WATER SMART PARKS

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Abstract
Climate change is a global challenge. Predicted induced reductions in rainfall and groundwater recharge of the Swan Coastal Plain mean that statutory water allocations currently available may be reduced. This paper illustrates one organisation's local solution to meet this challenge and to deliver sustainable water practices for the next generation.
Based on computer controlled irrigation evidence, the City of Stirling appears to be between 10-20% over its statutory groundwater licensing allocation. The City, in conjunction with the Department of Water, has determined that the annual target must not exceed 7,500 kilolitres/ha/yr. The challenge for the City of Stirling is to not only bring groundwater for irrigation within the licence allocation, but also to ensure that groundwater for irrigation purposes is balanced across all suburbs. This effectively means that some presently irrigated areas will need to be reduced to provide reticulation elsewhere.
To do this, the City has developed a Groundwater Conservation Strategy, better known as the 'Water Smart Park' strategy, in conjunction with a number of other strategies, which essentially consist of a range of hydro-zoning and eco-zoning management options. This is a local solution to optimise water use efficiency, and to match current and future use with groundwater allocations.
To achieve this target each of the hydro-zones will have different watering needs depending upon the eco-zone usage, resulting in an overall reduction in groundwater use. While all high use and active sporting grounds will be maintained as at present, residents may see their local park or reserve a little less green. We prefer to refer to this as the "olive-ing" of the parks. To preserve the amenity and aesthetic appeal of many of these areas, a number of the eco-zones will undergo extensive planting and landscaping, and depending upon the location, replanting with indigenous native plants.
Preliminary works have commenced on this innovative strategy to delineate eco-zones to ensure that the extensive range of parks and reserves continue to be available to residents and the next generation, but in an environmentally responsible manner.

Key Words: Water Smart Park strategy, climate change, groundwater recharge, public open space, hydro-zones, eco-zones, global challenge, local solution.

Introduction

The City of Stirling has developed the 'Water Smart Park' strategy to bring about savings in groundwater use in irrigated parkland and landscapes. As such, the City of Stirling has taken a strategic approach to groundwater conservation in accordance with the requirements of the Department of Water (DoW).
The Water Park Smart strategy is considered unique as it builds upon two other interrelated environmental initiatives in a cohesive manner. The three initiatives are elaborated as follows:
1) Water Smart Park strategy resulting from an identified need to conserve ground water use and reduce bore abstraction. The City of Stirling has developed a process of converting non-recreational areas of developed parkland into eco-zones consisting of heavily mulched areas with local native plantings of trees, shrubs and groundcover.
2) Urban Bushland Conservation Strategy (also known as the Green Plan). The City's successor, Green Plan 2, advocates the establishment of ecological links between local and regional remnant bushland. These links enable movements of birds, insects and small animals, and by this process, the transfer of plant genetic material to increase biodiversity. It is envisaged that the establishment of such links should occur between strategically located parkland and other reserves. Eco-zones and ecological links are therefore basically similar.
3) Million Tree initiative is the mechanism through which eco-zones for groundwater conservation and ecological links for

promoting biodiversity are being implemented. The City's 'Million Trees' initiative spans 10 years, with the aim to plant 100,000 trees annually.

The six key areas that the Water Smart Park strategy considers are:

1) The value of ground water.
2) Likely impacts of climate change.
3) The current status of irrigation in the City of Stirling's parks and reserves.
4) Planning for different scenarios.
5) The process of prioritisation; and,
6) Next steps/future directions.

The value of Groundwater

It has been estimated that all local authorities in Western Australia use approximately 26% of all groundwater abstracted compared to what is used by other institutions and domestic households. This represents a total of 40 gigalitres per year. Much of this is used for the watering of recreational parkland and sporting fields. The City of Stirling's current capital expenditure on irrigation management is approximately between $1.1M and $1.4M per annum. This consists of the installation of new bores and reticulation systems, plus programmed upgrading and maintenance of existing systems. However, this expenditure represents only 15% of the total annual expenditure on parks, suggesting that the expected flow-on effects from the investment in efficient irrigation infrastructure will be significant.

