

Vaal Gamagara Water Supply Scheme

Updated demographics and water balance to 2043



Complied for:

Pro-Plan

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This material has been prepared for informational purposes only, with no recommendations regarding future water allocations or designs.

Acronyms

AADD	Average annual daily demand
ACIP	Accelerated community infrastructure programme
BBBEE	Broad-based Black economic empowerment
BH	Borehole
CFO	Chief financial officer
CoGHSTA	Cooperative governance, human settlement and traditional affairs (Northern Cape)
CoGTA	Cooperative governance and traditional affairs
CPI	Consumer price index
DM	District municipality
DoH	Dept of Health
DPW	Department of Public Works
DWS	Department of Water and Sanitation (formerly Dept of Water Affairs)
EMIS	Education management information system
EPWP	Expanded public works programme
FB	Frances Baard District Municipality
FBW	Free basic water
FFC	Financial and Fiscal Commission
FY	Financial year
GDP	Gross domestic product
GVA	Gross value added
HH	Household
IDP	Integrated development plan
IRS	Implementation readiness study
IWA	International Water Association
JTG	John Taolo Gaetsewe District Municipality
kℓ	Kilolitre = 1 000 ℓ = 1 m ³
Km	Kilometre
KPA	Key performance area
KPI	Key performance indicator
KwH	Kilowatt hours
ℓ	Litre
ℓ/c/d	Litres per capita per day
ℓ/day	Litres per day
LM	Local municipality
m ³ /a	Cubic litres per annum
m ⁶ /m ³ /a	Million cubic meters per annum
Mℓ	Mega litre = 1 000 kℓ = 1 000 m ³
MTEF	Medium term expenditure framework
NRW	Non-revenue water
O&M	Operation and maintenance
p.a.	Per annum
p.m.	Per month
PGDS	Provincial Growth and Development Strategy
PICC	Presidential infrastructure coordinating commission
PRV	Pressure reducing valve
RBIG	Regional bulk infrastructure grant
SALGA	South Africa Local Government Association
SD	Source development
SDF	Spatial development framework
SIP	Strategic infrastructure projects
VGWSS	Vaal Gamagara Water Supply Scheme
VIP	Ventilated improved pit
WCDM	Water conservation and demand management
WHO	World Health Organisation
WL	Water loss
WSA	Water services authority
WTW	Water treatment works
WUA	Water user association
WUL	Water use license
ZFM	ZF Mgcawu District Municipality (previously Siyanda)

Content

1	INTRODUCTION	1
1.1	Background and methodology	1
1.2	History of pipeline and study area	2
2	SETTLEMENTS IN THE VGWSS SERVICE AREA.....	3
3	GROWTH OF THE SETTLEMENTS AND THE ECONOMY	4
3.1	Mining and life of mines	5
3.2	Solar plants	11
3.3	Growth of other settlements	12
3.4	Household trends	14
	<i>Relationship between population, households and housing</i>	<i>14</i>
	<i>Historical household trends</i>	<i>15</i>
	<i>Household size</i>	<i>16</i>
	<i>Dwellings in 2018</i>	<i>16</i>
4	POPULATION TRENDS AND FUTURE ESTIMATES	19
4.1	Historical population trends	19
	<i>Settlements in the VGWS supply area</i>	<i>19</i>
	<i>Local municipalities in the VGWSS area</i>	<i>20</i>
4.2	Population growth factors.....	21
	<i>Fertility and mortality.....</i>	<i>21</i>
	<i>Migration</i>	<i>23</i>
4.3	Future growth expectations in Northern Cape	24
4.4	Population estimates for the study area to 2043	27
4.5	Population forecasting caveats.....	33
5	WATER CONSUMPTION PATTERNS.....	34
5.1	International norms	34
5.2	Free basic water.....	34
5.3	Water consumption volumes in South Africa	35
5.4	Sedibeng Water sales.....	38
5.5	Water demands for new development in Kathu.....	39
5.6	Water volume consumed in Sesheng	40
6	WATER DEMAND	40

6.1	Water use sectors	41
	<i>Municipalities</i>	41
	<i>Municipalities with additional water sources</i>	41
	<i>Mines, industries, parastatals and other</i>	44
6.2	Summary of water demand projections	46
7	WATER SOURCES	49
7.1	Surface water	49
7.2	Groundwater	49
	<i>SD groundwater</i>	49
	<i>Dewatering by mines</i>	52
	<i>Water sources summary</i>	57
8	WATER BALANCE	58
8.1	Systems description	58
	<i>System 1 – Vaal River to Groenwater</i>	60
	<i>System 2 – Postmasburg to Kathu</i>	61
	<i>System 3 – Kathu to Black Rock</i>	63
8.2	Water balance	64
	<i>Scenario 1</i>	65
	<i>Scenario 2</i>	65
	<i>Scenario 3</i>	66
9	CONCLUSION	69

Tables

Table 1.	SIP 3 and 5	4
Table 2.	Mining towns and life of mines with employees' place of abode	7
Table 3.	Prospecting in study area	9
Table 4.	Solar plants in study area	12
Table 5.	Historical household growth 1996 to 2011	15
Table 6.	Households and annual growth 1996 to 2016 by local municipality	16
Table 7.	Households and population in 2011 and estimated in 2018 based on the average household size and dwelling counts	18
Table 8.	Population growth 1996 to 2011	19
Table 9.	Population and annual growth 1996 to 2016 by local municipality	20

Table 10.	Farm population trends 2001 to 2016 by LM	24
Table 11.	Annual growth rates applied to population estimates	29
Table 12.	Population estimates for study area to 2043.....	29
Table 13.	High growth scenario for the VGWSS study area.....	31
Table 14.	Low growth scenario for the VGWSS study area.....	32
Table 15.	Summary of water requirements	34
Table 16.	Percentage of non-revenue water (NRW), water loss (WL), litres per capita per day (ℓ/c/d) and infrastructure leakage index (ILI)	36
Table 17.	Sedibeng water sales in 2013/14 and 2017/18 ℓ/c/d and kℓ per household per month (based on 2011 population and households).....	39
Table 18.	Number of stands and litres per day converted to ℓ/d per stand and litres per capita per day at an assumed household size of 3.5	39
Table 19.	Purified water consumption by residential consumers in Sesheng (Mapoteng) in 2014/1540	
Table 22.	Mine and industry water demand projections in kℓ/a per entity to 2043.....	44
Table 23.	Solar plants water demand projections.....	45
Table 24.	Governmental and parastatal water demand projections in kℓ/a.....	46
Table 25.	Future water demand projections 2038-2043 by user group	46
Table 26.	Total water demand projections for the VGWSS	47
Table 27.	Recommended well field abstractions for SD1	50
Table 28.	Recommended well field abstractions for SD2	51
Table 29.	Recommended well field abstractions for SD4	52
Table 30.	Dewatering volumes from Sishen mine in kℓ/a	53
Table 31.	Dewatering volumes for Kolomela mine in kℓ/a	56
Table 32.	Future water demand projections 2038-2043 by user group	58
Table 33.	SD groundwater sustainable yield	58
Table 34.	Water demand – System 1	64
Table 35.	Water demand - System 2	64
Table 36.	Water demand - System 3	64
Table 37.	Scenario 1: SD sources minimum	65
Table 38.	Scenario 2: Dewatering minimum	66
Table 39.	Scenario 3: Most likely	66
Table 40.	Future water demand projections 2038-2043 by user group	69

Figures

Figure 1.	The current Vaal Gamagara water supply pipeline	2
Figure 2.	SD4 well field areas and settlements	4
Figure 3.	Mining production 2014-2017	5
Figure 4.	Mining production in 2017	6
Figure 5.	Global price of manganese from 2015 to 2020 (in U.S. dollars per dry metric ton unit)	6
Figure 6.	Map of manganese mines	7
Figure 7.	Life of mine in years (from 2018 onwards)	9
Figure 8.	Dwelling tenure in the study area	14
Figure 9.	Average household sizes in 1996, 2011 and 2018	16
Figure 10.	Dwelling growth p.a. from 2011 to 2018.....	18
Figure 11.	Population of local municipalities in the VGWS area 1996 to 2011	20
Figure 12.	Population pyramid of the VGWSS study area.....	21
Figure 13.	Population pyramid examples of the study area	22
Figure 14.	Recorded live births by magisterial district 1998 to 2016	22
Figure 15.	Learner numbers in the VGWSS area 1996, 2002, 2007-2016	23
Figure 16.	Population of 2011 living in the current location since October 2001	24
Figure 17.	Projected population aged 15 years and over for Northern Cape (Udjo)	25
Figure 18.	Northern Cape population growth estimates by source	26
Figure 19.	Northern Cape population estimates by source	26
Figure 20.	Population estimates for three districts in the study area by Udjo and DoH	27
Figure 21.	Population in 2018 and 2043 map	30
Figure 22.	VGWSS population estimate and growth rates to 2043	31
Figure 23.	VGWSS population estimates and low and high population scenarios to 2043 ..	32
Figure 24.	Billed water consumption in litres per capita per day	35
Figure 25.	Water consumption excluding water loss by province in litres per capita per day	36
Figure 26.	Population served and litres per capita per day in Northern Cape	37
Figure 27.	Litres per capita per day based on system input volume/population served	38
Figure 28.	Sedibeng water sales expressed in $\ell/c/d$	38
Figure 29.	Location of water meters (yellow dots) in Sesheng.....	40
Figure 30.	Municipal water demand projections in $k\ell/a$ and comparison of 100, 150 and 225 $\ell/c/d$	43

