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ABBREVIATIONS AND ACRONYMS

IWA	International Water Association
ORASECOM	Orange Senqu River Commission
NRW	Non-revenue water
NWRS	National Water Resources Strategy
SADC	Southern African Development Community
ToR	Terms of reference
VGG	Vaal Gamagara
WDM	Water demand management
WSS	Water supply and sanitation

1. EXECUTIVE SUMMARY

The Terms of Reference and Methodology

The ToR requested the team to analyse WDM potential in 62 Towns in SA, looking at the total water savings (in transboundary basins) that may be realised if the relevant infrastructure and processes are put in place in all these towns.
While these 62 Towns do not provide a good coverage of South Africa's transboundary basins, data has come available for 132 towns. This is more than half of SA's 237 local authorities, and covers more than 75% of the total domestic water supply in the Country.
The data from these 132 towns provided sufficient information to support the extrapolate to all 237 local authorities. While this added considerably to the overall scope of the work, it was considered necessary to effectively address the Terms of Reference.
Linking the NRW and physical water savings to drainage basins proved difficult, but GIS models provided the opportunity to 'allocate' the potential savings to South Africa's transboundary basins.

Key outcomes

- The implementation of WDM across South Africa is driven forward by a Presidential Directive – requiring local authorities to take action.
- The benefits are significant;
  - Non-revenue (unbilled) water (NRW) savings of on average 36.4% of total domestic supply are possible;
  - This is (for the whole of South Africa) can result in savings on some 1.6 billion m^3 of water per year.
  - Of this 25% makes up direct water savings (i.e. water losses).
  - The direct Financial benefit of these savings is some R 7.2 billion per year
- For the transboundary basins, Non-Revenue Water (NRW) savings are;
  - Limpopo - 280 million m^3/a
  - Orange-Senqu - 656 million m^3/a
  - InKomati - 45 million m^3/a
  - Usutu-Phongola – 82 million m^3/a (includes some non-transboundary systems)
- This translates into somewhat less actual savings in water, as only a portion of NRW is actual losses. Using the data from the 132 towns, and based on two scenarios for possible saving, the following has been extrapolated for physical water savings in the transboundary basins;
  - Limpopo – 66.2 to 90 million m^3/a
  - Orange-Senqu – 87 to 150 million m^3/a
  - InKomati – 9 to14 million m^3/a
  - Usutu-Phongola – 22 to 28 million m^3/a
- The actual savings are likely to be much lower, as in most cases the local authorities will plough back any savings into improved service delivery.
- To put these figures further in perspective, the total water demands in these basins are;
  - Limpopo – 2,600 million m^3/a
  - Orange-Senqu – 4,000 million m^3/a
  - InKomati - 844 million m^3/a
  - Usutu-Phongola – 717 million^3/a

Relatively speaking WDM, even if applied to every town in the transboundary basins, and assuming that all the saved water was left in the river, would make very little difference to overall water availability. However, the Revised SADC Protocol on Shared Watercourses requires that water use efficiency is considered as one of the factors in the reasonable and equitable use of water. WDM can consequently play an important role in transboundary water resources management. For example Some 780 Mm^3/annum are transferred into the Vaal sub-catchment from Lesotho. Potential water savings of some 87-147 Mm^3/a in the Vaal System are therefore significant in terms of the demand on the LHWP. Similarly, the 14 million m^3 water savings in the InKomati would provide for the agreed cross border flows in the interim Inco-Maputo Agreement.

Recommendations

CRIDF is not likely to be in a position to offer broad support for WDM to local authorities across South Africa; the number of projects may place a prohibitive burden on the Facility. However, the WDM technology is proven, and is clearly 'financeable' with considerable cost savings for local authorities.

It is therefore recommended that CRIDF;

- Investigates the modalities of establishing a loan financing facility that provides seed financing, with ring-fencing options to ensure repayment.

- Supports interventions in specific cases through its other projects, like the Vaal-Gamagara pipeline (and potentially the Ressano Garcia Weir), where WDM may have knock on benefits for other CRIDF objectives may be warranted, and were the water supply infrastructure crosses the border.

- Highlights the role of WDM in ensuring reasonable and equitable water use the longer-term, and hence in securing regional peace dividends.

- Includes WDM measures in any Projects aimed at improving potable water supply throughout the region.

2. INTRODUCTION

This potential project stems from a South African submission to the SADC Infrastructure Investment Conference in Maseru in September 2011. A number of local authorities in South Africa have established a range of WDM activities including pipe leakage repair, pressure reduction, re-use of water, and improved metering; with considerable success. Up to 31% reductions in total water use, and 38% reductions in Non-Revenue Water (NRW) losses have been noted. Reduced NRW losses has resulted in significant cost savings, with knock on benefits to the financial status of these local authorities and hence improved service delivery. For this reason, local authorities in South Africa have been encouraged, through a Presidential decree, to implement these measures as a matter of priority.

However, while the benefits to local authorities in South Africa are clear the transboundary and climate resilience benefits in terms of improved water supply in droughts are not as evident. Urban water use in South Africa has been estimated at 23% of total water use, and total water savings may be relatively modest. Direct benefits to neighbouring countries will be limited to transboundary basins. Climate resilience benefits may also largely depend on how local authorities, and the country as a whole, choose to use the savings.

The objective of this Activity is therefore to provide the information required to determine whether CRIDF should support WDM measures in local authorities in South Africa. This has been done through a scoping level examination of the transboundary climate resilience benefits that might accrue.

The Activity delivered the following;

- A determination of the water and financial savings that may result if WDM is implemented across the 62 (132) local authorities as outlined in South Africa's proposal at the Maseru Conference;
- An assessment of the extent to which the project may contribute to changed water availability in transboundary basins;
- An outline of other potential or indirect benefits that may accrue from the interventions;
- An assessment of viability of expanding this to other CRIDF focus countries.

3. DETERMINING POTENTIAL WATER SAVINGS

3.1 REVIEW OF EXISTING INFORMATION AND PREVIOUS STUDIES

The ToR make reference to "62 local authorities". This number comes from a study carried out for the Water Research Commission (Seago & Mckenzie, 2007) which based its findings on the analysis on 62 selected local authorities for which reasonable quality data were available. One of the objectives of this report was to use the results of the analysis to extrapolate a preliminary estimate of the total level of non-revenue water for all water supply systems in South Africa.

This study has recently been superseded by a more comprehensive study (McKenzie, Siqalaba, & Wegelin, 2012) in which 132 of the total of 237 municipalities in South Africa were analysed. The findings of this study, together with a study to develop a priority list for water loss reduction activities in South Africa's Department of Water Affairs (Directorate: Water Use Efficiency, 2012), provide the main inputs for this scoping study

Other literature reviewed includes:

- A short report on the benchmarking of leakage from water reticulations systems (Mckenzie & Seago, 2005),
- A business plan for the implementation of water conservation and WDM in the Upper and Middle Vaal (Department of Water Affairs and Forestry, 2007)

3.2 METHODOLOGY

3.2.1 Introduction

This section outline the approaches used to determine the total water use and financial savings that may result from implementing WDM firstly across the 132 local authorities that have been analysed in the 2012 study, and then through extrapolation to all local authorities in South Africa. The following key points are briefly discussed in the following paragraphs

- Non-revenue water;
- Classification/definition of local authorities;
- Location of local authorities, and;
- Information available for each municipality

3.2.2 Non-revenue water

There is sometimes some confusion on the various terms that are used in relation to non-revenue water. The standard terminology, as used by the International Water Association (IWA) is considered to be the most comprehensive and robust. The different elements of the IWA water balance are shown in Figure 3-1.