Likely Impacts from Climate Change

General scientific opinion predicts that by 2030 Western Australia will be hotter in the inland regions, and drier particularly in the southwest. This will be characterised by more extreme events with frequent droughts, heatwaves and fires, and conversely, more intense tropical storms with flooding more pronounced. Sea levels are predicted to rise by a range of 3 to 17 centimetres. For the Perth region this could mean reduced rainfall, reduced run-off and reduced recharge of groundwater aquifers, a noticeable trend pattern developing over the last 12 years. The obvious impact on management of recreational parkland would mean having to contend with increased moisture deficit in the soil profile and the need for increased irrigation to meet the resulting moisture deficit. Remnant natural areas and native bushland would be equally affected in terms of the gradual degradation of floristic abundance and diversity.

Other likely impacts that could accrue with reduced rainfall and the increased soil moisture deficit, include the oxidation of the upper soil profile thereby leading to the acidification of soils, particularly those with high sulphide mineral content, as well as the leaching of acids into groundwater systems, together with the release of iron and other heavy metals and toxic minerals such as arsenic.

If the reduced rainfall trend continues, Western Australia could face water restrictions similar to that already imposed in Queensland, Victoria, and South Australia. This will mean a scarcity of water for existing and new public open space especially under increased competition from the numerous private and other public bores all abstracting from the same aquifer.

The Current Status of Irrigation in our Parks and Reserves

The City of Stirling has 355 bores and associated infrastructure that represents a $32.5M irrigation asset. This system is designed to irrigate 740 hectares and to deliver a total output of 555,000 kilolitres per annum. All the City's bores are licensed and subject to quotas. The annual allocation target of 7,500 kilolitres/ha/yr is an average amount, and is subject to a review and may vary depending upon different turf surface requirements.

Nevertheless, our most recent records for groundwater abstraction (2006/2007) reveal that we have exceeded our annual allocation by approximately 10% to 20% depending on seasonal factors. This has resulted, in part, from having to over-water several older reserves to compensate poor coverage due to inefficiently designed irrigation systems, and from having to compensate for soil moisture deficit condition during an extremely dry year with above average temperatures. DoW, in conjunction with local authorities, is currently developing the requirements for Water Conservation Plans. The Water Smart Park strategy is one avenue through which this is being developed, and to ensure that the overall allocation is not breached they have advised that the new benchmark allocation will be 7,500 kilolitres/ha/yr. It is up

to each local authority to ensure that their usage is not in breach of the bore license conditions issued to it, otherwise permits could be revoked.

With regard to the management of its irrigation assets the City of Stirling has implemented a 25-year asset upgrading and replacement programme, which is based on industry standards. This is reviewed annually prior to budget submissions and adjusted depending on monitoring of the system's performance. All new systems are designed to Best Practice Standards (i.e. to provide 85% coefficient of uniformity in terms of sprinkler coverage and wetting pattern). Several reserves still operate with inefficiently designed systems and are waiting to be upgraded with successive budget programmes. Where appropriate, system components are designed for specific uses and all equipment selected such as sprinklers, valves etc, are the best available. The City's entire irrigation network is centrally controlled and regulated through its 'Computerised Irrigation Monitoring System' (CIMS). The system has the capacity to monitor watering programmes in all irrigated reserves and to assess systems performance in terms of flow volume and pressure at the pump source.

Many of the existing reserve based irrigation systems have been designed so that a concept of hydro-zoning can be implemented in conjunction with the process of eco-zoning. In addition, the City is nearing completion of a project, funded under the National Community Water Grant programme, for the refinement of a soil moisture monitoring system that could be directly linked into the CIMS unit.

Planning for Different Scenarios

In the development of the Water Smart Park strategy the following three scenarios were evaluated in terms of savings on water usage and annual operating costs.

Scenario 1 – represents a reserve previously operating on an inefficiently designed irrigation system but upgraded to provide an 85% coefficient of uniformity. It was estimated that with a simple upgrade a reduction in annual water usage by up to 13%, and a corresponding reduction in the annual operating cost could be realised.

Scenario 2 – follows on from the Scenario 1 reserve but with the introduction of hydro-zones around peripheral areas. These are the areas infrequently used for recreation and where turf quality can be sustained with a lower watering regime. It is estimated that with this treatment, a reduction in annual water usage by 19% could be achieved, with a corresponding reduction in annual operating costs could be realised in comparison to the original unimproved irrigated reserve.