Figure 31.	Total water demand projections for the VGWSS	47
Figure 32.	Water demand map	48
Figure 33.	Large scale groundwater sources	49
Figure 34.	Groundwater protection zones for SD1 – 22 boreholes	50
Figure 35.	Groundwater protection zones for SD2 – 21 boreholes	51
Figure 36.	Groundwater protection zones for SD4 – 15 boreholes	52
Figure 37.	Sishen dewatering volumes Jan 2015 to Jul 2018 in kℓ/h	54
Figure 38.	Sishen continuous probability distribution in kℓ/h to the VGWSS	54
Figure 39.	Sishen continuous probability distribution in kℓ/h to the VGWSS based on supplying VGWSS first.....	55
Figure 40.	Kolomela dewatering volumes in kℓ/h	56
Figure 41.	Kolomela continuous probability distribution in kℓ/h	57
Figure 42.	Water production 2017/18 in kℓ per month	57
Figure 43.	VGWSS scheme layout	59
Figure 44.	System 1	60
Figure 45.	System 2.....	62
Figure 46.	System 3.....	63
Figure 47.	Scenario 3 - System 1 in kℓ/a	67
Figure 48.	Scenario 3 – System 2 in kℓ/a	67
Figure 49.	Scenario 3 – System 3 in kℓ/a	68

Appendixes

A	Meetings held with municipalities
B	Dwelling counts
C	Solar plants

1 INTRODUCTION

A feasibility study and an implementation ready study (IRS) for the Regional Bulk Infrastructure Grant (RBIG) programme for the refurbishment/upgrading of the Vaal Gamagara Water Scheme (VGWS) project was drafted in 2011 and 2015 respectively. In 2016, Phase 1 of the project commenced which is currently under construction. With the commencement of the second phase, a recalculation of the water need and infrastructure options to meet the water demand in 2043 is required.

1.1 Background and methodology

The Vaal Gamagara Feasibility Study, and the subsequent Implementation Ready Study (IRS) for the bulk regional infrastructure grant (RBIG) undertaken by WorleyParsons (now iX Engineers) detailed water demand to 2030. This information, gained from users at a series of workshops in 2011, is outdated. With the planning of Phase 2 now underway, a revision and recalculation of projected water demand volumes is required to inform the water demand in 2043.

Aspects that are addressed and updated in this report include:

- Future water demand based on demographic and economic growth scenarios - This entailed updating, extending and refining water demand volumes based on future economic, and population growth expectations for the local municipalities (mainly household, business and institutional use). Estimates for each affected local municipality (LM) were presented and discussed at individual consultative visits with the municipality, i.e. Tsantsabane LM (6 November 2018), Gamagara LM (4 October 2018), Dikgatlong LM (9 November 2018), and Joe Morolong LM (6 November 2018). The mines and solar plants' water demand is included in the analysis based on the secondary data derived from off-take forms completed and submitted to Sedibeng Water during 2018.
- Water balance - Once the water demand is established, the information is compiled into water demand profiles per sub-system of the scheme. These profiles are analysed and compared to the available water sources. The availability and reliability of the mine dewatering water sources was discussed with the Sishen and Kolomela mines, as well as with Sedibeng Water. Historic dewatering volumes are studied, and supply trends compiled. Supply scenarios are drafted.

This report is based on quantitative and qualitative data obtained from secondary and primary sources. Secondary sources include published reports from Statistics South Africa, Department of Water and Sanitation, the relevant local and district municipalities, and others as referenced. Information received from Sedibeng Water regarding water sales and demand volumes of mines and solar plants was also sourced. Primary information was obtained from meetings held with municipalities and field visits conducted which is detailed in Appendix A and referenced in footnotes.

1.2 History of pipeline and study area

The Vaal Gamagara Government Water Supply Scheme (VGGWSS) was completed in 1968 to supply Vaal River water to Hotazel and further afield. The scheme consists of a purification works (13.27 million m³/a), numerous pumps, 10 reservoirs and 430 km of pipeline with the capacity to convey approximately 15 million m³/a into the D41J and D41K catchments. Furthermore, the volume of water imported to the D41J catchment is increased by the dewatering of mines near Postmasburg and its distribution via the Vaal Gamagara pipeline. The Kalahari East pipeline currently exports 1.7 million m³/a water from the D41J catchment, with the off-take from the Vaal Gamagara pipeline north of Sishen mine, and the water is primarily used for stock-farming and related domestic purposes to areas where the groundwater is not potable in the so-called salt block areas in the D42C catchment.¹

The study area covers the towns and settlements along the routing of the Vaal Gamagara pipeline, which includes Delporthshoop, Lime Acres, Postmasburg, Olifantshoek, Kathu and Hotazel. These are a mix of mining settlements and agricultural service centres, each of which has specific economies reliant on an adequate water supply for survival and long-term growth.

Figure 1. The current Vaal Gamagara water supply pipeline²



The continuous supply of water to the Northern Cape's mining corridor is needed since it is one of four national catalysts driving the strategic infrastructure projects (SIP) of the Presidential Infrastructure Coordinating Commission (PICC). In addition to supplying mines, numerous settlements located on the pipeline route across five local municipalities are supplied, as well as the Kalahari East pipeline which supplies remote settlements in the Mier area. Groundwater modelling and exploration indicates that adequate volumes can be abstracted from SD1, SD2 and SD4 resource areas to augment the water supply to the VGGWSS. Hence, it is proposed that Tsineng and a few adjacent rural settlements will be supplied from SD4 as part of Phase 1 of the project.³

Although the option to supply villages in Botswana along the border was considered, it is no longer part of the proposed Phase 2.

¹ Kv3 (2011) Development of reconciliation strategies for the area served/interacting by/with Sedibeng Water's Vaal Gamagara Scheme as well as a water master plan. 15 March 2011. Main report no. 245460/80.

² Department of Water Affairs. Locality map: WMA 14 (Lower Orange). [Online]. Available from: <http://www.dwaf.gov.za/Documents/Other/WQM/LowerOrange/Figure8b.pdf> (Accessed: 11 August 2011).

³ WorleyParsons (2014) Development of the SD4 Groundwater Resource - Tsineng and Village Supply. Draft October 2014.

2 SETTLEMENTS IN THE VGWSS SERVICE AREA

Many of the towns in the VGWSS service area developed because of iron ore and manganese mining activities. The Sishen Mine is one of the largest in the world and the ore railway line from Sishen to Saldanha is the longest iron ore carrier in the world. Many of its employees live in Kathu/Sesheng and Kathu is one of the fastest growing towns in the Northern Cape.

Other mining communities that obtain water from the VGWSS include Delportshoop, Longlands, Hotazel, Blackrock and Postmasburg. Postmasburg and Kathu currently use both groundwater and VGWSS water.

Lime Acres, established in 1950s, is mainly home to employees of the PPC lime factory and Finsch diamond mine. The town was previously owned by these two entities, but recent township establishment has made land ownership possible by employees. Bulk water for the 'Finsch' part of town is provided from the VGWS into the Clifton and Lime Acres reservoirs while the 'PPC' residential portion is supplied directly from mining quarries and pumped into a 0.7 Mℓ reservoir.⁴

Vaalgamagara, a settlement that mainly houses employees of Sedibeng Water; and Koopmansfontein, Maremane and Groenwater, which are restitution cases, have non-mining economies. Olifantshoek, at the foot of the Langeberg, is an agricultural service center and a dormitory town for mining employees.

Communities in the near vicinity of the VGWSS, which currently solely use groundwater, include Schmidtsdrift, Campbell, Griekwastad, Danielskuil, Papkuil, Jenhaven, Skeyfontein, Dibeng, Kuruman and the Heuningvlei area.

The Mier settlements of Askham, Andriesvale, Groot Mier, Klein Mier, Loubos, Rietfontein and Philandersbron are served by the Kalahari East Water Users Association (WUA), a bulk consumer of the VGWSS. The extension of the scheme to Mier benefits communities, farms and parks of the Mier area, which covers an area of 22 468 km², thus larger than Gauteng Province. Subsequent phases of the Kalahari-east pipeline development are intended to supply smaller farms to the north and commercial farms to the south of the Mier area; three border control posts; the Kgalagadi Transfrontier Park; and the settlements of Noenieput and Welkom. For the purposes of this study, Mier settlements are not discussed further since their water demand is allocated via the Kalahari East WUA.

