South Africa: a water scarce country

water

South Africa can be proud of the strides achieved in the design and development sector, which enabled the country to successfully host the World Cup whilst minimising the associated demand for freshwater resource.

6.1 Introduction

SOUTH AFRICA IS CONSIDERED TO BE A WATER SCARCE COUNTRY and, if the current rate of water usage continues, demand is likely to exceed supply at some point in the not-too-distant future. The improvement of water conservation, water quality and water-use efficiency is a key national priority, when compared against a global rainfall average of 870 mm per year, the country only receives 450mm. This makes South Africa the world's 30th driest country. Some projections estimate that South Africa already exploits about 98% of its available water supply resources.

Johannesburg is likely to run short of water should a severe drought occur in the next 10 years, as water wastage has not been stemmed and new sources of supply are still 10 years away. The second phase of the Lesotho Highlands Water Project is expected to come online by 2020 – and will supply Gauteng with water. According to experts, however, South Africa's two major river systems – the Vaal and the Umgeni – are already in deficit. These two river systems supply water to regions that generate two-thirds of the country's gross national product.

Should South Africa experience another extended drought period, water shortages will become acute and could result in extreme measures, including water rationing. With all eyes firmly on South Africa, the 2010 FIFA World Cup™ was the perfect time to give water conservation the attention it required and go the necessary distance to protecting this "liquid gold".

Taking note of this, all Host Cities identified the protection of this crucial resource during the 2010 FIFA World Cup™ as an important aspect of the National Greening Strategy. The Green Goal national targets for 2010 also stipulated a 10% saving in use of potable water (LOC, 2008a) via the directives listed below (DEAT, 2008a):

- Minimise consumption of water (improve conservation of water)
- Maximise rainwater capture and grey-water recycling
- Protect wetlands
- Minimise pollution of water resources.

SOUTH AFRICA'S TAP WATER IS OF EXCELLENT QUALITY, REMOVING THE NEED TO BUY BOTTLED WATER IN ALMOST ALL PARTS OF THE COUNTRY

Hosting this global mega-event provided several key opportunities for South Africa. Firstly, it challenged all planners and builders of the stadiums and other key infrastructure to showcase their ability to improve designs. Innovation was key in order for stadiums to meet the consumption required by the event, whilst not placing additional stress on existing systems. Taking advantage of opportunities to conserve natural water resources such as wetlands, rivers, streams and estuaries was encouraged. In many of the cases this took the form of rehabilitation programmes to offset the impacts of development associated with the event. Lastly, proactive actions would allow for the continued provision of potable water to both residents and visitors. Luckily, South Africa's tap water is of excellent quality, removing the need to buy bottled water in almost all parts of the country.

6.2 Actions taken

THE INFLUX OF PEOPLE TO CITIES HOSTING LARGE SPORTING EVENTS naturally places extra demands on water supply. In the absence of significant sources of rainwater or recycled water, drinking water ends up being used for non-potable purposes, such as the irrigation of pitches and stadium surrounds. The Green Goal and National Greening strategies therefore sought to put systems in place that would ensure the minimal use of potable water and increase the use of grey (recycled) water wherever possible.

In general, the objectives for water conservation were achieved through the promotion of:

- Water recycling (rain water harvesting and grey water use)
- Controlled/alternative irrigation methods and pitch management
- Installation of water efficient fixtures (e.g. low flow taps and dual flush systems)
- Construction of surfaces with permeable materials (stormwater control)

Natural resources create new opportunities for people. A job can bring a positive change into the lives of the unemployed and the poor. (Source: Working for Wetlands)

WORKING FOR WETLANDS

Wetlands play a vital role in human health and wellbeing, yet out of the 114,000 that have been mapped all over the country, many are either damaged or destroyed due to human impact. In 2000, the pressing need to intervene and rehabilitate these spaces nationwide led to the launch of the Working for Wetlands Programme. In 2009 alone, Working for Wetlands rehabilitated 95 wetlands in all nine provinces and in the process created employment for more than 1,500 people and made use of 250 small businesses. The programme is implemented by the South African National Biodiversity Institute (SANBI) on behalf of the departments of Environmental Affairs (DEA); Agriculture, Forestry and Fisheries (DAFF) and Water Affairs (DWA). It forms part of the government's Expanded Public Works Programme, which seeks to draw unemployed people into the productive sector of the economy.

- General and site-specific conservation programmes (to minimise water pollution and protect wetlands)
- Public awareness campaigns (discouraging wasteful use of water and promoting of the safety of drinking tap water).

6.2.1 General and site-specific stormwater management and wetland restoration programmes

Wetlands are key natural assets that provide critical ecological service functions, and therefore require protection. These fascinating and dynamic ecosystems provide us with a range of benefits, including flood attenuation and groundwater re-charge and cleansing. By acting as a natural filtration system for pollutants, wetlands are nature's way of providing us with safe water. Wetlands also support a wide range of biodiversity, enhance tourism, provide grazing for livestock and are a source of building and craft materials – if managed sustainably.

