State of water supply: Western Cape

Water for Agricultural Growth & Development

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Introduction

- It is impossible to predict the future
- South Africa is an arid country and with large variability in rainfall patterns
- Times of drought or water stress will happen
- Droughts naturally occur approximately every 10 years and may last for two or more years.
- We are currently in the third consecutive drought year and rainfall figures indicate it’s the worst year so far.
- The meteorological and hydrological drought could cause a socio-economic drought which could severely impact the agriculture industry of the Province.
- Water is critical for growth and development
- By planning for different scenarios it is easier to adapt to the unpredictable
- Water is an intimately local resource. There is no one solution for every community.
- Each community has to map its own pathway to better sustainable water access and use.
- Water restrictions are an integral part of water resource planning and are used on systems facing deficits to prolong the water supply during periods of water shortage and to prevent depleting (emptying – Day Zero) water supply sources.
<table>
<thead>
<tr>
<th>Management Area</th>
<th>Irrigation</th>
<th>Urban</th>
<th>Rural</th>
<th>Mining</th>
<th>Power Generation</th>
<th>Afforestation</th>
<th>Actual use in m³/a</th>
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<td>74</td>
<td>11</td>
<td>9</td>
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<td>Olientrants/Doring</td>
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<td>1</td>
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<td>2</td>
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<td>0</td>
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<td>704</td>
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<td><strong>Total</strong></td>
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<td><strong>-</strong></td>
<td><strong>12871</strong></td>
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</tbody>
</table>
Future Risk: What we can’t guarantee

1. Short/Medium Term Rainfall
2. Infrastructure Resilience
3. Population increase: Impact
4. Loss of Jobs (Agricultural Sector)
5. Indirect Consequences
   I. Animal Disease Outbreaks
   II. Human Health Impact
   III. Prolonged and more Severe Fire Season

Climate forecasts for this coming winter rainfall are largely inconclusive (due to the low skill of the climate prediction systems in this region) and conflicting (some pointing in different direction). SAWS SCP system indicating above average JJA rainfall is a possibility (a view not shared by all).

June
just below ave.
July
More than half of ave
The Hydro-illogical Cycle

- Panic
- Rain
- Apathy
- Drought
- Awareness
- Concern
Cape Town Weather Office Climate #: 0021178A3
2017 - Rainfall
updated 2017/07/26

2017 Rainfall 40 – 50% of long term average

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
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<tr>
<td>2017 Total Monthly Rain</td>
<td>3.6</td>
<td>0.6</td>
<td>7.6</td>
<td>19.4</td>
<td>5.6</td>
<td>86.0</td>
<td>35.8</td>
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<td>Long Term Average</td>
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<td>40.9</td>
<td>64.6</td>
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<td>Long Term Accumulation</td>
<td>10.4</td>
<td>19.9</td>
<td>32.7</td>
<td>73.6</td>
<td>138.1</td>
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<td>314.0</td>
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<td>2017 Accumulation</td>
<td>3.6</td>
<td>4.2</td>
<td>11.8</td>
<td>31.2</td>
<td>36.8</td>
<td>122.8</td>
<td>158.6</td>
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</table>
2015 represents the lowest national annual rainfall in South Africa since 1904 according to the South African Weather Service.

At present 2017 is well less compared to 2015.
The projection for September through to November period does not project either significant above or below the norm. For October through to December the indication is above the norm for both the Western and Northern Cape except the extreme southern parts of the Western Cape where it is projected to be slightly below the norm.
Impact of CC on the Western Cape

The interaction between rainfall and available water is complex

Summer rain → Reduced releases from dams?
Less early winter rain → less recharge > less runoff?
More intense rainfall → less divertable water into off-channel storage?
Different crops (olives/wine grapes) → reduced requirements?