The possibility of exploiting groundwater from resource area SD4 to augment the water from the Vaal River and the mines currently supplying the pipeline, means that the settlement of Tsineng and several rural villages located to the east of SD4 could also benefit from the project.

⁴ MVD (2010) Kgatelopele Municipality Spatial Development Framework 2010-2015. P 13, 50.

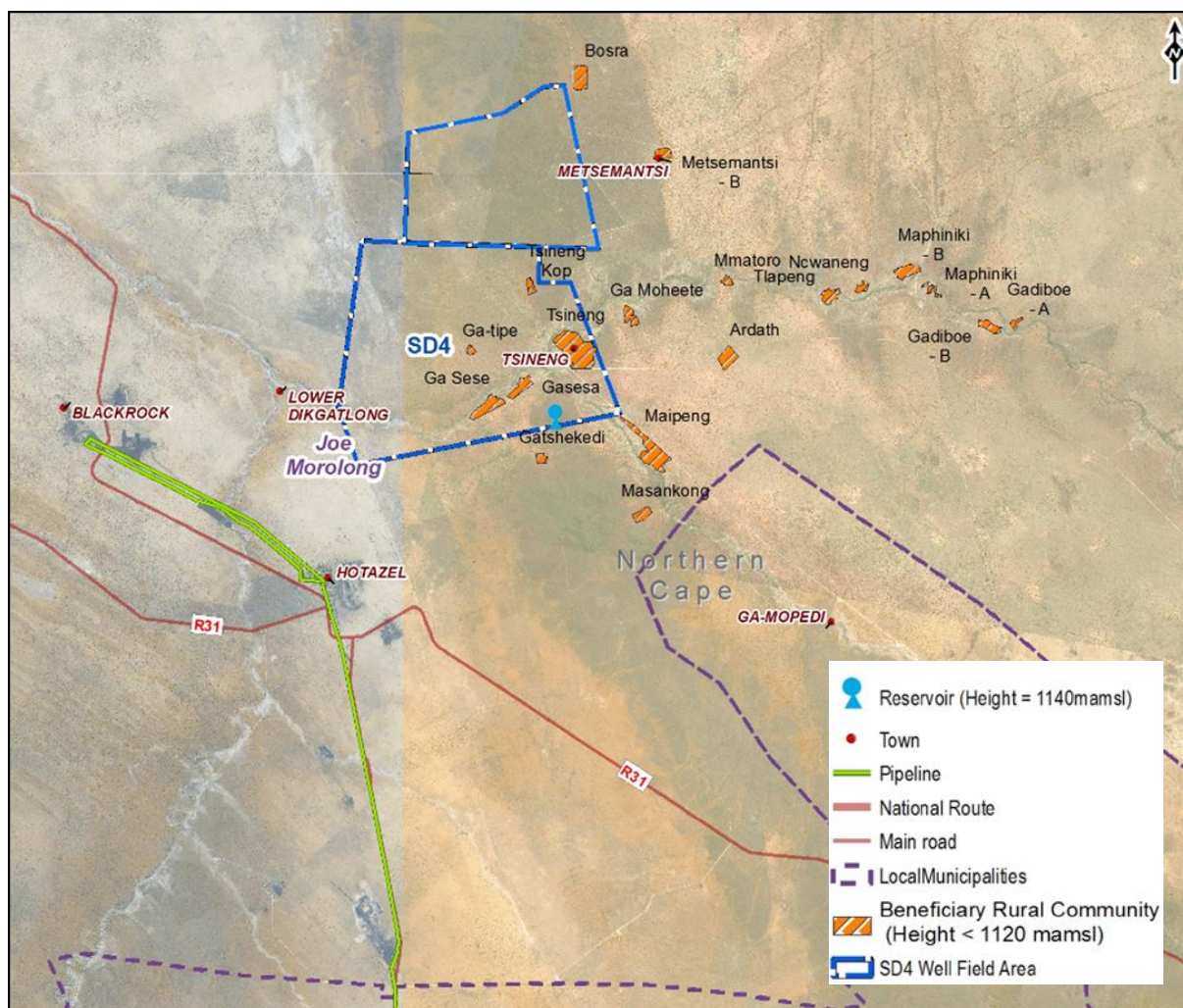


Figure 2. SD4 well field areas and settlements

3 GROWTH OF THE SETTLEMENTS AND THE ECONOMY

The Northern Cape Province has identified the development of the Gamagara mining corridor, with its significant manganese and iron ore deposits, as a critical growth area. Two of the five national geographic strategic infrastructure projects (SIP) are aimed at exploiting this mineral resource.

Table 1. SIP 3 and 5

	Corridor	Project
SIP 3	South-Eastern node & corridor development	Strengthen economic development in Port Elizabeth through a manganese rail capacity from Northern Cape manganese sinter (Northern Cape)
SIP 5	Saldanha-Northern Cape development corridor	Integrated rail and port expansion Expansion of iron ore mining production and beneficiation

3.1 Mining and life of mines

According to the StatsSA's *Mining: Winners and Losers of 2017*, released on 28 February 2018, the mining industry saw an overall decline of 4.0% in 2016, which was the largest annual fall in production since the global recession of 2009. Only diamond production recorded a positive growth of just under 1%, while all other minerals were in negative territory in 2016. In 2017, the industry performed better on the back of higher mineral prices and increased global demand.

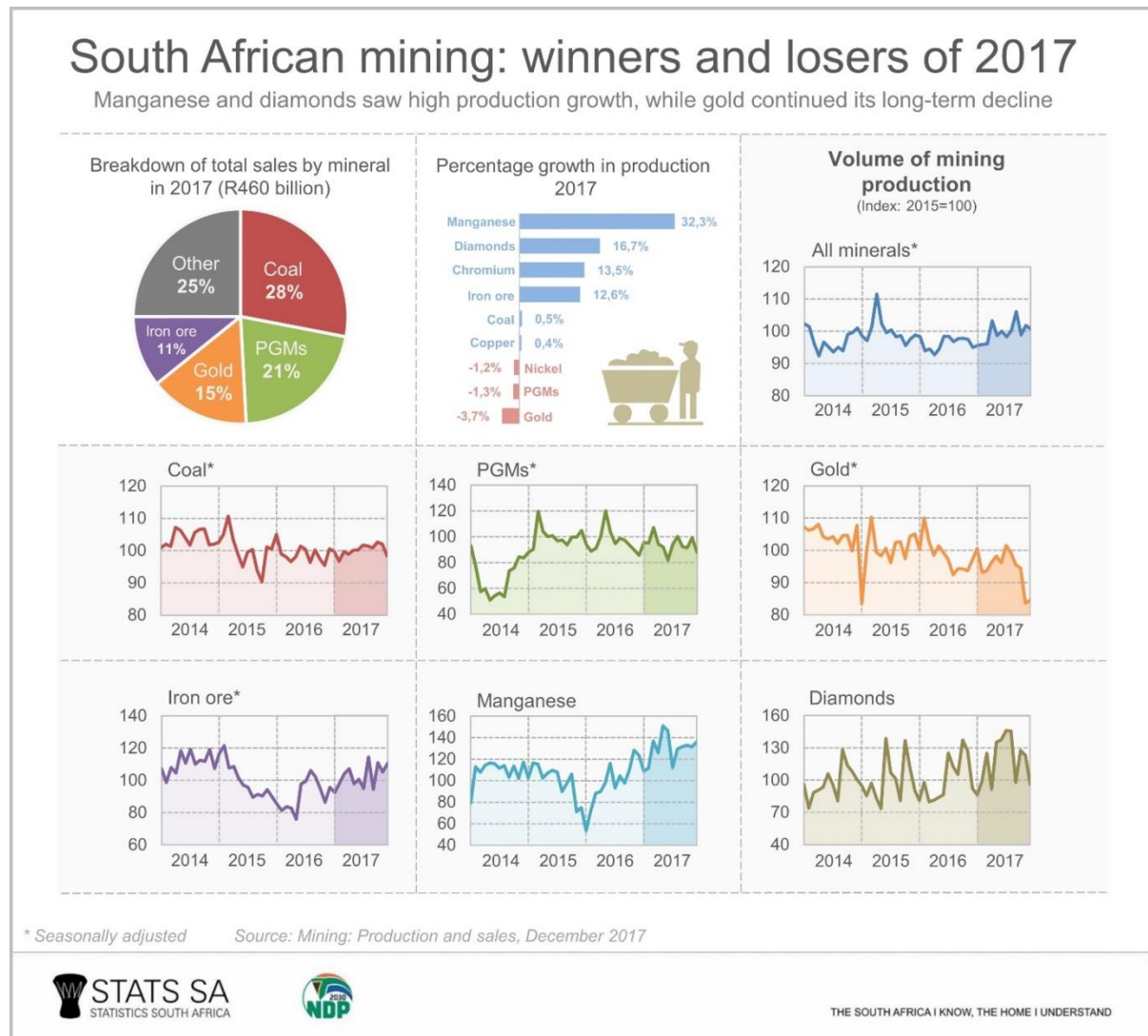


Figure 3. Mining production 2014-2017⁵

Manganese ore was the best performer of 2017, with production rising by 32%. Diamond mining, the sole performer of 2016, did even better in 2017, making it the second most successful mineral after manganese (up 17%).⁶