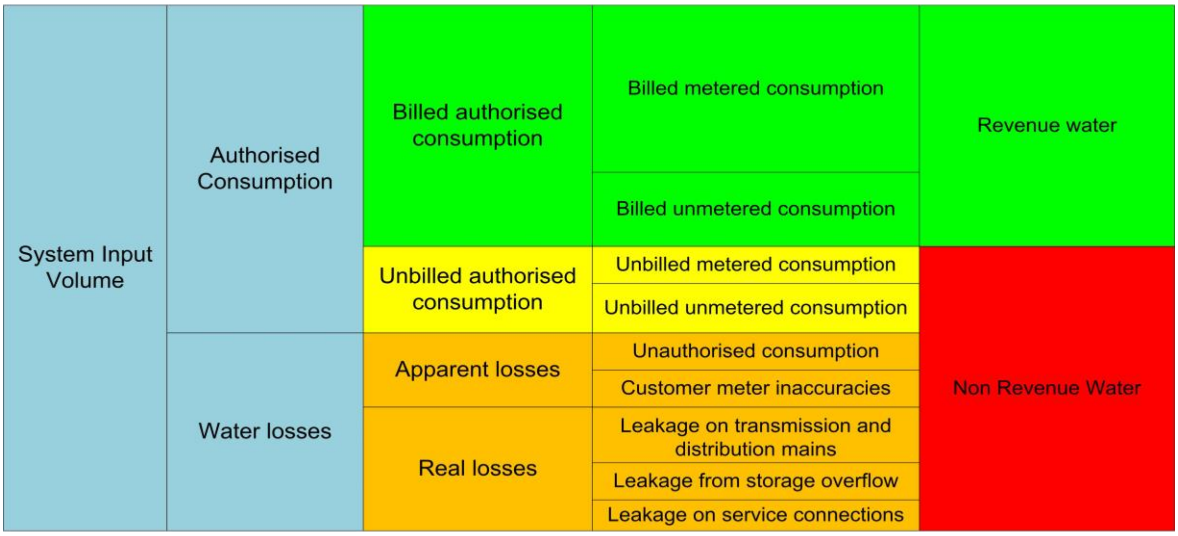


Figure 3-1: Standard IWA water balance

3.2.3 Classification/description of local authorities

Local authorities in South Africa are classified into 5 types as outlined in Table 3-1.

Table 3-1: Classification and description of local municipalities in South Africa

Category	Short description	Long Description	Number in sample of 132
A	Metros	Metropolitan municipalities	6
B1	Major cities	Secondary cities, local municipalities with the largest budgets	21
B2	Minor cities	Municipalities with a large town as core	29
B3	Rural dense	Municipalities with relatively small population and significant proportion of urban population	111

		but with no large town as core	
B4	Rural scattered	Municipalities which are mainly rural with, at most, one or two small towns in their area	70

3.2.4 Location of local authorities

The locations of the 132 municipalities used by (McKenzie, Siqalaba, & Wegelin, 2012, together with their classifications are shown in Figure 3-2, showing their locations in the various transboundary basins.

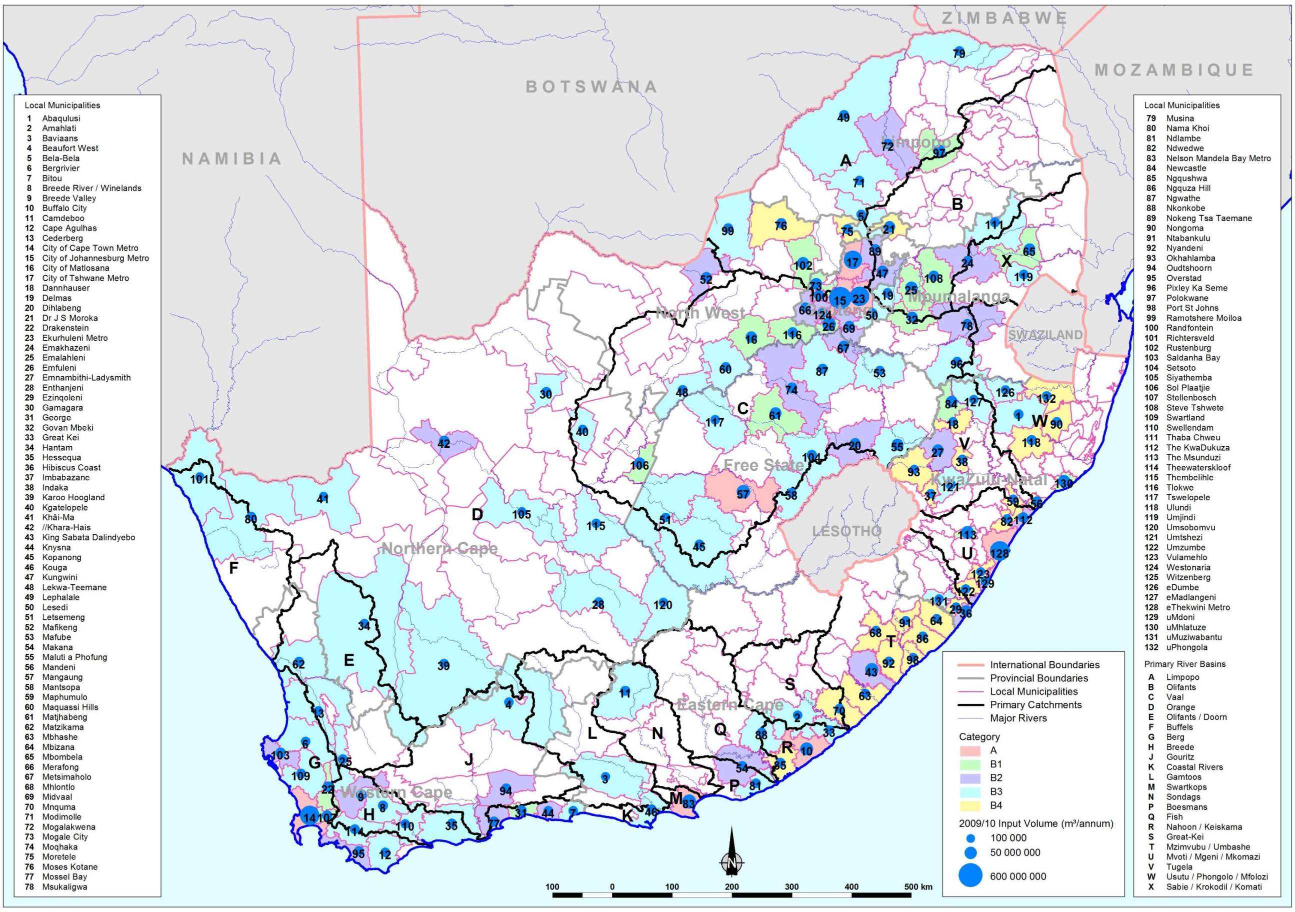


Figure 3-2: Location of local authorities within river basins

3.2.5 Information available and calculation method

The steps in calculating the NRW component of WDM measures and the financial savings that may accrue can be summarised as follows:

- Adequate information was available for 132 local authorities out of a possible 237.
- For the 132 local authorities, total water losses (*apparent losses* and *real losses* in Figure 3-1) were added to the estimated unbilled consumption (*unbilled unmetered* and *unbilled metered* in Figure 3-1) to obtain the figure for un-billed consumption. This compromises the NRM component.
- Knowing the input volume for each municipality meant that the percentage of NRW could be calculated for each authority.

- Based on the total water demand for all 237 local authorities, the 132 local authorities were estimated to represent 75% of the total volume of municipal water supplied in South Africa.
- Urban and rural water demand in 2000 was estimated as 3 471 Mm^3/a (Department of Water Affairs, 2004). Applying national population growth rate plus 1% to estimate current demand. (NB "demand" is the water input before any losses).
- Extrapolating these figures for each local authority type made it possible to calculate NRW nationally per municipality type.
- Different production rates (the cost of producing a unit of treated water in different local authorities) were used to estimate the financial value of the Non-Revenue Water

3.2.6 Sub-basin approach

Existing studies have not attempted to analyse the data by basin, which was required for this study. In this scoping assessment, the 132 local authorities were grouped into South Africa's 24 primary drainage basins (see Figure 3-2 and Annex 1). NRW was then estimated for each sub-basin.

