CAPE TOWN NEEDS GROUNDWATER

A Note on the Potential of the Cape Flats Aquifer Unit to Supply Groundwater for Domestic Use in the Cape Town Metropolitan Area

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ABSTRACT

The need to save water is becoming more crucial with ever-increasing pressures, mainly from urban development, being placed on South Africa's limited water resources. The greater Cape Town Metropolitan Area lies on one of the most extensive sand aquifers in South Africa and the supply potential of groundwater from this aquifer is highly significant. In line with the recently initiated National Water Conservation Campaign, aimed at reducing water usage and demand by all sectors, the exploitation of this aquifer is strongly encouraged. Groundwater can be abstracted very cheaply by means of well-points and utilised eg. for garden irrigation, thereby reducing the huge volumes of purified fresh water resources being wasted annually for these purposes.

1 INTRODUCTION

All too often the statement is made that South Africa has limited water resources. Generally, little cognisance of this fact is taken by the people fortunate enough to have an abundant supply of this essential resource. The caption *"No water - no nothing"* summarises the inestimable value of water, prompting the Minister of Water Affairs and Forestry to call for the urgent development of a water conservation culture in the country as the thrust to the National Water Conservation Campaign.

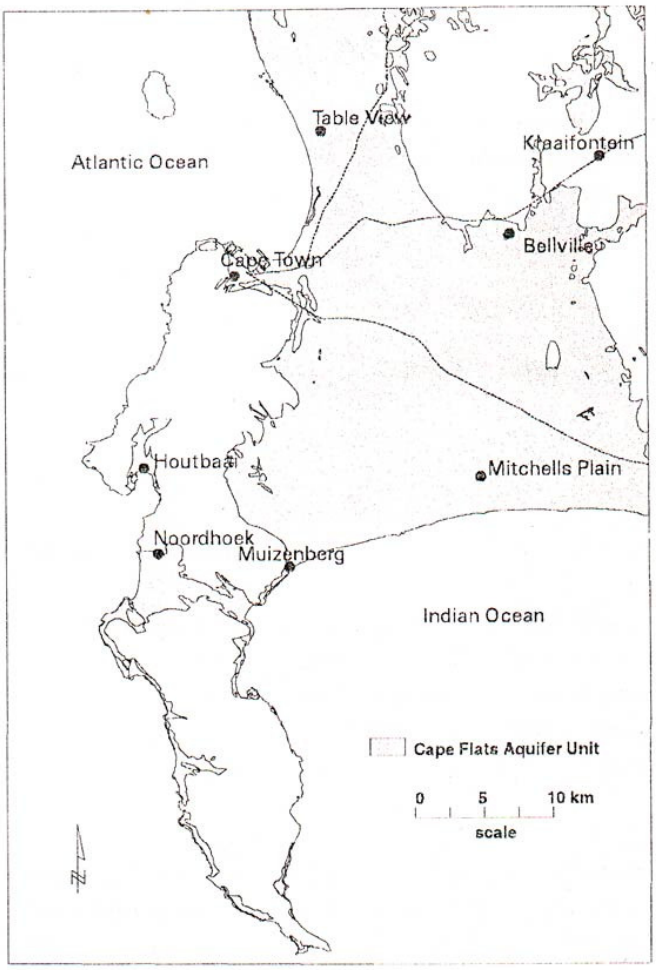

Figure 1 Regional extent of the Cape Flats Aquifer Unit.

Past periods of severe droughts in South Africa resulted in drastic water-saving measures being introduced to alleviate the situation. At present an imminent water-supply crisis is facing Gauteng and the introduction of a new severe sliding-scale tariff system is being considered for implementation in the whole of South Africa on the *"user pays"* principle. South Africa is among the twenty most water scarce countries in the world and her water-tariff structure is clearly unrealistic in the context of availability of supplies, and needs urgent adjustment. According to an international survey carried out in 1990 by the National Utility Service, South Africa's water is one of the cheapest in the world, fourth only to Norway, Canada and America. When compared with the rest of the country's major centres, Cape Town is by no means a water-rich area, with Cape Town's demand projected to exceed supply if new water sources are not developed by the summer of 1998/1999.