Legacy efforts of the 2010 FIFA World Cup™ regarding wetland restoration are discussed in greater detail in the biodiversity chapter. Key wetland maintenance and rehabilitation programmes include the rehabilitation of the Bergvlam Stream in the Mbombela Local Municipality (i.e. Nelspruit) in Mpumalanga Province, the Princess Magogo Stormwater Management Plan and Wetland Rehabilitation project in Durban, and the use of wetland for stormwater management at Royal Bafokeng Stadium in Rustenburg.

USE OF WETLAND FOR STORMWATER CONTROL AT THE ROYAL BAFOKENG STADIUM, RUSTENBURG

The Host City of Rustenburg recognised the important role that wetlands can play in flood attenuation and filtering pollutants. Stormwater from the Royal Bafokeng Stadium infiltrates the soil through many permeable surfaces in the landscape and is also directed to an adjacent wetland where it is filtered before reaching a nearby

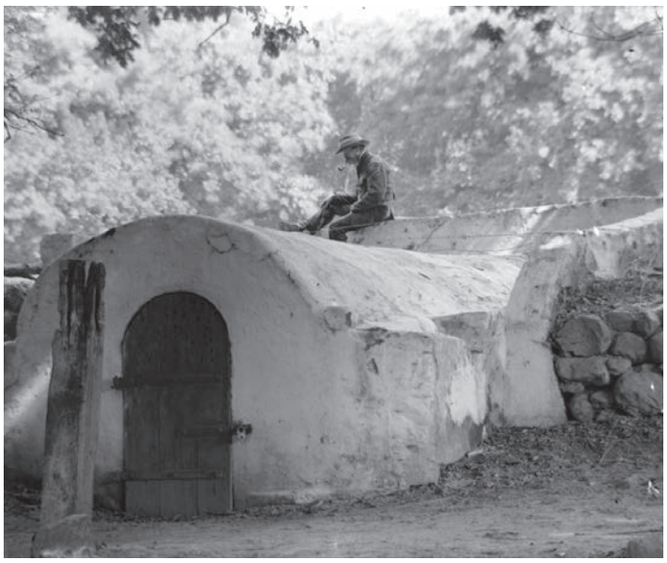
stream. The wetland thereby acts as a natural sponge to prevent flooding and erosion by absorbing floodwater and sending it slowly to the streams with wetland plants functioning to filter out pollutants, such as nitrogen and phosphorous.

6.2.2 Alternative irrigation methods

CAPE TOWN: RECLAIMING THE SWEET WATERS

Cape Town's 2010 Project Team was confronted with a massive challenge. Their mission was to create a multi-purpose stadium in an urban park context that would ensure post-event benefits for the public. This included setting aside 105 hectares of the Green Point Common, incorporating the Stadium, Green Point Park, golf course, beach front promenade, playing fields and athletics track.

One complication with such a proposal was to find a sustainable irrigation technique to water the 64 hectares of landscaped grassland, not to mention the irrigation of the football pitch itself. Historically, potable water has been used for irrigation of the Common– which from a water consumption perspective, is unacceptable in the long term. In the end, an alternative and sustainable solution to this problem turned out to be closer than many had originally thought.



From an historical aspect, the use of these springs was formalised in 1682 and a chamber to protect the Main Spring, the Stadtsfontein, was built in 1813. The repair of these chambers will assist in the promotion of civic hydrology - international examples of this resurfacing of original watercourses within the urban fabric of cities include Rome, Chengdu in China and Bellevue in USA.

The lush slopes of Table Mountain are home to the artesian Oranjezicht Springs – a water source used to sustain the Cape colonial community some centuries ago, but completely unutilised in the present day. In fact, it was these springs that facilitated the establishment of Cape Town as a refreshment station on the shipping route in 1652, and their nourishment of the Table Bay basin earned them the moniker Camissa, meaning 'the place of the sweet waters' in the indigenous Khoisan tongue. In the early 1990s the compromised potability of the spring water led to a decision by the City of Cape Town to divert the water away from domestic consumption and into the sea. The water from these springs has thus been flowing, unused, into the sea via a series of underground pipes. The Cape Town Municipality decided to investigate the viability of the springs as the answer to the Green Point Common irrigation problem.

Other alternatives such as desalination plants, borehole water, grey water treatment and even the continued use of potable water were scrutinised. The comparison of yields, costs and secondary benefits related to the different options showed that making use of water from the Oranjezicht Springs is financially attractive (costing a third of the continued use of potable water), sustainable and will meet the objectives of providing irrigation water to the Green Point Common. The Springs were found to be able to supply a year round flow in excess of 40 l/s, thus far exceeding the combined annual 600 kl irrigation needs of the Common, the Stadium, the Metropolitan Golf Course and the Mouille Point Beachfront. This initiative was fully supported by the Oranjezicht Heritage Society as contributing to the heritage fabric and tourism potential of Cape Town.

