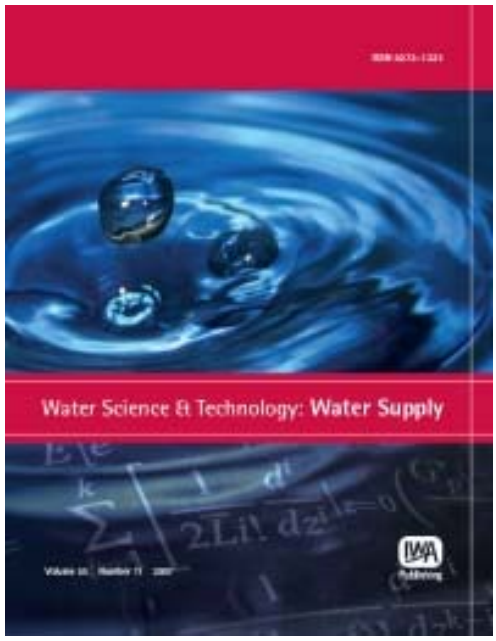

Soil solutions: improving water management across Sydney's public open spaces

Alisa Bryce and Andrew Porter

ABSTRACT

With the support and assistance of Sydney Water Corporation (SWC), URS Australia Pty Ltd (URS) have developed an Irrigation and Landscape Efficiency Assessment methodology (ILA) to improve the management of public open space across Sydney. To date over 180 ILAs have been conducted, with a number of key management issues identified. Excessive watering from poor irrigation scheduling practises, low soil water-holding capacity (from shallow or sandy textured soils); and inappropriate location of ornamental plantings are regularly encountered. This paper explores the key issues impacting water management across Sydney's public open spaces, and highlights methods available to rectify these issues and reduce potable water use into the future.

Key words | efficiency, irrigation, water consumption, water management

Alisa Bryce (corresponding author)
Andrew Porter
URS Australia P/L,
Sydney NSW,
Australia
E-mail: *alisa_bryce@URSCorp.com*

INTRODUCTION

The current drought and sundry climate change arguments have spurred the development of new and innovative ways to reduce potable water consumption. Sydney Water Corporation (SWC), located in Sydney, New South Wales, is one such water authority that requires measured reductions in per capita water consumption in response to operating licence conditions.

Mandatory water restrictions have been in place in Sydney since October 2003, increasing over the last 5 years from Level 1 to Level 3. These restrictions typically target outdoor water uses–irrigation of private and public open space, as well as, vehicle and/or boat washing and swimming pool top-up. Although water restrictions have assisted Sydney Water in reducing the per capita water consumption, there still exists a need to reduce water consumption further, and into the longer term, through more sustainable means.

Through the Sydney Water Every Drop Counts Business Program (EDC BP) URS have been investigating the efficiency of potable water application across irrigated urban open spaces, including parks, gardens, ovals and sporting fields.

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In order to identify potential water saving opportunities across these spaces, URS developed a methodology called the Irrigation and Landscape Assessments (ILA). The ILAs consider the actual landscape water demand and irrigation effectiveness of open spaces, and develops a series of recommendations on how to improve the efficient use of water at the site, whilst also maintaining plant health.

With assistance from SWC and the NSW Climate Change Fund, URS have completed over 180 assessments of public gardens, sporting fields, golf courses and parks across Sydney Water's area of operations.

RESEARCH DESIGN

The ILA methodology is based on detailed microclimatic modelling that calculates watering requirements using plant/soil water relationships. The adaptation of the methodology by URS allows the assessment to take into account a wide range of factors including (but not limited to):

- location within the six vegetation regions of Sydney;
- plant species;

- degree of foot traffic;
- soil texture, depth and structure;
- shade density and daily patterns;
- wind protection;
- site solar aspect and slope;
- proximity to a radiation source; and
- type and thickness of mulch used.

In addition to providing an understanding of the above factors relating to water use, the output from the ILA also provides park managers with a quantitative estimate of the potential water savings that could be achieved through:

- soil improvements; and/or
- alternative plantings; and/or
- management strategies (such as regular aeration/decompaction); and/or
- improving the performance of irrigation systems.