Will climate change stress our limited and highly variable fresh water from rainfall to an extent that our rivers would become highly stressed where they cannot sustain our water demand for domestic and agricultural etc?
## Overview of Provincial Status of Dams at 26 Sep 2017

<table>
<thead>
<tr>
<th>Item</th>
<th>Cap in $10^6$m³</th>
<th>2017 %</th>
<th>2016 %</th>
<th>Comments</th>
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<tbody>
<tr>
<td><strong>State dams</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Voëlvlei</td>
<td>889</td>
<td>37.16</td>
<td>61.64</td>
<td>Six (6) dams for Western Cape Water Supply System [WCWSS] including inter-basin transfer from Palmiet River * (City of Cape Town, Stellenbosch LM, Drakenstein LM, West Coast DM (Voelvlei Dam) [Swartland LM, Berg River LM and Saldanha LM], Overberg Water (TWK dam)[Caledon]) and agricultural users direct from dams and indirect from downstream releases (3 x WUA, 4 x IB plus individual farmers riparian to TWK dam).</td>
</tr>
<tr>
<td>Berg River</td>
<td>159</td>
<td>27.20</td>
<td>68.71</td>
<td></td>
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<td>Theewaterskloof</td>
<td>127</td>
<td>63.25</td>
<td>70.80</td>
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<tr>
<td>Wemmershoek</td>
<td>479</td>
<td>27.90</td>
<td>53.00</td>
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<td><strong>City’s dams</strong></td>
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<td></td>
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<tr>
<td>Steenbras Upper</td>
<td>32</td>
<td>100.00*</td>
<td>99.23</td>
<td></td>
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<tr>
<td>Steenbras Lower</td>
<td>34</td>
<td>44.79</td>
<td>67.86</td>
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<td>Wemmershoek</td>
<td>59</td>
<td>44.94</td>
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<td><strong>Other dams:</strong></td>
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<tr>
<td>Brandvlei</td>
<td>286</td>
<td>33.01</td>
<td>53.48</td>
<td>Greater Brandvlei Dams [50% restriction]</td>
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<tr>
<td>Kwaggaskloof</td>
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<td>34.04</td>
<td>54.79</td>
<td>Clanwilliam Dam [60% - 80% restriction]</td>
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<tr>
<td>Clanwilliam</td>
<td>122</td>
<td>41.26</td>
<td>99.17</td>
<td>De Doorns (Hexvalley) * Lakenvalley 83% [50% restriction]</td>
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<tr>
<td>Roode Elsberg</td>
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<td>36.85</td>
<td>99.00</td>
<td>Ceres &amp; Koekedouw IB [50% + expected restrictions]</td>
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<tr>
<td>Ceres-Koekedouw</td>
<td>17</td>
<td>43.06</td>
<td>93.62</td>
<td>Grabouw / Elgin [WCWSS restrictions – Palmiet IBT]</td>
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<td>Eikenhof</td>
<td>29</td>
<td>81.39</td>
<td>100.00</td>
<td>Villiersdorp [65% restrictions]</td>
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<td>Elandskloof</td>
<td>11</td>
<td>37.12</td>
<td>91.12</td>
<td>Calitzdorp (Klein Karoo) [50% + expected restriction]</td>
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<tr>
<td>Calitzdorp</td>
<td>5</td>
<td>27.93</td>
<td>85.39</td>
<td>Klein Karoo/Karoo (7 Irrigation dams &lt; 6%)</td>
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<tr>
<td>12 dams in WC</td>
<td></td>
<td>&lt; 15</td>
<td>&gt; 45</td>
<td></td>
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</table>
The integrated bulk water supply system is situated in a winter rainfall area, characterised by wet winters and dry summers, six (6) large dams are filled during the wet winter months, from May to September, when about 90% of the annual runoff occurs and the water requirement comprises only about 30% of the annual requirement.

During the dry summer months, from October to April, inflows to the dams are small and irrigation and requirements in the urban areas are large.

Approximately 50% of the dams’ storage volumes are required for storage during the winter so that the high water requirement (domestic, industrial and agricultural) during the summer can be met.

The remaining 50% of the dams' storage volume is required to provide long-term carry-over storage for periods of drought. Over the last three years the system could supply a restricted volume – tapping from this “reserve” storage. NO RESERVE LEFT !!!

Managing risk (specifically the risk of water supply failure – Day Zero) is an inherent theme underlying the Strategy. Applied restrictions going forth from 1 Oct 2017 limits Domestic & Industrial potable water supply by 40% and Agriculture by 50% against baseline of average use over last 5 years with capping at July 2014/July 2015.

