City of Cape Town

2010 FIFA WORLD CUP

Feasibility Study :

The Supply of Irrigation Water to Green Point Common

Reference Number: R030800196

9 May 2008

Preliminary Investigation Report
Issue 1

J27353

ARCUS GIBB
CONSULTING • DESIGN • MANAGEMENT

FEASIBILITY STUDY : THE SUPPLY OF IRRIGATION WATER TO GREEN POINT COMMON

PRELIMINARY INVESTIGATION REPORT

CONTENTS

1 INTRODUCTION

ARCUS GIBB (Pty) Ltd have been appointed by the City of Cape Town to review the various options already identified for the supply of irrigation water for the Green Point Common. The redeveloped Green Point common includes the reconstructed Metropolitan Golf Course, and the redevelopment of the surrounding Common as an attractive public facility.

ARCUS GIBB identified this need for irrigation water some time ago, even before the site was selected as a 2010 FIFA World Cup venue, and proposed a scheme (reuse of treated sewage effluent) to the Golf Club. The golf club was uncertain of the future of the course, but with the current development of the Green Point Common a broader need was identified, and again ARCUS GIBB identified the possibility of treating effluent from the V&A Waterfront, with this water being available for use on the Green Point Common and Golf Course. Potential benefits for both the Common as well as the V&A Waterfront were identified.

Parallel with this ARCUS GIBB also made representations to the City, the V&A Waterfront and the Two Oceans Aquarium to mount a demonstration desalination plant.

The City of Cape Town has also been proactive in identifying other potential sources of irrigation water, including rain water, which could be stored in concrete tanks, or ponds which could be constructed on Green Point Common. The possible use of ground water, abstracted via borehole on the common has also been considered.

ARCUS GIBB has investigated each of these alternatives, and have identified some variations to some.

2 DEMAND FOR IRRIGATION WATER

IRRIGATION REQUIREMENTS; GREEN POINT DEVELOPMENT : DESIGN MARCH 2007

AREAS TO BE IRRIGATED

1	Public Land.		
		Stadium	0.9 ha
		Urban Park	12.0 ha
		Beach Front	8.0 ha
		sub total	**20.9 ha**
2	Sports clubs		
		Playing fields	13.0 ha
		GP Track	4.0 ha
		sub total	**17.0 ha**
3	Golf course		
		Greens and Fairways	**26.0 ha**
	Total 1,2&3		**63,9 ha**

Optimal water requirements for irrigation

Month	**mm/week**	Public Land.	Sports clubs	Golf course	TOTAL	Ml/day
September	**10mm**	9.26	7.53	11.51	28.30	.91
October	**20mm**	18.51	15.06	23.03	56.60	1.83
November	**25mm**	23.14	18.82	28.79	70.75	2.28
December	**35mm**	32.40	26.35	40.30	99.05	3.20
January	**35mm**	32.40	26.35	40.30	99.05	3.20
February	**35mm**	32.40	26.35	40.30	99.05	3.20
March	**25mm**	23.14	18.82	28.79	70.75	2.28
April	**20mm**	18.51	15.06	23.03	56.60	1.83
May	**-**	.00	.00	.00	.00	.00
June	**-**	.00	.00	.00	.00	.00
July	**-**	.00	.00	.00	.00	.00
August	**-**	.00	.00	.00	.00	.00
Ml/year		189.74	154.34	236.04	580.12	

Assumed cost of potable water R6.14

3 ALTERNATIVE SOURCES OF IRRIGATION WATER

There are several options for the supply of irrigation water to the Green Point Common.

Historically, potable water was used for irrigation of the public areas, sports fields and golf course. As the importance to conserve water was realised, and as the use of the sports fields reduced, only the Metropolitan Golf Course continued, albeit at a reduced level of irrigation, using potable water.

With the construction of the new Green Point Stadium to cater for the 2010 World Cup Soccer tournament, and the need to reconstruct the Metropolitan Golf Course, the City of Cape Town plans to upgrade the Green Point Common. This upgrading is to include an Urban Park, playing fields, GP track, as well as to enhance the Beachfront area.

With the vision to revitalise this area with extensive lawns and landscaping, comes the need for irrigation water.

The alternatives considered have either been considered in the form originally proposed, or where there is merit, have been expanded to investigate alternatives or variations, as indicated below.

a) Stadium Roof Rainwater Collection Tank

The runoff from the roof of the new stadium could be collected and stored in a specially constructed tank located in the earth berm forming part of the stadium.

b) Rainwater Collection Pond

The extensive hardened area and associated stormwater control system around the stadium allows also for the collection of the runoff for storage in multipurpose ponds, ponds can be used as water features, detention ponds to attenuate peak storm flows, as well as flow balancing ponds for the irrigation system. It is logical that the rainwater from the stadium roof (item a) above) would also be collected in these ponds.

c) Waste Water Treatment

The treatment and re-use of the treated effluent has been considered as this represents an assured supply of as much water as will ever be required, even during the most extreme drought periods. In close proximity to the Green Point Common are two raw sewage outfall pipelines. A major trunk sewer (1650mm diameter) which serves the City Bowl and a part of Woodstock was build more than a 100 years ago and traverses the Green Point Common, with the effluent disposed at sea after primary treatment at Green Point. A second outfall runs down Beach Road conveying waste water from the V&A Waterfront.

