on the other hand will be classified as a minimal hydrozone.

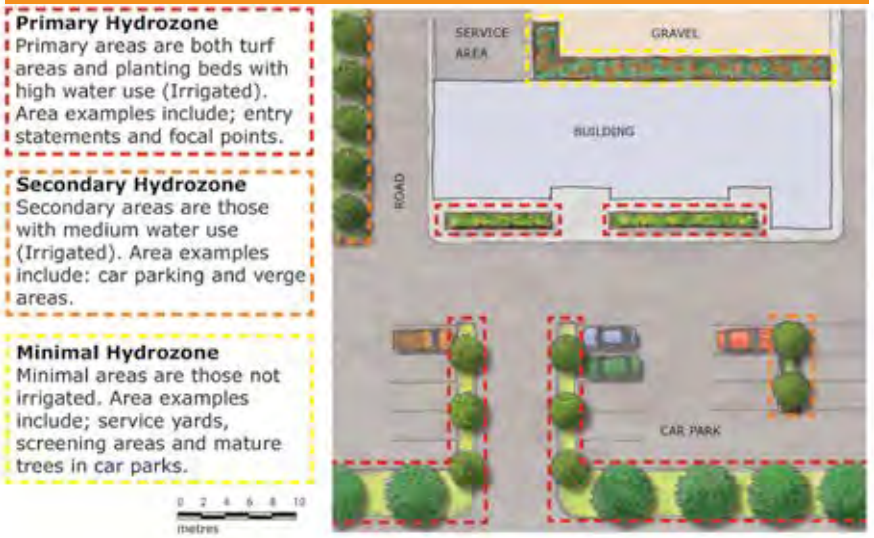
Classifying areas to the following three hydrozones (as listed in Table 1 right) can also be used to help inform the prioritisation of other resources, such as on-going maintenance, fertiliser and mulch.

Table 1: Hydrozone Type, Treatment, Water Usage and Area Examples

HYDROZONE	TREATMENT	WATER USAGE	AREA EXAMPLES
Primary	Planting beds and turf areas	High water use - Irrigated	Entry statements, entry to buildings, areas around signs, intimate spaces and focal points.
Secondary	Planting beds	Medium water use - Irrigated	Car parking and verge areas.
Minimal	Planting beds and turf areas	Not Irrigated	Service yards, screening areas, parkland areas and mature trees in car parks.

Refer to Figure 1, a sample landscape plan which is a visual representation of the hydrozones listed above.

Figure 1: Sample Landscape Plan Showing Hydrozones



Step 2. Key Ingredients of a Water Efficient Landscape

To achieve water efficiency in your landscape it is necessary to understand the key ingredients that help make a healthy waterwise garden.

2.1 Water Sensitive Planting

Regionally appropriate Western Australian native plants should be considered when replacement or infill planting is required as they are better adapted to the local climate and generally require less water.

Refer to Appendices 3-5 for sample planting palettes in your region or refer to the Waterwise Plants Database on the Water Corporation website for plants suited to your area.

Water Sensitive Planting

2.2 Organic Soil Conditioners

Applying organic soil conditioner to your planting beds helps improve moisture retention, which in turn reduces the amount of water you need to apply to these beds. Using a soil conditioner also provides plants with nutrients and assists beneficial soil microbes which help plants to develop strong root systems and in turn become more drought tolerant.

In large areas, soil conditioner should be installed at a thickness of 25 - 50mm and dug in to a depth of 200mm prior to installing drip irrigation and planting.

Alternatively, if infill planting areas with individual plants, soil conditioner should be used during planting by mixing with the back fill material as specified on the bag.

When sourcing organic soil conditioner, check that it:

- Is sourced from an accredited composting facility

OR

- If bagged, it should have the 'Waterwise Approved' or 'Smart Approved WaterMark' label on the side of the bag.

Organic Soil Conditioner

2.3 Mineral Soil Amendments

Soil amendments such as such as Bentonite Clay or Kaolin Clay can be used to improve the moisture and nutrient holding capacity of sandy soils when applied at the supplier's recommended rates. These soil amendments should be blended into the soil before installing drip irrigation or planting. Soil amendments should be applied to all irrigated hydrozone areas.

Clay Based Mineral Soil Amendment

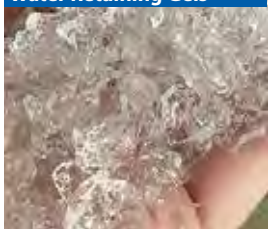
Soil Amendment with Water Retaining Granules

2.4 Soil Wetting Agents

Applying commercial grade soil wetting agents prior to planting will improve the 'wetability' of hydrophobic (non-wetting) soil. Soil wetting agents should also be applied to hydrophobic sands at the start of winter/wet season rains and again at the start of summer/dry season in irrigated areas (i.e. primary and secondary hydrozone areas). This ensures that any water applied to your landscaped areas penetrates deep into the root zone and is not wasted.

Soil Wetting Agent

Water Retaining Gels



Water Retaining Granules

2.5 Organic Mulch

Applying coarse textured organic mulch to your planting beds is essential in maintaining a waterwise and healthy garden. It not only dramatically improves moisture retention by reducing evaporation from the surface of the soil, but it feeds plants as it breaks down, helps to suppress weed growth and insulates plant roots from extreme temperature fluctuations. Coarse grade mulches are best as they allow water to penetrate through to the soil below.

Mulch levels should be maintained year round to a depth between 50-75mm.

When sourcing organic mulch, ensure you purchase from an accredited supplier to ensure that the mulches are weed and pathogen free and if bagged look for the 'Waterwise Approved' or 'Smart Approved WaterMark' labels.

Organic Mulch

2.6 Slow Release Fertilisers

Whilst fertilisers assist plant establishment and plant growth, it is important to minimise the use of fertilisers wherever possible. Native plants in particular require very little, if any after establishment, particularly if soils were improved before planting and if mulch is maintained. If plants are performing poorly, it is recommended that a comprehensive soil analysis be undertaken prior to fertilising to ascertain the exact type and quantity of fertiliser to use if any. It is best to get a soil analysis done bi-annually to determine if fertiliser is required.

If fertilising is required it is best to apply controlled release, low phosphate fertilisers to reduce the risk of nutrients leaching into waterways and into the ground water. Slow release fertiliser can be applied to all hydrozone areas. Refer to www.fertilisewise.com.au for more information on responsible fertiliser products and practices.

Slow Release Fertilisers

Step 3. Understanding Your Irrigation System

Understanding your irrigation system, its components and how they work is crucial to ensuring water efficiency in your landscape. The information below outlines the major components associated with normal irrigation systems used in Western Australia.

3.1 Automatic Irrigation Controllers

Automatic irrigation controllers are electronic timers that are programmable to switch irrigation valves (stations) on and off at specified times. Some commercial sites have multiple controllers due to the size and complexities of the landscape and wherever possible, the same type of controller should be used. As a minimum, when replacing a controller, always choose one that is compatible with your rain sensor, soil moisture sensor or evapotranspiration sensor.

Battery operated controllers are basic controllers that are installed in locations where 240 volt power supply is not available and are generally less sophisticated or reliable than conventional 240 volt controllers. Battery operated controllers are generally located at or near the water source such as on taps or underground in a valve box and use DC (direct current) latching coils to operate the valves. They are not recommended for commercial applications.

240 Volt irrigation controllers are more sophisticated and can perform complex irrigation sequences. Some may be able to connect to a computer and can be programmed from the office or in the field.

Some models can be controlled remotely with hand held radio transmitters that allow you to turn a station on for testing purposes whilst you are in the field. These remote control units can save valuable time and water when testing large irrigation systems.

Irrigation Controller

Irrigation Controller

Getting to Know Your Controller

It is essential that you become familiar with your irrigation controller. An instruction manual for your controller should always be kept within reach of the controller for quick reference and for fault finding. If you do not have a controller manual available you can always download a copy from the internet.

Irrigation Station Mapping

An Irrigation Station Mapping document (refer to Appendix 4) is a record that is kept to identify what stations on your controller irrigate certain zones or areas. It is also a record of what type of sprinklers/emitters are used on that station, what the expected run time should be to deliver a set amount of water to that zone and what days and times the irrigation system is programmed to water.

A copy of this document should be retained both in the office and inside the irrigation controller along with the controller manual.

Water Budget

Most controllers allow you to set a 'water budget'. The water budget function allows you to reduce your station run time by a percentage based on the season. For example, a summer station run time may be 40 minutes. To save you adjusting that run time to 30 minutes in autumn you can simply adjust the 'water budget' to 75%. This will reduce all station run times by 25%.