The water-supply tariffs were recently increased in the Greater Cape Town Metropolitan Area (GCTMA) with a new tariff structure scheduled to be announced in October, with cost increases of up to 500% being presented in the media. The increased tariffs are being imposed partly as an incentive to save water as well as to finance the development of additional water supplies. Against this background, it is essential that water demand management and water conservation strategies be implemented and alternative water supplies be considered. This should not only be the responsibility of the water-suppliers, but that of each water-user.

The purpose of this paper is to highlight the supply potential of the sand aquifer (Fig. 1) on which most of the GCTMA lies, as well as the merits of abstracting the presently under-utilised groundwater contained in this aquifer, by means of well-points, for small- to medium-scale use.

2 THE CAPE FLATS AQUIFER UNIT

The low-lying sandy flats connecting the Table Mountain-Cape Peninsula range in the west to the Tygerberg-Stellenbosch ranges to the east cover an area of 765km^2 and were formed chiefly by river and wind erosion and deposition. Thick unconsolidated silica sand deposits of Cenozoic age underlie most of the Cape Flats from False Bay in the south to Table Bay in the north and also occur along a narrow strip from Vishoek to Noordhoek, around Houtbaai and in the Kraaifontein-Joostenbergs Vlakte area (Fig. 1).

The generally shallow water table (av. 3.75m below surface) and medium- to coarse-grained nature of the saturated sands result in a primary aquifer of significant exploitation potential. The quality of the groundwater contained in the Cape Flats Aquifer Unit (CFAU) is classified as fresh [1], with salinity ranging generally from 300-1000mg/ℓ TDS i.e. falling within the limits for drinking water [2]. The author's experience has shown that groundwater of potable quality occurs in especially the southwest and northern area of the CFAU. Groundwater from the CFAU is presently utilised on a limited scale for irrigation of market-gardens and small-holdings mainly around Phillipi.

The southern portion of the CFAU has been well-researched and delineated by a pilot study carried out by the Geohydrology Directorate of the Department of Water Affairs and Forestry (DWA&F) in the 1980's. Studies presently being undertaken by this Directorate aim to geohydrologically characterise and accurately delineate the extent of the CFAU and determine its water-supply potential.

3 WATER USE IN THE CAPE TOWN METROPOLITAN AREA

According to DWA&F (1992), the domestic sector is by far the highest consumer of water in the GCTMA (Fig. 2) utilising 59% of the total annual consumption of 267.2Mm^3 (Table 1). Of the domestic consumption, for example, it is estimated that between 35% (DWA&F, 1994a) and 50% (Granger, 1992) is used for garden irrigation purposes (Fig. 3). This means that 20%-30% of the *total* purified water supplied to all user-sectors in the GCTMA is wasted annually in the quest for green gardens. Drinking and cooking, the only domestic water use for which purified water is considered essential, utilises a mere 1.8% of this total supply!

Clearly then, there is an urgent need to address the present enormously wasteful situation of supplying expensive purified water for sectors and uses which do not necessarily require water of a potable quality. The initiative should be taken by the individual water-user who possesses the financial means, to assist in reducing the ever-increasing pressure on the region's limited water resources, by utilising alternative supplies *viz.* groundwater.

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[1] Groundwater classification based on Total Dissolved Solids (TDS) presented in Freeze and Cherry (1979).

[2] DWA&F, 1993 maximum allowable limit for drinking water is 1950mg/ℓ TDS.

4 WATER SUPPLY POTENTIAL OF THE CAPE FLATS AQUIFER UNIT

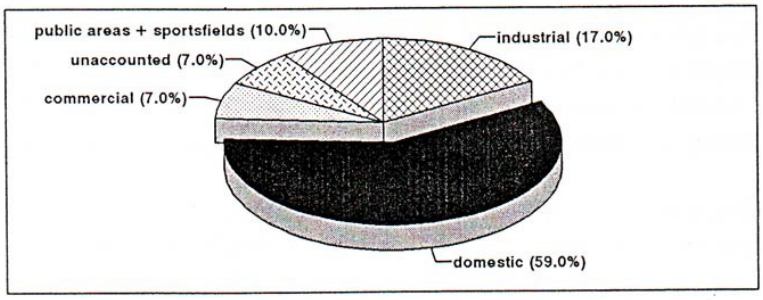

Figure 2 Water use per sector - GCTMA (DWA&F, 1992).