The Green Point Park project presents an opportunity to re-introduce the public to the Common – previously it was not openly accessible to the broader public and focused exclusively on sports-related use. The 12,5 hectare area within the Common, will serve as a public space for recreation and social interaction in a peaceful, green context. Water from the historic artesian springs will be introduced into the park in ways that create gathering spaces where people can see, hear, touch and be educated about the water. Channels and spillways will feed into low-lying ponds, which in turn will feed into a biodiversity garden and a wetlands garden demonstrating a strong focus on ecological awareness, sustainable practices and environmental interdependence.

The project was not ready in time for the World Cup itself. However, at the time of writing this report, the project was making good progress, most recently with a 5.1 km stretch of pipeline being completed. The project is being developed in two phases at a total cost of R24.1 million and has been funded by the City's Water and Sanitation Department (contributing R17.7 million), with the remainder coming out of the City's 2010 World Cup budget.

NELSON MANDELA STADIUM

The Nelson Mandela Bay Municipality explored a number of unusual avenues in the hunt for viable irrigation options for the Nelson Mandela Stadium. This turned out to be a somewhat circular journey.

Unfortunately, the collection of rainwater from the roof of the stadium was no feasible, as incorporation of this concept into stadium design was considered too late in the day. The next proposal was to make use of water from the North End Lake, which is located adjacent the Nelson Mandela Stadium. Given its proximity to the stadium it could potentially provide a convenient and reliable source of water for irrigation purposes in and around the arena.

However, problems were encountered when it was discovered that due to the historic management of the lake, the water contained significant levels of salt, rendering it unsuitable for irrigation. One proposed way around this problem was to use the water treatment method known as reverse osmosis, for salt extraction. However this technology is expensive, and was initially dismissed as a viable option. Later on, however, following water shortages and subsequent escalation of the price of water, the cost of treating the lake water became justifiable. The project has now been divided into 2 phases. Phase I, which involved the construction of a filtration and disinfection plant, has been completed. Phase 2 is set to continue once necessary funds have been secured.

A second project involving alternative irrigation methods was initiated in Nelson Mandela Bay at the Gelvandale training venue. The project channels the return of stormwater runoff from the pitch and athletics track into holding tanks for re-use to irrigate the pitch. This is projected to achieve a pitch water demand saving of 35%.

6.2.3 Public awareness campaigns

Raising awareness on water efficiency to promote behavioral change was another National Greening objective.

CITY OF DURBAN

The Greening Durban 2010 Programme, led by the eThekwini Municipality's Environmental Planning and Climate Protection Department, prepared a series of guidelines aimed at ensuring the 2010 FIFA Soccer World Cup™ was hosted in an environmentally sustainable manner, and that a positive, long term environmental legacy is achieved. The series includes a Water Conservation Guideline providing information to consumers on how to save water by implementing a water use efficiency programme on residential, commercial and institutional properties (Greening Durban 2010, 2009).

NELSON MANDELA BAY

The Water Wise Campaign initiated by the Nelson Mandela Bay Municipality was targeted at a public use level. The roll out aimed to use the Municipality's existing media sources to inform public on the conservation and management of potable water. Road shows also featured as part of the campaign.

'BLUE DROP' STATUS

In an attempt to increase the use of tap water for drinking purposes, the South African Department of Water Affairs introduced a new water standard termed the 'Blue Drop' status. The 'Blue Drop' indicates to users that the tap water conforms to international tap water standards, and can be safely consumed. Municipalities can request for their water quality to be tested in order to apply for 'Blue Drop' status.

In Cape Town, free tap water stations were installed in the FIFA Fan Fest and along the Fan Walk, as well as in many public parks and gardens.

FIGURE 7. WATER CONSUMPTION AT ELLIS PARK. SOURCE: STADIUM BASELINE REPORT FOR GREEN GOAL 2010 (GREEN GOAL OFFICIAL INITIATIVE, 2008)

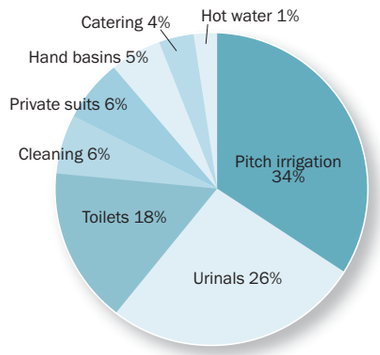
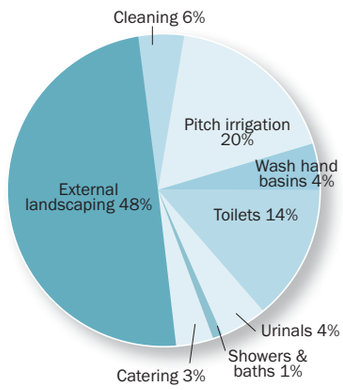


FIGURE 8. WATER CONSUMPTION AT CAPE TOWN STADIUM (WSP GREENBYDESIGN ET AL, 2010



CITY OF CAPE TOWN

The City of Cape Town launched the Drink Tap Water Campaign in order to promote the use of tap water and cut the amount of plastic waste generated during the 2010 FIFA World Cup™ from the unnecessary use of bottled water.