3.2 Irrigation Emitter Types

Pop Up Sprinkler Bodies

Put simply, pop up sprinklers 'pop up' when in operation. This 'pop up' action helps conceal the sprinkler when not in use and reduces potential vandalism. Pop up bodies can be used with fixed radius heads, gear drives and rotary nozzle types. They come in a variety of sizes and models however they are best used in turf areas due to vegetation blocking the spray path when used in garden beds. If these types are used in garden beds, it is important that vegetation is kept clear of all sprays.

Fixed Spray Sprinklers

Fixed spray sprinklers are sprinkler heads that are installed onto a riser in garden bed situations. The sprinkler heads are either fixed radius heads set at a pre-set arc and radius or rotary action.

Rotator Nozzles

Rotator nozzles can operate at relatively low pressures and rotate in a sweeping arc up to 360 degrees providing relatively even water distribution in calm conditions. As with all spray irrigation, significant amounts of water can be lost through evaporation and wind drift due to the large spraying distance. Spray patterns are significantly disrupted in garden beds as plants mature and obstruct the spray pattern.

Gear Drive Sprinklers

Gear drive sprinklers rotate up to 360 degrees and operate via water driven gears. Water moving through the sprinkler spins a turbine which then turns a set of gears and the nozzle. These generally require more water pressure to operate than rotary, spray or drip types of irrigation and deliver larger volumes of water per minute. Gear drive sprinklers are often used in turf areas and as with all spray irrigation, are vulnerable to water loss from wind drift and evaporation.

Micro Spray Irrigation

Unfortunately, micro spray irrigation has been installed in many commercial landscapes in Western Australia in recent years. Whilst they are cheap to install and appear to use less water compared to traditional spray and rotary systems, they have a number of disadvantages. These include; higher maintenance costs due clogging of the emitters; easily damaged/vandalised; distribute a reduced, uneven spray pattern due to the fine droplet size; and lose a significant proportion of irrigation water due to wind drift and misting. These types of systems are not recommended.

Drip Irrigation

Drip irrigation refers to either in-line drip irrigation or individual drippers installed at each planting location. It is best installed directly under mulch (sub mulch) and is the most effective, water efficient means of irrigation currently on the market today. Drip irrigation applies water on the ground and close to the root zone, effectively eliminating water loss due to overspray and wind drift. Drip irrigation is concealed under the mulch and therefore reduces vandalism if mulch depth is maintained properly. Inline drip tube contains a series of sophisticated drippers at set spacing's along the pipe. In most cases, these drippers emit a precise volume of water at a set pressure so it is very easy to calculate how much water is being applied to the soil.

Pop Up Sprinkler Bodies

Fixed Spray Sprinklers

Rotator Nozzles

Gear Drive Sprinklers

Micro Spray Irrigation

Drip Irrigation

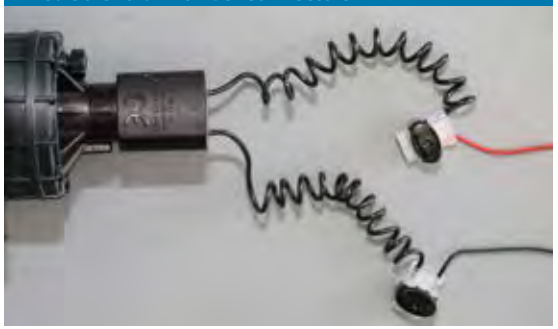
3.3 Solenoid Cables and Connectors

Generally solenoid cables are multi-strand wires with a polypropylene outer sheath which connect the irrigation controller to the valves. Each solenoid valve will have 2 x solenoid wires that go back to the controller; one wire goes to the 'common' terminal and the other wire goes to a 'station' terminal.

Solenoid cables should be installed either inside a designated conduit or as a minimum, underneath the irrigation system pipe work to protect it from damage. Unfortunately, some systems that may not have been installed this way will be vulnerable to damage by digging or even erosion.

Many problems result from incorrect or badly wired systems. To minimise these problems, ensure that all connections are water tight and protected from the elements with gel filled connectors. Gel connectors are inexpensive and easy to use.

Wired Solenoid With Gel Connectors



3.4 Irrigation System Sensors

Irrigation system sensors are complimentary units that attach to an irrigation controller and either modify the programmed irrigation cycle or pause the irrigation controller altogether. They can be inexpensive devices which are easily added to most automatic irrigation systems and ensure the landscape isn't overwatered, reducing the amount of water wasted.

Different types of sensors include;

- **Rain sensors** are sensors which essentially interrupt the automatic irrigation system controller when a specific amount of rainfall has occurred;
- **Soil moisture sensors** are sensors which modify the pre-set irrigation run time based on the amount of moisture in the soil. i.e. if it has rained recently and the soil is moist, it will either reduce the run time or may even stop the program temporarily, and;
- **Evapotranspiration sensors** and weather stations are sensors which are more technical and will regulate the irrigation cycle based on the current climatic conditions and the plants estimated demand for moisture.

Rain Sensor

Soil Moisture Sensor

Evapotranspiration Sensor

3.5 Filters

Filters prevent small sand particles and debris from clogging solenoid valves or emitters and wearing moving parts such as gear drive and rotary nozzles. There are several different types of filters on the market; however, disk filters are appropriate for most commercial irrigation systems. Disk filters are easy to maintain by regularly removing the filter from the canister and washing under a running tap.

Disk Filter

3.6 Valve Boxes

Valve boxes house and protect valves and other irrigation components underground for easy maintenance access. They are commonly made out of durable plastic and come in a range of sizes and shapes.

Commercial irrigation components should be housed in lockable valve boxes to ensure they cannot be vandalised. When selecting a valve box, always chose one that is slightly larger than the component being housed so as there is room to work when undertaking maintenance.

Valve Box

3.7 Valves

Valves are devices used to control the flow of water. Most irrigation systems have both manual and automatic valves as components in the system.

Below are descriptions of valves commonly used in commercial landscape irrigation systems;

- **Solenoid Valves** are automatic valves actuated from the controller that turns the water on and off to individual 'stations' or zones in the landscape. The term 'solenoid' refers to the electronic plunger located at the top of the valve body that turns it on or off when power is sent to it from the controller. Most solenoid valves also have a 'bleed' screw or switch on the valve body that is used to turn the valve on manually and is also helpful in flushing debris from the valve. Always use this when turning the valve on manually in the field.
- **Isolation Valves (i.e. Gate Valves**) are manually operated valves used for infrequent shut-off of the water. An isolation valve is usually located at the water source so the water can be shut off for maintenance, repairs or during the winter.

Isolation Valves

Isolation Valves

- **Vacuum Release Valves** are valves used in drip irrigation systems that allow air into the pipework when the system is shut down (depressurising), therefore avoiding the risk of any pollutants being sucked back into the system through the drippers (suck back). Vacuum release valves should be installed at the highest point of the system.
- **Flush Valves** are valves usually installed at the end point of the system to allow any particles/algae to be flushed from the system when the valve is opened. These valves are a critical component of a drip irrigation system and can be manual or semi-automatic.
- **Pressure Regulating Valves (PRV)** are valves installed after the filter on a drip irrigation system. They can be pre-set to the required pressure and ensures that the system is operating at its optimum performance and reduce the likelihood of fittings bursting.

Flush Valves

Pressure Regulating Valves

Vacuum Release Valves

3.8 Backflow Prevention Devices

A backflow prevention device is a spring loaded device that allows water to travel in one direction only and not 'backflow' to prevent 'dirty water' from being sucked back into the drinking water supply in the event of a break in the main supply line. It is a requirement to install backflow prevention device on all systems that are connected to a potable scheme water service in Western Australia.

Note, that these devices can restrict your water supply so all flow tests for design purposes should be taken after the backflow device.

3.9 Mainlines, Laterals and Sub-mains

Laterals and Sub-Mains

These are the pipes on the delivery side or sprinkler side of the station valves and are generally only pressurised when the solenoid valve is turned on. They can be made of various materials including white Polyvinyl Chloride (PVC) pipe, Black High Density Polyethylene pipe (HDPE) or Black Low Density Polyethylene pipe (LDPE).