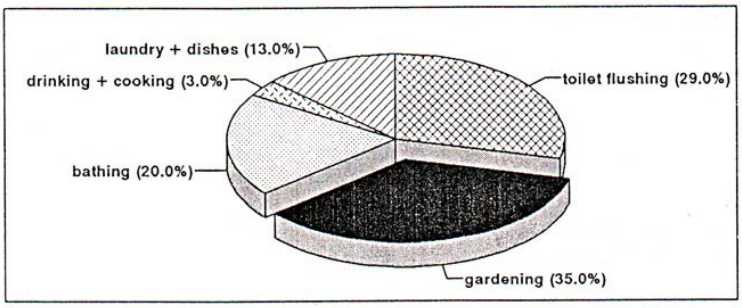

Figure 3 Domestic water use - GCTMA (DWA&F, 1994a).

The pilot study of the Cape Flats Aquifer carried out by the Geohydrology Directorate of DWA&F in the 1980's, determined the supply potential for the part of the CFAU centred on Mitchells Plain to be 18Mm³/yr, with individual borehole yields of up to 30ℓ/s in areas of highly transmissive sandy gravel. This source is scheduled to be developed as a water supply to the GCTMA and to come on line by 2005 (DWA&F, 1994b). The recharge by rainfall to the whole CFAU (Fig. 1) is conservatively calculated at 53.4Mm³/yr, i.e. the potential sustainable yield of the CFAU. This yield is equivalent to 20% of the total water supply to the GCTMA (Table 1). The scale of the potential supply of groundwater from the CFAU to the GCTMA is, therefore, significant, with ± 1.6 million people living on the CFAU standing to benefit from local groundwater use (Table 1).

Table 1 Water supply and population statistics for the GCTMA and CFAU area.

	Total GCTMA	CFAU area	CFAU % of Total
Water supply (m³/yr)	267 152 550 †	162 891 711 *	61
Population	2 220 856 ‡	1 561 473 *	70

* Calculated - this report.
† Cape Town City Council City Engineer's Dept. for 1994/1995 water consumption of GCTMA.
‡ Cape Town City Council City Planner's Dept. and SA (1992).

Not all of the CFAU is capable of supplying sustainable high yields of groundwater for eg. town supply purposes, but localised use of the CFAU can provide sufficient groundwater for small-scale use such as garden irrigation, resulting in large water-savings. By way of illustration, if the present water use for garden irrigation (Fig. 3) is halved as a result of groundwater utilisation, a reduction of 28.5Mm³/yr in the annual water requirement of the GCTMA could be achieved. The water thus saved could, instead, be used for improving the situation of inhabitants of the GCTMA who do not, as yet, have access to adequate water-supply and sanitation. This saving would also result in reducing the existing pressure to augment the water supply to the GCTMA from surface water sources such as dams.

In addition to domestic garden irrigation, groundwater abstracted from the CFAU can be utilised for RDP community supply and upliftment projects such as vegetable garden irrigation and market gardens. This is considered to be a priority option, since most of the communities in dire need of water i.e. residents of Kayelitsha, Langa, Guguletu, Nyanga and Crossroads (± 614 000 people) are situated directly on top of an area of the CFAU with a high exploitation potential.

Local authorities should be strongly encouraged to utilise groundwater for the irrigation of public areas and sportsfields, a sector which consumes 10% of the total supply of water to the GCTMA (Fig. 2). Such irrigation is carried out at present on a limited scale in the Mitchells Plain area by the Parks and Forests Division of the Cape Town City Council, and at the Lentegeur Psychiatric Hospital. The utilisation of groundwater from the CFAU should be extended to include *inter alia* irrigation of school grounds, cluster-home developments and business grounds with large gardens.

As increased realisation of the exploitation potential of the CFAU occurs, and subsequent large-scale utilisation of this resource results, the possibility exists that over-abstraction of groundwater from the CFAU may occur. Salinisation of the aquifer, localised dewatering or ground subsidence could then result. This, however, is unlikely to happen as abstraction rates in excess of the annual recharge to the aquifer unit would need to occur, requiring eg. ± 8 500 well-points each pumping at 0.2ℓ/s, for 24 hours a day. If over-abstraction of the aquifer should occur in the future, then localised management of the aquifer, based on a resource-protection philosophy, would be carried out as is standard practice in similar groundwater abstraction projects.