3.3 Findings

3.3.1 Introduction

This section outlines the possible NRW and physical water losses for the South African portion of transboundary basins which lie partly in the territory of South Africa, using the methodologies outlined above.

3.3.2 Water use savings

3.3.2.1 Overall

Non-Revenue Water estimated for the whole of South Africa is 36.4% of the water demand, while 25.4% is considered to be losses through physical leakage (real losses). The NRW figure is similar to the estimated world average of 36.6% but is considered high in comparison to other developed countries and low when compared to other developing countries. Other SADC countries, which may be less resourced, are likely to have higher percentages of NRW. However, Namibia which has invested heavily in water savings have lower NRW losses. Noting that major cities (category B1) in South Africa have on average 41.6% NRW, and rural areas have up to 47.6% NRW; one may expect that SADC countries where the cities are less well resourced, and with higher rural populations may have similar percentages of NRW.

Total water demand (input) for the 237 local authorities corresponds to 4 292 Mm^3/annum. This compares to 3 190 Mm^3/annum for the 132 analysed authorities. NRW for the selected authorities corresponds to 1 164 Mm^3/annum and 1 589Mm^3/annum for all local authorities. The results are summarised in Table 3-2.

Table 3-2: National extrapolated Non-Revenue Water

Municipality Category	Population (2010)	Input (mcm/a)	NRW (mcm/a)	RW (mcm/a)	% NRW	l/c/d
A	18 809 957	1 955 907 543	676 579 565	1 279 327 978	34.6%	285
B1	6 366 742	576 850 894	240 197 621	336 653 273	41.6%	248
B2	3 882 070	325 623 095	89 213 737	236 408 358	27.4%	230
Urban Total	29 058 769	2 858 381 532	1 004 784 393	1 853 597 140	35.2%	269
B3	3 845 279	230 642 568	84 447 079	146 195 489	36.6%	164

B4	4 245 736	101 138 956	73 334 514	27 804 442	72.5%	65
Rural Total	8 091 015	331 781 524	157 781 593	173 999 931	47.6%	112
National Total	**37 149 784**	**3 190 163 056**	**1 163 773 516**	**2 027 597 071**	**36.4%**	**235**
Extrapolated	**49 988 373**	**4 293 108 595**	**1 561 294 608**	**2 731 814 088**	**36.4%**	**235**

3.3.2.2 Savings by sub-basin

OVERVIEW

The volume and percentage of NRW by primary drainage area was done as follows:

- For the 132 local authorities for which adequate data are available, their positions and main water sources were determined.
- The total input and non-revenue losses for each of the basins shown in Figure 3-2 was summed. These are shown in columns 3 and 4 of the table below.
- As 75% of the national demand was covered by the 132 towns; 25% of both the input and non-revenue water was distributed around the remaining 105 local authorities in proportion to their populations.
- The final step was to allocate the demand against one of the main river basins A to X. The GIS was useful for this but some care had to be taken because many local authorities draw water from a catchment adjacent to the one in which they are situated. In many cases, local authorities lie in more than one basin.
- The total water demand and the non-revenue water was then determined for each drainage basin (see Table 3-3).

Table 3-3: Summary on water input and non-revenue water by main river basin

ID	River Basin	Input (mcm/a)	NRW (mcm/a)	Total Input (mcm/a)	Total NRW (mcm/a)	% NRW
A	Limpopo	127 705 764	49 343 859	286 195 097	110 582 091	38.6%
B	Olifants	154 250 879	74 048 894	353 162 361	169 537 330	48.0%
C	Vaal	1 510 748 971	561 732 699	1 611 121 291	599 053 534	37.2%
D	Orange	46 105 570	12 528 567	211 060 771	57 352 917	27.2%
E	Olifants-Doorn	14 154 537	4 020 718	28 551 522	8 110 305	28.4%
F	Buffels	364 443	143 837	20 123 342	7 942 205	39.5%
G	Berg	394 041 517	94 752 430	394 499 231	94 862 493	24.0%
H	Breede	26 340 724	6 705 736	26 340 724	6 705 736	25.5%
J	Gouritz	26 980 254	6 085 151	39 962 109	9 013 091	22.6%
L	Gamtoos	11 136 102	2 942 012	18 290 414	4 832 087	26.4%
M	Swartkops	94 036 000	35 122 000	94 036 000	35 122 000	37.3%
N	Sondags	6 590 000	2 330 000	11 518 991	4 072 724	35.4%
P	Boesmans	3 368 070	134 1700	3 368 070	1 341 700	39.8%
Q	Fish	5 248 991	1 483 991	17 542 657	4 959 647	28.3%
R	Nahoon-Keiskama	68 087 068	29 579 572	68 087 068	29 579 572	43.4%
S	Great-Kei	6 337 990	3 559 118	45 786 090	25 711 321	56.2%
T	Mzimvubu-Umbashe	96 600 266	12 195 192	182 969 447	23 098 771	12.6%
U	Mvoti-Mgeni-Mkomazi	411 389 230	170 831 107	453 042 613	188 127 849	41.5%
V	Tugela	77 968 762	46 314 010	137 006 922	81 383 105	59.4%
W	Usutu-Phongola-Mfolozi	73 513 985	34 395 733	174 976 040	81 867 812	46.8%
X	Sabie-Krokodil-Komati	35 193 933	14 317 191	115 467 936	46 973 339	40.7%
	TOTALS	**3 190 163 057**	**1 163 773 516**	**4 293 108 695**	**1 589 022 101**	**37.0%**

TRANSBOUNDARY BASINS

The volume and percentages of NRW for the transboundary basins shared by South Africa are summarised in Table 3-4.

Table 3-4: Transboundary basin shared by South Africa

Code on Figure 2.2	Basin	Shared with	NRW (mcm/a)	% NRW
A + B	Limpopo	Zimbabwe, Botswana, Mozambique	280 119 421	43.8%
C + D	Orange-Senqu	Lesotho, Botswana, Namibia	656 406 451	36.0%
Part of W	Usutu-Phongola-Mfolozi	Swaziland, Mozambique	81 867 812	46.8%
X	Sabie–Krokodil-Komati	Mozambique, Swaziland	46 973 339	40.7%

3.3.3 Financial savings

Using the costs of supplying treated water in various categories of local authority, it was possible to estimate the financial value of the Non-Revenue Water as summarised in **Error! Reference source not found.**. The estimated value of NRW is more than R7 billion annually.

Table 3-5: Financial value of Non-Revenue water

Municipal Category	Production Rate (R/kl)	Estimated cost to supply water (R million/a)	Estimated value of NRW (R million/a)
A	R5.00	R9 245.46	R3 170.96
B1	R4.50	R3 076.50	R1 271.63
B2	R4.00	R1 302.49	R397.63
Urban Total		**R13 624.45**	**R4 840.22**
B3	R3.50	R807.25	R298.30
B4	R3.00	R303.42	R220.00
Rural Total		**R1 110.67**	**R518.30**
National Total		**R14 735.12**	**R5 358.52**
Extrapolated Total		**R19 827.42**	**R7 210.38**

3.3.4 Other findings

Other findings which are of relevance include the following:

- **High % losses in low income areas**: The average bulk system input volume per property served for the low to medium income areas is 37 kl per property per month compared to an expected value of 12 kl per property per month. Suggesting that NRW losses in these areas may be up to 3 times that of higher income areas.
- **Lower % loss rates in medium to high income areas**. The average monthly water use per property in the medium- to high-income areas was estimated to be in the order of 46 kl per property per month. It seems that opportunities to reduce this figure may be limited since levels of NRW in these areas are generally quite low.

