Irrigation Scheduling

Irrigation scheduling is planning when and how much water to apply to maintain the desired turf quality throughout the year.

Deciding on the rate and frequency of water applications is crucial to:

- meet the water needs of the turf to prevent deterioration in quality due to water stress
- use available water resources efficiently and minimise waste
- minimise the potential for nutrient leaching.

Effective irrigation practices depend on forecasting turf water needs, and regular monitoring of soil moisture levels and turf condition. Delaying irrigation until turf stress is evident, or applying too little water, is detrimental to turf quality.

Site-Specific Irrigation

Developing site-specific irrigation schedules requires:

- an irrigation audit to measure system performance
- a methodology for estimating turf water requirements
- regular soil moisture monitoring; and a plan for delivering the water.

Irrigation audit

An irrigation audit is the process of taking field measurements using catch cups to evaluate the performance of an irrigation system. The key performance indicators are the average precipitation rate and the uniformity of application.

Precipitation rate
The rate of water application is measured in mm/hr. This can be used to calculate the appropriate station run time based on estimated turf water use (mm/day).

$$\text{Run time (minutes)} = \frac{\text{Estimated daily turf water use (mm)}}{\text{Precipitation Rate (mm/hr)}} \times 60$$

For example, if the estimated daily turf water use is 6 mm and the precipitation rate is 12 mm/hr, a run time of 30 minutes per station is required.

Run time =

$$\frac{6 \text{ mm}}{12 \text{ mm/hr}} \times 60 = 30 \text{ minutes}$$

If the precipitation rate is 8 mm/hr, the run time should be 45 minutes per station.

Run time =

$$\frac{6 \text{ mm}}{8 \text{ mm/hr}} \times 60 = 45 \text{ minutes}$$

When scheduling irrigation, it is important to think in terms of millimetres of water applied, rather than in minutes of run time. There is considerable variation in the output of different irrigation systems, leading to large differences in the amount of water applied when the same run times are used.

Uniformity

The uniformity of application is measured using an index called the *Coefficient of Uniformity (CU).* It is calculated as a percentage, based on the average deviation of catch cup readings from the overall average precipitation rate. CU treats over watered and under watered areas the same. The minimum industry benchmark for CU is 85%, where 100% refers to perfect uniformity.

To represent the extent of under watering within an irrigation pattern, *Distribution Uniformity* (DU) is used as the industry standard measurement. DU is based on the average of the lowest quarter of catch cup readings as a percentage of the overall average precipitation rate. The minimum industry benchmark for DU is 75%. For example, on a system with an average precipitation rate of 10 mm/hr and a DU of 75%, one quarter of the area being watered receives an average of 7.5 mm/hr.

Using the example above, the run time has to be increased from 60 minutes to 80 minutes (multiplied by 1.33) to apply an average of 10 mm to the lowest quarter.

The risk of using the scheduling coefficient to increase run times on systems with poor uniformity is that large areas will be over watered in order to apply adequate water to the dry areas. Wasting water to compensate for poor irrigation uniformity can't be justified and some dry areas of turf have to be tolerated.

Estimating turf water requirements

Irrigation targets need to be set according to the estimated daily evapotranspiration (ET) for a turf surface. Daily turf water use changes throughout the year due to the variation in weather conditions. Climatic parameters having a major effect on the turf's daily water use include solar radiation, wind, humidity and temperature.

The two main tools available to turf managers to estimate daily turf water use are the evaporation pan (Epan) and weather stations.

Epan
The weather bureau records a daily Epan reading for the Perth area, which is made available to the public on a daily basis. This provides a good indication of turf water requirements based on current weather conditions and the irrigation schedule can be adjusted accordingly.

Alternatively, historical averages for Epan can be used to forecast turf water requirements. The table below shows the average daily evaporation based on the monthly averages. This information provides a useful guide, but it does not allow the turf manager to respond to daily fluctuations in evaporation. During summer, it is not uncommon to have up to 15 mm evaporation per day in the Perth area.

To calculate the estimated turf water use, the daily Epan figure is multiplied by a crop factor. The crop factor most commonly used for warm season grasses grown under Perth conditions is 0.6. For example, on an average summer day with 10 mm evaporation, the estimated daily water use for kikuyu is 6 mm.

Weather stations
On-site weather stations are used to calculate the estimated turf water use based on measurements of solar radiation, wind, temperature and humidity. The weather station provides climatic data relevant to a particular location. It has the capacity to respond to changes in weather conditions by adjusting the irrigation schedule.

A computer software program is used to calculate the Reference ET, which is the estimated daily water use for a reference crop of high cut cool season grass. An adjustment factor, called the crop coefficient, is used to convert the Reference ET to an estimated daily water use for a particular turf situation. For warm season grasses, a suitable crop coefficient is 0.7.

Monitoring soil moisture

Scheduling irrigation to replace turf water use assumes that there is sufficient plant available moisture in the root zone. If the soil moisture content is not maintained in the optimum range, turf quality will suffer from either drought stress or water logging. The optimum moisture content depends on the soil type and will be different for each individual site.

Two common ways of estimating soil moisture content in the field are by the feel/appearance method or the use of soil moisture sensors.

The feel method involves collecting soil core samples from the root zone. The moisture content for each sample is estimated by feeling the soil and judging the soil moisture, based on experience. This is a simple and quick method that should be a regular practice during site inspections in the irrigation season.

Soil moisture sensors provide a more accurate method of determining the current soil moisture content. It can be difficult on sand root zones to judge by feel and appearance whether the moisture content is adequate. Various devices have been developed to accurately measure soil moisture status. Regular soil moisture monitoring picks up changes in moisture content of the soil and provides data on which to base irrigation scheduling decisions.

Planning the irrigation schedule

The irrigation season in Perth's climate stretches from September until May. It is only the winter months when irrigation scheduling is not a regular management activity. The irrigation season can be broken up into three major periods, which require different approaches to scheduling.

Spring shoulder period (September/October)
This period is normally mild with intermittent rainfall. This is a critical period for monitoring soil moisture, when the soil can dry out before the turf shows any obvious symptoms. It is important that the soil is not allowed to go into moisture deficit before summer, or it will be difficult to recover soil moisture levels over summer.

Dry summer period (November to March*)*
This period is normally hot with high evaporative conditions and minimal rainfall. Irrigation should at least replace daily turf water use and maintain sufficient soil moisture to avoid turf drought stress.

Autumn shoulder period (April/May)
This period is normally warm with intermittent rainfall. The turf water requirement is reduced and soil moisture monitoring should be used as a guide to reducing irrigation frequency. It is important not to over water and have the soil at 'full point' prior to winter rainfall.

Guidelines for planning a site-specific irrigation schedule

- Set water application targets. A practical method is to set a weekly target of water (mm) to apply. The target is based on the estimated turf water use for the week. Take into account the cumulative ET in the previous week, the amount of rainfall, and the weather forecast.
- Monitor the soil moisture status and turf condition and take these into account when setting watering targets.
- Calculate how much water (mm) is required per application by dividing the total weekly target by the number of applications per week. The frequency of application depends on the rate of water use and the soil moisture holding capacity (see table 1 below). As the rate of water use decreases in the shoulder periods, irrigation frequency can be reduced.
- Calculate the station run time required by dividing the amount of water (mm) per application into the average precipitation rate (mm/hr) of the irrigation system obtained in the irrigation audit.

Table 1 Average daily evaporation (mm) for the Perth area

Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
10.3	10.0	7.9	5.3	3.1	2.3	2.2	2.7	3.6	5.0	7.2	9.0