

IRRIGATION AUDITING –WHAT IS IT AND WHY IS IT NEEDED?

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The importance of sound irrigation design and management

A quality watering system is one of the critical ingredients for year-round high quality turf. Over the summer months in New Zealand, most of Southern Australia and, during the dry season, in sub-tropical regions, an irrigation system is required to hold a turf cover, to enable recovery after use, and to provide suitable conditions for players and spectators.

Applying water efficiently to turf is critical for a number of reasons, including:

- Reducing overall water use to ensure best use of a scarce resource
- Lowering costs of turf maintenance
- Optimising plant health and soil performance
- Reducing deep percolation water loss or runoff (and associated nutrients)
- Improving playing conditions (more uniform and consistent surface conditions)

Given the growing significance of water as a scarce resource on our planet, it is inevitable those using water in bulk will be required to demonstrate efficiency of utilization in order to retain a permit to apply the resource.

Identifying deficiencies with the watering system

Despite the investment in an irrigation system too often we encounter poorly designed or managed systems; application of water to turf seems to be a case of “out of sight out of mind”. A poor watering system may perform adequately for much of the year, and any deficiencies may not show up until a critical stress period is encountered. It would seem logical that effort should be made to ensure a watering system is designed and operated to a high standard.



Fig 1. Deficiencies with a watering system only become noticeable when the system is most needed.

An irrigation system audit is a means by which the efficiency of the watering system can be determined in advance of problems occurring. An irrigation system audit should involve a thorough analysis of how water is used within the system – both with above and below ground water application. The information derived from an audit will assist the owner/operator to identify if water is being used efficiently and if not what is needed to optimize the water resource and to minimize water wastage.

The auditing process

An irrigation system audit should cover:

- How the irrigation system design performs from an engineering viewpoint
- The soils/agronomy component, to ensure that efficient water entry into and storage within the soil
- How well the system is operated and maintained

The irrigation system audit involves a thorough site inspection to check out the overall performance of the system, covering both design and maintenance elements. The audit will not only help pinpoint problem areas, but more importantly will indicate what is needed to improve water use efficiency.

A starting point is to gather all available information about the watering system, including information on components, scheduling methods, the turf and soil system and climatic data. It is a decided advantage if as-built plans, aerial photos and records of modifications can be accessed.

The system audit involves checking out the system during operation, noting obvious problems, such as broken, misaligned, sunken, mis-matched or incorrectly positioned heads, and high or low pressure. Some of things to note include:

- Wet spots/areas close to sprinklers (may be related to a faulty check valve or other malfunction of the sprinkler)
- Pop-up risers that do not lift sufficiently above the surrounding ground or are obstructed by grass during operation

- Damaged or mis-aligned sprinkler heads
- Sprinkler arcs that fail to achieve full rotation (generally 360° although sprinklers located on the perimeter of the fields are likely to be set to 180° rotation)
- Sprinklers are perpendicular to the surface so that they are vertical to give a trajectory that is not impeded during operation

The audit will determine the uniformity of water application to the surface. This usually involves laying out a network of catch cans, measuring the volume captured in each can and using a standard equation to calculate the uniformity (DU). The higher the DU, the better the irrigation efficiency, with value in excess of 75% DU targeted for a standard sports field system.



Fig 2. Using catch cans to check the uniformity of watering

The investigation will check that the actual on-site installation, in particular sprinkler spacing/distance, match the design. This will include checking that sprinklers have matched precipitation in terms of sprinkler brand.

The pressure of each sprinkler in the test locations will be tested under normal operating conditions, generally using a standard Pitot gauge (Pressure readings should ideally be recorded at typical scheduling times (e.g. at night) to gain a true representation of the system's performance, although this is not always practical.



Fig 3. Measuring pressure at the nozzle using a pitot tube

System operation

Having a properly designed and installed system is only half the battle; it is equally important to ensure the system is correctly operated and maintained. The auditing process will check out whether there are accurate and robust systems in place for water use scheduling.

Irrigation scheduling is a combination of science and experience. The operator needs to have a sound basis for calculating the frequency and duration of watering. A basic soil water balance is a good starting point here, enabling the operator to get a ball park estimate of the scheduling requirement. Using a water balance approach will require routine collection of rainfall and evapotranspiration data, plus a knowledge of the soil water holding properties, irrigation system efficiency and specific crop factor information.

Soil moisture measuring devices, such as a theta probe, could then be used to fine tune the water balance process. Routine soil moisture monitoring (even if done by core sampling and visual observation) offers the additional benefit of checking on the uniformity of watering, enabling problems to be picked up before they start to show up in the turf.

Experience comes in to the equation when accounting for seasonal variation and recognizing the variation in watering needs of different areas (for example reduced water use in shaded areas; more frequent water requirement in shallow root zone areas).



Fig4. Use of a theta probe to measure soil water content

Consider what happens below ground

Having a watering system that applies water evenly to the surface and at the correct rate and frequency is still not the end of the story. What happens once water hits the soil surface also impacts on water use efficiency, and our auditing process must account for this. We need to ensure the soil is capable of accepting, storing and releasing applied water.

Points to look for here include:

- Identifying the water repellency (hydrophobicity) potential of the soil
- Recognising the potential for by-pass flow (where water moves directly via large cracks, worm channels or similar to the sub soil or the underlying drainage system)
- Rooting depth and distribution, in so far as it impacts on water storage and retrieval capability
- Soil water retention characteristics (soil type, organic matter etc). Without an understanding of the soil and its properties the system operator is flying blind

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Fig 5. Uniform water application doesn't assure good turf if there is a root zone problem such as hydrophobicity.

Summary

A watering system is a significant investment, both in terms of capital outlay and the on-going costs of water and maintenance. Given the investment it would seem logical that due regard be given to ensuring the irrigation system is properly designed and managed. Irrigation system auditing allows us to benchmark current performance of the system and, more importantly, identify what could be done to make best use of the water resource. A professionally conducted irrigation system audit will investigate not only the system hardware, but also how it is used and the impact of the soil reservoir on water use efficiency.