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**Project Steering Committee Representatives**
- SA Water
- South Australian Turf and Irrigation Technical Working Group
- Department of Environment Water and Natural Resources
- Adelaide and Mount Lofty Natural Resources Management Board
- SA Murray-Darling Basin Natural Resources Management Board
- Office for Recreation and Sport
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- Local Government Association
- Bureau of Meteorology
- Adelaide University

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Disclaimer:
While every care has been taken in the preparation of the material contained in this resource, no responsibility or liability can be accepted for any errors or omissions. Ultimately the responsibility for sound sports ground irrigation and turf management lies with the turf manager.
The Operational Guide is designed to assist those who are responsible for the irrigation management of sports grounds but are not considered professional irrigation managers. Typically this situation applies to small local government councils, sports clubs and some schools.

Turf and irrigation management requires multiple skills and comprehensive knowledge of a wide range of areas. *The Code of Practice – Irrigated Public Open Space* details the principles of best practice in this area.

This guide provides a simplified version to assist in sound turf and irrigation management. The aim of this guide is to assist irrigation managers achieve acceptable standards of irrigation efficiency, effective cost management/monitoring, minimise wastage and provide a functional turf surface.

**The following questions will be answered in this guide:**

1. Does my irrigation system perform adequately?
2. What information do I need to irrigate efficiently?
3. How much water does the turf need and how often do I need to irrigate?
4. For how long do I need to run the irrigation system?
5. Should I adjust the irrigation program for variations in weather?
6. How do I monitor irrigation efficiency and the cost of water over the irrigation season?
7. How do I ensure the turf is maintained in a healthy condition?
1. Does my irrigation system perform adequately?

TIP Refer to Section 6.0 of the Code of Practice for more detailed information on irrigation system performance.

This guide assumes that the irrigation system performs adequately and is able to apply water at a reasonable consistency. If the irrigation system is obviously non-performing, advice from a qualified irrigation professional is advised. Examples of non-performance are irregular grass coverage during the summer periods and green rings of grass around individual sprinkler heads.

Important factors that contribute to irrigation system performance

**Water Supply**
A reliable water supply is critical. The water supply must have the capacity to meet the peak water demand of the turf in summer. Types of water supply include:

- SA Water mains
- ground water bore
- harvested stormwater
- treated wastewater
- combination of one or more of the above

**Water Supply Infrastructure**
Water supply infrastructure is required to deliver water at the necessary pressure and flow rate for the irrigation system to operate effectively. Types of water supply infrastructure include:

- mains water meter of adequate size (40-80 mm diameter)
- backflow prevention device
- holding tank of appropriate size to supply water demand (5 000-80 000 L)
- holding dam
- pump station.

A guide to the required pressure and flow is:

- operating pressure at sprinkler head: eg. 200–500 kPa
- operating flow (depends on the number of sprinklers) eg. 100-400 L/min.

**Irrigation System Design and installation**

**Design** – The irrigation system should be designed by a qualified irrigation design professional.

**Installation** – The irrigation system should be installed by a qualified irrigation installation contractor. The contractor should provide an as-constructed irrigation plan. In many cases irrigation plans are not available for older systems.

**Pipe work** – Pipe sizing should be adequate to supply water at appropriate pressure to the sprinklers.
**Master valve** – A master valve should be fitted to isolate water from the system in the event of a pipe burst, malfunction or to carry out maintenance.

**Solenoid valves** – The solenoid valves should be adequate to control the flow of water to the sprinklers.

**Stations** – Irrigation stations or zones should have the appropriate number of sprinklers according to the pressure and flow of the water supply. Generally each station will have 3-6 sprinklers. Half or part circle sprinklers should, where possible, be grouped on separate stations to full circle sprinklers. It is important that sprinklers with similar application rates are grouped and controlled together.

**Sprinklers** – Sprinklers should be installed upright, 10 mm below the ground surface.

**Nozzles** – Nozzles should be sized according to the pressure and flow of the water supply. It is important that nozzle size is consistent across each part of the system.

**Sprinkler Layout and Spacing** – Sprinklers should generally be set out in a square or triangular layout, with spacings of between 10-18 m depending on the pressure and flow of the water supply.