FIGURE 6. WATER LEGACY PROJECTS IN SUMMARY

GENERAL AND SITE-SPECIFIC CONSERVATION PROGRAMMES
Mbombela: Bergvlam Stream Rehabilitation
Durban: Wetland Rehabilitation at Princess Magogo Training Venue

USE OF NATURAL SYSTEMS IN STORMWATER CONTROL
Durban: Princess Magogo Stadium Wetland
Rustenburg: Royal Bafokeng Wetland

ALTERNATIVE IRRIGATION METHODS
Cape Town – Oranjezicht Springs: Cape Town Stadium
Nelson Mandela Bay – North Lake: Nelson Mandela Bay Stadium
Stormwater Return System: Gelvandale Training Venue

WATER AWARENESS CAMPAIGNS
Nelson Mandela Bay: "Water Wise"
Durban: "Water Conservation Guideline"
Cape Town: "Drink Tap Water Campaign"

6.2.4 Stadium designs for water efficiency

The new and existing world cup stadiums were the perfect arenas for the implementation of new and innovative technologies for all environmental aspects, not least, for water conservation. To this end, a baseline study was carried out between May and July 2008 on selected stadiums to enable the compilation of Green Goal national targets for the 2010 FIFA World Cup™.

Prior to the 2010 FIFA World Cup™ none of the stadiums included in the baseline study had water conservation plans and almost none had water management systems in place. The only evidence of a water management system was the rainwater harvesting system found at Ellis Park Stadium.

The findings showed that the majority of water usage in stadiums was attributed to irrigating the playing fields (34%), with the next largest contribution coming from toilets (18%) and urinals (26%) (Figure 7).

Water usage at stadiums is dependent mainly on the type of water fixtures and operational procedures employed at the stadium, which therefore became the focus for water efficiency interventions. For example, cleaning methods varied between the stadiums, but often used high pressure water, contributing significantly to water consumption.

In order for South African host cities to meet the Green Goal target of a 25% reduction of water usage within the stadiums (LOC, 2008b), focus areas for improvement included:

- The construction or retrofitting of venues with water efficient fittings
- Systems for the use of harvested rainwater
- Sustainable landscaping and irrigation practices.

Sports facilities often have large surface areas where rainwater can be harvested (parking areas, stadium roofs and playing fields) for use on site for irrigation, venue cleaning, and toilet flushing. Many new technologies have been developed recently for the storage of water below ground and even under paving or sports fields.

CAPE TOWN STADIUM

According to the Greening Stadia Sustainability Evaluation report conducted for the Cape Town Stadium (WSP GreenByDesign *et al*, 2010) the most significant water

Water collection piping on ceiling of Cape Town Stadium. (Source: CoCT)

consumers of this 68,000[2] spectator stadium were identified as: the landscaped park (58%), the pitch (16%) and sanitary fittings (14%) (Figure 8). Taking into account the water saving measures specified by the designers of the stadium, a 61% saving on annual water consumption would be achieved. Annual consumption would be 25,067m^3 compared to 64,299 m^3 per annum of the baseline scenario – saving enough water to fill almost 26 olympic size swimming pools each year. Due to scheduling and cost constraints, many of these measures were not implemented for the World Cup. The measures that have been implemented, or are in the process of being implemented, are listed in Table 13.

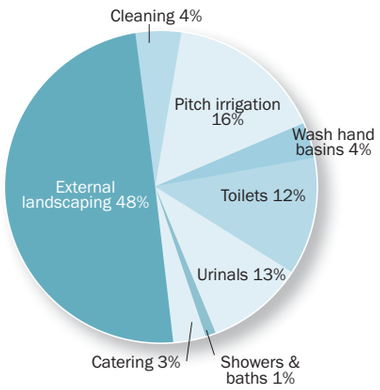
If a hybrid pitch had been specified and added, significant additional water savings could have been achieved – annual savings would increase from 61% to 69%. To

TABLE 13. SUSTAINABILITY ANALYSIS FINDINGS AT CAPE TOWN STADIUM (WSP GREEN BY DESIGN ***ET AL***, 2010)