Mainline

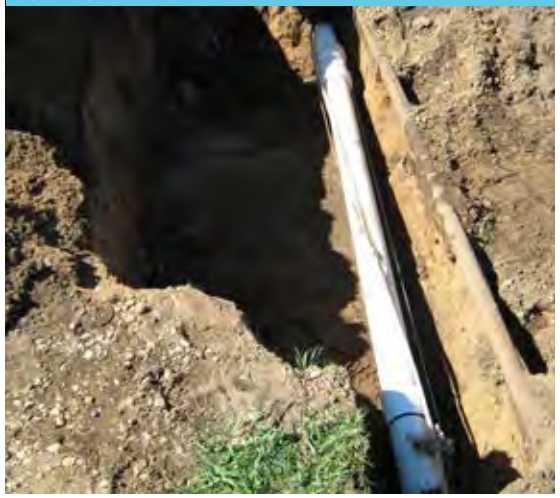
The mainline is the pipe that runs from the water supply source to the solenoid valve. It can be permanently pressurised or non-permanently pressurised depending on the control of your system. Commercial irrigation mainlines in Western Australia will generally be PVC.

Backflow Prevention Device

Brown Dripline Laterals

Sub-Main Irrigation Pipe

Mainline



3.10 Pipe Types

Polyvinyl Chloride (PVC)

PVC (Polyvinyl chloride) pipe is used in high and low pressure applications and is supplied in straight lengths. For irrigation purposes it is generally white and will have the size & class rating stamped in black on the outside. PVC pipe can be used in all aspects of the irrigation system including mainline and lateral pipe work. It is very rigid and cannot be bent around corners. All connections in a PVC pipe system must be carefully glued but remember, when installing or repairing PVC pipe, you must always clean the section of pipe and fitting to be glued with a PVC primer. Ensure clean sand is used under the pipe in the trench and to backfill as rocks/stones can damage the pipe with minor ground movement or compaction.

High Density Polyethylene (HDPE)

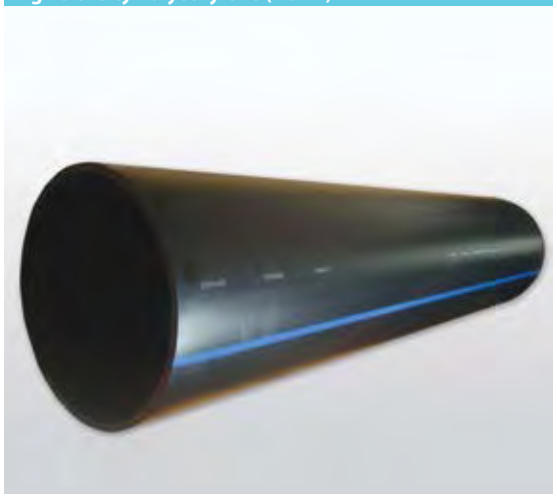
HDPE (High Density Polyethylene) is a high pressure pipe generally used for the mainline or for larger long pipe runs. It comes in large rigid rolls and may require specialist equipment to install the larger pipe sizes. Fittings used to connect smaller HDPE pipes are generally compression fitting and larger diameters may require electro fusion fittings.

Low Density Polyethylene (LDPE)

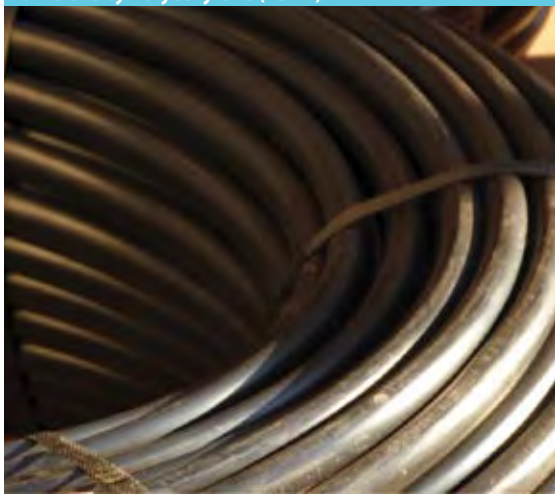
LDPE (Low Density Polyethylene) is a low pressure pipe supplied in rolls. Whilst it is soft and pliable and can be curved around sweeping bends it is also easy to kink. LDPE is not used for mainlines and is generally restricted to lateral pipe work or drip irrigation systems where a lower operating pressure is used. Clips must be used on all LDPE connections.

Polyvinyl Chloride (PVC)

High Density Polyethylene (HDPE)



Low Density Polyethylene (LDPE)



3.11 Understanding Flow and Water Pressure

Water Flow

Water flow is the amount of water available through a pipe. If flow is restricted by means of a sprinkler nozzle, for example, you will have more pressure but less water available or if the flow is unrestricted, for example if you have a burst pipe, you will have more water and less pressure. Water flow is measured in litres per minute and is the amount of water flowing from your water source. As different emitters use certain volumes of water at certain pressures, your flow rate will determine how many emitters you can install in your system at a set pressure.

Water Pressure

In this reference, water pressure is the flow strength of water through a pipe. Different types of irrigation systems or emitters require different water pressures to operate. For example, drip irrigation generally requires up to 250kpa to operate effectively whilst pop-up sprinklers can require up to 400kPa to operate.

From reading this, you can see that simply adding more sprinklers or drippers to the system can have a negative impact on the operation of your irrigation system and can result in poor performance and sprinkler coverage due to loss of pressure. It is therefore critical that you test your flow and pressure before installing or modifying an irrigation system to ensure your system can cater for additional emitters.

Water Flow

Water Pressure Gauge

Good Water Pressure Emitted from Sprinkler Head

Step 4. Assessing and Improving the Water Efficiency of an Existing Irrigation System

4.1 Common Problems – Simple Solutions

Now that you have a good understanding of your irrigation system you can tackle some of those common problems. Some of these and their solutions are outlined in this section.

Identifying and Fixing Broken Sprinklers

Broken or damaged sprinklers can usually be identified by water spurting into the air from the sprinkler head or by forming large pools of water around the sprinkler head during testing or operation.

To fix a broken sprinkler:

1. Make sure the water to that irrigation line is turned off.
2. Dig around the sprinkler to clear all dirt away from the sprinklers screw thread.
3. Twist off existing sprinkler head and replace it with a new one.
4. Ensure the same sprinkler head is used throughout the application area (whether it is a planting bed or turf area). For further information on the type of sprinkler heads available, refer to Step 3, under irrigation emitter types.
5. Adjust the arc of the sprinkler to ensure overspray onto footpaths or roadways is kept to a minimum.

Identifying and Fixing Broken irrigation Pipes

Common indicators which suggest there is a broken pipe include; areas of inundated water, soggy lawn or planting areas; washed up sand patches and/or depressions in the ground surface.

To fix a broken irrigation pipe:

1. Turn off the water to the irrigation line.
2. Dig a suitably sized hole around pipe for easy access and ascertain the pipe type and size. Important note: broken pipes must be repaired with the same class of pipe (refer to Step 3, under Pipe Types for more information).
3. Cut and remove the affected section of pipe.
4. Ensure the same sprinkler head is used throughout the application area (whether it is a planting bed or turf area). For further information on the type of sprinkler heads available, refer to Step 3, under irrigation emitter types.

Important note: If you are not familiar with the pipework class system, it is best to engage a Waterwise Irrigation Specialist to undertake these pipe repairs.

Broken Sprinkler

Broken Irrigation Pipe

Broken Irrigation Pipe

Inundated Water Caused by Broken Irrigation Pipes

Identifying and Fixing a Leaking Solenoid Valve

A leaking solenoid valve can be identified by signs of water 'constantly' trickling out of one or another of the sprinklers even when that station is off. This could indicate that a solenoid valve is not fully closing and is usually caused by debris or sand stuck inside the valve.

A broken solenoid valve, which is a less likely occurrence, can be identified by a pool of water directly around the solenoid valve. This pool of water could also be the result of a broken pipe, so ensure you assess the situation carefully to ensure you identify the correct problem.

Solenoid valves can be dismantled and carefully cleaned or simply replaced. The malfunction could also be due to bad wiring.

Adjusting Sprinkler Spray Radius and Arc

It is important to make sure the spray from the sprinkler heads are applying water to the required areas and not over spraying onto walls, footpaths or roads.

There are various methods of adjusting radius and arc depending on the type of sprinkler you are using.

Gear Drive Sprinklers generally require a generic adjustment tool to adjust the arc and radius and it is worthwhile obtaining instruction on this before attempting this work.

Fixed Sprinklers and Pop Ups require the purchase of a nozzle with a nominated radius to suit the application. Minor adjustment may require forcing the shaft left or right to attain the desired radius. Minor arc adjustment of a fixed sprinkler or pop up can be made via a small screw in the centre of the nozzle.