Scenario 3 – follow on from the Scenario 1 reserve but in this instance with the introduction of hydro-zones and eco-zones. Eco-zones are portions within hydro-zones converted to native tree and shrub plantings. Such areas are eradicated of the original turf and heavily mulched thereby removing the necessity for irrigation. It was estimated that with this treatment a reduction of 42% in annual water usage and a reduction in the annual operating costs could be realised in comparison to the original unimproved irrigated reserve.

Implementation of these scenarios is also expected to deliver other beneficial outcomes, such as lower maintenance of the asset base, significant energy savings, and enhanced recreational amenity values.

The Process of Prioritisation

There are a number of developed reserves that lend themselves to the implementation of any one of the above scenarios, but this will need to be prioritised. It is envisaged that the City's formally adopted Public Open Space (POS) strategy and guiding principles of classification will determine which of the reserves are to be select for the Water Smart Park programme.

Some of the relevant criteria in the POS strategy include the type and use of sports ground/recreational parkland, the location of the reserve with regard to the coast/inland, the availability of water in terms of quantity/quality, and whether the reserves in the locality has exceeded its allocation (e.g. the Gwelup Scheme Water Borefield Zone). Furthermore, the type of turf species present and its resilience to wear under environmental stresses, the existence of remnant native vegetation from which eco-zones could be extended and other criteria significant to the classification of reserves

under the POS Strategy would need to be considered.

It is envisaged that the POS strategy and guiding principles classification would then enable a priority to be developed for the implementation of hydro-zones and eco-zones into high, medium and low priority classification reserves. Naturally, the high order reserves would then be targeted for the formulation of Water Conservation Plans and attendant implementation schedules, quantity surveys, production of designs, costing of intended works, funding allocation and completion timeframes. An essential practical element would be the establishment of performance measurements for an effective water allocation monitoring regime. It would be important at this stage to seek the endorsement of relevant statutory authorities such as the Department of Water, and the Department of Environment and Conservation (DEC), and other stakeholders such as the Western Australian Local Government Association (WALGA) as well as to gain general public support for the concept.

Next Steps/Future Directions

There are several steps involved in the future direction of this project. These steps include:

1) Develop a complete profile of the City and its reserves in terms of the following:
   - Hydrogeology – groundwater height above sea level and depth to groundwater.
   - Topography – elevation and drainage.
   - The type of facility e.g. sports ground/ recreational parkland.
   - The location of the reserve via coastal/ inland.
   - The availability of water in terms of quantity and quality.
   - Whether the area is already fully allocated e.g. in the Gwelup Scheme Water Borefield zone.
   - The type of turf species present and its resilience to wear under environmental stresses; and,
   - The existence of remnant native vegetation from which eco-zones could be extended.
2) Undertake a review to identify all reserves with potential for hydro-zoning and eco-zoning based on the information obtained above:
   - High priority – reserves where eco-zones are already present as 'pockets' of native bushland and where associated parkland could be easily hydro-zoned e.g. Earn Rannoch Tay, Richard Guelfi etc; reserves where groundwater use is well above licence allocations.
   - Medium priority – multi use reserves with a mix of active sports fields, passive parkland and natural areas and/or reserves where groundwater use is somewhat above licence allocations.
   - Low priority - where groundwater use is within licence allocations.
3) Develop Water Conservation Plans for 'Water Smart' Reserves outlined as follows:

   Concept design production:
   - Quantity surveys.
   - Production of designs.
   - Costing of intended works.
   - Budget allocation.
   - Implementation timeframes.

   Systems upgrading:
   - Upgrade irrigation in reserves that are operating with inefficient watering systems.

   Implement Hydro-zoning and rationalise watering allocation on the following basis:
   - Turf sports surfaces – suggested 11,000 kilolitres/ha/yr.
   - Informal recreational lawn areas suggested at 9,000 kilolitres/ha/yr.
   - Peripheral low-use lawn areas suggested at 4,000 kilolitres/ha/yr.

   Implement Eco-zoning:
   - Site survey and define eco-zones intended on 'Water Smart' reserves.
   - Undertake site preparation (removal of turf, soil renovation and weed eradication, followed by mulching).
   - Preference for seed collection, propagation and planting of local native and indigenous plants.
   - Consideration of the use of some exotic "water wise" plants where contextually appropriate.