5 WELL-POINTS AS A WATER-SUPPLY

Well-points or tube-wells are small-diameter pipes (usually PVC or polyethylene) jetted into unconsolidated sandy or gravelly formations. The bottom of the pipe is slotted to allow sand-free water to flow into the well-point from where the groundwater is pumped to surface. Well-points are most often utilised for small-scale water-supply or dewatering applications. Depending on the water-transmitting capability of the formation, and the capacity of the pump, a number of well-points can be connected - most effectively in a ring-main configuration - for medium-scale supply (3-5ℓ/s).

The unconsolidated nature of the sand and shallow water-table in the CFAU make for ideal well-point installation and operating conditions. In Cape Town a large number of home-owners on the CFAU have capitalised on this situation and successfully use well-points for garden irrigation (Fig. 4). The installation of well-points for uses other than domestic garden irrigation (as outlined in Sect. 4) is highly feasible and strongly encouraged as a water-saving strategy in the GCTMA. They are cheap to install and operate, and the potential savings (both in water and capital) are significant as outlined below.

5.1 Installation and Operating Costs

The cost to install a complete operating well-point varies between R600 and R2000 (including fittings and pump) depending on whether they are installed by the home-owner or by a well-point contractor. The centrifugal pumps, which are most often connected to the well-points, are self-priming and designed for continuous operation with minimal servicing required, resulting in low maintenance costs.

A 1Hp pump connected to a well-point yielding 0.15ℓ/s (i.e. approximately half what a municipal tap yields) utilises 1.5kWhr at a cost of 25½c to deliver the same volume of water that a municipal tap delivers in 1 hour i.e. ±1080ℓ at a cost of 132c [3]. In this example, groundwater is in the region of 5 times cheaper than municipal water.

The example presented above is, however, a conservative estimate of potential savings since it has been the author's experience that a correctly designed and installed well-point in a transmissive saturated sand horizon, can easily deliver the same or more water than a garden tap, in which case groundwater becomes at least 10 times cheaper than municipal water.

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[3] Figures calculated from July 1995 service charge for water @R1.22/kℓ (Milnerton Municipality) and electricity @16.98c/kWhr (Eskom, Bellville).