- Unbilled authorised consumption in the low- to medium-income areas is greatest. However, unbilled authorised consumption is generally based on a “deemed consumption” or assumed meter readings, which may underestimate actual use.

The potential savings in water in towns and cities elsewhere in SADC, with higher proportions of low to middle income areas, is therefore likely to be significant. WDM studies should therefore be included in any CRIDF projects aimed at ensuring water supplies to urban areas. However, the financial savings would depend on the amount of NRW that can be billed, which depends on how the local authority recovers the costs of water provision.

4. IMPACT ON TRANSBOUNDARY BASINS

4.1 OVERVIEW

Non-revenue water makes up a significant portion of total water supplied to domestic users in the four transboundary basins that lie partly in South Africa, making up to 40% of total water supplied for domestic use. However, the extent to which efforts to tackle non-revenue water losses will result in substantial transboundary benefits will depend on two factors;

- The percentage of NRW that is made up of real water losses; and
- Whether any savings in water and income would go to improving the reliability of supply or reticulating new areas within the local authority;

As indicated in Figure 3-1, only a part of non-revenue water comprises real physical losses; of these physical losses not all can be prevented. It is reasonable to assume, and experience suggests that NRW can be brought down to between 25 and 30 % of total water demand and that 75% of NRW could represent real water savings. Table 4-1 is based on these assumptions and shows the quantities of water that would be freed up if efforts to address NRW are applied to all the Local Authorities in the transboundary basins.

Table 4-1: Potential water savings (Mm^3/annum) from WDM in transboundary basins

Basin ID[1]	Basin	NWR reduced to		Saved water if NWR reduced to		Actual water freed up if NWR reduced to:	
		30%	25%	30%	25%	30%	25%
A	Limpopo	85.9	71.5	24.7	39.0	18.5	29.3
B	Olifants	105.9	88.3	63.6	81.2	47.7	60.9
	TOTAL Orange	**191.8**	**159.8**	**88.3**	**120.2**	**66.2**	**91.2**
C	Vaal	483.3	402.8	115.7	196.3	86.8	147.2
D	Orange-Senqu	63.3	52.8	0	4.6	0	3.4
	TOTAL Limpopo	**546.6**	**455.6**	**115.7**	**200.9**	**86.8**	**150.6**
W	**Usutu-Phongola-Mfolozi**	**52.5**	**43.7**	**29.4**	**38.1**	**22.0**	**28.6**
X	**Sabie–Krokodil-Komati**	**34.6**	**28.9**	**12.3**	**18.1**	**9.2**	**13.6**
	Totals	**825.6**	**688.0**	**239.8**	**377.4**	**179.8**	**283.0**

[1] NRW have been shown separately for the Vaal and Olifants sub-basins since NRW is much higher in these areas. NWR in the Orange-Senqu (excluding Vaal) is only 27%, thus actual water savings are not possible for the 30% reduction scenario target (hence the 0 value)

While the quantities of water that could become available represent a significant portion of the total domestic and industrial water supply, the impact on savings in this sector must be set against the overall water demand in the basins. In all of the transboundary basins, domestic and industrial water demand accounts for a small portion of the overall demand:

- In the Limpopo Basin, domestic and industrial demand at 286.2 Mm^3/a, is only just over 10% of the total demand of 2 806Mm^3/a within the South African portion of the basin.
- In the Orange-Senqu Basin, domestic and industrial demand at 1 822 Mm^3/a, is 45% of the total demand of 4 053 Mm^3/a within the South African portion of the basin
- In the Inkomati Basin, domestic and industrial demand at 115 Mm^3/a, is just over 13% of the total demand of 844 Mm^3/a within the South African portion of the basin.
- In the Usutu Basin, domestic and industrial demand at 175 Mm^3/a, is only just over 24% of the total demand of 717Mm^3/a within the South African portion of the basin

In the Limpopo and Inkomati basins, the transboundary impact of implementing WDM in all towns on the total availability of water would be relatively small. Savings through more efficient irrigation are likely to be much more significant.

However, in the Orange-Senqu Basin the majority of domestic and industrial use is in the Vaal sub-basin. In this sub-basin, domestic and industrial demand represents more than 80% of the overall demand. In addition to this, NRW accounts for more than 37% of domestic and urban demand. WDM in the Vaal sub-system may therefore make an appreciable difference to the demands on the Lesotho Highland Scheme. Some 780 Mm^3/annum are transferred into the Vaal sub-catchment from Lesotho. Potential water savings of some 87-147 Mm^3/a are therefore significant.

The introduction of WDM in the Vaal system may therefore push out the need for further augmentation of supplies to the Gauteng Province in South Africa, with potentially regional (SADC wide) impacts. Additional water could also be supplied to Botswana from the lower reaches of the Vaal system without affecting the overall the security of supply to South Africa. Nonetheless, the basin-wide perspective also needs to account for impacts on Lesotho in terms of water royalties and power production on water transferred, as well as Namibia's rights and obligations.

Similarly, the some 14 million m^3 that could potentially be saved in the InKomati could make up the minimum cross border flows required under the interim Inco-Maputo Agreement. Recognising that the economy of water use is one of the considerations underpinning the reasonable and equitable use of water outlined in the Revised SADC Protocol on Shared Watercourses.

As such, while WDM will not necessarily result in significantly increased cross border water availability, it must play an important role in the reasonable and equitable use of water in transboundary basins in the longer term.

4.2 SPECIFIC CASE (S) OF VAAL GAMAGARA SCHEME

4.2.1 Introduction

In terms of the potential impacts of WDM on transboundary water resources it is useful to distinguish between two situations:

- Transboundary basins where the raw water resources are shared. A reduction in use upstream would make more water available for downstream uses (and *vice versa* in some cases).
- Transboundary basins where water supply infrastructure is (also) transboundary or could be, for example the possible extension of the Vaal Gamagara pipeline into Botswana.

The Vaal-Gamagara pipeline deserves special attention since it is possible that water demand management at local authorities served by the pipeline could reduce the size and cost of the proposed upgrading project and make the possibility of extending the pipeline to communities in Botswana more feasible and economical. Bearing in mind that the majority of users in Botswana will be non-commercial, Botswana will have a strong interest in keeping costs down and clearly the overall cost will be dependent on efforts made by both the commercial and domestic sectors in South Africa. This project is briefly reviewed in the following sections.

4.2.2 Brief description of the scheme

The Vaal Gamagara (VGG) Government Water Supply Scheme was completed in 1968 with the purpose to deliver Vaal River water to towns in South Africa, south of the border with Botswana (Figure 4-1). It consists of a purification works with capacity of 13.27 million m³/a, booster pumps, 10 reservoirs and 430 km of pipelines, stopping some 100km south of the Botswana border. The pipeline currently has the capacity to convey approximate 15 million m³/a. (KV3, WRP, Kayamandi Development Services *et al*, 2011). The de-watering of mines in proximity to Postmasburg and the distribution of this water via the Vaal Gamagara pipeline can increase the volume of water imported to some areas of the system. The system provides water to some areas where there is no potable groundwater, the so-called the so-called salt block areas.