Category	Intervention	Potential Savings	Achieved
Cutting edge	Alternative source of water for irrigation	Full 600 kl irrigation needs	✔
	Hybrid Pitch	8% reduction in water consumption	✘
Best practice	Dual flush toilets for VIP facilities	5.5% reduction in potable water consumption (R 53,160/annum saving)	✔
	Low Flow shower heads	1% reduction of potable water consumption (R 6,000/annum saving)	✔
Good practice	Metering valves and tap aerators	3% reduction in potable water consumption (R 20,500/annum saving)	✔
	Water wise indigenous landscaping	20% less water required (R 187,725/annum saving)	✔
	Dust control by "recycled" water	No figure – compliant with City of Cape Town by-law	✔

2 Although the Stadium seated 68,000 for World Cup purposes, the capacity has since been reduced to 55,000 seats.

FIGURE 9. MOSES MABHIDA WATER CONSUMPTION (WSP GREENBYDESIGN *ET AL*, 2010)



ensure compliance with FIFA pitch standards. This measure may be implemented in the future.

In line with the Green Goal objective to reduce the use of potable water by 10%, water from the Oranjezicht Springs will be captured and used for ablutions and irrigation thereby replacing the use of potable water. In cost terms, the initiative is expected to lead to significant savings to the stadium management – but also result in huge environmental benefit over time. Tanks for rain collection (i.e. rooftop) have been built into the design of the Cape Town Stadium and are to be installed at a later stage when funds are available.

MOSES MABHIDA STADIUM

According to the Greening Stadia Sustainability Evaluation report conducted for the Moses Mabhida Stadium (WSP GreenByDesign et al, 2010), the most significant water consumers of this 70,000 spectator stadium were identified as: the landscaped park (53%), the pitch (18%) and sanitary fittings (17%) (Figure 9). This baseline scenario would equate to 59,112m^3 /year. However taking into account the water saving measures specified by designers, a 70% saving on annual consumption would be achieved. Annual consumption would be 17 717m^3/year – this water saving equates to 7 olympic-size swimming pools per year.

The management of the Moses Mabhida Stadium faced a number of region-specific challenges. Firstly, the event was held during Durban's dry season. Therefore, the municipal line was used as a secondary water source during match days. All retail and restaurant basins are metered separately, predominantly for cost/charging purposes. It was reported by the stadium manager that a 74% reduction in its water footprint was achieved. This saving can be attributed mainly to the use of an intelligent pitch-irrigation system, tap aerators and low flow showers, water-efficient toilets

The Moses Mabhida Stadium, Durban.

TABLE 14. SUSTAINABILITY ANALYSIS FINDINGS AT MOSES MABHIDA STADIUM (WSP GREEN BY DESIGN *ET AL*, 2010)

Category	Intervention	Potential Savings	Achieved
Cutting edge	Intelligent irrigation system	30% reduction in demand for irrigation water	✔
	Rainwater harvesting	Rainfall tank of 700 m3 results in the potential annual saving on potable water consumption costs of R 2.5 million	✔
	Hybrid soccer pitch	Not calculated but perceived as significant	✘
Best practice	Metering valves and aerators for wash-hand basins	Saving of R 22 350 per annum in potable water costs	✔
	Dual flush toilets for VIP facilities	Not calculated but perceived as minimal	✔
	Low flush toilets for public facilities	2.6% reduction on potable water consumptions	✔
	Low Flow shower heads	0.1% reduction in potable water consumption	✔
	Water wise indigenous landscaping	20% less water required	✔
Good practice	Individual bath tubs	0.2% less potable water consumed	✔

and urinals (including low flush and dual flush toilets), and rain- and pitch-water harvesting to enable use of non-potable water for irrigation of the water wise external landscape. Dual-flush toilets were installed only in VIP facilities as the capital cost compared to future savings still needs to be to be explored. Finally, a hybrid pitch was not installed as this would depend on the future frequency of the use of the pitch and in which season matches would predominantly take place. Should the pitch become multipurpose the intention is to move to hybrid. Table 14 presents a summary of interventions that were implemented.

SOCCER CITY

A target of utilising 25% recycled water for irrigation was adopted by this stadium. Harvesting of rain water involved a moat being covered and converted into a water reservoir to collect rain water for irrigation use and for ablution purposes. The pitch uses 100,000 litres per day, of which approximately 80% is recycled water. The toilet flushing system is controlled by a BMS and can be adjusted to flush at different frequencies at different times. This can be totally switched off on non-match days, adjusted to low frequency during the match and high frequency at half time.

NELSON MANDELA BAY STADIUM

Unfortunately, many opportunities were lost in terms of water efficiency at this stadium, as environmental aspects were not considered sufficiently during the planning and design stages. However, a less water-intensive stadium has been achieved through the following interventions: the toilets throughout the stadium have been fitted with dual-flush systems, while all the urinals have been fitted with motion detectors in order to prevent wastage of water. These measures are in line with the Green Goal objectives for conservation of potable water. In addition, impressive water savings will be realised on completion of the North End Lake Augmentation System (described earlier) which will supply an alternative source of water for irrigation purposes.