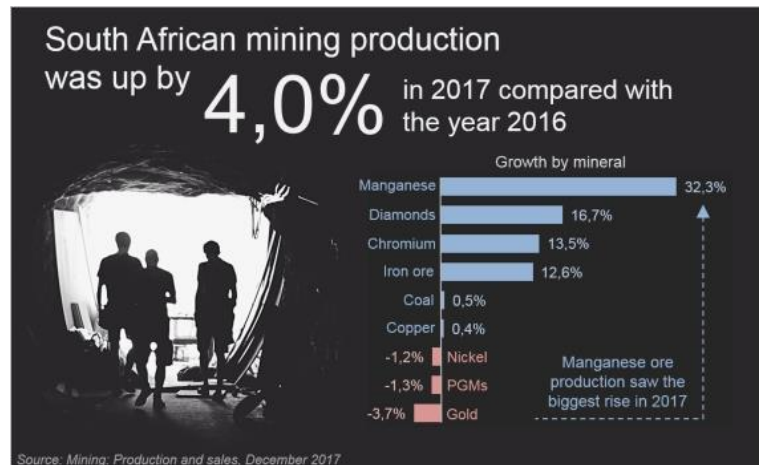
⁵ StatsSA (2018) Mining: winners and losers of 2017. [Online]. Available from: http://www.statssa.gov.za/wp-content/uploads/2018/02/Infographic_v04-1.jpg

⁶ StatsSA (2018) Mining: winners and losers of 2017. [Online]. Available from: http://www.statssa.gov.za/wp-content/uploads/2018/02/Infographic_v04-1.jpg

Growing demand in China for steel was the main driver of the rise in manganese production. Chromium and iron ore, two other minerals used in the production of steel (in the case of chromium, stainless steel), were the third and fourth best performing minerals in 2017.⁷

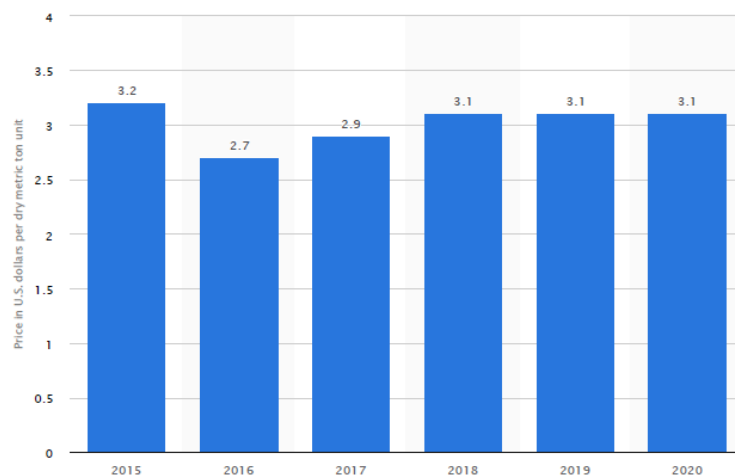
Figure 4. Mining production in 2017⁸

The South African mining sector is the fifth largest in the world.⁹ Mining makes up most of the overall economy in the study area, with manganese, iron ore and diamond mining being the three main mining activities. South Africa has approximately 78% of the world's identified manganese resources¹⁰, most of it located in the Northern Cape Province, within the study area.



Although individual mines within the study area have indicated lifespans of 25-30 years, there are iron ore and manganese ore deposits in the Gamagara mining corridor that can be mined for a century or more. This largely depends on commodity prices that allow this economic prospect.¹¹ This image in Figure 5 represents the global price of manganese from 2015 through what is predicted for 2019 and 2020 at 3.1 U.S. dollars per dry metric ton unit in 2020. Manganese is an essential element to the iron and steel production industry; and it is also the fourth most heavily consumed mineral after iron, aluminium and copper; thus, output is linked to the demand for steel, as is the price.¹²

Figure 5. Global price of manganese from 2015 to 2020 (in U.S. dollars per dry metric ton unit)¹³



Mining commodities are hugely affected by global markets and due to constant fluctuations in the global demand for minerals and raw materials, the mining industry in the study area has gone through many boom-bust cycles and will without doubt continue to do so. In recent

⁷ StatsSA (2018) Mining: winners and losers of 2017. [Online]. Available from: <http://www.statssa.gov.za/?p=10963>

⁸ StatsSA (2018) Mining: winners and losers of 2017. [Online]. Available from: http://www.statssa.gov.za/wp-content/uploads/2018/02/Infographic_v04-1.jpg

⁹ Antin, D. (2013) The South African Mining Sector: An Industry at a Crossroads. Hans Seidel Foundation (Southern Africa).

¹⁰ U.S. Geological Survey (2018) Mineral commodity summaries 2018: U.S. Geological Survey, 200 p.

¹¹ Vela VKE (2012) Gamagara Mining Corridor Study. Volume 4: Trends and Development, September 2012. P 9.

¹² United Manganese of Kalahari (n.d.) Manganese – Uses, a new mine, and the benefits of high-grade ore.

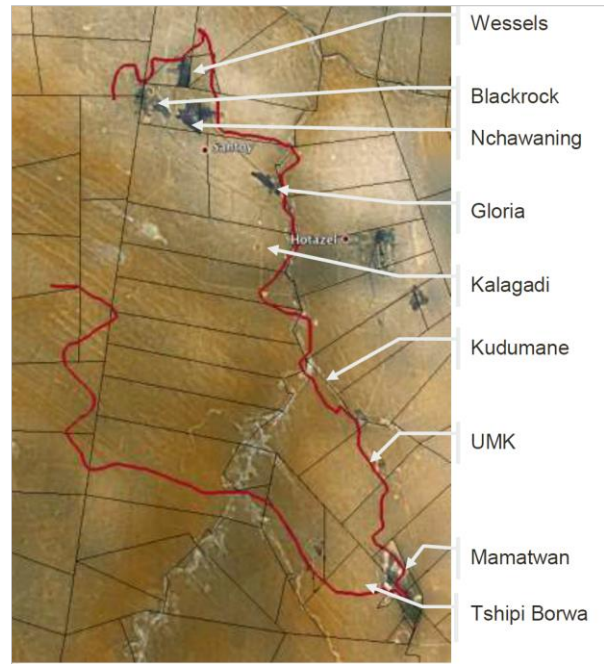
Presentation. [Online]. Available from:

http://www.manganese.org/_data/assets/pdf_file/0003/82848/3._UMK_130909.pdf (Accessed: 3 October 2011).

¹³ <https://www.statista.com/statistics/247633/manganese-price-forecast/>

years, the effects of such a cycle was experienced in the iron ore industry, and specifically the town of Kathu was hard hit. As the iron ore mines had to slow down, many thousands were retrenched, resulting in a recession in the town and general area. However, since 2016, the global iron and steel market attempted to rebalance following an ongoing glut in production for raw steel and steel products from China and iron ore from Australia and Brazil. Globally, iron ore production in 2017 increased by 20 million tons from that of 2016, following an increase of 30 million tons in 2016 from that of 2015.¹⁴ And the mines around Kumba have again started to employ more people.

Figure 6. Map of manganese mines¹⁵



The table below demonstrates the data publicly available for mines in the areas through which the pipeline traverses. The water demand forms which mines, and solar plants submitted to Sedibeng Water, also indicate where their employees reside.¹⁶

Table 2. Mining towns and life of mines with employees' place of abode

Nearest town	Mine (owner) and place of employee residence	Commodity	Life of Mine (as of 2018); Reserves & Resources
Blackrock	Blackrock Mine = Gloria & Nchwaning (Assmang) Employees live in Kuruman (68%), Blackrock (20%) and Kathu (10%)	Manganese	23 years
Hotazel	Hotazel Manganese Mines: Wessels (South 32, Anglo America Plc & BBBEE entities) Employees live in Kuruman villages (40%), Kuruman (20%), Hotazel (30%) and Kathu (10%)	Manganese	Wessels represents one of the largest manganese reserves in South Africa having estimated reserves of 190.8 million tonnes of manganese ore grading 55% manganese metal
	Hotazel Manganese Mines: Mamatwan (South 32, Anglo America Plc & BBBEE entities)	Manganese	
	Mokala Manganese Most employees live in Kuruman and surrounding villages	Manganese	

¹⁴ U.S. Geological Survey (2018) Mineral commodity summaries 2018: U.S. Geological Survey,

¹⁵ Tshipi. International Manganese Institute, 39th Annual Conference

Istanbul June 2013. [Online]. Available from: <http://www.manganese.org/events/imni-event/2013-imni-39th-annual-conference/>

¹⁶ Water demand forms completed and signed by mines and solar plants dated 2018, provided by Sedibeng Water.