By constructing an activated sludge waste water treatment works either at the site of the existing pre-treatment and outfall pumping station at Green Point, or buried in the landscaping proposed for the new golf course, a ready source of irrigation water could be made available. A small balancing volume would be required to facilitate irrigation time of use with the daily availability of the treated waste water.

d) Springwater and Stormwater Harvesting

In this alternative, the source of springwater is in fact the original supply of water from the Oranjezicht springs which facilitated the establishment of Cape Town as a replenishment station for shipping in 1652.

As a result of this history, an opportunity to not only make use of this source water in a practical way, but also to expand the heritage fabric and tourism potential of Cape Town has been highlighlighted by Caron van Ziel and Colleen Stoltzman the Oranjezicht Heritage Society.

The stormwater from the City Bowl area has been included, but is essentially a separate alternative. However is is noted that the water from the springs is currently conveyed via the stormwater drainage system to the sea. This stormwater system is in itself also of historical interest.

e) Borehole Water

Investigations were carried out to establish the potential of groundwater in the area of Green Point Common.

f) Desalination

With Green Point Common located so close to the sea, and great interest in the possibility of using a desalination process to produce potable water from sea water arising from the longer term needs of the greater Cape Town in the future, the possibility of a pilot plant with sufficient capacity to serve the irrigation water needs of Green Point Common have been investigated.

g) Potable Water

Historically, the Metropolitan Golf Course was irrigated (sparingly) with potable water. As a basis for comparison of capital and running costs, the cost of potable water has been used.

This document reports on the initial assessment of these alternatives, together with preliminary estimates of cost of development of each. These estimated project costs include all costs (construction of civil works, electrical power supply upgrading, supply and installation of mechanical and electrical equipment, commissioning, 15% contingencies, design fees and disbursements, and 14% VAT).

Running costs include electrical power, chemicals, personnel, transport, and sludge handling.

The ease of operation, and number and degree of skill of the process controllers and support staff has also been considered for each of the alternatives.

The disposal and or use of the sludge generated by the works has also been taken into account. This is currently a liability, and alternatives to reach a break even or even a positive cash flow from this resource have been sought.

The annual expenditure anticipated over the next twenty years has been analysed leading to a cost/m^3, based on a net present value analysis and a calculation of unit cost per m3 treated. This forms a good basis for comparison of alternatives.

The scope of the environmental impact of each alternative solution has also been reviewed.

These aspects are then tabulated to facilitate comparison.

3.1 Alternative 1 – Stadium Roof Rainwater Storage Tanks

3.1.1 Technical Solution

It has been noted that it would be relatively straightforward to collect rainwater from the western half of the stadium roof, and by using a storage tank, the demand for irrigation water for the stadium pitch, which has been estimated to be in the order of 9 317m3/year, could be reduced considerably.

The area of the roof is approximately 14 725 m^2, and could collect during an average year some 7 853m^3. This would be substantially less during drought periods, but during an average year could cater for 85% of the demand, providing sufficient storage is provided.

In order to make use of the inflow of water during the wet winter months when it is not necessary to irrigate, a seasonal balancing storage volume would be required, in the order of 3 000m^3.

The alternative of a small balancing tank say 200m^3, with very much reduced yield, as also been considered. This would provide about 3 334 m3 per year, about a third of the demand for irrigating the football pitch in the stadium.

3.1.2 Potential for Integrating with Other Projects

Concrete tanks have the advantage of being enclosed, reducing the chance of being polluted with rubbish, birds, etc.

In time of surplus rainfall, this water could be used not only for irrigation of the main pitch, but also other irrigation, and/or for flushing toilets.

During time of drought, this source would need to be supplemented from other sources.

3.1.3 Operational Aspects

The water collected from the roof would be clean, with the result that very little operational and maintenance effort would be required, other than ensuring the leaf and litter grids are kept clear, and the tank is cleaned during April each year.

3.1.4 Sustainability

Due to the simple nature of this system, it is attractively sustainable as a source of irrigation water but does not cater for drought periods. This could have very severe consequences for the grass and vegetation being sustained with this water.