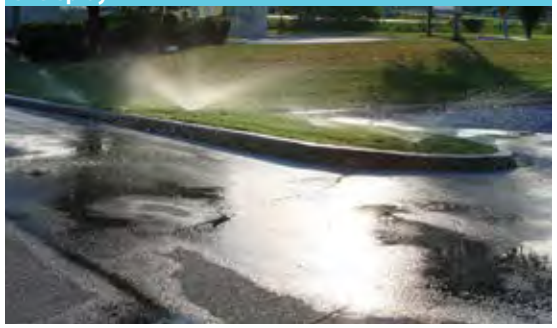
Overspray

Poorly Maintained Solenoid Valve

Leaking Solenoid

Irrigation Controller

Overspray



Incorrectly Set Irrigation Controllers

You can save thousands of litres of water, stop potential overwatering of areas and avoid fines for breaching sprinkler rosters by programming your irrigation controller correctly. Check the internet to find a specific manual for your particular controller.

Quick Step Guide to Programming a Controller:

1. Ensure there is a fully charged battery installed in your controller. Power cuts can affect what you have programmed and a malfunctioning irrigation controller is not an excuse for not complying with your allocated watering days or times.
2. Set the current date and time.
3. Set the days to water for each program based on your watering roster. Refer to the Water Corporation website for your watering days.
4. Set the start times for each program. Try and set your start times early in the morning to avoid vandalism to sprinkler heads.
5. Set the run times for each station. Each run time will vary on numerous factors including the location, the sprinkler type and the hydrozone classification. Refer to Appendices 5-7 for recommended watering times.
6. Set the seasonal adjustment.

Mismatched Sprinkler Heads on Stations

Sprinkler head types have different precipitation rates and distribution areas. To ensure accurate, effective and uniform distribution across your landscape area you need to ensure sprinkler heads are all of a consistent type, size and model.

For garden beds, fixed sprinklers on risers that are positioned above plant height can be used, as they have good distribution and require relatively low maintenance. Micro sprayers are not recommended due to high maintenance requirements and poor distribution.
The best irrigation system for garden bed areas is drip irrigation, but it is best to engage a Waterwise Irrigation Specialist to design and install the system.

For turf areas, pop up gear drives and rotor drives are recommended.

Important note: If you don't feel comfortable repairing any of these items above, it is best to engage a Waterwise Irrigation Specialist to undertake the required work.

4.2 Recommended Watering Times

Watering run times will differ based on the type of emitter used, as well as the level of presentation required of the various garden or turf areas. The information provided in Appendices 5-7 addresses the recommended watering times for each region (South West, Mid-West and North West) that should be programmed for each hydrozone. Primary hydrozone areas receive an application of 10mm per watering day, with the secondary zones receiving slightly less water application per watering day and minimal hydrozones to receive no irrigation.

Irrigation Controller

Programming Your Irrigation Controller

Step 5. Maintaining Your Irrigation System

5.1 Routine Testing of Your Irrigation System

Regular assessments and checks are important to ensure your system is fully operational and maximises water efficiency. The type of facility will determine how frequently you should check your system, for example, if you manage a large shopping complex with lots of car parks, you will find there may be more testing required to identify breaks in the system.

It is recommended that you constantly keep your eyes open to observe daily issues on site, whilst thorough fortnightly and seasonal assessments are undertaken and recorded throughout the year. Refer to Appendices 10-12 for assessment sheets.

Note: When testing your irrigation system outside local allocated roster days and operation times, it is strongly recommended that a sign is installed identifying that testing procedures are being undertaken. This helps to avoid complaints from the general public about irresponsible water use.

Table 2 below, is a quick guide showing the key maintenance items to look out for.

Table 2: Key Maintenance Items

FREQUENCY	TYPE OF INSPECTION	WHAT TO LOOK FOR:
Daily	Visual inspection	• Keep your eyes open. Observe everything as you are working in the gardens • Look for obvious broken sprinklers or pipes and repair them immediately • Look for flooding or washed sand patches that indicate broken underground pipes • Keep an eye out for dying plants or turf. This may indicate a faulty or damaged irrigation system
Fortnightly	Record on Fortnightly Checklist (Appendix 8)	• Clean filters if non potable water is used • Check irrigation controller time, date and programs against your 'Irrigation Station Mapping' • Manually test all stations and check for blocked spray heads, leaks and sprinkler or pipe damage • Adjust spray radius and arc on sprinklers to ensure water is not spraying on pathways, roads or buildings • Visually check spray pattern for water pressure • Read and record water meter readings and compare against last reading for consistency (this can identify leaks in your system)
Seasonal	Record on Seasonal Assessment Checklist (Appendices 9 and 10)	• Clean all Filters • Measure and record station pressure and compare to system design pressures (this can identify sub surface leaks) • Adjust irrigation program run times to reflect seasonal changes • Flush all drip line systems • Check all solenoid and manual valve operations • Check and clean your rain sensor

5.2 Annual Assessments of Your Irrigation System

Annual assessments are essential to ensure your irrigation system has all the vital components and is fully operational prior to the irrigation period. Refer to Table 3 in conjunction with Appendices 9 and 10 for further information as to the tasks required in your annual assessment.

Table 3: Annual Assessment Requirements

TIME OF YEAR	WHAT TO LOOK FOR:
Before the beginning of the irrigation season (beginning of summer/dry season)	• Undertake system evaluation – test station flow rates, operating pressure and distribution (emission) uniformity and record results • Test bore and pump (if required) • Inspect all system components and replace defective ones • Inspect and clean all filters • Test and flush system. Depending on water quality, for bore users, flushing of the system is required to be undertaken annually, as a minimum • Replace batteries in controllers (if required)
Annually before system shutdown (winter, end of dry season)	• Flush all drip lines • Switch off system

Maintaining a Lush Landscape is to Ensure Annual Assessments are Undertaken

Further Information and Assistance

It is important to note that a certified irrigation specialist should be engaged to undertake all new irrigation works or a comprehensive irrigation audit. Specialists are also available to provide advice and assist with anything to do with existing irrigation systems. The following are places where you can find further assistance with your existing or new irrigation systems.

Irrigation Australia Limited

Irrigation Australia Limited (IAL) is Australia's leading organisation representing the irrigation industry. IAL provides an Irrigation Efficiency Training Course. This training is technically specific to the irrigation industry but is also beneficial for people looking to expand their irrigation knowledge and skills. Refer to Irrigation Australia Limited for further information: www.irrigation.org.au.

Waterwise Specialists

Waterwise Specialists have been trained especially to help you save water by providing specialist advice on waterwise products and services.

Waterwise Garden Irrigators are qualified to install and schedule efficient garden watering systems to an industry standard. They can also provide advice and assistance to improve the efficiency of existing systems.

Waterwise Irrigation Design Shops have trained experts who can provide all the answers to your questions about waterwise irrigation design. Staff can provide advice at any point of your design whether you are starting from scratch or improving or replacing an existing system.

To find a Waterwise Specialist near you visit watercorporation.com.au

Look for these Symbols and Save

Look for the Waterwise Approved and Smart Approved WaterMark symbols when choosing landscape and irrigation products such as mulch, plants, soil improvers and sprinklers.

Waterwise Training

Water Corporation has developed a number of online training courses designed to improve basic knowledge of water efficient garden and irrigation principles. For more information visit watercorporation.com.au or contact the Water Efficiency Projects Branch.

Water Efficiency Projects Branch
Water Corporation
Phone: 9420 2644
Email: water.efficiency@watercorporation.com.au