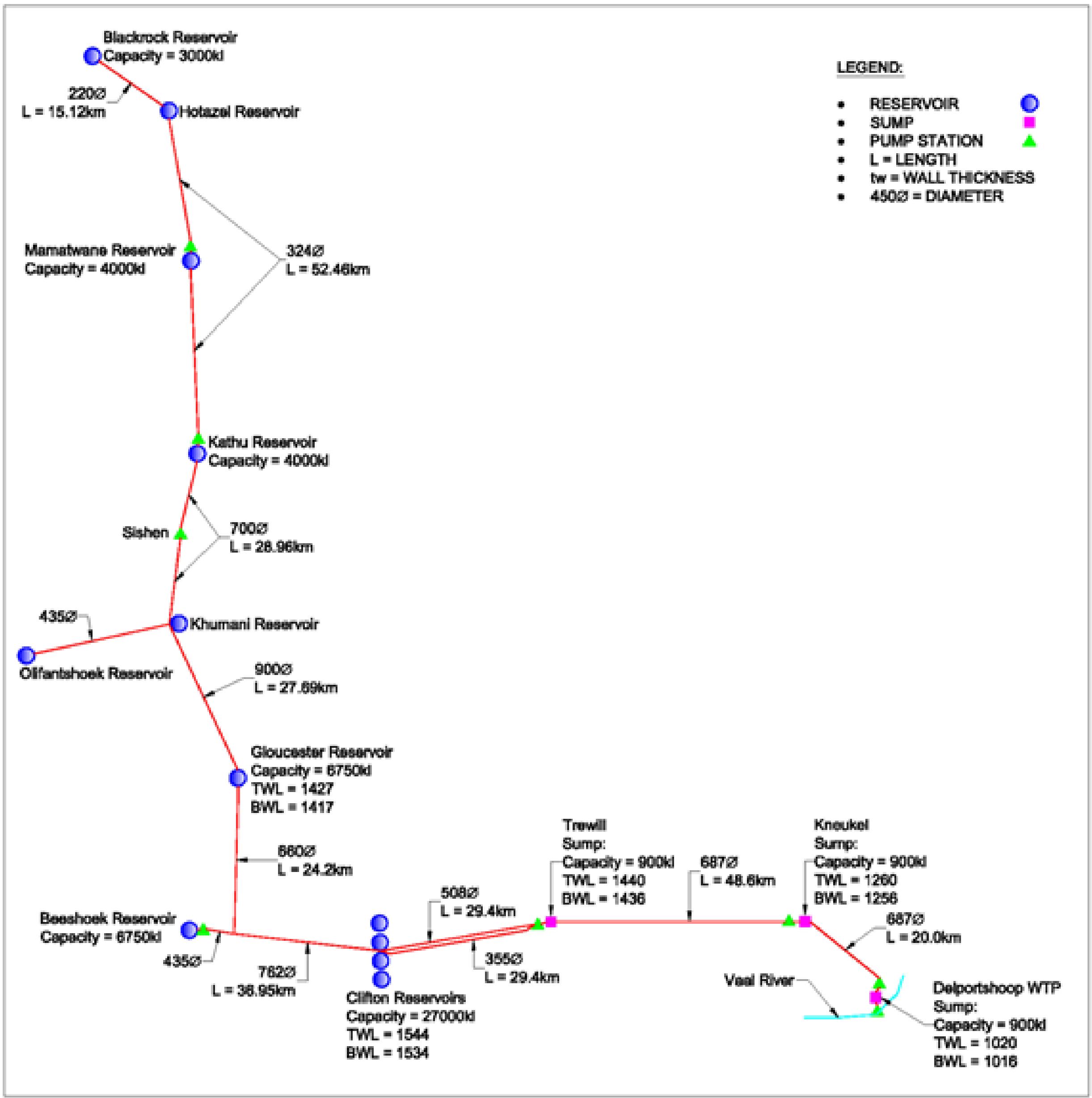


Figure 4-1: Layout of the Vaal Gamagara Water Pipeline and Scheme

The majority of the assets of the original Vaal Gamagara Scheme are 35 to 40 years old and are operating over or very near to the expected useful life. The condition of the pipeline and pump stations has been investigated in detail, and replacement and repair of pumping stations is an ongoing process. The cathodic protection system on the pipeline is only partially functional and corrosion rates are high in many places. Internal inspection (KV3, WRP, Kayamandi Development Services et al, 2011), revealed that there has been comprehensive failure of the internal pipeline lining and that internal corrosion was generalised.

As a result of the deteriorated condition and the need for increased capacity, three options for upgrading the system have been considered.

- Replacing the existing pipeline with an single larger scheme and abandoning the existing pipeline at a total cost of 5 444 million ZAR
- Refurbish the existing pipeline and have two parallel pipelines at a cost of 6 946 million ZAR
- Refurbish the existing pipeline and develop conjunctive use with augmented groundwater at a cost of 5 782 million ZAR.

Plans are well underway to replace a degraded section of the pipeline as a matter of urgency. However, construction on the wider project could be offset if WDM is implemented, providing more time for demands to catch up with the current capacity of the pipeline. This would provide the opportunity for Botswana to be fully engaged in discussions around their participation in the scheme.

4.2.3 Current and future water demands

The total current and projected water use from the Vaal Gamagara Scheme, according to the different water use sectors, is presented in Table 4-2. The mining sector currently (2010) utilises 63.5% of the Vaal Gamagara Scheme, whereas the local authorities and other water users currently utilise 14.7% and 21.8% of the total scheme's water use respectively. A water demand of 5 Mm^3/annum via an extension to Botswana has been included in the current studies on the upgrading of the pipeline. These projections include the introduction of WDM along the pipeline.

Table 4-2: Summary of current and future water demand for the Vaal Gamagara Scheme[1]

Description	Surface Water (Vaal Gamagara Scheme) m^3/annum		
	Required Water Use assuming Scenarion4 (see next section)		
	2010	2015	2030
Total Local Authority	**2 076 319**	**3 229 380**	**9 812 200**
Total Gov (Exp. Station)	29 267	30 730	35 574
Total Gov (Lohatla)	757 302	817 886	1 030 301
Total Gov (Clinton Founation)	0	1 452 000	2 752 000
Total Gov	**786 569**	**2 300 617**	**3 817 875**
Total Farming	**87 812**	**92 167**	**97 036**
Total Kalahari East	**2 140 015**	**3 250 433**	**3 250 433**
Total Transnet	48 409	50 830	58 884
Total Eskom	3 311	3 476	4 024
Total Private	921	967	1 015
Total Industry	**52 641**	**55 273**	**63 923**
Total Existing Mining	8 745 343	14 659 618	13 848 550
Total New Mining	217 250	2 626 650	2 644 900
Total Prospecting	0	911 638	1 823 275
Total Mining	**8 962 593**	**18 197 906**	**18 316 725**

[1] Source : (KV3, WRP, Kayamandi Development Services et al, 2011)

Cross-border to Botswana	0	0	5 000 000
TOTAL	14 105 949	27 563 776	40 796 192

4.2.4 Water Demand Management

The study on the upgrade of the pipeline considered four different municipal water requirement scenarios as highlighted below.