3.1.5 Capital and Running Cost Implications

Capital	2008/2009/2010	R 7 700 000 for 3 000m^3 concrete tank and pipes
Running	2010	R 50 000
NPV cost/m3	6% discount	R86.63/m3

Capital	2008/2009/2010	R1 476 000 for 200m^3 concrete tank and pipes
Running	2010	R 40 000
NPV cost/m3	6% discount	R35.04/m3

3.1.6 Environmental Impact and Planning Approval

As this will be an integral part of the construction of the stadium, there will be no external environmental impact.

Similarly, being part of the same City of Cape Town development, planning approval for this option will be easily obtained.

3.1.7 Time for Implementation

The time for required to plan and construct a 200m3 reinforced storage tank will be in the order of 6 months, but will need to be integrated with the many other activities for the construction of the stadium.

It will take a good deal longer to construct a 3000m3 reinforced concrete tank, and will require very careful planning to not delay the completion of the stadium works in that area.

3.2 Alternative 2 – Rainwater Ponds

3.2.1 Technical Solution

With the redevelopment of Green Point Common, provision is being made for the establishment of storm water detention ponds, as well as ponds which form part of the landscaping.

The possibility of using these water bodies for also providing a volume for balancing the daily inflow of irrigation water (from whatever source) and the meeting with the irrigation demand which will be spread over a period of say 8 hours, is attractive. In addition to providing aesthetic appeal, some of these ponds will also be used to detain and attenuate peak storm flows so that the stormwater can be run to the sea via existing stormwater pipes, with seasonal storage considered.

The volume required for balancing the daily variations of steady inflow, with the demand for irrigation water amounts to approximately 3 000 m^3 per day during the driest month.

The volume required for seasonal storage and balancing is some 266 000 m^3. Closer examination shows that the area of the five ponds envisaged amounts to some 30 000 m^2. This implies that the water level would have to range some 2meters. In addition, extensive modifications to the stormwater collection system beyond the Green Point Common would be required to divert sufficient stormwater for storage and use as irrigation water. In addition, the flat topography and distances between the various ponds leave little opportunity for using an interconnected network of ponds for seasonal storage.

The practical limit to the amount of water that can be stored on a seasonal basis is in the order of 30 000 m^2 x 0.5m ie 15 000 m^3, a fraction of the required seasonal balancing storage of 266 000 m^3 The additional yield is in the order of 18 000 m^3

3.2.2 Potential for Integrating with Other Projects

It was noted above that the storage of rainwater on a seasonal basis for the 1 ha football pitch in the stadium would require some 3 000m^3. This volume can be cost effectively stored in the multi use ponds (aesthetic / detention / storage).

The provision of additional storage in the ponds does assist with the daily variations of supply, from not only rain, but also other sources.

3.2.3 Operational Aspects

Control of litter and other windblown debris such as leaves and grass cuttings is important to limit the amount of debris that will need to be screened out prior to pumping into the irrigation system.

3.2.4 Sustainability

By providing some 15 000m3 for seasonal storage capacity, approximately 2.6% of the total irrigation requirement of 580 000m3/per year could be provided from this source. Even this is subject to reduction during drought years, when irrigation water is most needed.

3.2.5 Capital and Running Cost Implications

Capital	2008/2009/2010	R6 300 000 for 18 000m^3 additional pond volume and pipes
Running	2010	R 60 000
NPV cost/m3	6% discount	R29.18/m3

3.2.6 Environmental Impact and Planning Approval

The ponds form part of the infrastructure already included in the planning and approval documentation, so there would not need to be additional attention paid to this aspect.

3.2.7 Time for Implementation

Additional planning and detail design work, and additional excavation would take approximately 10 weeks for implementation, but water supply would then be subject to rainfall. Realistically the rainy season of 2009 would fill these ponds with stormwater runoff.

3.3 Alternative 3 – Waste Water Treatment

3.3.1 Technical Solution

Untreated waste water is conveyed across the site of the Green Point Common in the 1600mm brick sewer to Green Point outfall, while a second stream is conveyed down Beach Road from the V&A Waterfront.

Treatment of this waste water, with both sources running at flows well in excess of demands for irrigation water, represents an assured supply, independent of climatic conditions.

There are three possible sites, one near Fort Wyngard underground in a berm forming part of the golf course landscaping, while the second possible site is on the Green Point Outfall as it traverses the side on the Signal Hill side, disguised in a manner similar to the first, while the third site is at the Green Point Sewage Outfall Pumping Station.

The treatment system envisaged makes use of a relatively newly developed form of the activated sludge process which makes use of membranes (membrane bioreactor MBR). This process is particularly suited to the treatment of waste water where it is intended to re-use the effluent as planned here for irrigation. As a result of the use of membranes for retaining the activated sludge in the system, the plant can be significantly reduced in size, with the main attribute being the effective filtration of very small particles including bacteria and protozoa. The treated effluent from such a plant is considered safe for irrigation after the chemical sterilisation, usually chlorine.