MBOMBELA STADIUM

The Mbombela Stadium (Nelspruit) achieved commendable results in water conservation and management through water harvesting and treatment. Rainwater from the roof area is piped through a separate system to a retention pond that can hold 30,000m^3 of rainwater from the roof and will attenuate a further 24,000m^3 of storm-water flow from hard surfaces in the stadium. Water runs through a separate open channel system to an artificial reedbed to filter the retention pond water for irrigation of the 17 hectares of landscaped area on the stadium site – much of which will be indigenous landscaping. The pond will also improve water quality and provide a community lifestyle improvement asset.

THE MBOMBELA STADIUM (NELSPRUIT) ACHIEVED COMMENDABLE RESULTS IN WATER CONSERVATION AND MANAGEMENT THROUGH **WATER HARVESTING AND TREATMENT**

At Soccer City, the pitch uses 100,000 litres per day, of which approximately 80% is recycled water.

IF A HYBRID PITCH WERE TO BE INSTALLED IN FUTURE, **THE REQUIREMENT FOR IRRIGATION WOULD BE AT LEAST 40% LOWER** THAN IN THE CASE OF A COMPLETELY NATURAL PITCH

ROYAL BAFOKENG STADIUM

Extensive efforts were made in Rustenburg to minimise environmental impacts resulting from the expansion of the Royal Bafokeng stadium to host key FIFA Confederation and World Cup games. Assisting the creation of a balanced performance in terms of sustainability criteria was the fact that initial designs of the stadium did take into consideration water and energy-efficiency. The following are listed by WSP GreenByDesign *et al* (2010) as the key water interventions implemented:

- Stormwater is directed to an adjacent wetland where it is filtered before reaching a nearby stream
- Dual-flush cisterns, waterless urinals, low-flow shower heads and metered taps are fitted throughout
- Stormwater infiltrates the soil through the many permeable surfaces in the landscape
- Indigenous planting (100%) with low water requirements.

PETER MOKABA STADIUM

Polokwane has suffered water restrictions over the past six years and was forced to reduce water consumption by 30% prior to the 2010 FIFA World Cup™. The municipality worked hard to bring its vision of a multifunctional, environmentally friendly stadium to fruition through the efficient use of energy and water. Efficient use of the earth's resources also played an important part of the stadium design. The concrete mix for example, contains 30% recycled water in the form of fly-ash. During construction, and with operation of the stadium in mind, the following water efficiency initiatives were included in the design (WSP GreenByDesign *et al*, 2010):

- Rainwater harvested off the pitch, stored in a 50m^3 underground tank and reused for irrigation purposes
- Stormwater harvested, stored in a retention pond and reused for irrigation purposes
- Water-efficient fittings (low-flush cisterns, low flush toilets)
- Automatic pitch and landscape irrigation linked to a rain sensor
- Permeable surfaces in landscaped areas
- Indigenous planting (96%) with low water requirements
- Shredded coconut husks mixed into the pitch's growing medium to reduce the need for irrigation.

ATHLONE STADIUM

The refurbishment of the Athlone Stadium in Cape Town commenced in 2008, earmarked to function as a training venue or fan park. As the stadium was existing and construction of the new stands was progressing rapidly at the time of the sustainabil-

ity review, it was too late to implement major interventions such as rainwater harvesting, re-use of greywater, permeable paving or more efficient sanitary fixtures. Positive water-saving features initially incorporated in the design included (WSP GreenBy-Design *et al*, 2010):

- Dual-flush toilets in VIP facilities
- Most hand-wash basins in public facilities supplied with cold water only
- Only the pitch is irrigated and no additional landscaping introduced, and stadium design allows for the future installation of water meters without having to redo the plumbing.

In the case of Athlone Stadium, pitch irrigation accounts for 45% of total water. If a hybrid pitch were to be installed in future, the requirement for irrigation would be at least 40% lower than in the case of a completely natural pitch (WSP GreenByDesign *et al*, 2010). Although the capital costs to install this type of pitch would be high, the potential savings in water consumption and maintenance would be significant. Over and above the high initial costs, another reason for the artificial turf not being installed prior to the 2010 FIFA World Cup™ is the need for compliance with the standardised natural pitch specified by FIFA for the tournament.