A guide to the required irrigation system performance is:

- application/distribution uniformity: 70-80 %
- application rate: 8-16 mm/hr

**Basic Irrigation Maintenance**

Basic irrigation system maintenance includes regular system checks where all stations are activated for 3 minutes and sprinkler operation is checked to ensure that:

- solenoid valves open and shut effectively
- sprinkler pop-up is to full height; alignment is perpendicular to the turf surface; rotation is smooth and continuous; and water stream is not impeded by turf.

**Assessment of Irrigation System Performance**

It is recommended that the system performance is assessed by a qualified irrigation professional. This involves an irrigation audit that assesses all aspects of the system operation. An irrigation audit will also provide all information on the site, climate and irrigation system that is required to manage the irrigation of the sportsground efficiently.

**TIP** Information on the importance of an irrigation audit is available as part of SA Water’s *Irrigation System Performance Guide*. 
2. What information do I need to irrigate efficiently?

The following information is essential to operate and manage the irrigation of turf efficiently.

**Site Details**

**Site area (m²)**
Measure the irrigated area of your site.

**TIP** You can use Google Earth to measure the irrigated area of your site.

**Grass type/species**
Generally grass type on local sports grounds and parks in SA is Kikuyu, a warm season grass.

**TIP** Refer to Section 7.3 of the Code of Practice for more information on turf species.

**Quality/standard (TQVS Classification)**
The Turf Quality Visual Standard (TQVS) system is used to classify turf.

- **TQVS 1 – Elite Sports Turf**
- **TQVS 2 – Premier Sports Turf**
- **TQVS 3 – Local Sports Turf**
- **TQVS 4 – Passive Recreational Turf**

The quality or standard of the turf has a significant impact on the water usage and maintenance costs. Not all sports grounds have to be at an elite or premier level. Generally local sports grounds will be TQVS 3 and passive recreation parks will be TQVS 4.

**TIP** Refer to Section 7.4 of the Code of Practice for more information on the TQVS classification of turf.

**Root depth**
Using a spade, take out a square of turf to depth of approximately 250 mm and measure the depth of the root system of the turf.

**Tip** Generally healthy Kikuyu turf will have root system depth of 100-200 mm and average root depth of 150 mm.

**Soil type**
Take a sample of soil from the root zone and use the Hand Bolus Method to determine the type of soil.

**TIP** Refer to Soil Type Test Information Sheet on the SA Water website for further detail on how to determine soil type. Soil type will be sand, sandy loam, loam, clay loam or clay.
Climate Details

**Bureau of Meteorology (BoM) Region**
The BoM has many weather stations located across the state. Choose the weather station from the list that is the nearest to the sports ground you are irrigating.

**TIP** A list of weather station locations can be found on the BoM website at www.bom.gov.au/watl/eto/

**Evapotranspiration**
The Evapotranspiration is the amount of water in mm depth used by the plant over a given period (day/month). This figure is calculated by the Bureau of Meteorology. The average evapotranspiration rate for the last 10 years is used.

**Rainfall**
Rainfall is measured in mm depth of rain for a given period (day/month). Rain replenishes the moisture in the soil. Where there is insufficient rain to meet the needs of the turf, irrigation must be applied to provide the required water for healthy plant growth. Rainfall is measured by the Bureau of Meteorology. The average rainfall for the last 10 years is used.
3. How much water does the turf need and how often do I need to irrigate?

**TIP** Refer to Section 8 of the *Code of Practice* for more information on plant water use.

**TIP** The *Basic Irrigation Management Toolkit* available on the SA Water website provides assistance in determining turf water requirement and developing a water budget.

To find out how much water needs to be applied to the sportsground, enter the above site and climate data into the SA Water *Basic Irrigation Management Toolkit*. The toolkit will then calculate how much water you need to apply at each optimal irrigation event and how many times in a month you will need to irrigate.

**Optimal Irrigation Event**

The toolkit will calculate the optimal irrigation event in millimeters. This is the depth of water (in millimetres) that should be applied at each irrigation event.

**How often do I need to irrigate?**

The toolkit will calculate how often you need to apply the optimal irrigation event.