RESULTS

Figure 1 presents the six (6) main issues identified throughout the assessments. Compaction and lack of topsoil depth are most common, with 64% of sites experiencing compaction, and 56% having inadequate topsoil depth. Approximately 35% of the sites had a poor topsoil texture, 19% were subjected to tree competition/shading and water logging was observed at 16% of the sites, indicating poor drainage. Water repellence was observed at 14% of the sites.

Of these six issues, five can be attributed to or are dependent upon soil characteristics.

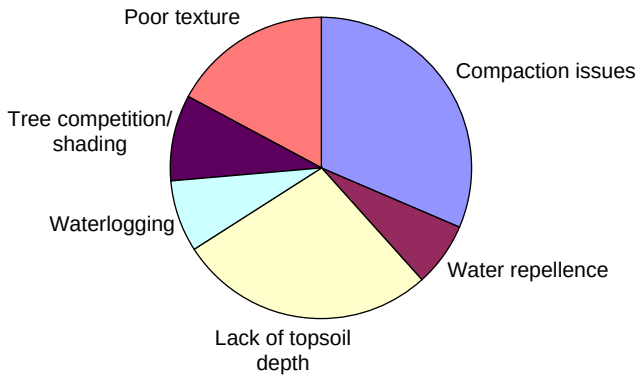

Figure 1 | Common issues observed across Sydney's public open space.

The soil

From the 180 sites assessed across the greater Sydney region, one recurring theme held strong – the soil itself is often the best water storage available at each site. Storing water in the soil for direct access by plant roots is often more beneficial than a large, rainfall dependent alternative water storage sited adjacent to the field. Accordingly, maximizing the storage potential of the soil is the primary goal of the ILA initiative.

Three soil physical characteristics, namely texture, structure and depth, define soil water holding capacity, and therefore the size of the 'soil water tank'.

Ascertaining the correct soil texture is, like most public open space management issues, highly dependent upon the historical construction methods of the site and the degree of foot traffic the site is subjected to. A very sandy profile (Figure 2) will not have the capacity to hold the water and nutrients required for turf growth without regular supplementary irrigation, whilst a heavy textured soil (clay profile) will readily compact.

'Layering' within a soil profile has the potential to reduce the size of the 'soil water tank' by impeding water filtration into the profile, and therefore the turf root zone. Management regimes involving topdressing with materials of differing texture is often the main culprit behind soil layering (Figure 3), particularly when imported turf is grown in a clay loam underlay.

Soil structure, though potentially intricately described through pedology, can be simply described as either

Figure 2 | A typical sand profile. Note the bare patches on the surface.

Figure 3 | Profile layering. Note the clay layers above a sandy profile.

'compacted' or 'not-compacted'. Essentially compaction is a sliding scale, with varying degrees and intensity, but for the purpose of public open space assessment, soil compaction is defined when it is having an adverse effect on turf or soil health.

Compaction decreases the porosity of the profile and thus the ability of the profile to hold water -reducing the potential size of the 'soil water tank'. A minimum of 10 percent porosity is required for plant root growth. In many cases throughout Sydney, compaction levels have been found to inhibit turf root growth, and reduce irrigation efficiency to plant root zones.

Adequate topsoil depth allows for greater root growth, leading to increased drought resistance in turf and plants. Although turf roots have been known to extend greater than 500 mm, allowing turf roots to grow between 250 and 300 mm is considered acceptable across Sydney. Adequate topsoil depth directly increases the storage capacity of the 'soil water tank', as well as providing a greater medium for nutrient storage.

The status of these three soil physical characteristics outlines not only what other underlying issues may be present, but their severity as well. Water repellence and water logging can often be prevented and ameliorated by maintaining/improving the structure of the profile. Root depth is a function of soil depth, whilst compaction itself is dependent upon soil texture and the degree of foot traffic. Each of the three soil physical characteristics is interrelated. Creating a soil profile with these three factors at their optimum is the aim of any well managed public open space–and is therefore considered Sydney Best Practice.