Appendices

APPENDIX 1 PLANT PALETTE - SOUTH WEST REGION

KEY	BOTANICAL NAME	COMMON NAME	RECOM. POT SIZE	MATURE HEIGHT RANGE (m)	MATURE SPREAD RANGE (m)	POSITION
PRIMARY ZONE						
TREES/LARGE SHRUBS						
Af	*Agonis flexuosa*	WA Peppermint Tree	10-45L	4.0-10.0	3.0-5.0	sun
As	*Adenanthos sericeus*	Pencil Perfect	10-45L	1.0-3.0	0.5-1.0	sun
Cf	*Corymbia ficifolia (dwarf)*	Dwarf Red Flowering Gum	10-45L	2.0-10.0	3.0-5.0	sun
Rt	*Ricinocarpus tuberculatus*	Wedding Bush	10-45L	2.0-3.0	2.0-3.0	sun
FEATURE PLANTS						
Mr	*Macrozamia riedlei*	Zamia	transplant	2.0-3.0	2.0-3.0	sun
Xp	*Xanthorrhoea preissii*	Grass Tree	transplant	1.0-3.0	1.0-2.0	sun/part shade
SHRUBS						
Ac	*Acacia cognata*	Bower of Beauty Wattle	tubestock	1.0-2.0	1.0-2.0	sun/part shade
Al	*Acacia lasiocarpa*	Pandang	140mm/tubestock	0.3-1.0	1.0-2.0	sun
Cv	*Callistemon viminalis*	Bottlebrush 'Little John'	tubestock	1.0-2.0	1.0-2.0	sun
Gp	*Grevillea preissii*	Sea Spray	140mm/tubestock	0.5-0.7	1.0-3.0	sun/part shade
Cq	*Calothamnus quadrifidus*	Clean and Green'	140mm/tubestock	1.0-1.5	1.0-1.5	sun/part shade
Oa	*Olearia axillaris*	Little Smokie	140mm/tubestock	0.3-0.5	0.5-1.0	sun
Sc	*Scaevola crassifolia*	Thick leaved Fan Flower	140mm/tubestock	0.5-1.5	0.5-1.5	sun
Wd	*Westringia dampieri* (Low growing form)	Coastal Rosemary	140mm/tubestock	0.2-1.0	0.5-1.0	sun
GROUNDCOVERS						
Eg	*Eremophila glabra*	Kalbarri Carpet	140mm/tubestock	0.3-0.5	1.0-3.0	sun/part shade
Cv	*Carpobrotus virescens*	Coastal Pigface	140mm/tubestock	0.1-0.3	0.5-3.0	sun
Gc	*Grevillea crithmifolia*	Green Carpet	140mm/tubestock	0.4-0.6	1.0-2.0	sun
Go	*Grevillea obtusifolia*	Gin Gin Gem	140mm/tubestock	0.25	2.0-3.0	sun/part shade
Gt	*Grevillea thelemanniana*	Spider Net Grevillea	140mm/tubestock	0.5-1.0	1.0-2.0	sun
Mp	*Myroporum parvifolium*	Creeping Boobialla	140mm/tubestock	0.2-0.4	0.5-1.0	sun/part shade

APPENDIX 1 CONTINUED PLANT PALETTE - SOUTH WEST REGION

KEY	BOTANICAL NAME	COMMON NAME	RECOM. POT SIZE	MATURE HEIGHT RANGE (m)	MATURE SPREAD RANGE (m)	POSITION
GRASSES						
Abr	*Anigozanthos flavidus*	Kangaroo Paw 'Big Red'	140mm/tubestock	1.0-2.0	0.5-1.0	sun/part shade
Ayg	*Anigozanthos flavidus x pulcherimus*	Yellow Gem	140mm/tubestock	1.0-2.0	0.5-1.0	sun/part shade
Cc	*Conostylis candicans*	Yellow Cottonheads	140mm/tubestock	0.3-0.5	0.3-0.5	sun
Dr	*Dianella revoluta*	Dwarf Flax Lily	140mm/tubestock	0.3-0.5	0.3-0.5	sun/part shade
SECONDARY ZONE						
TREES/LARGE SHRUBS						
Af	*Agonis flexuosa*	WA Peppermint Tree	10L	4.0-10.0	3.0-5.0	sun
Cf	*Corymbia ficifolia (dwarf)*	Dwarf Red Flowering Gum	5L	2.0-10.0	3.0-5.0	sun
Ce	*Casuarina equisetifolia*	Coastal Sheoak	5L	8.0-10.0	4.0-8.0	sun
Co	*Casuarina obesa*	Swamp Sheoak	5L	8.0-10.0	8.0-10.0	sun
Jm	*Jacaranda mimosifolia*	Jacaranda	5L	6.0-10.0	6.0-10.0	sun
SHRUBS						
Ac	*Acacia cognata*	Bower of Beauty Wattle	tubestock	1.0-2.0	1.0-2.0	sun/part shade
Bp	*Banksia praemorsa*	Cut-Leaf Banksia	tubestock	2.0-4.0	2.0-5.0	sun
Cq	*Calothamnus quadrifidus*	Clean and Green	140mm/tubestock	1.0-1.5	1.0-1.5	sun/part shade
Cv	*Callistemon viminalis*	Bottlebrush Little John	tubestock	1.0-2.0	1.0-2.0	sun
Lb	*Leucophyta brownii*	Silver Cushion Bush	140mm/tubestock	1.0-1.5	1.0-1.5	sun
Pf	*Pimelea ferruginea*	Pink Riceflower	140mm/tubestock	0.5-1.0	0.5-1.5	sun/part shade
Sc	*Scaevola crassifolia*	Thick leaved Fan Flower	140mm/tubestock	0.5-1.5	0.5-1.5	sun
GROUNDCOVERS						
Cv	*Carpobrotus virescens*	Coastal Pigface	140mm/tubestock	0.1-0.3	0.5-3.0	sun
Gc	*Grevillea crithmifolia*	Green Carpet	140mm/tubestock	0.4-0.6	1.0-2.0	sun
Gt	*Grevillea thelemanniana*	Spider Net Grevillea	140mm/tubestock	0.5-1.0	1.0-2.0	sun
Hc	*Hardenbergia comptoniana*	Native Wisteria	140mm/tubestock	1.0-1.5	0.5-3.0	sun
Hs	*Hibbertia scandens*	Snake Vine	140mm/tubestock	0.2-0.5	1.0-2.5	part shade
GRASSES						
Ol	*Orthrosanthus laxus*	Morning Iris	140mm/tubestock	0.4-0.6	0.4-0.7	sun/part shade
TURF						
Pc	*Pennisetum clandestinum*	Kikuyu	Seed	0.1-0.4	1.0-2.0	sun
Er	*Elytrigia repens*	Couch	Seed	0.1-0.5	1.0-2.0	sun

APPENDIX 1 CONTINUED PLANT PALETTE - SOUTH WEST REGION

KEY	BOTANICAL NAME	COMMON NAME	RECOM. POT SIZE	MATURE HEIGHT RANGE (m)	MATURE SPREAD RANGE (m)	POSITION
MINIMAL						
TREES/LARGE SHRUBS						
Af	*Agonis flexuosa*	WA Peppermint Tree	tubestock	4.0-10.0	3.0-5.0	sun/part shade
Cp	*Callitris preissii*	Rottnest Pine	tubestock	3.0-9.0	1.0-3.0	sun
Ce	*Casuarina equisetifolia*	Coastal Sheoak	tubestock	8.0-10.0	4.0-8.0	sun
Co	*Casuarina obesa*	Swamp Sheoak	tubestock	8.0-10.0	8.0-10.0	sun
Cc	*Corymbia calophylla*	Marri	tubestock	4.00-60.0	10.0-20.0	sun
Eg	*Eucalyptus gomphocephala*	Tuart	tubestock	10.0-40.0	8.0-15.0	sun
El	*Eucalyptus leucoxylon rosea*	Yellow Gum	tubestock	10.0-30.0	8.0-12.0	sun
Em	*Eucalyptus marginata*	Jarrah	tubestock	20.0-40.0	10.0-20.0	sun
En	*Eucalyptus nicholii*	Narrow Leaved Black Peppermint	tubestock	12.0-16.0	5.0-6.0	sun
Ep	*Eucalyptus platypus*	Moort	tubestock	4.0-10.0	5.0-10.0	sun
Ml	*Melaleuca lanceolata*	Rottnest Tea Tree	tubestock	3.0-8.0	2.0-4.0	sun
Mr	*Melaleuca rhaphiophylla*	Swamp Paperbark	tubestock	2.0-10.0	2.0-6.0	sun
SHRUBS						
Ac	*Adenanthos cygnorum*	Common Woolly Bush	tubestock	1.0-2.0	1.0-3.0	sun
Ah	*Allocasuarina humilis*	Dwarf Sheoak	tubestock	0.2-2.0	0.5-2.0	sun
Bp	*Banksia praemorsa*	Cut-Leaf Banksia	tubestock	2.0-4.0	2.0-4.0	sun
Cq	*Calothamnus quadrifidus*	Clean and Green	tubestock	1.0-1.5	1.0-1.5	sun/part shade
Dl	*Dampiera linearis*	Common Dampiera	tubestock	0.3-0.6	1.0-2.0	sun/part shade
Ghg	*Grevillea Honey Gem*	Honey Gem Grevillea	tubestock	1.0-2.5	1.0-3.0	sun
Tr	*Templetonia retusa*	Cockies Tongue	tubestock	0.3-4.0	0.5-5.0	part shade
GROUNDCOVERS						
Eg	*Eremophila glabra*	Kalbarri Carpet	tubestock	0.3-0.5	1.0-3.0	sun/part shade
Gc	*Grevillea crithmifolia*	Grevillea ' Green Carpet'	tubestock	0.4-0.6	1.0-2.0	sun
Gt	*Grevillea thelemanniana*	Spider Net Grevillea	tubestock	0.5-1.0	1.0-2.0	sun
Hs	*Hibbertia scandens*	Snake Vine	tubestock	0.2-0.5	1.0-2.5	part shade
GRASSES						
Am	*Anigozanthos manglesii*	Mangles Kangaroo Paw	tubestock	0.6-1.0	0.5-1.0	sun/part shade
Cc	*Conostylis candicans*	Yellow Cottonheads	tubestock	0.3-0.5	0.3-0.5	sun
Fn	*Ficinia nodosa*	Knotted Club Rush	tubestock	0.5-1.0	0.3-0.7	sun
Ol	*Orthrosanthus laxus*	Morning Iris	tubestock	0.4-0.6	0.4-0.7	sun/part shade