**How much water will I use?**

The toolkit will also calculate how much water you will use each time you irrigate for each month in the irrigation season and for the entire irrigation season.

**SA Water – Irrigation Management Toolkit Example**

The following is an example of the irrigation management information that is calculated using the SA Water *Basic Irrigation Management Toolkit*. The example is for a school or council oval located in the western suburbs of Adelaide using the site information detailed above. Enter the required information into the appropriate section and the toolkit will do all the calculations as in the example below.

<table>
<thead>
<tr>
<th>Irrigated Area</th>
<th>16 000 m² (1.6 ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Purpose (turf quality)</td>
<td>TQVS 3 (local sports ground)</td>
</tr>
<tr>
<td>BoM Region (weather station)</td>
<td>Adelaide Airport</td>
</tr>
<tr>
<td>Turf Type</td>
<td>Kikuyu (warm season turf)</td>
</tr>
<tr>
<td>Soil Type</td>
<td>Loam</td>
</tr>
<tr>
<td>Root Zone Depth</td>
<td>150 mm</td>
</tr>
</tbody>
</table>
The toolkit calculates the following information:

**Optimal Irrigation Event (mm)**  
14 mm (to be applied each time the oval is irrigated)

**Optimal Irrigation Event (kL)**  
225 kL (is applied each time the oval is irrigated)

**Irrigation Schedule:**

<table>
<thead>
<tr>
<th></th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No of Irrigation Events</strong></td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>33</td>
</tr>
<tr>
<td><strong>Irrigation Required (kL)</strong></td>
<td>373</td>
<td>746</td>
<td>1,122</td>
<td>1,297</td>
<td>1,503</td>
<td>1,129</td>
<td>909</td>
<td>430</td>
<td>7,509</td>
</tr>
</tbody>
</table>
4. For how long do I need to run the irrigation system?

**TIP** Refer to Section 9.0 of the Code of Practice for more information on irrigation scheduling.

We now know that we need to apply 14 mm of water each time we irrigate and we also know how many times each month we need to irrigate. However, at this stage, we don’t know how long we need to run the irrigation system to apply the required 14 mm.

To determine how long we need to run the irrigation system each time we irrigate, we need to know what the irrigation system application rate is in mm per hour.

**TIP** The system will have numerous stations or zones and stations will often have either full circle or half circle sprinklers. The general rule is that stations with half circle sprinklers will have double the application rate of stations with full circle sprinklers.

What is the irrigation system application rate?

**Irrigation design plan** – If the irrigation system is relatively new or if there is an irrigation system design plan, the application rate of each station should be recorded on the plan.

Often there is no irrigation plan available and other methods of determining the application rate must be used.

**Catch can test** – The application rate of the irrigation system can be measured using catch cans (100 mm diameter plastic food containers can be used) set out in a grid (between 10 – 20 cans set out evenly) between sprinklers on one or two stations to collect water while the system is running. Operate the stations for a minimum of 20 minutes. Measure the depth of water collected in the cans (in mm) using a ruler. The average depth of water in all the cans gives the application rate in mm per 20 minutes. Multiply the average by 3 to calculate the application rate in mm per hour.

An irrigation audit by an experienced irrigation professional will determine the application rate of the system as part of the audit.
**Irrigation event test** – If there is no irrigation design plan and you are not able to do a catch can test, you can calculate the irrigation application rate (millimetres per hour) by doing an irrigation event test. The irrigation event test should generally be done overnight as the entire system needs to operate for 20 minutes. This could take several hours and it is important that there is no other water use occurring during the test. To do an irrigation event test follow these steps:

1. Read the water meter before starting and record the meter reading.
2. Set the irrigation system to run for 20 minutes per station. If there are stations with half circle sprinklers set these stations to run for 10 minutes.
3. Activate the system to operate all stations.
4. When the irrigation has finished read the water meter and record the reading.
5. Subtract the second meter reading from the first and this will tell you how much water the system used in a 20 minute event. Then multiply the result by 3 to calculate how much water would be used if the system was to run for an hour.