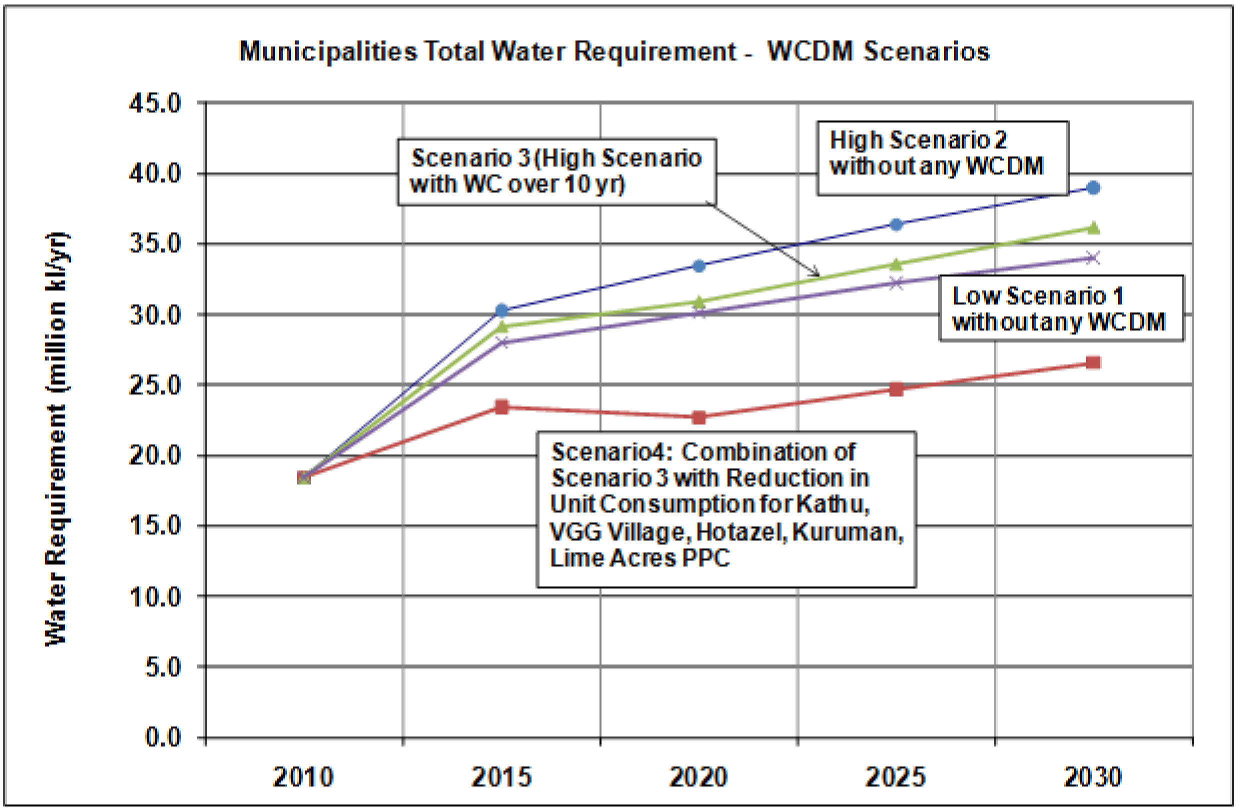


Figure 4-2: Projected water requirements under low and high growth scenarios

Scenarios 1 and 3 are essentially the low and high growth scenarios respectively, both without any significant WDM and water conservation efforts. Scenario 3 is based on the assumption that a physical loss reduction programme would be applied at all towns, irrespective of current levels of consumption. Scenario 4, however, has taken the potential impact of WDM separately for each town. Towns with excessive per capita consumption were treated differently from those with low per capita consumption. A more detailed and aggressive WDM programme was assumed for these local municipalities. They included the following towns:

- Skeyfontein,
- Kathu,
- Hotazel,
- Kuruman and
- Lime Acres PPC and
- KEW

The per capita consumption and levels of NRW (where known) for these towns is highlighted in Table 4-3. While urban water demand is much smaller than mining demand it is still significant. NRW for the 5 towns highlighted in Table 4-3 amounts to 5.3 Mm^3/a. This is the same order of magnitude as Botswana's cross-border demand of 5.0 Mm^3, although only a portion of the NRW will be actual water savings.

Table 4-3: Levels of consumption and NRW at towns served by the VGG system

District Municipality	Local Municipality and towns		Population	Total system input (m^3)	NRW (%)	NRW (m^3)	Per capita (l/day)
Frances Baard	Dikgatlong						
		Delportshoop	10 224	696 420	0.38	263 247	70
John Taolo Gaetsewe	Gamagara						
		Kathu and Sesheng	**9 168**	**5 073 500**	**0.33**	**1 679 329**	**501**
		Deben and Haakbosdraai	5 520	405 150	0.55	222 833	111
		Hotazel	**1 775**	**401 500**	**0.43**	**172 645**	**266**
		Olifantshoek	8 243	558 450	0.40	223 380	74
	Moshaweng						
		Heuningvlei	No data	No data	No data	No data	
	Ga-Segong						
		Kuruman	**74 506**	**5 621 000**	**0.55**	**3 085 929**	**113**
Siyanda	Kgatelopele						
		Danielskuil	15 447	689 556	0.40	275 822	49
		Lime Acres	**12 500**	**1 840 000**	**0.40**	**736 000**	**161**
	Tsantsabane						
		Postmansburg	19 638	1 425 690	0.30	427 707	60
		Jenhave	No data	No data	No data		
		Metsimatale	1 070	No data	No data	No data	
		Skeyfontein	1 237	1 648 204	0.36	599 946	1 328
Pixley ka Seme	Siyancuma						
		Campbell	1 500	141 985	No data	No data	
KEW Scheme	KEW Scheme						
		KEW Scheme	**1 716**	**2 047 255**	**0.36**	**745 201**	**1 189**

Water demand by the mining sector dominates. Accurate data is not available for all mines. For the three who reported details (KV3, WRP, Kayamandi Development Services et al, 2011), levels of unaccounted for water were low, between 5 and 14%. 10% is considered a reasonable target for all mines. In general water usage per tonne of ore (manganese and iron ore) should lie between 200 litre/tonne and 400 litre/tonne. At only three mines were the figures in excess of 400litre/tonne. With one as high as 3 200 litre/tonne.

Many mines have implemented some measures to reduce water demand and water leakage including water metering, water balancing, wastewater re-use, process water re-use, stormwater harvesting, awareness campaigns for personnel, use of dry processes to minimise water use, replacement of old steel water pipelines, use of methods to increase water recovery from tailings disposal and planned maintenance.

The importance of following the WDM and water conservation measures specified in Scenario 4 is critical if the proposed upgrading of the scheme is going to meet requirements and be affordable.

4.2.5 Conclusions

WDM studies for the VGG system have shown that major water savings can be made and that losses in some settlements are very high. The adopted water requirement projection assumes that a relatively successful level of WDM and water conservation will be achieved in both the domestic and commercial sectors. In view of the transboundary nature of the resource, the future transboundary nature of the infrastructure and the need to ensure that both countries are comfortable with contributing to the costs of this infrastructure, achieving the targets is especially important.

5. OVERALL CONCLUSIONS

The benefits of WDM can be seen as falling under two broad and not necessarily mutually exclusive categories:

- Implications on the developed resource;
- Implications on the raw or undeveloped resource.

With respect to the implications on the developed resource:

- There are significant benefits for the local authorities - with considerable savings in water and costs. These benefits would however accrue mostly to South African local authorities;
- Pro-poor benefits are substantial. Local authorities will be in a better position to provide improved services and to reticulate more areas without having to purchase more water from the bulk water supplier. In the South African context, this may reduce service delivery protests;
- However, the transboundary benefits will require the water supply infrastructure is also cross border.

With respect to the implications on the raw or undeveloped resource:

- Net savings in water will depend on how much of the physical savings in water are left in the river. In most cases, as implied above, it will be used to improve supplies to under serviced areas.
- Even where the savings made are “left in the river”, the volumes are relatively modest when set against the total demands in the transboundary basins.
- However, these savings may be important when considering the reasonable and equitable use of water by all the watercourse States.

In specific cases were the WSS infrastructure may be transboundary in nature (like the Vaal-Gamagara), WDM can make a much more substantial contribution. Water savings can reduce the investment costs and encourage full financial involvement by both transboundary partners. In the case of the Vaal-Gamagara pipeline the water supplied will be very much pro-poor within Botswana and it will be difficult for Botswana to justify investment if the infrastructure is more expensive than necessary due to wastage in South Africa, especially within the commercial sector.

In other SADC countries WDM could bring much more substantial physical water savings since smaller and less resourced Local Authorities tend to have more water losses. In some areas this may make considerable inroads into improving the reliability of supply in the face of climate change.