APPENDIX 2 PLANT PALETTE - MID-WEST REGION

KEY	BOTANICAL NAME	COMMON NAME	RECOM. POT SIZE	MATURE HEIGHT RANGE (m)	MATURE SPREAD RANGE (m)	POSITION
PRIMARY ZONE						
TREES/LARGE SHRUBS						
Af	*Agonis flexuosa*	WA Peppermint Tree	10L	4.0-10.0	3.0-5.0	sun
Dr	*Delonix regia*	Poinciana Flamboyant Tree	10L	4.0-8.0	4.0-8.0	sun
Jm	*Jacaranda mimosifolia*	Jacaranda	10L	6.0-10.0	6.0-10.0	sun
Li	*Lagerstroemia indica*	Crepe Myrtle	10L	4.0-8.0	2.0-4.0	sun
Pr	*Plumeria rubra*	Frangipani	10L	2.0-4.0	2.0-4.0	sun/part shade
SHRUBS						
Ac	*Acacia cognata*	Bower of Beauty' Wattle	tubestock	1.0-2.0	1.0-2.0	sun/part shade
Cv	*Callistemon viminalis*	Bottlebrush 'Little John'	tubestock	1.0-2.0	1.0-2.0	sun
Eg	*Eremophila glabra*	Emu Bush Fuchsia Bush	tubestock	0.5-1.0	1.0-2.0	sun
Oa	*Olearia axillaris*	Coastal Daisy	tubestock	1.0-2.0	1.0-2.0	sun
Sg	*Salvia greggii*	Autumn Sage	tubestock	0.5-2.0	0.5-2.0	sun
Sc	*Scaevola crassifolia*	Thick leaved Fan Flower	tubestock	0.5-1.5	0.5-1.5	sun
GROUNDCOVERS *(Note: * This plant is an annual)*						
Em	*Eremophila maculata*	Spotted Emu Bush	tubestock	0.5-1.0	0.5-1.0	sun/part shade
Es	*Eremophila subteretifolia*	Lake King Eremophila	tubestock	0.5-1.0	1.0-2.0	sun
Go	*Grevillea obtusifolia*	Gingin Gem	tubestock	0.5	1.0-2.0	sun/part shade
Gt	*Grevillea thelemanniana*	Spider Net Grevillea	tubestock	0.5-1.0	0.5-1.0	sun/part shade
Sf	**Swainsona formosa*	Sturt's Desert Pea	tubestock	0.5	1.0-2.0	sun
TURF						
Pc	*Pennisetum clandestinum*	Kikuyu	Seed	0.1-0.4	1.0-2.0	sun
Er	*Elytrigia repens*	Couch	Seed	0.1-0.5	1.0-2.0	sun
SECONDARY ZONE						
TREES/LARGE SHRUBS						
As	*Acacia saligna*	Jam Wattle, Orange Wattle	5L	4.0-8.0	2.0-4.0	sun
Af	*Agonis flexuosa*	WA Peppermint Tree	5L	4.0-10.0	3.0-5.0	sun
Ce	*Casuarina equisetifolia*	Coastal Sheoak	5L	8.0-10.0	4.0-8.0	sun
Ek	*Eucalyptus kingsmillii*	Kingsmill's Mallee	5L	4.0-8.0	2.0-4.0	sun
Jm	*Jacaranda mimosifolia*	Jacaranda	5L	6.0-10.0	6.0-10.0	sun
Pp	*Pittosporum phylliraeoides*	Weeping Pittosporum	5L	4.0-8.0	2.0-4.0	sun

APPENDIX 2 CONTINUED PLANT PALETTE - MID-WEST REGION

KEY	BOTANICAL NAME	COMMON NAME	RECOM. POT SIZE	MATURE HEIGHT RANGE (m)	MATURE SPREAD RANGE (m)	POSITION
SHRUBS						
Em	*Eremophila maculata*	Spotted Emu Bush	tubestock	0.5-1.0	0.5-1.0	sun/part shade
Go	*Grevillea obtusifolia*	Gingin Gem	tubestock	0.5	1.0-2.0	sun/part shade
Sf	**Swainsona formosa*	Sturt's Desert Pea	tubestock	0.5	1.0-2.0	sun
Sc	*Scaevola crassifolia*	Thick leaved Fan Flower	tubestock	0.5-1.5	0.5-1.5	sun
GROUNDCOVERS *(Note: * This plant is an annual)*						
Em	*Eremophila maculata*	Spotted Emu Bush	tubestock	0.5-1.0	0.5-1.0	sun/part shade
Go	*Grevillea obtusifolia*	Gingin Gem	tubestock	0.5	1.0-2.0	sun/part shade
Gt	*Grevillea thelemanniana*	Spider Net Grevillea	tubestock	0.5-1.0	0.5-1.0	sun/part shade
Sf	**Swainsona formosa*	Sturt's Desert Pea	tubestock	0.5	1.0-2.0	sun
MINIMAL						
TREES/LARGE SHRUBS						
As	*Acacia saligna*	Orange Wattle	tubestock	4.0-8.0	2.0-4.0	sun
Af	*Agonis flexuosa*	WA Peppermint Tree	5L	4.0-10.0	3.0-5.0	sun
Ce	*Casuarina equisetifolia*	Coastal Sheoak	tubestock	8.0-10.0	4.0-8.0	sun
Ek	*Eucalyptus kingsmillii*	Kingsmill's Mallee	tubestock	4.0-8.0	2.0-4.0	sun
Pp	*Pittosporum phylliraeoides*	Weeping Pittosporum	tubestock	4.0-8.0	2.0-4.0	sun
SHRUBS						
Bc	*Boronia crenulata*	Aniseed Boronia	tubestock	0.5-1.0	0.5-1.0	sun/part shade
Cv	*Callistemon viminalis*	Bottlebrush Little John	tubestock	1.0-2.0	1.0-2.0	sun
Oa	*Olearia axillaris*	Coastal Daisy	tubestock	1.0-2.0	1.0-2.0	sun
Rb	*Rhagodia baccata*	Berry Saltbush	tubestock	0.5-1.0	2.0-4.0	sun
Sc	*Scaevola crassifolia*	Thick leaved Fan Flower	tubestock	0.5-1.5	0.5-1.5	sun
GROUNDCOVERS *(Note: * This plant is an annual)*						
Al	*Acacia lasiocarpa*	Sand Heath Wattle Padjang	tubestock	0.5-1.0	1.0-2.0	sun
Em	*Eremophila maculata*	Spotted Emu Bush	tubestock	0.5-1.0	0.5-1.0	sun/part shade
Go	*Grevillea obtusifolia*	Gingin Gem	tubestock	0.5	1.0-2.0	sun/part shade
Gt	*Grevillea thelemanniana*	Spider Net Grevillea	tubestock	0.5-1.0	0.5-1.0	sun/part shade
Sf	**Swainsona formosa*	Sturt's Desert Pea	tubestock	0.5	1.0-2.0	sun
GRASSES						
Am	*Anigozanthos manglesii*	Mangles Kangaroo Paw	tubestock	0.6-1.0	0.5-1.0	sun/part shade
Cc	*Conostylis candicans*	Yellow Cottonheads	tubestock	0.3-0.5	0.3-0.5	sun
Fn	*Ficinia nodosa*	Knotted Club Rush	tubestock	0.5-1.0	0.3-0.7	sun
Ol	*Orthrosanthus laxus*	Morning Iris	tubestock	0.4-0.6	0.4-0.7	sun/part shade