Level of use

Water is a necessity for all plant growth, however the amount required in public open space depends on (and is driven by) the dual standards of acceptance/expectations and use. First class coverage is expected of an elite sports field, whilst a lesser standard is accepted on a local field. With respect to use, elite sports fields are constantly in use, and often have the resources and budgets to sufficiently manage the wear and tear this causes. Interestingly, recent social trends have placed more pressure on outdoor activities, leading to an increase in the number of sporting clubs and matches. It is not uncommon for a local sports field to be in use every afternoon and evening for training (under lights), all weekend for matches and during week days by school groups. Typically these local fields do not have the budgets or resources for maintenance and repair that the elite surfaces have. Accordingly, Figures 4 and 5 show the clear contrast in turf quality between an elite and local sports turf.

For the purpose of the ILA methodology and modelling, assessed fields are placed into one of four categories–Elite, Premier, Local or Passive Recreation. These standards provide a basis for the degree and intensity of management practices undertaken on a field, and have a direct impact on watering requirement.

Figure 4 | Elite sports turf.

Figure 5 | Local sports turf.

Figure 6 | Inefficient water application.

It is important to note that a lush, green, rainfed passive recreation area in Sydney is possible under most climatic scenarios, provided the quality of the underlying soil profile is maintained, and appropriate management practices are implemented, regularly.

Distribution uniformity

Even if the watering requirement of a field is low, the uniformity and efficiency at which the water is applied is critical to achieving sustainable water savings.

An irrigation system will apply water but the question is, how evenly is it applied across the field? In a single irrigation event, one half of the field may receive double that of the other half. Ascertaining the application efficiency of an irrigation system is another focus of the ILA. Irrigation Australia (IA) require a Distribution Uniformity (DU) of 75% for outdoor irrigated spaces. This minimum performance standard has only been observed at one (1) site to date. The most common problems affecting the DU are poor system pressure, broken sprinkler heads and differing sprinkler heads/nozzles across the field.

Lack of head to head coverage is another common issue leading to inefficient water application and a stark difference in turf growth and quality. As evident in Figure 6, turf exposed to good water coverage is healthy and growing (green) whilst other turfed areas have gone into dormancy (white), on the same field. The pattern of irrigation is therefore easy to see.

Although a lack of maintenance will result in the gradual decline of a system, foot traffic on a field often results in broken/bent heads, whilst crucial maintenance regimes such as topdressing gradually bury the system, requiring it to be lifted every few years (Figure 7). Sunken sprinkler heads were a common feature of Sydney's sports fields.

The efficiency and DU at which an irrigation system applies water has a profound effect on the potable water used on a site. As an example, if a field requires 2 megalitres (ML) of water/year to remain healthy, but the irrigation system has an efficiency of around 40%, double the amount of water, or 4 ML will need to be applied before the required 2 ML has been distributed across of the field. This has significant time and cost implications for park managers.

Figure 7 | Sunken sprinkler head.

Simple methods such as ensuring the same sprinkler head is used across the site, maintaining system pressure at 400 kPa and replacing broken sprinkler heads will aid in increasing the efficiency of an irrigation system.

Communication through the BPG

The findings of the ILA are being used by Sydney Water to develop a series of Best Practice Guidelines for the management of sports fields across Sydney Water's area of operations.

These guidelines will outline the main issues encountered in public open space, present recommended management techniques as well as address the science behind healthy turf management across Sydney. The Guidelines will provide landscape managers with direction on how to increase their 'soil water tank', thereby minimising irrigation frequency whilst maintaining turf quality.

CONCLUSION

The URS Irrigation and Landscape Assessment methodology (ILA) has identified a number of common issues that affect landscape water use. The majority of these issues are soil based, the amelioration of which leads to an increase in the soil water holding capacity, or 'soil water tank'. The greater the 'soil water tank', the less supplementary irrigation is required to maintain healthy plants. Ultimately this leads to financial benefits, as well as potable water savings. Through the development of Best Practice Guidelines, SWC will provide managers with the information required to maximise their 'soil water tank', improve turf health and minimise annual water requirements, sustainably over the longer term.

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