Western Cape Water Supply System
Water Foot Print of Western Cape Water Supply System
Future water supply options

- Water is a non-replaceable source and the Department is constantly investigating and exploring alternatives to ensure long term availability of water.
- From the Western Cape Water Reconciliation Strategy, 2007 (update 2017) other potential surface and ground water interventions are being studied with planned years for introduction, such as
  - the Voëlvlei Pumpscheme Phase I from Berg River (2019) – ave 23 Mm3/a (4 m3/s rate)
  - deep aquifer TMG groundwater augmentation, (2017 – 2019 +, progressive) +/- 50 Mm3
  - Cape Flats aquifer Alluvial groundwater (2017 – 2019 + progressive) +/- 30 Mm3
  - local re-use of treated water and desalination. (2017 - 2019, progressive)
  - the Raising of Lower Steenbras Dam with possible further phases of the existing Transfer Scheme from the Palmiet River to the Steenbras Dams in a partnership with ESKOM,
  - Mitchell’s Pass Diversion (Upper Breede) in augmentation of the Voëlvlei Dam (Phase ii),
- The DWS promotes the move towards a multi water use mix of
  - rainfall reliance schemes,
  - groundwater,
  - desalination,
  - recycling of water
  - maintaining an applied water use efficiency (brown and green footprint)

1 Mm3 = 1000 Ml
Assurance of Supply

• Domestic and Industrial Users (97%)
  – Means that a local community may face a water shortage for 3 years out of 100 years, hence may receive 70% or less water.
  – This is calculated into water supply reconciliations strategies and restrictions adopted in accordance.
  – Future growth and demand drives establishment of augmenting projects in time as not to place a continued burden on end users.

• Agriculture (91%)
  – Means for 7 out of 10 years they may receive 100% of their lawful allocation, but for 3 years that may receive 70% or less.

Water supply systems are usually designed with an assurance rate of 97%, which means that in the worst case they may fail only 3% of time. The conditions we are experiencing 2015 – 2017 seem to be well beyond what one usually plans for.
the heaviest restrictions that can be imposed (and practically implemented) in the worst case scenario are about 30% (up to 50%) for urban users and from 50% (up to 80%) for agricultural users.
Traditional water use for Agriculture in Western Cape

- Agriculture raw water – river abstraction – irrigation – near sole dependency on state dams
- Limited own storage and groundwater - largely run of flow of river
- Minimal reuse - low assurance of supply
- Largely ELU (lawful water use)
- Minimal licensed use
- Limited new fresh water for Agriculture in future*
- Potential for alternate water use options**
Groundwater
The alternative back up water supply

• Groundwater is not a infinite source

• It require rain and snowfall to replenish primary (alluvial aquifers) and deeper secondary aquifers (TMG)

• Groundwater feeds perched- and perennial springs, as well as contribute to significant river or stream flows

• Groundwater suffers from two major disadvantages.
  
  • First, it is intangible – it cannot be seen or touched.
  
  • Second you need to have undergone specialised training to understand its occurrence and movement, and the resource has to be properly managed to promote its sustainable use.
Beaufort West: Groundwater Monitoring Route

- Groundwater level

Main Purpose:
Monitor the communal aquifer status, used for Municipal supply, agriculture and private residents in the town.

Long-term trend:
Downward long term trend accentuated in vicinity of production wellfields was reversed by 2011 floods resulting in the Brandweg wellfield case in virtual full recovery since records began in 1984. In general groundwater in all well fields surrounding Beaufort West are showing a declining trend since the 2011 floods.

Short-term trend:
In the Beaufort West area the 2010 drought was broken when groundwater levels replenished well during 2011. Since then in the Beaufort West area there is a steady decline in groundwater levels in 2013 - 2015 period, but the current groundwater levels are generally still significantly above those of 2010.

Groundwater levels at Brandweg aquifer (Brandweg wellfield vicinity) north east of Beaufort West has since the 2011 end of drought recovered strongly from 45m below ground level (m.b.g.l) to less than 10 m.b.g.l. This progressive recovery in 2013, two years after the flood may indicate a lagged deep regional groundwater flow contribution to the wellfield combined with reduced abstraction. Furthermore, it has been noticed that groundwater level has been slightly declining since 2014 up to date, which significant decline in two geosite G29870L & G29887Ta with a column of 1 and 11 m.b.g.l, respectively.

Comment/Emerging trends:
The resource becomes locally stressed during prolonged drought. The situation has been relieved to some extent by Municipal development of further resources to the south of Beaufort West. Long term sustainability would be better assured by developing groundwater resources even further afield where there is less competition for the resource.

Monitoring recommendations:
Further expansion of monitoring should be achieved via licensing conditions.