3.3.2 Potential for Integrating with Other Projects

The implementation of a waste water treatment works will provide as much irrigation water as required by this project, and any others that may develop in the future, by simply increasing the capacity of the works.

Of significance could be the extension of the current permit the City of Cape Town holds for disposal of waste water to sea via the Greenpoint Outfall. Currently the flows are approaching the maximum annual volume, while future developments within the City Bowl (Culemborg and District 6) will put this outfall under pressure. Reduction of flow and organic load with the diversion, treatment and re-use of treated effluent for irrigation will be perceived as advantageous also from an environmental point of view, since the flow currently being discharged receives only primary screening before being discharge via the sea outfall pipeline some distance off the coast.

3.3.3 Operational Aspects

The implementation of a new sewage treatment works will require additional staff for its operation, with this staff being shared with the staff required for the operation of the existing Green Point outfall works.

The waste sludge from the new works is to be preferably treated and used as an organic conditioner on the golf course.

3.3.4 Sustainability

The effluent which is currently receiving primary treatment, will be processed to meet all irrigation needs of the Green Point Common, together with the supply of the treated waste sludge for use as compost and a conditioner.

The activated sludge process is dependant on electrical power (some 200 to 250kW), but will reduce the amount of greenhouse gases emitted by Cape Town by the equivalent of some 400 tonne CO2 per year, worth in financial terms, about 25% of the electrical power cost.

3.3.5 Capital and Running Cost Implications

Capital	2008/2009/2010	R 32 000 000	
Running	2010	R 6 260 000	not taking carbon credits into account
Running	2010	R 6 000 000	taking carbon credits into account
NPV cost/m3	6% discount	R17.21/m3	not taking carbon credits into account
NPV cost/m3	6% discount	R16.56/m3	not taking carbon credits into account

3.3.6 Environmental Impact and Planning Approval

A new sewage works will require a full Environmental Impact Assessment, while support of the Waste Water Department of the City of Cape Town will be required.

3.3.7 Time for Implementation

The time taken for the full EIA, with detail design and tender documentation prepared in parallel, construction and commissioning of this works will taken a minimum of three years, and most likely four years.

3.4 Alternative 4 – Springwater and Rainwater Harvesting

Field of Springs - Oranjezicht

3.4.1 Technical Solution

(a) Spring Water

Water from the Oranjezicht springs was the original supply which facilitated the establishment of Cape Town as a replenishment station for shipping in 1652. The use of this spring was formalised in 1682, with a chamber to protect thew Main Spring built in 1813. Historical information has been drawn from “Homestead Park : Contextual Information Inventory, Design Intervention Guidelines, Development Strategies, Implementation & Management Principles” prepared by Caron von Zeil in February 2006 for the Oranjezicht Heritage Society

As a result of this history, there is an opportunity to not only make use of this source water in a practical way, but also to expand the heritage fabric and tourism potential of Cape Town as has been highlighted by Caron van Ziel and Colleen Stoltzman of the Oranjezicht Heritage Society.

The "Field of Springs" is located adjacent to Homestead Park, with the flow from several springs (Main, Lammetjies and Klip) as well as others collected in a second chamber called the New Main Spring built in 1853.

The flow from these springs has been monitored, with a flow from the New Main Spring measured as being some 26l/s. Our own investigations at the end of the summer of 2008 (which was moderate, with some rainfall) showed that there are several other springs which have been formalised, with flow discharged below the New Main Spring collection chamber. This combined flow was measured at a point where it currently flows down a 3' (914mm) internal diameter brick stormwater pipe. This flow, well in excess of 40l/s. City of Cape Town staff who have observed the flow from the Main Spring over many years have indicated that it is not sensitive to seasonal changes.

These springs therefore have sufficient capacity to provide for not only the irrigation needs of the immediate surroundings, but also the Company Gardens which are fed from the lower Molteno Reservoir No 2, as well as the full demand from Green Point Common. The Molteno Reservoir has sufficient capacity to provide seasonal storage, even though this is not needed with the adequate flow from the Main Spring and the Field of Springs.

Four options for conveyance of the water from the Oranzezicht Springs have been considered.