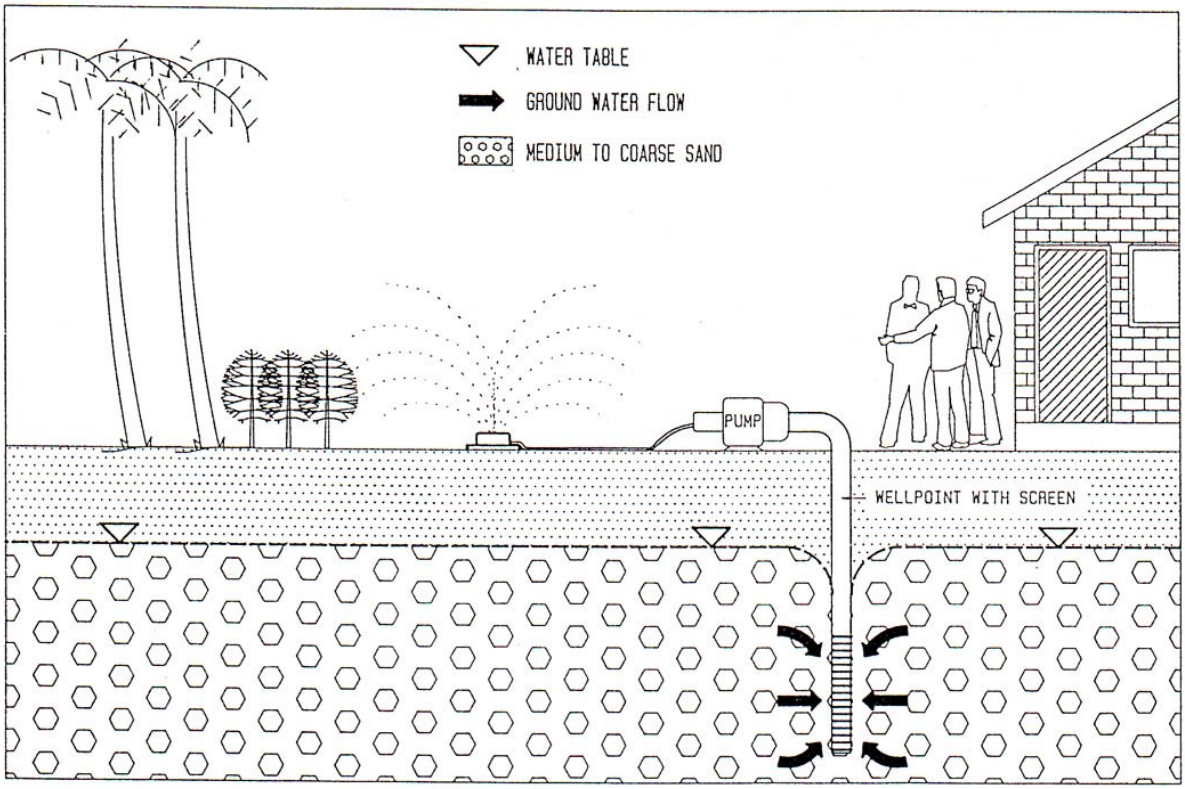

Figure 4 Schematic well-point design.

5.2 Potential Savings

Studies carried out by the author show that summertime water-consumption reductions of between 60% and 80% are realized in an average middle-income household after installation of a well-point utilised exclusively for garden irrigation purposes (Fig. 5). This has resulted in large savings on water-bills and these savings will continue to increase as the cost of water escalates with time.

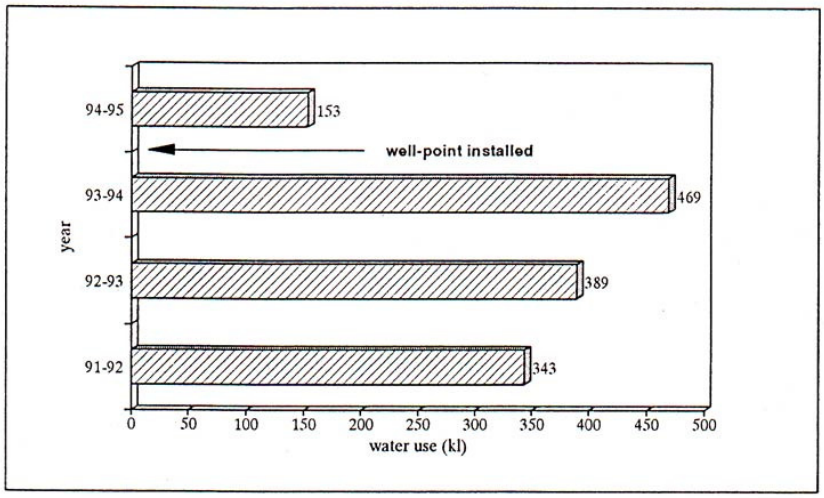

Figure 5 Reduction in summertime (Sept-Apr) domestic water consumption after installation of a well-point.

Enterprising home-owners could install a dual-reticulation system in their house (provided the groundwater pipeline is isolated from the municipal supply) where groundwater from the CFAU is used for all household purposes, except drinking and cooking. This could result in a total saving of 97% on a domestic water bill, according to the breakdown presented in Fig. 3.

If chemical analysis indicates the water to be hard (causing scaling) or have a high iron content (stains laundry), then water-treatment methods can correct the situation. If water-treatment is not considered to be an economically viable option, then savings of ±80% (Fig. 3) on the domestic water-bill can still be realised if groundwater is utilised on the cold-water line for garden irrigation, bathing and toilet flushing.

6 CONCLUSION AND RECOMMENDATIONS

An increased water conservation and awareness ethic has recently been called for by the Minister of Water Affairs and Forestry. One area in which potentially huge water-savings can be realised in the Cape Town Metropolitan Area is by utilising groundwater from the Cape Flats Aquifer Unit, especially for irrigation purposes. Groundwater abstracted from the CFAU by means of well-points is cheap, viable and an environmentally friendly water-supply method and will reduce Cape Town's present dependence on limited surface water resources. Water-savings achieved in this way will assist in realising the government's objective of "water for all", where purified water presently being utilised for eg. garden irrigation can be targeted instead for community supply and sanitation.

An urgent appeal is made to all water-consumers who have the financial means to implement water-saving options, such as middle- to high-income home-owners, schools, municipalities and water-supplying authorities in general, to consider the implementation of groundwater supply systems. This will greatly help to reduce the pressure placed on surface water resources supplying the Greater Cape Town Metropolitan Area, and the unnecessary wastage of purified water that presently occurs annually in Cape Town for uses which do not require water of such a high quality.

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