Nearest town	Mine (owner) and place of employee residence	Commodity	Life of Mine (as of 2018); Reserves & Resources
	Kalagadi Manganese (ArcelorMittal, Kalahari Resources & IDC)	Manganese	Started mining in 2014. The recent exploration programme has identified 102 million tons of Mineral Resources. Underground mine to produce 3 million tons per annum of run of mine ore (38% Mn). An ore preparation facility and sinter plant which will beneficiate the ore into 2.4 million tons per annum of a high-grade sinter at full production
	York & Telele (Kudumane Manganese Resources) Most employees live in Kuruman and surrounding villages (85%), Hotazel (10%) and Kathu (5%)	Manganese	30 years - After the 30 years, re-mining of the proposed TSF (tailings) may be considered
	United Manganese of Kalahari (UMK) Most employees live in Kuruman (60%) and Kathu (40%)	Manganese	20 years
	Tshipi Borwa Mine (Tshipi é Ntle Manganese Mining Proprietary Limited) Most employees live in Kuruman (70%) and Kathu (30%)	Manganese	25 years
Kathu	Khumani (Assmang) Most employees live in Kathu (44%), Kuruman, (25%), Postmasburg (15%), Olifantshoek (10%)	Iron ore	25 years
	Sishen Mine – Kumba (Anglo-American)	Iron Ore	13 years
Postmasburg	Lomoteng (Adistra 11 CC and Super Mayer Investment Ltd)	Manganese and Iron Ore	Mining right, issued in 2010, is for 15 years, renewable, however sufficient resources and reserves for 128 years
	Huatian SA Most employees live in Postmasburg (57%), and Olifantshoek (21%), and Kathu (14%)		
	Beeshoek (Assmang) Employees live in mainly in Postmasburg, but also Olifantshoek (10%)	Iron Ore	24 years
	Kolomela (Anglo-American) Most employees live in Postmasburg	Iron Ore	13 years
	Sedibeng (Tata, Cape Gannet & IDC)	Iron Ore	12 years
	Autumn Skies Iron Ore (ASIO) owned by Autumn Skies Resources and Logistics (ASR&L)	Iron Ore	Started operating in 2018 with minable resource of approximately eighteen million tons of iron ore
Lime Acres	Finch Mine (Petra Diamonds)	Diamonds	13 years Petra's initial mine plan has a life to 2030, but resources in Block 6 and the adjacent Precursor kimberlite orebody, which sits next to the main body of the Finsch kimberlite pipe, are expected to prolong the actual LOM.

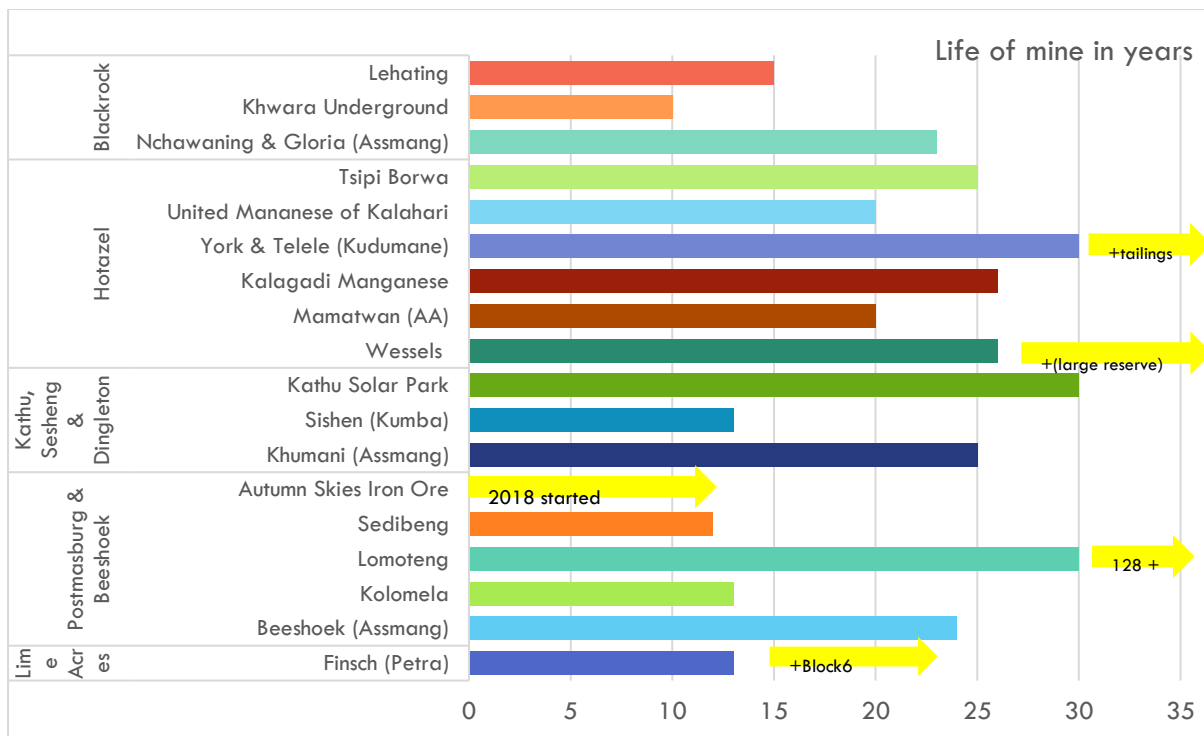


Figure 7. Life of mine in years (from 2018 onwards)

There is also much exploration and prospecting being undertaken in the study area and the following proposed mines have been identified as listed in the table below.

Table 3. Prospecting in study area

Nearest town	Proposed mine (owner)	Commodity	Planned Life of Mine	Other info
Blackrock/ Hotazel	Lehating Mine (Lehating Mining (Pty) Ltd) Employees living in Kuruman (250) and Hotazel (50)	Manganese	15 years	The construction of the Lehating Mine is still to commence. Will employ 350 persons.
	Khwara Underground (Tshipi é Ntse Manganese Mining (Pty))	Manganese	10 years	The resource will be accessed and mined from the Lehating mine (underground). Employees from the Lehating Mine will be utilised. No new employment opportunities.

There is a high risk that Hotazel and Blackrock will become (or be perceived to be) a boom area, causing a great influx of job seekers, even though most of the new mines will not employ more than a few hundred persons, whether as direct permanent employees or as contractors. Most of the literature regarding the anatomy of boomtowns shows that the rising prices of the mined commodity influences the size of the population within the town as well as in its economic activity. This is demonstrated very well in Kathu with the extraordinary increase in the demand for housing in the area due to the increase in iron-ore mining since 2001. Kathu with its increasing higher order of services and amenities, such as a newly opened private school, Curro, with a capacity of 1600 learners, has the potential to become the main service centre of this mining area which further reinforces its attraction to migrants.¹⁷ It has been noted that recent growth in the tertiary sector in Gamagara points to a diversifying economy, and overall employment trends have been positive with an approximate 333 new employment

¹⁷ Meeting with Gamagara Municipality on 4 October 2018. See notes in Appendix A.

opportunities created annually between 2013 and 2017.¹⁸ Not only are towns such as Postmasburg and Kathu growing at a rapid rate, but Kuruman and surrounding villages are also a sought-after residential areas for mine employees.¹⁹ As can be seen in Table 2 above, the nearest town to a mine is not the only residential area chosen by employees since mines offer employees the choice between accommodation and transportation to work. Thus Kuruman, Kathu and surrounding villages play a dormitory role for mines nearby even though they are not necessarily the closest residential area to the mine.²⁰ Kathu and Kuruman are attractive because of the increasing range of goods and services provided, whilst the villages surrounding Kuruman offer a rural lifestyle.²¹ Another benefit of Kathu is that it has private land on which to expand, whilst both private land in Kuruman and its bulk infrastructural capacity are limited.²² Possible social impact can occur when the housing supply cannot meet the demand, resulting in increased number of occupants per dwelling. This situation is further compounded by contractors who often “over-occupy” dwellings.²³

This area is also a semi-arid region, and it is important to highlight other socio-economic factors that should be considered, such as the sparse population, low productivity and remoteness. The low levels of available water lead to the towns in the study area to be naturally sparsely populated. Rendering services, such as water provision, to these communities is also more expensive because of their remoteness.²⁴ The municipalities in the study area are essentially rural in nature and lack the capacity to deal with service delivery pressures caused by an influx of job seekers. Gamagara Municipality's most recent IDP states that the 2016 Community Survey found that the municipality has a total population of 53 656 as compared to 41,617 in 2011, which indicates a population increase of 33.4% (12,039 individuals), and a growth rate of 5.21% per annum from 2011 to 2016. The municipality also has an urbanisation rate of 97.6%, which is significantly higher than that of the District at 24.9%. Such an influx also creates social problems. Research has found that the main driver of the 2012-2014 labour unrests in the North West Province was the living conditions, i.e. lack of formal housing with low levels of sanitation and water delivery, instead of the level of wages. The large percentage of youth who are unemployed also contributes to the ongoing socio-political instability across the country. In the study area the largest group of the population is between 20-34 years old. This is concerning when one considers the youth unemployment figures on South Africa as a whole. With the onset of automation in mining, even fewer people will be employed in mining in the next decades.