These incluse;

- **Option 1:** 300mm cast iron Pipe from the Oranzezicht Springs to the top of Long Street, with the remainder a new 300mm uPVC pipe laid through the City to Green Point Common.
- **Option 2:** 300mm Cast Iron Pipe from the Oranzezicht Springs to the top of Long Street, with reuse of abandoned cast iron pipes and 300mm uPVC connection pipes from the lower end of the City to Green Point.
- **Option 3:** Slip line 300mm cast iron Pipe from the Oranzezicht Springs to the top of Long Street, with the remainder a new 300mm uPVC pipe laid through the City to Green Point Common.
- **Option 4:** Stormwater system, as at present, from Oranzezicht, via Orange Street, Queen Victoria Street and Adderly Street to the Fountain in the Heeregracht, with a pump station and new uPVC rising main in combination with various cast iron pipes.
- **Option 5:** Stormwater system, as at present, from Oranzezicht, via Orange Street, Queen Victoria Street and Adderly Street to the Fountain in the Heeregracht, with a pump station and new uPVC rising main to Green Point. Provision has been included for slow sand filtration in one of the constructed water features forming part of the Green Point Common development.
- **Option 6:** Treat Oranjezicht Spring water to potable standard, deliver, as in the past to Molteno Reservoir, and abstract from the potable water reticulation system at Green Point.

Of these options, Option 1, 3 and 5 have been considered in more detail, the other being discarded as a result of anticipated problems with re-using very old cast iron pipes. It is felt that these were removed from service as a result of increasing maintenance being required.

Of particular interest is Option 5 which has the potential to integrate the development of the water heritage aspects along the route as part of, or in parallel with the need to convey the water to Green Point.

The option of using the potable water system for conveyance is not favoured, as in time, it will be seen as potable water, and not irrigation water.

(b) Rainwater harvesting

Harvesting stormwater from the City Bowl area has also been considered, but is essentially a separate alternative. However it is noted that the water from the springs is currently conveyed via the stormwater drainage system to the sea. This stormwater system is in itself also of historical interest.

As seen from the examination of the use of stormwater and rainwater harvesting from the Green Point Stadium and Common, the storage of the water collected in winter, for irrigation during the summer requires storage of some 600 000 m^3. The lower Molteno Reservoir (No 1) built during the period from 1849 to 1852 holds some 11 360 000 m^3 but is currently in need of refurbishment. In 1856 a second reservoir (No 2) was built, has a volume of 54 550 000 m^3 and is currently used to store water for watering the Company Gardens and for firefighting. This reservoir receives water from the Main Spring via an existing 300mm dia cast iron pipe, as well as from Waterhof and other springs

3.4.2 Potential for Integrating with Other Projects

The re-use of the water from the Oranjezicht springs promises to enhance the visible heritage, provide the means for preserving it, while at the same time developing additional interest for tourists and local population.

3.4.3 Operational Aspects

The system makes use of existing infrastructure, so no additional maintenace will be required for the system from Oranjezicht to Adderly Street Fountain. A new pump station located at that point will require normal operation and maintance.

The treatment system, making use of slow sand filters in the constructed water features, will require attention for the removal of litter collected on the inlet screen, and cleaning of the filter sand every 3 months.

3.4.4 Sustainability

The option to convey the water in an enclosed pipe for the full distance is the least maintenance, functional alternative.

The benefits that will be derived from developing and making use of the historical aqauaducts may well prove to be more sustainable, as there will be secondary benefits of income and job creation arising from tourism.

3.4.5 Capital and Running Cost Implications

(a) Option 1 – 300mm dia CI to Long St plus uPVC to Green Point

Capital	2008/2009/2010	R7 900 000
Running	2010	R 200 000
NPV cost/m3	6% discount	R1.42/m^3

(b) Option 3 – Slip line 300mm dia CI to Long St plus uPVC to Green Point

Capital	2008/2009/2010	R12 700 000
Running	2010	R 200 000
NPV cost/m3	6% discount	R2.08/m^3

(c) Option 5 – Heritage Route via Stormwater and Graghte to Fountain, pump to Green Point

Capital	2008/2009/2010	R9 600 000
Running	2010	R 300 000
NPV cost/m3	6% discount	R2.01/m^3

3.4.6 Environmental Impact and Planning Approval

No negative environmental impact, nor approval needed. An integrated approach to to planning is required to maximise the broad potential of particularly Option 5

3.4.7 Time for Implementation

12 months

3.5 Alternative 5 – Borehole Water

3.5.1 Technical Solution

Originally 6 borehole sites were identified by a hydro-geologist and drilling was undertaken on 3 sites as follows (see ***Fig 1*** for layout).

The following results were obtained

- Borehole site 2

  Water was found at 40 meters at an estimated yield of 1500l/h. The Electrical Conductivity was measured as 719 mS/s and therefore this water is unsuitable for irrigation use due to the high salt content. (See ***Appendix A*** for test results).

- Borehole site 3

  This was first hole to be drilled. Water was found at 40 meters and a yield of approximately 1000l/h. At a depth of 100 meters strong water was found. The Electrical Conductivity was measured as 401 mS/s and therefore due to the high salinity further yield tests were not undertaken and the operation stopped. (See ***Appendix A*** for test results).

- Borehole site 7

  The position of this borehole had to be moved about 15 meters, as the original point was in the middle of a proposed road. No water was found, although drilling reached a depth of 100 meters.