6. RECOMMENDATIONS

The following recommendations are made for CRIDF with respect to the WDM project proposed by South Africa at the Maseru Conference;

CRIDF is not likely to be in a position to offer broad support for WDM to local authorities across South Africa; the number of projects may place a prohibitive burden on the Facility. However, the WDM technology is proven, and is clearly 'financeable' with considerable cost savings for local authorities.

It is therefore recommended that CRIDF;

- Investigates the modalities of establishing a loan financing facility that provides seed financing, with ring-fencing options to ensure repayment.
- Supports interventions in specific cases, like the Vaal-Gamagara pipeline (and potentially the Ressano Garcia Weir) where WDM may have knock on benefits for other CRIDF objectives may be warranted, and were the water supply infrastructure crosses the border.
- Highlights the role of WDM in ensuring reasonable and equitable water use the longer-term, and hence in securing regional peace dividends.
- Includes WDM measures in any Projects aimed at improving potable water supply throughout the region.

7. REFERENCES

Department of Water Affairs. (2004). *National Water Resource Strategy, First Edition.* Pretoria: DWAF.

Department of Water Affairs and Forestry. (2007). *Potential Savings through WC/WDM in the Upper and Middle Vaal Water Management Areas.* Pretoria: DWA.

Directorate: Water Use Efficiency. (2012). *DWA Priority List for the Implementation of Loss reduction Activities in Municpalities.* Pretoria: Department: Water affairs Republic of South Africa.

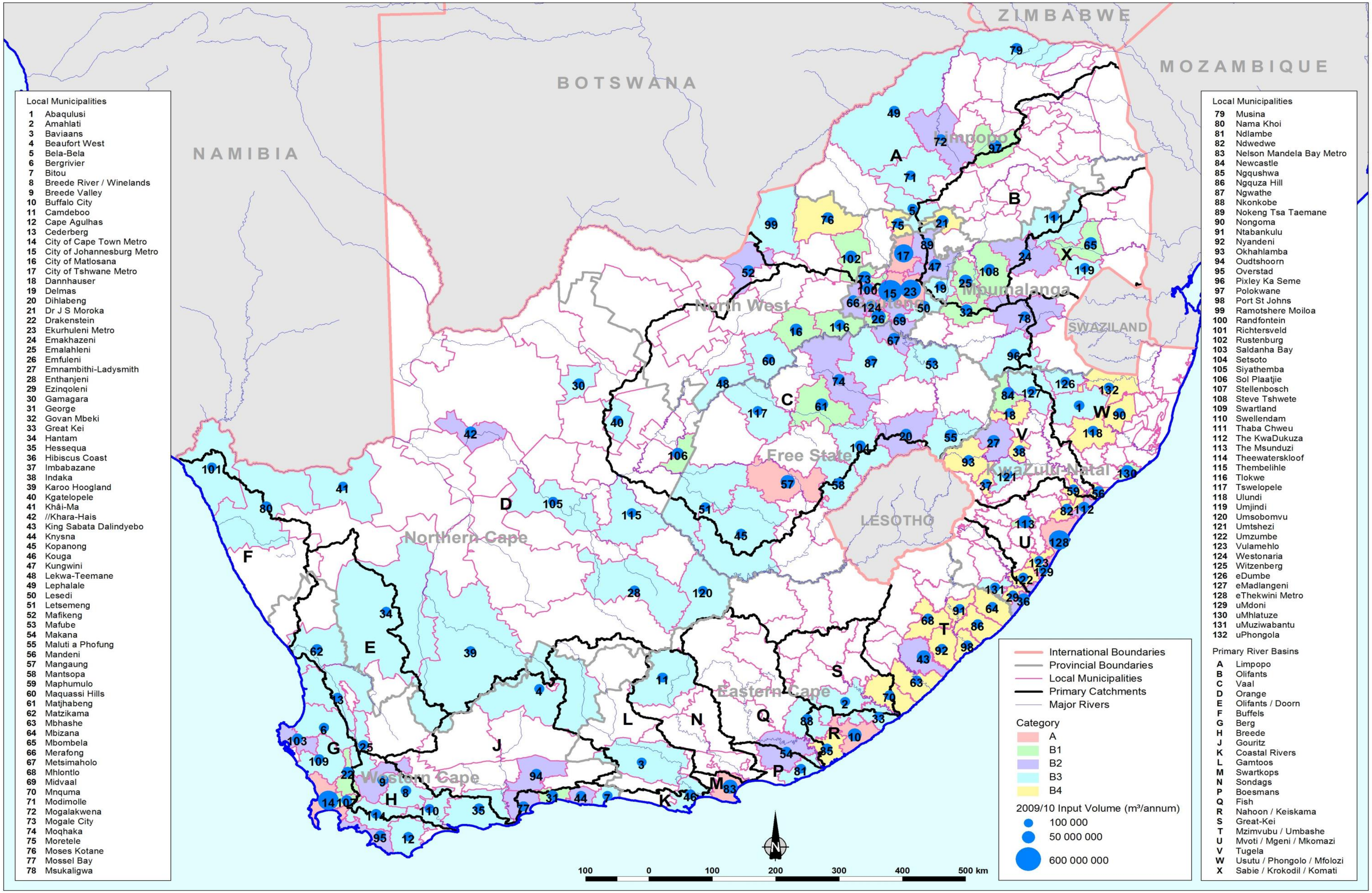
McKenzie, R. S., Siqalaba, Z. N., & Wegelin, W. A. (2012). *The State of Non-Revenue Water in South Africa.* Pretoria: Water Research Commission.

Mckenzie, R., & Seago, C. (2005). *Benchmarking of Leakage from Reticulation Systems in South Africa.* Pretoria: Water Research Commission.

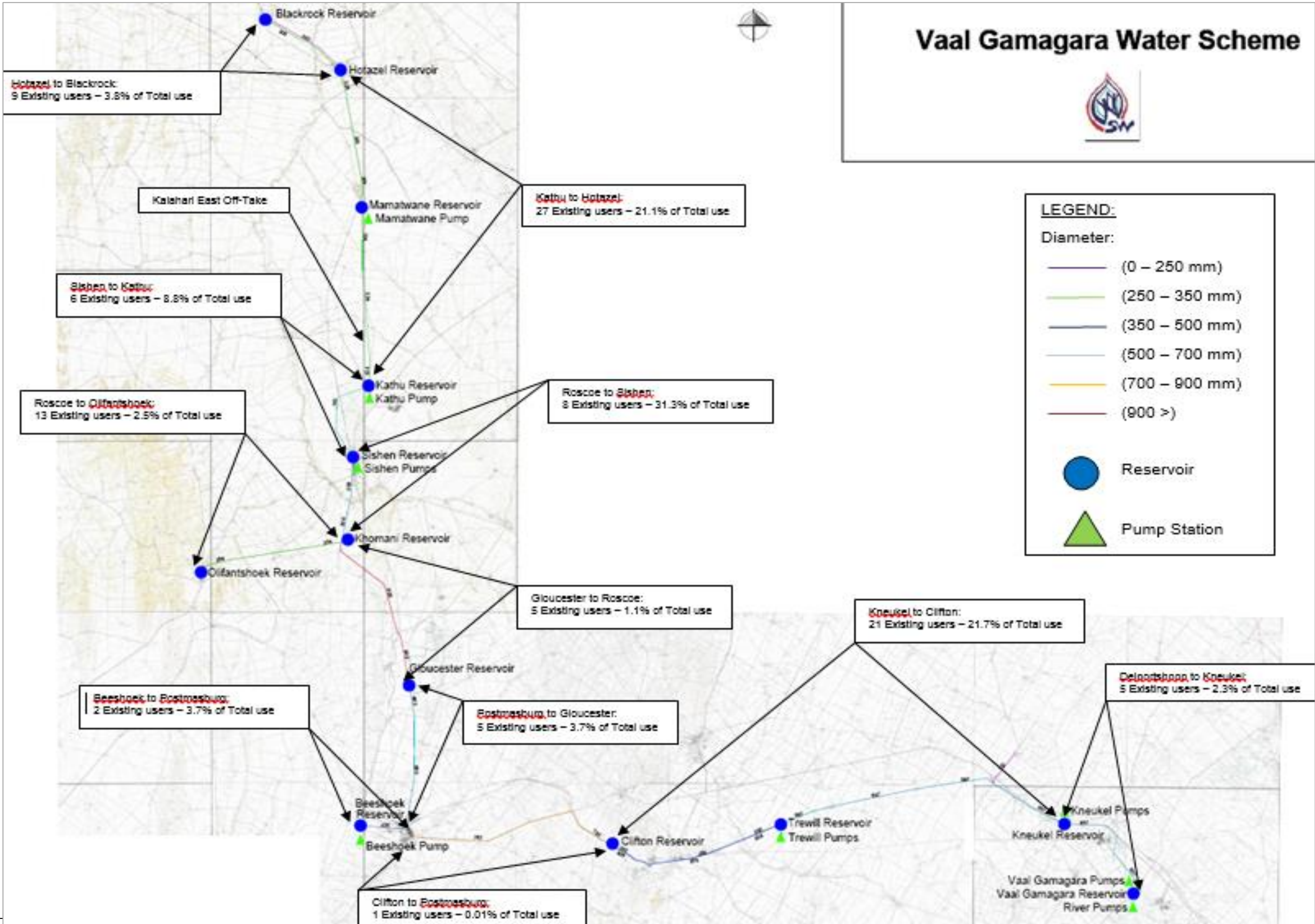
Seago, C. J., & Mckenzie, R. S. (2007). *An Assessment of Non-Revenue Water in South Africa.* Pretoria: Water Research Commission.