GREENING OF DURBAN TRAINING VENUES

In July 2008 the eThekwini Environmental Planning and Climate Protection Departments (EPCPD) commissioned a study to identify generic designs, strategies and technological interventions and retrofits in the upgrading of the three existing stadiums to be used as training venues. These were Sugar Ray Xulu in Cleremont; King Zwelithini in Umlazi; and Princess Magogo in KwaMashu. One of the purposes of the study was to minimise the impact on already scarce water resources and for recommendations to be made on possible greening interventions that could be achieved within a reasonable budgetary framework; and for funding to be sourced externally. Whilst it was understood that other potential interventions were not to be overlooked, (e.g. climate neutrality, embodied energy of construction materials, waste and biodiversity), energy and water efficiency strategies were most closely scrutinised. Analysis revealed that many greening interventions were already incorporated into the upgrades – particularly those where difference in cost between "green" products and technologies and "business-as-usual" is marginal. Spreadsheets for each stadium were provided recommending interventions. Based on their cost-to-'green' benefit ratio, interventions were rated on a scale, in order for the EPCPD to readily assess their efficacy and where appropriate recommend that funding be made available. These initiatives are summarised in Table 15.

TABLE 15. WATER EFFICIENCY-INTERVENTIONS THAT WERE IMPLEMENTED AT THE THREE TRAINING VENUES (ETHEKWINI EPCPD, 2010)

Intervention	King Zwelithini	Princess Magogo	Sugar Ray
Rainwater harvesting		✔	
Flow-resistant valves in hand basins	✔	✔	✔
Intelligent pitch irrigation	✔	✔	✔
Hi tech pitch		✔	✔
Dual-flush toilets			✔
Tap aerators	✔	✔	✔

The Princess Magogo Stadium received 43% of the total funding from eThekwini Municipality and DANIDA. A total of R 470,000 was spent on the hi-tech pitch and intelligent pitch irrigation (eThekwini EPCPD, 2010). While the pitch will serve as a large collector of rainwater, embedded sensors control the level of irrigation and, with the drainage system linked back to a pump, the stadium is able to reclaim between 50-60% of the water used (Choromanski Architects, 2010). In this way the dissolved nutrients are also recycled.

The DEA-commissioned "Guidelines for the Greening of Large Sports Events with a Focus on the FIFA World Cup" in 2008 (DEA, 2008b) outlined interventions that could be implemented and facilitated as strategies to minimise water usage, protect water resources, and more broadly, to raise awareness to promote behavioral change. Table 16 summarises which stadiums initiated interventions to reduce water usage and protect adjacent water resources.

TABLE 16. SUMMARY OF STADIUM WATER GREENING INITIATIVES

Strategy	Action	Purpose/Description	Realisation at match venues	Realisation at training venues
Minimisation of water usage	Water management plan	Building management systems	Cape Town, Moses Mabhida, Soccer City, Mbombela	
	Water Audits	To identify water uses, consumption levels and areas for improvement	Cape Town, Moses Mabhida, Peter Mokaba, Royal Bafokeng	Loftus, Newlands, Vodacom and Ellis Park, Athlone
	Design or retrofit venues to maximise water efficiency	Installation of water efficiency equipment (eg. low- and dual-flush toilets, low flow shower head, tap aerators and spray taps)	Moses Mabhida, Soccer City, Cape Town, Nelson Mandela Bay, Royal Bafokeng, Peter Mokaba	Athlone, Philippi (Cape Town), King Zwelithini, Princess Magogo, Sugar Ray Xulu
		Harvesting of rainwater (stadia roofs provide large areas and store water in above/below tanks) and use for irrigation or toilet flushing	Soccer City, Moses Mabhida, Peter Mokaba, Mbombela	Ellis Park, Princess Magogo, Olympia Park (Rustenburg)
		Ecological sanitation systems on site e.g. biological/reed bed filtration of sewerage, with water produced for irrigation	Mbombela	
		Installation of drip irrigation for landscaping and/or moisture sensor irrigation system	Cape Town, Moses Mabhida	
		Selection of indigenous/drought tolerant plants for gardens and landscaping	Cape Town, Moses Mabhida, Royal Bafokeng, Peter Mokaba, Mbombela	Princess Magogo
		Use of non-potable water for irrigation (non-potable wells, municipal treated water and recycled grey water)	Cape Town, Nelson Mandela Bay	Gelvandale
		Intelligent pitch irrigation system to minimise water consumption	Moses Mabhida, Peter Mokaba	Princess Magogo, Sugar Ray Xulu, King Zwelithini
		Monitor and maintain water systems to avoid losses through leakage, and install sub-meters to enhance identification	Cape Town, Soccer City, Mbombela, Moses Mabhida	
Protection of water resources	Promote conservation of wetlands or estuaries near event	Work with local conservation organisations	Princess Magogo, Mbombela	
	Use porous or permeable paving	To allow stormwater infiltration, groundwater recharge and on-site storage of water	Royal Bafokeng, Peter Mokaba	
	Divert Rainwater	Into ponds or rivers or build retention dams/"ponds" on site	Royal Bafokeng, Peter Mokaba	Princess Magogo

Deborah Robertson, First princess Miss Earth South Africa helps with the rehabilitaion of Bergvlam Stream.