Total dissolved solids (TDS) are a measure of the quantity of various inorganic salts dissolved in water. However, Electrical Conductivity (EC) is used to estimate the quantity of TDS as it is easier to measure. The relationship between TDS and EC can be represented in the following formula

$$EC\ (mS/m\ at\ 25\ ^\circ C) \times 6.5 = TDS\ (mg/\ell)$$

Most grasses are moderately sensitive to salt. The target water quality range for irrigation for these types of grasses is 40 – 90 mS/m. Grasses can only be maintained with the use of a low frequency irrigation system.

Based on the results of test done on the three boreholes, the volume of water that can be abstracted from the geological strata underlying the Green Point Common is insignificant compared with the demand (24m3/ day from one borehole against a demand in excess of 3 000 m3 during the driest month). In addition the water is saline, and cannot be used without treatment.

3.5.2 Potential for Integrating with Other Projects

There is no merit in the use of groundwater for other purposes (topping up ornamental ponds for example), and the yield is too low, and the quality too poor to be of use.

3.5.3 Operational Aspects

With such low yields, and poor water quality which will lead to corrosion of pumps, this option is not attractive.

3.5.4 Sustainability

This option is not viable.

3.5.5 Capital and Running Cost Implications

As a result of the poor quality and low yield, costs were not considered.

3.5.6 Environmental Impact and Planning Approval

Not considered

3.5.7 Time for Implementation

With different results, boreholes could have been established quickly.

3.6 Alternative 6 – Desalination

3.6.1 Technical Solution

Since Green Point Common is located less than 1 km from the sea, a desalination plant could be constructed near by.

The advantage of such a plant is the assuredness of supply under all climatic conditions. Further to that, with the City of Cape Town considering the use of desalination to augment the supply of potable to Cape Town in the future, such a project would afford the opportunity to use this plant as a pilot plant, to test various new processes under working conditions, to train staff, and as a result of the locality, to educate the public of the implications of desalination.

A site within the V&A Waterfront has previously been identified during an initiative by the V&A to augment their water supply. Although circumstances have changed, a suitable site within the V&A Waterfront can still be found.

To produce 3 000m3/d, a desalination plant draws in approximately double that amount of seawater. The waste brine stream of about 3 000m3/day caries away the salt that has been removed, with the salinity roughly double that of the incoming sea water. Care in disposing this brine stream is required.

3.6.2 Potential for Integrating with Other Projects

As mentioned this plant could be used as a pilot desalination plant for the City of Cape Town. The needs of the V&A Waterfront could also be addressed by increasing the size of desalination plant.

3.6.3 Operational Aspects

Dealing with sea water is always problematic, and a combination of design and careful operation will be required to ensure a successful project.

3.6.4 Sustainability

While the sea is an 100% reliable source, the power required to operate a desalination plant is of concern. In the longer term, renewable electrical sources that could be considered at this site include wind (but the visual impact is likely to be un acceptable), wave and swell energy and use of ocean currents. In the short term, grid power would be required.

3.6.5 Capital and Running Cost Implications

Capital	2008/2009/2010	R35 000 000
Running	2010	R 3 200 000
NPV cost/m3	6% discount	R11.76/m^3

3.6.6 Environmental Impact and Planning Approval

Full EIA and DWAF permit

3.6.7 Time for Implementation

48 months

4 REVIEW OF ALTERNATIVES

The irrigation of the Green point Common, Stadium, Metropolitan Golf Course and Beachfront requires a total annual volume of 580 000 m^3 per year.

The results of the investigation into the various alternative sources investigated are summarised as follows:-

	Yield m^3/year	Capital Cost	Annual Running Cost	NPV – Unit reference value R/m^3
Alternative 1 – Stadium Roof Rainwater Storage Tanks	7 853 3 334	7 700 000 1 476 000	50 000 40 000	86.63 35.04
Alternative 2 – Rainwater Ponds	18 000 (limited by storage volume on site)	6 300 000	60 000	29.18
Alternative 3 – Waste Water Treatment	580 000	32 000 000	6 260 000	17.21
Alternative 4 – Springwater and Rainwater Harvesting Options 1, 3 and 5	580 000	7 900 000 12 700 000 9 600 000	200 000 200 000 300 000	1.42 2.08 2.01
Alternative 5 – Borehole Water	Not viable			
Alternative 6 – Desalination	580 000	35 000 000	3 200 000	11.76
Potable water	580 000			6.14

Further considerations that affect the decision are

	Time for Implementation	Environmental issues
Alternative 1 – Stadium Roof Rainwater Storage Tanks	12 months	None
Alternative 2 – Rainwater Ponds	12 months	Minor
Alternative 3 – Waste Water Treatment	48 months	Full EIA
Alternative 4 – Springwater and Rainwater Harvesting	12 months	None – DWAF notification
Alternative 5 – Borehole Water	N/A	N/A
Alternative 6 – Desalination	48 months	Full EIA
Potable water	Immediate	No additional

It can therefore be seen that the use of the water from the Oranjezicht Springs is the most attractive, with conveyance to be via the existing and/or new pipelines, or via historical aquaducts and pumped from the Adderly Street Fountain.