Postmasburg, Kathu and other mining towns will undoubtedly grow because of immigrants. Municipalities such as Dikgatlong supported this viewpoint and explained that even people from Barkly West move there because of the mining economy.²⁵ Between 1996 and 2011 Postmasburg more than doubled its number of households (3 965 and 8 112 respectively – see Table 5) and development continues. Kolomela mine is developing housing for the new mine, and housing developments are underway in Postdene, Airfield, and Recreation opposite the

¹⁸ Maxim (2018) Motivation report - proposed Township Establishment Kathu extensions 6,7,8,9 and 10, removal of restrictive title conditions, consolidation and subdivision on Portions 1 and 2 of the farm Kalahari Gholf en Jag Landgoed No. 775, Division Kuruman, Northern Cape Province. P 6. [Online]. Available from: <https://www.sahra.org.za/sahris/sites/default/files/additionaldocs/8-75-1%20Memorandum%20Kathu%20Extensions%206-10.pdf>

¹⁹ Meeting with Gamagara Municipality on 4 October 2018. See notes in Appendix A.

²⁰ Meeting with Gamagara Municipality on 4 October 2018. See notes in Appendix A.

²¹ Meeting with Gamagara Municipality on 4 October 2018. See notes in Appendix A.

²² Meeting with Gamagara Municipality on 4 October 2018. See notes in Appendix A.

²³ Meeting with Gamagara Municipality on 4 October 2018. See notes in Appendix A.

²⁴ Marais, L. and Cloete, J. (2009) Mining and housing: the case of the “village under the trees” (Kathu – South Africa). *Town and Regional Planning* 55: 32-38.

²⁵ Meeting with Dikgatlong on 9 November 2018. See notes in Appendix A.

Showgrounds, as well as a small development by Transnet.²⁶ Furthermore, in situ upgrading of informal areas is taking place and 8000 stands have been approved and finalised at Greenfields, Boichoko, Mt View (Koppie) and an 11 Mℓ reservoir is planned.²⁷

Studies^{28 29} have also found that in remote places, such as the study area, for every ten jobs created in mining during a mining boom, the spill-over effect is less than two jobs created in the local goods sectors of construction, retail, and services; but that for every ten jobs lost in the mining sector, three and a half jobs are lost in the construction, retail and services sectors.

It has been demonstrated that mining's regional employment outcomes are often unsustainable and unable to generate long-term opportunities for residents.

Risks in mining that can result in premature closing of mines include:

- Commodity markets and exchange rate fluctuations
- Poor third-party infrastructure such as the water pipeline, roads, etc.
- Mining legislation and regulatory compliance
- Socio-economic governance challenges e.g. higher labour costs and/or automation can lead to significant retrenchments. The impact of this on communities and the process of retrenchment could aggravate negativity and violence. Protests and uprisings disrupts mining activities.
- Stakeholder engagement failure and loss of social licence to operate
- Cyber risk
- Resource depletion
- Climate change is an escalating problem. Mining companies need to assess the potential impact of adverse weather patterns on their operations (excessive or below-average rain, heat, fog and dust impacting on operations) and the communities in which they operate. If the company cannot afford these adaptations, the mine might have to scale down or close.
- Climactic conditions affect the stability and effectiveness of infrastructure and equipment, as well as transportation networks, which in turn affects the financial bottom line of the mine. If the mine cannot absorb these costs brought along by a rapidly changing and unpredictable climate, it has a high risk of scaling down and closing.

Job-seeking migrants who moved into the area might not be able to leave again (due to their financial situation and very few jobs in the country or province) and this puts pressure on local government to provide services, including water.

3.2 Solar plants

Another fast-growing commercial development in the study area is that of the renewable energy sector, specifically solar thermal plants. The table below lists some of these developments. It should be noted that even though these businesses employ relatively few people permanently, the perception of the number of potential jobs might be the opposite and they might also add to the influx of job-seekers.

²⁶ Meeting with Tsantsabane Municipality on 6 November 2018.

²⁷ Meeting with Tsantsabane Municipality on 6 November 2018.

²⁸ Black, D., McKinnish, Sanders, S. (2005) The economic impact of the coal boom and bust. *The Economic Journal*. 115: 449-476.

²⁹ Tonts, M. (2010) Labour market dynamics in resource dependent regions: an examination of the Western Australian Goldfields. *Geographical Research* 48,2: 148-165.

Table 4. Solar plants in study area

Town	Name	Capacity/Size	Life of Enterprise	Jobs
Hotazel	Adams Solar PV (Enel Green Power)	82.5 MW	20 years	1443 (appears exaggerated compared to other operations)
Kathu	Kathu Solar Park (GDF)	100 MW	30 years	During construction: 500 jobs During operation: 81 permanent jobs Sharp decline in jobs as of Oct 2018
Postmasburg	Jasper Solar (Solar Reserve Consortium)	96 MW	20 years	Unknown but expected to be less than 100 permanent jobs Employees live in Postmasburg (50%) and Groenwater (50%)
	Lesedi Solar (Oakleaf)	75 MW	20 years	Unknown but expected to be less than 100 permanent jobs Most employees live in Postmasburg
	Redstone (CSP project) (ACWA, Solar Reserve Consortium)	100 MW	20 years	80 permanent jobs, mostly living in Postmasburg

Apart from the above, there are also current applications for proposed solar plants, such as the ACWA solar plant near Postmasburg, which will produce 20 MW and will have a life of enterprise of approximately 20 years. During construction of these plants, jobs created are high and generally exceed 1000 jobs, but these jobs are temporary and once operations start, decline to less than 100 as is evident from the Kathu Solar Park and Redstone projects.

A high proportion of new dwellings at Groenwater is linked to employment opportunities on the Jasper and Lesedi solar projects. According to Jasper Solar approximately half of its employees live in Groenwater.³⁰ Permanent residence in Groenwater is a condition that governs plot allocation in the village, which favours the elderly and those with employment nearby.³¹ Please see further details of solar plants in Appendix C.

3.3 Growth of other settlements

Koopmansfontein, a land claim settlement which Transnet owned, received an influx of farmworkers, of whom some might still work on farms, during 2013-2014.³² This settlement, which currently receives no services, has had plots surveyed and positive growth is foreseen by the municipality since alluvial diamond mining takes place in the area and there are two operational farms, one an experimental farm, the other managed by the CPA.³³

No growth is expected in Vaalgamagara, which is a private 'gated' settlement, not serviced by the municipality, and occupation is linked to employment at Sedibeng Water.³⁴ It is unlikely that any new dwellings will be built, and unoccupied houses were noted at the time of the field visit in November 2018.³⁵

Delportshoop and Longlands have grown at a fair pace between 1996 and 2011 i.e. household growth of 4.70% p.a. (see Table 5). Inhabitants commute to Kimberley and Barkly West for work, and some also work at AfriSam near Ulco.³⁶ Currently RDP houses with services

³⁰ Sedibeng Water agreement form completed by Jasper Solar in 2018.

³¹ Meeting with Tsantsabane Municipality on 6 Nov 2018. Please see meeting notes in Appendix A.

³² Meeting with Dikgatlong on 9 November 2018. See notes in Appendix A.

³³ Meeting with Dikgatlong on 9 November 2018. See notes in Appendix A.

³⁴ Meeting with Dikgatlong on 9 November 2018. See notes in Appendix A.

³⁵ Field visit on 12 November 2018.