ANNEXES

Annex 1: Location of Local Authorities relative to river basins in South Africa


ZIMBABWE
MOZAMBIQUE
BOTSWANA
NAMIBIA
SWAZILAND
LESOTHO
Limpopo
Mpumalanga
North West
Gauteng
Free State
KwaZulu-Natal
Northern Cape
Eastern Cape
Western Cape
Local Municipalities
1 Abaqulusi
2 Amahlati
3 Baviaans
4 Beaufort West
5 Bela-Bela
6 Bergrivier
7 Bitou
8 Breede River / Winelands
9 Breede Valley
10 Buffalo City
11 Camdeboo
12 Cape Agulhas
13 Cederberg
14 City of Cape Town Metro
15 City of Johannesburg Metro
16 City of Matlosana
17 City of Tshwane Metro
18 Dannhauser
19 Delmas
20 Dihlabeng
21 Dr J S Moroka
22 Drakenstein
23 Ekurhuleni Metro
24 Emakhazeni
25 Emalahleni
26 Emfuleni
27 Emnambithi-Ladysmith
28 Enthanjeni
29 Ezinqoleni
30 Gamagara
31 George
32 Govan Mbeki
33 Great Kei
34 Hantam
35 Hessequa
36 Hibiscus Coast
37 Imbabazane
38 Indaka
39 Karoo Hoogland
40 Kgatelopele
41 Khâi-Ma
42 //Khara-Hais
43 King Sabata Dalindyebo
44 Knysna
45 Kopanong
46 Kouga
47 Kungwini
48 Lekwa-Teemane
49 Lephalale
50 Lesedi
51 Letsemeng
52 Mafikeng
53 Mafube
54 Makana
55 Maluti a Phofung
56 Mandeni
57 Mangaung
58 Mantsopa
59 Maphumulo
60 Maquassi Hills
61 Matjhabeng
62 Matzikama
63 Mbhashe
64 Mbizana
65 Mbombela
66 Merafong
67 Metsimaholo
68 Mhlontlo
69 Midvaal
70 Mnquma
71 Modimolle
72 Mogalakwena
73 Mogale City
74 Moqhaka
75 Moretele
76 Moses Kotane
77 Mossel Bay
78 Msukaligwa
Local Municipalities
79 Musina
80 Nama Khoi
81 Ndlambe
82 Ndwedwe
83 Nelson Mandela Bay Metro
84 Newcastle
85 Ngqushwa
86 Ngquza Hill
87 Ngwathe
88 Nkonkobe
89 Nokeng Tsa Taemane
90 Nongoma
91 Ntabankulu
92 Nyandeni
93 Okhahlamba
94 Oudtshoorn
95 Overstad
96 Pixley Ka Seme
97 Polokwane
98 Port St Johns
99 Ramotshere Moiloa
100 Randfontein
101 Richtersveld
102 Rustenburg
103 Saldanha Bay
104 Setsoto
105 Siyathemba
106 Sol Plaatjie
107 Stellenbosch
108 Steve Tshwete
109 Swartland
110 Swellendam
111 Thaba Chweu
112 The KwaDukuza
113 The Msunduzi
114 Theewaterskloof
115 Thembelihle
116 Tlokwe
117 Tswelopele
118 Ulundi
119 Umjindi
120 Umsobomvu
121 Umtshezi
122 Umzumbe
123 Vulamehlo
124 Westonaria
125 Witzenberg
126 eDumbe
127 eMadlangeni
128 eThekwini Metro
129 uMdoni
130 uMhlatuze
131 uMuziwabantu
132 uPhongola
Primary River Basins
A Limpopo
B Olifants
C Vaal
D Orange
E Olifants / Doorn
F Buffels
G Berg
H Breede
J Gouritz
K Coastal Rivers
L Gamtoos
M Swartkops
N Sondags
P Boesmans
Q Fish
R Nahoon / Keiskama
S Great-Kei
T Mzimvubu / Umbashe
U Mvoti / Mgeni / Mkomazi
V Tugela
W Usutu / Phongolo / Mfolozi
X Sabie / Krokodil / Komati
International Boundaries
Provincial Boundaries
Local Municipalities
Primary Catchments
Major Rivers
Category
A
B1
B2
B3
B4
2009/10 Input Volume (m³/annum)
100 000
50 000 000
600 000 000
100 0 100 200 300 400 500 km

Annex 2: Vaal Gamagara Water Scheme


Vaal Gamagara Water Scheme
LEGEND:
Diameter:
(0 – 250 mm)
(250 – 350 mm)
(350 – 500 mm)
(500 – 700 mm)
(700 – 900 mm)
(900 >)
Reservoir
Pump Station
Blackrock Reservoir
Hotazel Reservoir
Hotazel to Blackrock:
9 Existing users – 3.8% of Total use
Kalahari East Off-Take
Mamatwane Reservoir
Mamatwane Pump
Kathu to Hotazel:
27 Existing users – 21.1% of Total use
Sishen to Kathu:
6 Existing users – 8.8% of Total use
Kathu Reservoir
Kathu Pump
Roscoe to Olifantshoek:
13 Existing users – 2.5% of Total use
Roscoe to Sishen:
8 Existing users – 31.3% of Total use
Sishen Reservoir
Sishen Pumps
Khomani Reservoir
Olifantshoek Reservoir
Gloucester to Roscoe:
5 Existing users – 1.1% of Total use
Kneukel to Clifton:
21 Existing users – 21.7% of Total use
Gloucester Reservoir
Beeshoek to Postmasburg:
2 Existing users – 3.7% of Total use
Postmasburg to Gloucester:
5 Existing users – 3.7% of Total use
Delportshoop to Kneukel:
5 Existing users – 2.3% of Total use
Beeshoek Reservoir
Beeshoek Pump
Clifton Reservoir
Trewill Reservoir
Trewill Pumps
Kneukel Pumps
Kneukel Reservoir
Vaal Gamagara Pumps
Vaal Gamagara Reservoir
River Pumps
Clifton to Postmasburg:
1 Existing users – 0.01% of Total use