5 PROPOSED PROGRAM

The implementation of the project will depend on the availability of funds, and planning and tender procedures.

It is anticipated that with the use of the water from the Oranjezicht springs being the preferred option, the choice between conveyance via pipelines, or via historical routes, that the latter will be preferred as it will add so much more to the City.

The program, should normal processes be followed, allows for the decision to be taken by the end of July 2008, with the tenders to be invited in August and an award to be made by the end of September. An 8 month construction period will enable water being made available for irrigation by the spring of 2009.

6 CONCLUSIONS AND RECOMMENDATIONS

This project has covered a very broad spectrum of alternatives, each with its own merits. After analysis, comparison of the yields, cost and secondary benefits show that the project is financial very attractive (a third of the cost of using potable water), is sustainable, and will meet with the objective of providing irrigation water to Green Point Common for the benefit of all.

We therefore await your instructions, and look forward to an exciting and interesting project.

Dave Crombie
Senior Associate
for
ARCUS GIBB (Pty) Ltd
8 July 2008

APPENDIX A

Certificate of Analyses

CITY OF CAPE TOWN
SCIENTIFIC SERVICES BRANCH

CERTIFICATE OF ANALYSIS

FILE: CB2/M4 LAB REF NO.: ALSEW2007/117-118

SAMPLE TYPE: Borehole ***(No 3)***
LOCATION: Green Point Stadium
SAMPLED BY: Mr C Theunissen
DATE OF RECEIPT: 2007-11-23
DATE OF ANALYSIS: 2007-11-24
DATE OF REPORT: 2007-11-28

ATTENTION: Mr C Theunissen **CC:** Peter King

RESULTS OF ANALYSIS

Parameter	**Units**	GP_BH_100m	GP_BH_40 m
Calcium	mg/L	187	45
Potassium	mg/L	79	33
Magnesium	mg/L	254	59
Sodium	mg/L	2245	813
NH_3	mgN/l	<0.4	<0.4
Ortho-phosphate	mgP/l	0.1	0.1
pH		7.61	7.79
Conductivity	mS/m	1203	401
Cl^-	mg/l	3858	1015
Alkalinity	$mgCaCO_3/l$	237	273

Remarks:

A mixture of 40% water from borehole at 40m and 60% of fresh water is recommended for irrigation. The water from borehole at 100m is not recommended due to very high salt content.

for **MANAGER: SCIENTIFIC SERVICES**
Water and Sanitation

FIGURES

PROJECT	GREEN POINT IRRIGATION INVESTIGATION
DETAIL	POSITIONS OF BOPREHOLES

Drawn By	Designed By	Reviewed By	Scale	Date	Project No	Drg No	Rev
			NTS	JUNE 2008	J28065A	FIG 1	

ARCUS GIBB
CONSULTING • DESIGN • MANAGEMENT

This drawing is not to be used in whole, or part, other than for the intended purpose and project as defined on this drawing.

Refer to the contract for full terms and conditions

TYPICAL FINANCIAL ANALYSIS

SPRING WATER - OPTION 5

Annual volume diverted 580000 million m3/annum

Notes
1 Costs in R mil
2 Prices = Jan 2000
3 Maintenance
.25% x civil
4.00% x mech & elec
0.5% x pipeline
4 Annual running cost
R 0.30 mill
5 Pump station costs
50% mechnical
20% electrical
30% civil

		Civil	Mech.	Elec	Total
Treatment		600 000.0	1500 000.0	900 000.0	3000 000.0
Pump Station		160 000.0	400 000.0	240 000.0	800 000.0
Heritage	m3	1000 000.0			1 000 000
Pipelines		4800 000.0			4800 000.0
		6560 000.0	1900 000.0	1140 000.0	9600 000.0