<table>
<thead>
<tr>
<th>1st read</th>
<th>2nd read</th>
<th>Water Used (kL)</th>
<th>Water used (L) 20 mins</th>
<th>Water used (L) 60 mins (1 hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>43571.6</td>
<td>43637.2</td>
<td>65.6</td>
<td>65 600</td>
<td>196 800</td>
</tr>
</tbody>
</table>

6. We now know that the irrigation system applies 196,800 litres of water per hour. To convert the volume (L/hr) to mm per hour (mm/hr) we need to divide the total water used (L/hr) by the area irrigated (m²).

<table>
<thead>
<tr>
<th>Water Used (L/hr)</th>
<th>Irrigated Area (m²)</th>
<th>Irrigation System Application rate (mm/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>196 800</td>
<td>16 000</td>
<td>12.3</td>
</tr>
</tbody>
</table>

Irrigation system application rate – 12 mm/hr

**What is the irrigation run time?**

In this example we need to apply 14 mm per irrigation event and we know that the irrigation system will apply 12 mm/hr. If we divide the amount required or the optimal irrigation event (14 mm) by the application rate (12 mm/hr), we can calculate the system runtime in hours. We then multiply this by 60 to calculate the irrigation system runtime in minutes.

<table>
<thead>
<tr>
<th>Optimal Irrigation Event (mm)</th>
<th>Irrigation System Application rate (mm/hr)</th>
<th>Irrigation System Runtime (hrs)</th>
<th>Irrigation System Runtime (mins)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>12</td>
<td>1.2</td>
<td>70 (per station)</td>
</tr>
</tbody>
</table>

Irrigation System Runtime (minutes) – 70 min (to apply 14 mm)
5. Should I adjust the irrigation program for variations in weather?

This guide provides advice based on average weather conditions. However, weather patterns are changing and we are experiencing extreme events from prolonged heat waves to unseasonal high rainfall.

It is critical that the person responsible for the ground monitors the actual weather variations and responds by adjusting irrigation programs accordingly.

**TIP** One important principle is that the optimal irrigation event and irrigation system runtimes don’t change. However, the frequency of irrigation events can be changed in response to varying weather patterns.

**Heat waves** - Where a region experiences extreme prolonged periods of hot weather, the irrigation events for that period should be increased to cater for higher water demand by the turf. If a prolonged heat wave was experienced in December, the number of irrigation events might be increased from 6 to 8.

**High rainfall events** - Where a region experiences unseasonal high rainfall events, the number of irrigation events for that period should be decreased as the water requirement has been reduced by the additional rain. If 60 mm of rain fell in January, the number of irrigation events might be reduced from 7 to 5.

**Monitor the health of the turf** - It is important to monitor the health and vigour of the turf over the irrigation season to ensure that it is not suffering moisture stress. Irrigation events should be adjusted in response to the needs of the turf grass. Add an irrigation event if the turf is browning off or stop an irrigation event if the turf is lush.
6. How do I monitor irrigation efficiency and the cost of water over the irrigation season?

**TIP** refer to Section 12.0 of the Code of Practice for more information on irrigation efficiency reporting.

Monitoring water use and irrigation efficiency is as simple as reading the water meter monthly during the irrigation season. The amount of water used should be compared to the amount of water required as calculated in the Basic Irrigation Management Toolkit in section 3 of this guide.

The Basic Irrigation Management Toolkit also provides a template which calculates the water use and cost per month. Simply enter the water meter readings into the appropriate section and the toolkit will do all the calculations as in the example below.

### Water Use Recording Sheet - Meter 1

- **Start meter:** 19101
- **End Jul:** 19102
- **End Aug:** 19103
- **End Sep:** 19104
- **End Oct:** 19105
- **End Nov:** 19106
- **End Dec:** 19107
- **End Jan:** 19108
- **End Feb:** 19109
- **End Mar:** 19110
- **End Apr:** 19111
- **End May:** 19112
- **End Jun:** 19113
- **End Sum:** 19114