APPENDIX 3 PLANT PALETTE - NORTH-WEST REGION

KEY	BOTANICAL NAME	COMMON NAME	RECOM. POT SIZE	MATURE HEIGHT RANGE (m)	MATURE SPREAD RANGE (m)	POSITION
PRIMARY ZONE						
TREES/LARGE SHRUBS						
Ce	*Casuarina equisetifolia*	Coastal Sheoak	10L	8.0-10.0	4.0-8.0	sun
Dr	*Delonix regia*	Poinciana Flamboyant Tree	10L	4.0-8.0	4.0-8.0	sun
Ev	*Eucalyptus victrix*	Smooth Barked Coolibah	10L	15.0-22.0	8.0-10.0	sun
Ht	*Hibiscus tiliaceus*	Cottonwood	10L	2.0-8.0	2.0-8.0	sun
Ti	*Tamarindus indica*	Tamarind	10L	24.0-30.0	8.0-12.0	sun
SHRUBS						
Aa	*Agave attenuata*	Agave	tubestock	0.5-1.0	0.5-1.0	sun/part shade
Cv	*Callistemon viminalis*	Bottlebrush 'Little John'	tubestock	1.0-2.0	1.0-2.0	sun
Oa	*Olearia axillaris*	Coastal Daisy	tubestock	1.0-2.0	1.0-2.0	sun
St	*Sansevieria trifasciata*	Mother in Law's Tongue	tubestock	0.5-1.0	0.5	sun/part shade
Sc	*Scaevola crassifolia*	Thick leaved Fan Flower	tubestock	0.5-1.5	0.5-1.5	sun
GROUNDCOVERS *(Note: * This plant is an annual)*						
Ah	*Acacia hilliana*	Tabletop Wattle	tubestock	0.5-1.0	2.0-4.0	sun
Em	*Eremophila maculata*	Spotted Emu Bush	tubestock	0.5-1.0	0.5-1.0	sun/part shade
Go	*Grevillea obtusifolia*	Gingin Gem	tubestock	0.5	1.0-2.0	sun/part shade
Pe	**Ptilotus exaltatus*	Tall Mulla Mulla (Joey)	tubestock	0.5-1.0	0.5-1.0	sun
Sf	**Swainsona formosa*	Sturt's Desert Pea	tubestock	0.5	1.0-2.0	sun
TURF						
Pc	*Pennisetum clandestinum*	Kikuyu	Seed	0.1-0.4	1.0-2.0	sun
Er	*Elytrigia repens*	Couch	Seed	0.1-0.5	1.0-2.0	sun
SECONDARY ZONE						
TREES/LARGE SHRUBS						
Ce	*Casuarina equisetifolia*	Coastal Sheoak	5L	8.0-10.0	4.0-8.0	sun
Dr	*Delonix regia*	Poinciana Flamboyant Tree	5L	4.0-8.0	4.0-8.0	sun
Ev	*Eucalyptus victrix*	Smooth Barked Coolibah	5L	15.0-22.0	8.0-10.0	sun
Pp	*Pittosporum phylliraeoides*	Weeping Pittosporum	5L	4.0-8.0	2.0-4.0	sun
Ti	*Tamarindus indica*	Tamarind	5L	24.0-30.0	8.0-12.0	sun

APPENDIX 3 CONTINUED PLANT PALETTE - NORTH-WEST REGION

KEY	BOTANICAL NAME	COMMON NAME	RECOM. POT SIZE	MATURE HEIGHT RANGE (m)	MATURE SPREAD RANGE (m)	POSITION
SHRUBS						
Cv	*Callistemon viminalis*	Bottlebrush Little John	tubestock	1.0-2.0	1.0-2.0	sun
Cc	*Crotalaria cunninghamii*	Green Bird Flower	tubestock/seed	0.5-1.0	1.0-2.0	sun
Oa	*Olearia axillaris*	Coastal Daisy	tubestock	1.0-2.0	1.0-2.0	sun
Sc	*Scaevola crassifolia*	Thick leaved Fan Flower	tubestock	0.5-1.5	0.5-1.5	sun
Sa	*Senna artemisioides*	Silver Cassia	tubestock/seed	1.0-2.0	1.0-2.0	sun
GROUNDCOVERS *(Note: * This plant is an annual)*						
Ah	*Acacia hilliana*	Tabletop Wattle	tubestock/seed	0.5-1.0	2.0-4.0	sun
Em	*Eremophila maculata*	Spotted Emu Bush	tubestock	0.5-1.0	0.5-1.0	sun/part shade
Go	*Grevillea obtusifolia*	Gingin Gem	tubestock	0.5	1.0-2.0	sun/part shade
MINIMAL						
TREES/LARGE SHRUBS						
Ce	*Casuarina equisetifolia*	Coastal Sheoak	tubestock	8.0-10.0	4.0-8.0	sun
Ev	*Eucalyptus victrix*	Smooth Barked Coolibah	tubestock	15.0-22.0	8.0-10.0	sun
Pp	*Pittosporum phylliraeoides*	Weeping Pittosporum	tubestock	4.0-8.0	2.0-4.0	sun
SHRUBS						
Cv	*Callistemon viminalis*	Bottlebrush 'Little John'	tubestock	1.0-2.0	1.0-2.0	sun
Cc	*Crotalaria cunninghamii*	Green Bird Flower	tubestock/seed	0.5-1.0	1.0-2.0	sun
Oa	*Olearia axillaris*	Coastal Daisy	tubestock	1.0-2.0	1.0-2.0	sun
Sc	*Scaevola crassifolia*	Thick leaved Fan Flower	tubestock	0.5-1.5	0.5-1.5	sun
Sa	*Senna artemisioides*	Silver Cassia	tubestock/seed	1.0-2.0	1.0-2.0	sun
GROUNDCOVERS *(Note: * This plant is an annual)*						
Ah	*Acacia hilliana*	Tabletop Wattle	tubestock/seed	1.0	3.0	sun
Em	*Eremophila maculata*	Spotted Emu Bush	tubestock	0.5-1.0	0.5-1.0	sun/part shade
Go	*Grevillea obtusifolia*	Gingin Gem	tubestock	0.5	1.0-2.0	sun/part shade
Pe	**Ptilotus exaltatus*	Tall Mulla Mulla (Joey)	tubestock/seed	0.5-1.0	0.5-1.0	sun
Sf	**Swainsona formosa*	Sturt's Desert Pea	tubestock/seed	0.5	1.0-2.0	sun

APPENDIX 4 IRRIGATION STATION MAPPING SHEET

CONTROLLER TYPE				
WATER SOURCE				
BORE LICENSE NUMBER				
METER NUMBER				
	START	**FINISH**	**TOTAL HRS**	**DAYS TO WATER**
PROGRAM A START TIME				
PROGRAM B START TIME				

STATION NUMBER	**AREA**	**SPRINKLER TYPE**	**PROGRAM (A-B-C)**	**STATION RUN TIME PROGRAM A (Mins)**	**STATION RUN TIME PROGRAM B (Mins)**	**Operating Pressure**	**NOTES**
STATION # 1							
STATION # 2							
STATION # 3							
STATION # 4							
STATION # 5							
STATION # 6							
STATION # 7							
STATION # 8							
STATION # 9							
STATION # 10							
STATION # 11							
STATION # 12							
STATION # 13							
STATION # 14							
STATION # 15							
STATION # 16							
STATION # 17							
TOTAL RUN TIME				0:00:00	0:00:00		

APPENDIX 5 RECOMMENDED WATERING TIMES (SOUTH WEST REGION)

HYDROZONE TYPE	TREATMENT	EMITTER TYPE	TYPICAL WATERING RATE (PER HOUR)	RECOMMENDED IRRIGATION RUN TIME					
				SUMMER Dec – Feb	AUTUMN Mar-May	1st of June WINTER SPRINKLER BAN STARTS	WINTER June – August	31st of AUGUST WINTER SPRINKLER BAN ENDS	SPRING Sept – Nov
Seasonal Adjustment on Irrigation Controller's				**100% water budget**	**75% water budget**		**N/A**		**75% water budget**
Primary 10mm application rate	Planting beds	Pop up/Fixed spray	35-45mm	13-17 mins	10-13 mins		SYSTEM OFF		10-13 mins
		Rotary Nozzle	10-15mm	40-60 mins	30-45 mins		SYSTEM OFF		30-45 mins
		Gear Drive Nozzle	10-20mm	30-60 mins	23-45 mins		SYSTEM OFF		23-45 mins
		Drip line	15-20mm	30-40mins	23-30 mins		SYSTEM OFF		23-30 mins
	Turf	Pop up/Fixed spray	35-45mm	13-17 mins	10-13 mins		SYSTEM OFF		10-13 mins
		Rotary/Fixed Spray	10-15mm	40-60 mins	30-45 mins		SYSTEM OFF		30-45 mins
		Gear Drive Nozzle	10-20mm	30-60 mins	23-45 mins		SYSTEM OFF		23-45 mins
Secondary 75% of Primary application rate	Planting beds	Pop up/Fixed spray	35-45mm	10-13 mins	8-10 mins		SYSTEM OFF		8-10 mins
		Rotary Nozzle	10-15mm	30-45 mins	23-34 mins		SYSTEM OFF		23-34 mins
		Gear Drive Nozzle	10-20mm	23-45 mins	17-34 mins		SYSTEM OFF		17-34 mins
		Drip line	15-20mm	23-30 mins	17-23 mins		SYSTEM OFF		17-23 mins
Minimal	Planting Beds	No irrigation	None	SYSTEM OFF	SYSTEM OFF		SYSTEM OFF		SYSTEM OFF