   Implement a monitoring regime:

- Install and refine the operation of electronic soil moisture probes to determine the threshold between deficit levels and sustenance levels in ‘Water Smart’ reserves.
- Install and refine the operation of a ‘weather station’ to generate dependable data.
- Install and refine an effective irrigation control and regulation system based on automatic relay from the soil moisture probes and the ‘weather station’.
- Establish key performance measures to enable evaluation and identify improvement opportunities.
- Ensure additional resource allocation for monitoring.

4) Undertake research and technical reviews:
   To supplement past research in the Turf Irrigation and Nutrient Study (TINS) in which the City played a major role.
   To supplement turf research undertaken recently by the City in conjunction with the University of Western Australia.

Review and update the CIMS to:

- Enhance possibilities in the following:
- Use of wetting agents.
- Identification of new turf species.
- Improvement of turf species currently used.

5) Strategic Integration to enable:

Develop and review strategic plans such as Green Plan, POS Strategy, Local Area Planning and other plans addressing organised sports ensuring principles of the Groundwater Conservation Strategy are appropriately considered.

Develop and review implementation action plans to ensure actions are compatible and supportive across all strategies.

Ensure action plan timeframes are appropriately coordinated to address issues in a timely manner, and maximise the benefit to the City.

Review policy and practices for the design and development of POS.

6) Develop a Communication Plan:

Undertake internal and external stakeholder and wider general community consultation.

Actively promote the idea of 'Water Smart Parks' to seek general public acceptance including designating high profile reserves for the development of Water Conservation Plans ensuring reserves conform to the following criteria:

- Existence of an already updated and efficiently operating irrigation system.
- Effective irrigation monitoring and control systems already in place.
- Existence of eco-zone potential.
- Water regime complies with conditions of current bore license; and,
- The reserve conforms to all other criteria.

Seek the support of statutory authorities such as the Department of Water and the Western Australian Local Government Association and others.

Consider a regional catchment approach:

- Involve state government and determine what role they can play.
- Similarly involve other organisations and institutions with the view to establishing partnerships.
- Similarly involve the industrial/ commercial sector.
- Similarly involve the residential sector.

7) Endorsement:

Seek statutory authority endorsement from the Department of Water and Department of Environment and Conservation, for following the City's Groundwater Conservation strategy and Water Conservation Plans for 'Water Smart' reserves.

Conclusion

The City of Stirling has accomplished a significant amount since the implementation of the 'Groundwater Conservation Strategy' and the subsequent launch of the 'Water Smart Park' strategy, and in conjunction with the POS strategy will enable a more sustainable provision and development of public open space.

The City, as part of the roll-out, will designate particular reserves as 'Water Smart' reserves. This will enable the City to introduce the concept of hydro-zones and eco-zones to the public as part of the Water Smart Park reserves. In accordance with this, the City of Stirling has developed a communication strategy for the City-wide Water Conservation Plan and the Water Smart Park reserves.

Public knowledge, understanding and acceptance of changes, will be an essential element to the successful implementation of the water conservation strategies. These strategies, in conjunction with the POS strategy and the commencement of the Million Tree initiative, within a short timeframe will be a significant change for the community and essential if the City is to maintain its investment in parks and reserves infrastructure, and achieve a 10% reduction each year, and a uniform redistribution of its water allocation across the City.

In conclusion, the City of Stirling is poised to make significant progress in reducing the amount of water it consumes via the Groundwater Conservation Strategy. This is supported by the Urban Bushland Conservation Strategy and the Million Trees initiative that seeks to establish ecological links or eco-zones in non recreational areas where irrigation is being removed. The City of Stirling aims to provide leadership to the next generation through a local solution (Water Smart Parks) to a global challenge (Groundwater conservation strategy) to create a sustainable City.

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Author Biography:

Geoff Eves is the Director Infrastructure at the City of Stirling, the largest local authority in Western Australia, a position he has held for the past four years. He has over 30 years experience in local government, with qualifications in engineering, accountancy and administration, and is currently enrolled for his PhD at the Curtin University. Geoff sees his role as essentially one of providing leadership in strategic planning, finance and governance to a multi-disciplinary team covering the broad technical areas of engineering, parks and reserves, building and waste and fleet operations. The Water Smart Parks strategy is an exciting innovation being developed and implemented by the Manager Parks & Reserves – Sam Morrison.