<table>
<thead>
<tr>
<th>Month</th>
<th>Meter Read</th>
<th>% Irrigation requirement</th>
<th>Actual irrigation water use</th>
<th>Approx monthly cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>19101</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jul</td>
<td>19102</td>
<td>0</td>
<td>0</td>
<td>1,285.35</td>
</tr>
<tr>
<td>Aug</td>
<td>19103</td>
<td>2</td>
<td>195</td>
<td>2,490.16</td>
</tr>
<tr>
<td>Sep</td>
<td>19104</td>
<td>2</td>
<td>441</td>
<td>3,152.18</td>
</tr>
<tr>
<td>Oct</td>
<td>19105</td>
<td>2</td>
<td>609</td>
<td>4,129.82</td>
</tr>
<tr>
<td>Nov</td>
<td>19106</td>
<td>2</td>
<td>768</td>
<td>5,365.38</td>
</tr>
<tr>
<td>Dec</td>
<td>19107</td>
<td>2</td>
<td>283</td>
<td>6,680.48</td>
</tr>
<tr>
<td>Jan</td>
<td>19108</td>
<td>2</td>
<td>768</td>
<td>1,205.82</td>
</tr>
<tr>
<td>Feb</td>
<td>19109</td>
<td>2</td>
<td>1247</td>
<td>3,580.12</td>
</tr>
<tr>
<td>Mar</td>
<td>19110</td>
<td>2</td>
<td>1,412</td>
<td>2,086.50</td>
</tr>
<tr>
<td>Apr</td>
<td>19111</td>
<td>2</td>
<td>621</td>
<td>2,086.50</td>
</tr>
<tr>
<td>May</td>
<td>19112</td>
<td>2</td>
<td>1,090</td>
<td>2,367.36</td>
</tr>
<tr>
<td>Jun</td>
<td>19113</td>
<td>2</td>
<td>652</td>
<td>3,152.16</td>
</tr>
<tr>
<td>Sum</td>
<td>19114</td>
<td>2</td>
<td>7,503</td>
<td>28,847.35</td>
</tr>
</tbody>
</table>

**Performance Graph - Meter 1**

- **Total water used:** 8,526 kL
- **Total forecast water requirement:** 7,509 kL
- **Total cost of water used:** $28,647.35

Monitoring water usage monthly enables you to identify over-usage early and take steps to manage the irrigation scheduling to remain within budget.

**TIP** In extremely hot summers the actual usage might be significantly higher than the forecast requirement. It is important to monitor turf health and vigour as well as water usage to ensure turf does not suffer moisture stress in hotter than normal conditions.

**TIP** Where the water meter supplies club rooms as well as irrigation, the total water usage is expected to be higher than the irrigation requirement. This however is generally not significant and would account for between 5 – 10% of water used.
7. How do I ensure the turf is maintained in a healthy condition?

Irrigation is only one of the inputs that need to be considered in maintaining the turf. The health and condition of the soil and the turf plant must also be considered.

The turf maintenance program should address the following issues:

- maintaining and improving soil condition
- de-compaction and aeration works to relieve compaction
- mowing to ensure a functional and uniform surface
- fertiliser application to ensure nutrient requirement are met
- pest and weed control
- top-dressing
- turf re-establishment after wear

Where there are serious problems with the health of the turf, advice should be sought from qualified turf professionals.

| TIP | Section 11.4 of the Code of Practice provides further information in relation to turf maintenance. |
| TIP | The Sports Turf Maintenance Guide available from the SA Water web page is a useful resource in developing a turf maintenance program. |
| TIP | The Sports Turf Association SA is available to provide support and advice. |
The support tools and resources referenced in this guide are available from the following organisations:

- **SA Water – Irrigated Public Open Space Web Page**
  - Basic Irrigation Management Toolkit
  - Advanced Irrigation Management Toolkit
  - Irrigation Efficiency Checklist
  - Sports Turf Maintenance Guide
  - Irrigation System Performance Guide
  - Water Efficiency Plan Toolkit
  - Soil Type Test Information Sheet

- **Office for Recreation and Sport, South Australia.**
  - STARCLUB Club Development Program : Sustainable Clubs

- **Sports Turf Association SA (STASA)**
  - Industry support and advice
  [www.sportsturf.asn.au/](http://www.sportsturf.asn.au/)

- **Irrigation Australia Ltd (IAL)**
  - Industry support and advice