Cal year	Year	m3/yr Additional Yield		Storage Reservoir	Annual costs Pipelines	Treatment works Pump stations	Maintenance	Labour & Elec.	Total
2008	1			500 000.0	2 400 000.0	.0			2 900 000.0
2009	2	580,000		500 000.0	2 400 000.0	.0		150 000.0	3 050 000.0
2010	3	580,000				1 900 000.0	28 400.0	300 000.0	2 228 400.0
2011	4	580,000				1 900 000.0	150 000.0	300 000.0	2 350 000.0
2012	5	580,000					150 000.0	300 000.0	450 000.0
2013	6	580,000					150 000.0	300 000.0	450 000.0
2014	7	580,000					150 000.0	300 000.0	450 000.0
2015	8	580,000					150 000.0	300 000.0	450 000.0
2016	9	580,000					150 000.0	300 000.0	450 000.0
2017	10	580,000					150 000.0	300 000.0	450 000.0
2018	11	580,000					150 000.0	300 000.0	450 000.0
2019	12	580,000					150 000.0	300 000.0	450 000.0
2020	13	580,000					150 000.0	300 000.0	450 000.0
2021	14	580,000					150 000.0	300 000.0	450 000.0
2022	15	580,000				1 520 000.0	150 000.0	300 000.0	1 970 000.0
2023	16	580,000				1 520 000.0	150 000.0	300 000.0	1 970 000.0
2024	17	580,000					150 000.0	300 000.0	450 000.0
2025	18	580,000					150 000.0	300 000.0	450 000.0
2026	19	580,000					150 000.0	300 000.0	450 000.0
2027	20	580,000					150 000.0	300 000.0	450 000.0
2028	21	580,000					150 000.0	300 000.0	450 000.0
2029	22	580,000					150 000.0	300 000.0	450 000.0
2030	23	580,000					150 000.0	300 000.0	450 000.0
2031	24	580,000					150 000.0	300 000.0	450 000.0
2032	25	580,000		500 000.0	2 400 000.0		150 000.0	300 000.0	3 350 000.0
2033	26	580,000		500 000.0	2 400 000.0		150 000.0	300 000.0	3 350 000.0
2034	27	580,000					150 000.0	300 000.0	450 000.0
2035	28	580,000					150 000.0	300 000.0	450 000.0
2036	29	580,000					150 000.0	300 000.0	450 000.0
2037	30	580,000				1 520 000.0	150 000.0	300 000.0	1 970 000.0
2038	31	580,000				1 520 000.0	150 000.0	300 000.0	1 970 000.0
2039	32	580,000					150 000.0	300 000.0	450 000.0
2040	33	580,000					150 000.0	300 000.0	450 000.0
2041	34	580,000					150 000.0	300 000.0	450 000.0
2042	35	580,000					150 000.0	300 000.0	450 000.0
2043	36	580,000					150 000.0	300 000.0	450 000.0
2044	37	580,000					150 000.0	300 000.0	450 000.0
2045	38	580,000					150 000.0	300 000.0	450 000.0
2046	39	580,000					150 000.0	300 000.0	450 000.0
2047	40	580,000					150 000.0	300 000.0	450 000.0
2048	41	580,000					150 000.0	300 000.0	450 000.0
2049	42	580,000					150 000.0	300 000.0	450 000.0
2050	43	580,000					150 000.0	300 000.0	450 000.0
2051	44	580,000					150 000.0	300 000.0	450 000.0
2052	45	580,000				1 520 000.0	150 000.0	300 000.0	1 970 000.0
2053	46	580,000				1 520 000.0	150 000.0	300 000.0	1 970 000.0
2054	47	580,000					150 000.0	300 000.0	450 000.0
2055	48	580,000					150 000.0	300 000.0	450 000.0
2056	49	580,000		500 000.0	2 400 000.0		150 000.0	300 000.0	3 350 000.0
2057	50	580,000		500 000.0	2 400 000.0		150 000.0	300 000.0	3 350 000.0
Present value @	6%	9110392	R	2106 181.9	10109 673.1	9561 864.0	2232 787.0	4570 762.2	18315 275.0
							Unit reference value		2.01
Present value @	8%	7083055	R	1996 355.0	9582 504.1	8715 307.2	1715 777.9	3524 760.1	13365 437.8
							Unit reference value		1.89
Present value @	10%	5745652	R	1895 393.4	9097 888.2	7971 447.2	1373 993.4	2835 525.1	11328 728.2
							Unit reference value		1.97

DOCUMENT CONTROL SHEET (FORM IP180/B)

CLIENT : City of Cape Town

PROJECT : Supply of Irrigation Water to Green Point Common

PROJECT No : J28 065A

TITLE : Investigation Report

	Prepared by	Reviewed by	Approved by
ORIGINAL	NAME **D J Crombie**	NAME	NAME
DATE **8 / 7 / 2008**	SIGNATURE	SIGNATURE	SIGNATURE

REVISION	NAME	NAME	NAME
DATE	SIGNATURE	SIGNATURE	SIGNATURE

REVISION	NAME	NAME	NAME
DATE	SIGNATURE	SIGNATURE	SIGNATURE

REVISION	NAME	NAME	NAME
DATE	SIGNATURE	SIGNATURE	SIGNATURE

ARCUS GIBB (Pty) Ltd

Website : www.arcusgibb.co.za