Report reference:
GBG/INFORMATION PRODUCT/Georitz/BeaufortWest/BeaufortWest_mon2016-A3

Imagery / data used: Geology 1:250 000 map series; gcs_3222. (Council of Geoscience)
Alternative water supply options

Wastewater re-use

In Israel, however, fully 85% of purified sewage gets reused for agriculture. Today, nearly half the water used for agriculture in Israel comes from highly treated waste water.

The country with the second-highest use of recycled water is Spain. They recycle about 25%.

Local shared use to safe guard domestic growth of town – Hexvalley WUA

Desalination of groundwater

Groundwater inherent qualities may require pre-treatment – although blending with stored fresh water is the preferred treatment choice by most agricultural users, technology has much improved to treat this under developed resource at reasonable cost.
Groundwater supplies +/- 60% of irrigation water in normal rainfall seasons.

If not carefully managed (restricted) this resource could also become depleted.
New fresh water options

Agriculture has been identified as a sector to expand in the National Development Plan, with intensive, export orientated industries in particular identified as key in creating jobs within the rural economy.

Ambitious job creation targets will require investment in irrigation infrastructure and consequently, the response to the current drought must continue to foster an enabling environment where investment can flourish.
Informed?

We make water plans ...
Clanwilliam Dam
(Lower Olifants River System)

- A barrage was built in 1917 about 26 kilometers downstream of now called Clanwilliam Dam, known as the Bulshoek dam and a system of canals extending a further 80 kilometer down the Olifants River valley form part of the system.

- Clanwilliam Dam was completed in 1935 and had a gross capacity of 77.64 million m³. The scheme was initially built to support irrigation of 8 500 ha of land along the Olifants River and Van Rhynsdorp District.

- The Clanwilliam dam was raised in the 1960`s to a capacity of 122 million m³ and the dam capacity is currently being increased further to about 344 million m³ by raising the wall by 13m. The raising could make water available for nearly an additional 5000 hectares of new crop establishments.

- The agricultural sector has a current allocation of $192 \times 10^6$ m³ /a, versa the full supply capacity of the dam set as $122 \times 10^6$. The remainder of the water allocations is dependent on rainfall and flows generated by the Doring River.
• Although the Clanwilliam Dam supports water primarily for irrigation it also supplies domestic and industrial use to five towns and four settlements.

• The Clanwilliam Dam is currently on 41.26% \(26/09/2017\). The same time last year it was on 99.19%. Based on the projection of rainfall and inflow into the dam the level in the dam could reach about 45% by the end of September 2017.

• In a normal year the allocation of water for the irrigation is in the region of 8 000 m\(^3\) per hectare per year during the summer months of October to May.

• With the current situation, the maximum allocation estimated is in the region of 1400 m\(^3\) per hectare after allowing enough water for the towns until next winter. This is a restricted supply of near 80% in allocation of irrigation water.

• 860 commercial farmers, 12500 hectares of crops, 7000 permanent workers, similar amount of seasonal workers and large scale industry will may face severe socio-economic impacts.

• This impact across the whole valley would continue in 2018/19 even if the 2018 rainy seasons is above normal or extreme. This would be as a result of the current prolonged drought on permanent crops.
The Brandvlei Project

– The Canal:
  • Cost of increasing the wall of the canal by 30 cm: R15 million
– Capacity created:
  • Additional water to be stored: 33 million m³
  • Additional area to be irrigated: 4 400 ha
– Impact on irrigation farming:
  • Capital to be attracted: R2,2 billion
  • Primary jobs to be created: 8 000
  • Secondary jobs to be created: 6 500
– Phase 2:
  • Increase capacity of the Papenkuils Pump Station
  • Additional 51 million m³ to be stored.
  • This is enough to irrigate an additional 6 800 ha
  • Pre-feasibility will be commissioned
Currently 29% full in comparison to 48% last year.

The additional yield to this dam has already been diverted to increase sure supply since 1996.

Existing agricultural users could also face severe restrictions in supply this oncoming season commencing at 1 November.
Irrigated crops under the Brandvlei scheme

- **27 138 ha irrigated**

- Wine grapes: 72%
- Peaches: 7%
- Apricot: 4%
- Lucerne: 4%
- Plums: 3%
- Olives: 2%
- Naartjies: 1%
- Small grain: 1%
- Table grapes: 1%
- Oranges: 1%
- Other: 4%

**Source:** WCDOA (2016)
Water