APPENDIX 6 RECOMMENDED WATERING TIMES (MID-WEST REGION)

HYDROZONE TYPE	TREATMENT	EMITTER TYPE	TYPICAL WATERING RATE (PER HOUR)	RECOMMENDED IRRIGATION RUN TIME					
				SUMMER Dec – Feb	AUTUMN Mar-May	1st of June WINTER SPRINKLER BAN STARTS	WINTER June – August	31st of AUGUST WINTER SPRINKLER BAN ENDS	SPRING Sept – Nov
Seasonal Adjustment on Irrigation Controller's				**100% water budget**	**75% water budget**		**N/A**		**75% water budget**
Primary 10mm application rate	Planting beds	Pop up/Fixed spray	35-45mm	20-26 mins	15 -19 mins		SYSTEM OFF		15 -19 mins
		Rotary Nozzle	10-15mm	60-90 mins	45-68 mins		SYSTEM OFF		45-68 mins
		Gear Drive Nozzle	10-20mm	45-90 mins	34-68 mins		SYSTEM OFF		34-68 mins
		Drip line	15-20mm	45-60 mins	34-45 mins		SYSTEM OFF		34-45 mins
	Turf	Pop up/Fixed spray	35-45mm	20-26 mins	15-19 mins		SYSTEM OFF		15-19 mins
		Rotary/Fixed Spray	10-15mm	60-90 mins	45-68 mins		SYSTEM OFF		45-68 mins
		Gear Drive Rotator	10-20mm	45-90 mins	34-68 mins		SYSTEM OFF		34-68 mins
Secondary 75% of Primary application rate	Planting beds	Pop up/Fixed spray	35-45mm	15-19 mins	11-14 mins		SYSTEM OFF		11-14 mins
		Rotary Nozzle	10-15mm	45-68 mins	34-51 mins		SYSTEM OFF		34-51 mins
		Gear Drive Nozzle	10-20mm	34-68 mins	25-51 mins		SYSTEM OFF		25-51 mins
		Drip line	15-20mm	34-45 mins	25-34 mins		SYSTEM OFF		25-34 mins
Minimal	Planting Beds	No irrigation	None	SYSTEM OFF	SYSTEM OFF		SYSTEM OFF		SYSTEM OFF

APPENDIX 7 RECOMMENDED WATERING TIMES (NORTH WEST REGION)

HYDROZONE TYPE	TREATMENT	EMITTER TYPE	TYPICAL WATERING RATE (PER HOUR)	RECOMMENDED IRRIGATION RUN TIME	
				PEAK IRRIGATION PERIOD Oct - May	OFF PEAK IRRIGATION PERIOD June - Sept
Seasonal Adjustment on Irrigation Controller's				**100% water budget**	**75% water budget**
Primary 10mm application rate	Planting beds	Pop up/Fixed spray	35-45mm	13-17 mins	10-13 mins
		Rotary Nozzle	10-15mm	40-60 mins	30-45 mins
		Gear Drive Nozzle	10-20mm	30-60 mins	23-45 mins
		Drip line	15-20mm	30-40mins	23-30 mins
	Turf	Pop up/Fixed spray	35-45mm	13-17 mins	10-13 mins
		Rotary/Fixed Spray	10-15mm	40-60 mins	30-45 mins
		Gear Drive Rotator	10-20mm	30-60 mins	23-45 mins
Secondary 75% of Primary application rate	Planting beds	Pop up/Fixed spray	35-45mm	10-13 mins	8-10 mins
		Rotary Nozzle	10-15mm	30-45 mins	23-34 mins
		Gear Drive Nozzle	10-20mm	23-45 mins	17-34 mins
		Drip line	15-20mm	23-30 mins	17-23 mins
Minimal	Planting Beds	No irrigation	None	SYSTEM OFF	SYSTEM OFF

APPENDIX 8 FORTNIGHTLY IRRIGATION CHECKLIST / FOR ALL REGIONS

	FACILITY NAME	NAME OF INSPECTION PERSONNEL	IRRIGATION SUB METER READING (KL)	DATE & TIME OF INSPECTION

ZONE/STATION	GENERAL			IRRIGATION LINES		SPRINKLER HEADS/ DRIP IRRIGATION		FILTER	CONTROLLER		RAIN SENSOR	VALVES		COMMENTS
	Any leaks?	Areas of over-watering?	Water pressure adequate	Damaged/ Worn/ Broken/ Leaks?	No. of Broken/ worn sprinkler heads	No. of clogged sprinkler heads	Spray radius and arc correct?	Clean filter if Non Potable Water is Used?	Is the time & day showing correctly?	Match controller program with Irrigation Station Mapping	Is it clean & operating correctly	Inspect valve electrical connections	Inspect valve covers & boxes	
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														

APPENDIX 9 SEASONAL IRRIGATION ASSESSMENT CHECKLIST / SOUTH WEST AND MID WEST REGIONS

	FACILITY NAME	NAME OF INSPECTION PERSONNEL	IRRIGATION SUB METER READING (KL)	DATE & TIME OF INSPECTION
SUMMER (S)				
AUTUMN (A)				
SPRING (S)				

ZONE/STATION	SEASONS	GENERAL			IRRIGATION LINES		SPRINKLER HEADS/ DRIP IRRIGATION					CONTROLLER					RAIN	VALVES		COMMENTS
		Any leaks?	Areas of over-watering?	Water pressure adequate	Damaged/ Worn/ Broken/ Leaks?	Clogged Lines?	Consistency of sprinkler head types?	No. of Broken/ Worn sprinler heads	No. of clogged sprinler heads	Spray radius and arc correct?	Clean/ Replace filter?	Is the time & day showing correctly?	Controller cabinet clean and insect free	Check for loose wires on terminal block?	Replace battery and write install date on new battery	Re-program to seasonal adjustment and water	Is it clean & operating correctly	Inspect valve covers & boxes	Inspect valve electrical connections and test operation	
1	S																			
	A																			
	SP																			
2	S																			
	A																			
	SP																			
3	S																			
	A																			
	SP																			
4	S																			
	A																			
	SP																			
5	S																			
	A																			
	SP																			

APPENDIX 10 SEASONAL IRRIGATION ASSESSMENT CHECKLIST / NORTH WEST REGION

	FACILITY NAME	NAME OF INSPECTION PERSONNEL	IRRIGATION SUB METER READING (KL)	DATE & TIME OF INSPECTION
PEAK IRRIGATION PERIOD (P) (Oct - May)				
OFF- PEAK IRRIGATION PERIOD (OP) (June - Sept)				

ZONE/STATION	SEASONS	GENERAL			IRRIGATION LINES		SPRINKLER HEADS/ DRIP IRRIGATION					CONTROLLER					RAIN	VALVES		COMMENTS
		Any leaks?	Areas of over-watering?	Water pressure adequate	Damaged/ Worn/ Broken/ Leaks?	Clogged Lines?	Consistency of sprinkler head types?	No. of Broken/ Worn sprinler heads	No. of clogged sprinler heads	Spray radius and arc correct?	Clean/ Replace filter?	Is the time & day showing correctly?	Controller cabinet clean and insect free	Check for loose wires on t erminal block?	Replace battery and write install date on new battery	Re-program to seasonal adjustment and water	Is it clean & operating correctly?	Inspect valve covers & boxes	Inspect valve electrical connections and test	
1	P																			
	OP																			
2	P																			
	OP																			
3	P																			
	OP																			
4	P																			
	OP																			
5	P																			
	OP																			
6	P																			
	OP																			
7	P																			
	OP																			
8	P																			
	OP																			

ISBN 1 74043 829 9 March 2013

Water Efficiency Projects Branch

(08) 9420 2644

water.efficiency@watercorporation.com.au

watercorporation.com.au

water for all, forever WATER CORPORATION