6.3 Outcomes

6.3.1 Broad targets, challenges and benefits

The National Greening objectives for water, including the minimisation of water consumption and pollution of water resources, maximisation of rainwater capture, and the protection of wetlands, were achieved to varying degrees of success across the country. A target of a 10% potable water saving was set by Green Goal programme, although not all Host Cities agreed to this target – each confronted its own set of challenges. In some cases not enough time was provided to fully address the issues. In order for sustainability and water efficiency to inform a cohesive overarching strategy, these concepts need to be borne in mind from an early stage in the planning process.

Sustainability efforts are often crucially dependent on large upfront investments required to cover costs of water efficiency installations and to ensure the commencement and completion of programmes and projects. The augmentation of the North End Lake to provide the Nelson Mandela Bay Stadium with an alternative source of irrigation is an example of a projected halted halfway through as it awaits further funds in order to proceed. Similarly, in the Mbombela Municipality, a lack of funding was viewed as the key challenge to project implementation.

Nonetheless, it is evident from a number of successful projects that many Host Cities did take action – in many instances with assistance from national and donor funding. DANIDA funding, for example, was received for the greening of Durban's training venues, and collaboration occurred between DEA and the Royal Danish Embassy for the facilitation of baseline studies and sustainability evaluations of a number of key stadiums.

In Mbombela, the stadium footprint led to a regrettable direct loss of about 27 hectares of former wetland. The Matsafeni Wetland in close proximity to the Mbombela Stadium was therefore identified as highly suitable as an offset mitigation area. The aim of this was to rehabilitate a degraded wetland of comparable or larger size than the wetland that has been lost, within the same quaternary catchment. A rehabilitation plan was prepared in 2008, however, to date no progress has been made due to

THE REHABILITATION OF THE BERGVLAM STREAM IS A COMMENDABLE EXAMPLE OF HOW **A PROJECT'S SUCCESS CAN BE GREATLY IMPROVED THROUGH COLLABORATION**

Caring for South Africa's freshwater resources: a rehabilitation wetland in Zeekoeivlei. (Source: Working for Wetlands)

TOP TWO SAVERS IN THE CUTTING EDGE INITIATIVES CATEGORY: ALTERNATIVE SOURCES OF IRRIGATION AND INTELLIGENT PITCH SYSTEM

a lack of funding. It is reported that the City's Environmental Management Unit will become responsible for its future rehabilitation.

The rehabilitation of the Bergvlam Stream is a commendable example of how a project's success can be greatly improved through collaboration. Local project-related future benefits include:

- The upgrade of the stream will improve tourist facilities thereby providing increased income generation for the Mbombela Local Municipality
- The community and the local educational organisations will have a recreational area to enjoy the natural beauty of Nelspruit, which will comprise making use of the planned maintenance program of the stream for educational purposes
- NGOs assisting with scientific knowledge and funding will be able to advertise their contribution to the project.

The City of Cape Town has achieved more than expected through the consideration and reintroduction of the Oranjezicht Spring as a source of non-potable water for stadium use. The project presents a remarkable opportunity for the City of Cape Town to benefit from this unique environmental feature – a natural 6.5 km dual-water system that flows through four distinct landscapes (natural, suburban, urban and industrial) each with their own layered remnants of history and linking two key heritage sites – Table Mountain and Robben Island. It is also reported that the water sourced from the Oranjezicht Spring will be harnessed to drive a hydro-electric water wheel situated in the Green Point Park to generate electricity for use in the Green Point Park and showcase renewable energy technologies.

The implementation of various stormwater management measures that took place throughout South Africa as part of the stadium developments and upgrades all have, or will, result in the following benefits:

- Minimisation of soil erosion
- Natural water filtration and cleansing
- Enhancement of nutrient transformation and flood attenuation and biodiversity
- Replacement of ecosystem services that were potentially lost through World Cup related development.

6.3.2 Stadium targets and achievements

Stadium design represents some of the smartest moves towards water conservation and sustainability. With sophisticated water-saving and recycling interventions, they have left a tangible legacy. Water recycling was implemented in the following instances:

- Soccer City's pitch uses 80% recycled water
- The concrete mix used for the Peter Mokaba Stadium contained 30% recycled water
- The intelligent pitch irrigation system at the Princess Magogo Stadium allows reclaiming and reuse of 50-60% of the water used.

The above interventions as well as the implementation of a number of best practice and cutting edge initiatives have resulted in major water savings and the reduction of water footprints in two of South Africa's newest and most iconic stadiums:

- Moses Mabhida – 70%, reduction in water usage from the initial baseline of 59,112m^3/year water, which includes the elimination of potable water usage for irrigation.
- Cape Town – 61% reduction in water usage from the initial baseline of 25,067m^3/year water, which includes the elimination of potable water usage for irrigation. This could be reduced to 71% if additional features are installed, such as a hybrid pitch.

South Africa can therefore be proud of the strides achieved in the design and development sector, which enabled the country to successfully host the World Cup whilst minimising the associated demand for freshwater resource.