³⁶ Meeting with Dikgatlong on 9 November 2018. See notes in Appendix A.

are being built, as well as a new development at Delportshoop named '7de Laan', and almost 300 stands in an extension of Rooikoppies which are not yet serviced.³⁷ Small-scale alluvial diamond mining continues in the Dikgatlong municipal area although the underground diamond mine, Van Wyk's Diamond Mine on the farm Good Hope, has closed.³⁸

Maremane, a small settlement resulting from a land restitution case, is situated between the railway line and the VGWSS pipeline, and west of the Lohatla military base. The Tsantsabane municipality indicated that Maremane is unlikely to grow much in the future, although they are currently busy with township establishment.³⁹

There is also another small informal settlement called Maremane, which is new and not far from the Maremane land restitution case. Its inhabitants also want services although this is not necessarily supported by the municipality.⁴⁰

The urbanisation and migration process is not straightforward.⁴¹ Although some settlements in Joe Morolong are home to mining employees, it is also a safety net to have a home in Joe Morolong which can be used if retrenched and for retirement.⁴² Strong links remain between urban dwellers and rural areas and movement occurs from both rural to urban areas and from urban to rural.⁴³ Not all the migration to urban areas is permanent, but people moving to small towns typically do not return to rural villages.⁴⁴

An outmigration from villages in Joe Morolong to more urban mining towns can also be linked to the mines' performance and related opportunities.⁴⁵ Joe Morolong was among the least productive municipalities in the country. The others in this category include Ratlou in the North West and Fetakgomo in Limpopo, with the rest predominantly cluttered along the east in KwaZulu-Natal and the Eastern Cape.⁴⁶

The development and attractiveness of tribal settlements are generally influenced by factors such as electrification and good transport networks, but the growth of settlements in the Tsineng area is determined by the place and rate at which tribal authorities allocate land.⁴⁷

According to the Joe Morolong Municipality, the future expansion of Blackrock is limited. Black Rock Mine Operations has built houses in Kuruman and Kathu, rather than only in Blackrock, and provides transport to its mines.⁴⁸

It is perceived that Hotazel is 'better' than Blackrock because it has schools and recreation facilities. Hotazel's development has been driven by South32's housing plan, and development in both these towns is driven by mines' housing demand.⁴⁹

³⁷ Meeting with Dikgatlong on 9 November 2018. See notes in Appendix A.

³⁸ Meeting with Dikgatlong on 9 November 2018. See notes in Appendix A.

³⁹ Meeting with Tsantsabane Municipality on 6 November 2018.

⁴⁰ Meeting with Tsantsabane Municipality on 6 November 2018.

⁴¹ Walsh, K (2011) Understanding consumer profile, PDG Occasional Paper Number 2, November 2011. P 5.

⁴² Meeting with Joe Morolong 6 November 2018. See notes in Appendix A.

⁴³ Walsh, K (2011) Understanding consumer profile, PDG Occasional Paper Number 2, November 2011. P 5.

⁴⁴ Collinson et al (2006) cited in Walsh, K (2011) Understanding consumer profile, PDG Occasional Paper Number 2, November 2011. P 5.

⁴⁵ Meeting with Joe Morolong 6 November 2018. See notes in Appendix A.

⁴⁶ StatsSA. Simulating key estimates for local municipality socio-economic development models: applications of the rank - size rule from 2007 to 2012. [Online]. Available from:

<http://www.statssa.gov.za/publications/D9129/D91292012.pdf>

⁴⁷ Meeting with Joe Morolong 6 November 2018. See notes in Appendix A.

⁴⁸ Meeting with Joe Morolong 6 November 2018. See notes in Appendix A.

⁴⁹ Meeting with Joe Morolong 6 November 2018. See notes in Appendix A.

3.4 Household trends

Relationship between population, households and housing

According to Mulder⁵⁰ there is a two-sided relationship between population and housing. On the one hand population change, and particularly a growth in the number of households, shapes housing demand; and on the other hand, the supply of housing influences the opportunities for population increase through migration. Adequate housing supply may attract migrants or influence the choice of residential location. He also found that home owners are considerably less likely to migrate than renters because cost of relocation is greater for home owners.⁵¹ This link is evident from the high proportion of rented accommodation in Kathu, Hotazel and Blackrock seen in Figure 8 and the high rates of in migration seen in Figure 16.

In 2011, the mining towns in the study area displayed a predominance of rental accommodation at 33% compared to the 18.8% at provincial level. At Lime Acres, Kathu, Vaalgamagara, Hotazel and Blackrock more than 50% of households rented homes in 2011. Towns with little migration, such as Delportshoop/Longlands, have relatively few households renting accommodation.

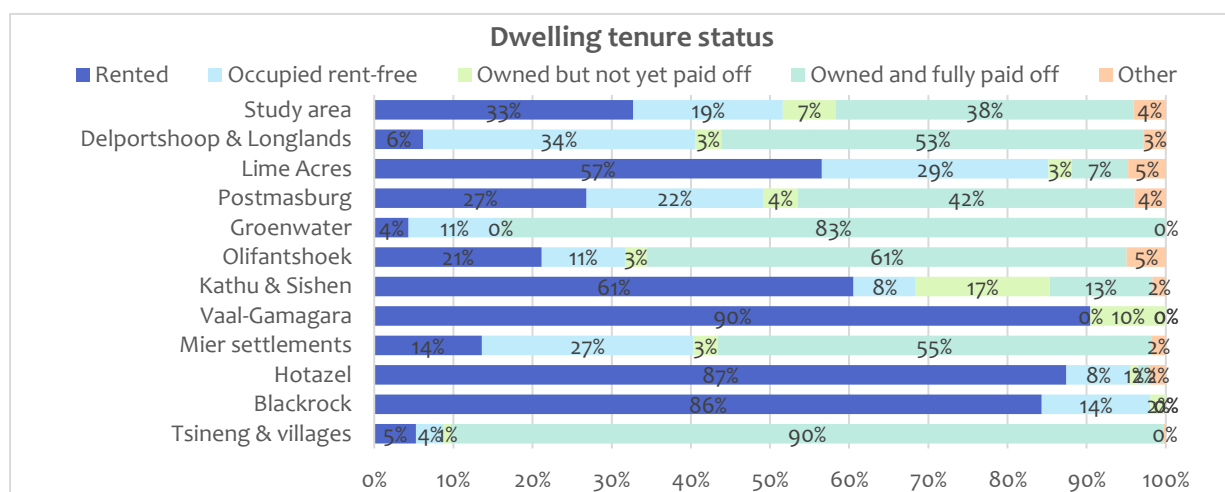


Figure 8. Dwelling tenure in the study area⁵²

Mulder notes further that urgent migrants such as refugees and those moving for education or work are unlikely to choose the destination according to the availability of housing.⁵³ In addition, those moving for work are more likely to substitute housing of a lower quality.⁵⁴ The

⁵⁰ Mulder, CH (2008) The relationship between population and housing. Sixty-ninth session of the UNECE Committee on Housing and Land Management - Key note presentation. 22 - 23 September 2008. Geneva, Switzerland. [Online]. Available from:

<http://www.unece.org/fileadmin/DAM/hlm/archive/Key%20note%20population%20and%20housing.pdf>

⁵¹ Mulder, CH (2008) The relationship between population and housing. Sixty-ninth session of the UNECE Committee on Housing and Land Management - Key note presentation. 22 - 23 September 2008. Geneva, Switzerland. [Online]. Available from:

<http://www.unece.org/fileadmin/DAM/hlm/archive/Key%20note%20population%20and%20housing.pdf>

⁵² StatsSA. 2011 Census.

⁵³ Mulder, CH (2008) The relationship between population and housing. Sixty-ninth session of the UNECE Committee on Housing and Land Management - Key note presentation. 22 - 23 September 2008. Geneva, Switzerland. [Online]. Available from:

<http://www.unece.org/fileadmin/DAM/hlm/archive/Key%20note%20population%20and%20housing.pdf>

⁵⁴ Goegeluk (1997) cited in Mulder, CH (2008) The relationship between population and housing. Sixty-ninth session of the UNECE Committee on Housing and Land Management - Key note presentation. 22 - 23 September 2008. Geneva, Switzerland. P 4. [Online]. Available from:

<http://www.unece.org/fileadmin/DAM/hlm/archive/Key%20note%20population%20and%20housing.pdf>

recent influx into Kathu of people occupying informal dwellings in an informal area maybe an example of this. This informal area⁵⁵ is being developed for approximately 1265 low and medium income houses by the HDA and another approximately 5600 houses are planned to the north-east of Kathu.⁵⁶

Historical household trends

Households in the study area increased annually by 4.08% between 1996 and 2011. This is at a higher rate than that of population growth (3.03%). The greatest annual increase in households is noted in Kathu and Delpportshoop & Longlands, while negative household growth rates were recorded at Koopmansfontein and Blackrock. Household growth outstrips population growth as the RDP housing programme allows new households to form and many towns to expand. Households also form in “belief” that each new unit is entitled to a housing subsidy.⁵⁷

This contributes to informal settlement, which a response to the housing “backlog” as well. For example, by 2011 there were 1 664 informal dwellings in Sishen representing 46.1% of all dwellings; an indication of housing demand.

Table 5. Historical household growth 1996 to 2011⁵⁸

HOUSEHOLDS	Number			1996-2011 growth p.a.	Average HH size		
	1996	2001	2011		1996	2001	2011
Delpportshoop & Longlands	1 640	2 371	3 264	4.70%	4.80	3.81	4.07
Vaal Gamagara	68	45	63	-0.51%	4.68	4.11	3.14
Koopmansfontein	104	57	37	-6.66%	4.33	6.73	6.73
Lime Acres	1 081	1 228	1 758	3.30%	4.37	3.03	2.51
Groenwater		128	210	15.25%		3.98	3.51
Postmasburg & Beeshoek	3 965	5 012	8 112	4.89%	4.81	4.24	3.71
Maremane			196				3.51
Olifantshoek	1 380	1 540	2 169	3.06%	5.22	4.56	4.72
Kathu, Sesheng & Dingleton	3 050	3 852	6 747	5.44%	3.19	2.88	3.34
Hotazel	322	503	597	4.20%	4.32	2.43	2.94
Blackrock	249	638	153	-3.19%	5.43	1.56	2.65
Tsineng and surrounding villages	2 000	2 065	1 926	-0.25%	3.25	4.05	3.65
TOTAL HOUSEHOLDS	13 859	17 439	25 232	4.08%	4.23	3.66	3.63

In the table below, household growth over the 20-year period from 1996 to 2016 is recorded by local municipality. Over this period Gamagara had the highest annual growth rate (5.35%) whilst Joe Morolong experienced in the lowest growth (0.96%).

⁵⁵ Area 27a (as per the Sesheng Bulk Water Supply study area layout drawing)

⁵⁶ Meeting with Gamagara Municipality on 4 October 2018. Please see notes in Appendix A.

⁵⁷ Tomlinson, MR (2015) Why can't we clear the housing backlog? PoliticsWeb, 06 October 2015 [Online]. Available from: <http://www.politicsweb.co.za/news-and-analysis/why-cant-we-clear-the-housing-backlog--irr>

⁵⁸ Data source: StatsSA censuses 1996, 2001 and 2011. Used average LM growth rate to estimate Tsineng and surrounding villages 1996 population. 2018 data based on own calculations from dwelling counts. Please see Appendix B.

Table 6. Households and annual growth 1996 to 2016 by local municipality⁵⁹

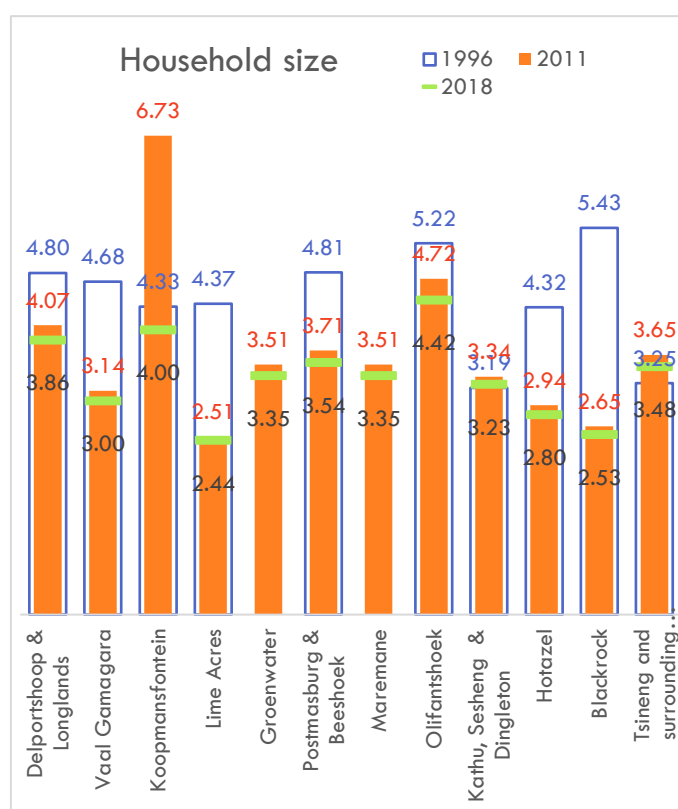
by LM	Households				Growth rate pa			
	1996	2001	2011	2016	1996-2001	2001-2011	2011-2016	1996-2016 (20 yrs.)
Dikgatlong	8 254	10 224	11 967	14 824	4.37%	1.59%	4.37%	2.97%
Kgatelopele	3 733	3 585	5 381	6 206	-0.81%	4.14%	2.89%	2.57%
Tsantsabane	6 035	6 800	9 839	11 821	2.42%	3.76%	3.74%	3.42%
Gamagara	5 546	5 306	10 808	15 723	-0.88%	7.37%	7.78%	5.35%
Joe Morolong	19 765	21 749	23 707	23 919	1.93%	0.87%	0.18%	0.96%
TOTAL	43 332	47 664	61 702	72 492	1.92%	2.62%	3.28%	2.61%

Household size

The trend towards smaller household sizes is illustrated in the adjacent figure. Household sizes decreased between 1996 and 2011 in all but two settlement areas i.e. Koopmansfontein and Tsineng & surrounding settlements. An assumed household size is shown for 2018.

Figure 9. Average household sizes in 1996, 2011 and 2018⁶⁰

According to Udjo the national average household size is projected to decrease from about 3.4 persons per household in 2011 to about 2.9 persons per households by 2021, while projected Northern Cape household size is 3.2 in 2021.⁶¹ Furthermore, Udjo projected the number of households per district in South Africa by 2021. The Northern Cape's households are projected to grow by an average of 2.76% per annum, with Frances Baard having the highest rate (3.46%) and Namakwa the lowest (0.86%). The growth rate in ZFM (3.10%) is only slightly lower than that of Frances Baard.⁶²



Dwellings in 2018

To determine the population in 2018, new dwellings were counted. The latest aerial photography on Google Earth was used to count new dwellings since 2011 (or the closest date to 2011 which was mostly 2009 and 2010). The period between the two aerial photograph dates was recorded as well as the additional number of dwellings between these two dates.

⁵⁹ Data source: StatsSA. SuperWeb2. Interactive adtata Censuses 1996, 2001 and 2011. Community Survey 2016.

⁶⁰ Own calculations based on StatsSA census 1996 and 2011, and assumed for 2018

⁶¹ Udjo, EO (2015) Projecting population, numbers of households and dwelling units in South Africa 2011-2021. African Population Studies Vol. 29, No. 1, 2015. [Online]. Available from: <http://aps.journals.ac.za>

⁶² Data source: Udjo, EO (2015) Projecting population, numbers of households and dwelling units in South Africa 2011-2021. African Population Studies Vol. 29, No. 1, 2015. [Online]. Available from: <http://aps.journals.ac.za>

From this the total number of estimated dwellings in 2018 was determined. Average household sizes were applied to each place and the population for 2018 was determined.

The growth in absolute numbers of dwelling per year was established and it was assumed that this growth took place evenly between the two photography dates. Since the number of households⁶³ in 2011 was known, the period between the latest photography and 2011 was used to determine the annual growth rate which was extrapolated to a total number of estimated dwellings in 2018. Based on this methodology, it is calculated that there was an increase of 4.2% of dwellings per annum between 2011 and 2018, i.e. an increase from 20 593 dwellings in 2011 to 34 249 in 2018 in the study area. Please see Appendix B.

A high proportion of new dwellings were counted at Groenwater which is presumed to be related to employment opportunities on the Jasper and Lesedi solar projects. Approximately half of the employees of the Jasper plant live in Groenwater.⁶⁴ Influx into Groenwater took place especially after the electrification in 2012/13, but it has stabilised around 567 plots.⁶⁵ However, new dwellings did not necessarily result in the formation of new households at Groenwater.⁶⁶ Households increased from 210 in 2011 to 567 in 2018, while dwellings increased to 810. Most plots have more than one dwelling and it common for a plot to have a formal household and a shack located on it. Local women confirmed that plots with two dwellings were occupied by one household at Groenwater.⁶⁷ Officials at Dikgatlong also explained that when RDP houses are erected, the shacks are usually kept even if it is moved on the plot which is used by the family or rented out.⁶⁸

This phenomenon of a shack and formal dwelling on one plot does not seem to occur at any other settlements in the study area because almost all the dwellings counted in 2018 were at new housing extensions or informal areas where only one dwelling occupied a site, albeit an informal site. Please see the dwelling count table in Appendix B.

Whilst formal housing developments took place at Olifantshoek, Kathu and Postmasburg, these towns also displayed high numbers new dwellings built in informal areas. This illustrates the fact that poor households take up residence in informal settlements and backyard shacks because they are prepared to accept poor quality housing to be close to economic opportunities.⁶⁹

It is recognised that the number of people per dwelling is likely to differ for different dwelling types, and household size is not the same as number of occupants per dwelling. Nevertheless, the average household size was used to estimate the number of people living in each of the towns in 2018, except Groenwater where the plot count was used. The table below shows population estimates for each of the towns based on dwelling counts and assumed occupancy rates.

⁶³ Although a household and a dwelling are not necessarily the same.

⁶⁴ Sedibeng Water agreement form completed by Jasper Solar in 2018.

⁶⁵ Meeting with Tsantsabane Municipality on 6 Nov 2018. Please see meeting notes in Appendix A.

⁶⁶ Site visit on 6 November 2018 and meeting held with Tsantsabane Municipality on the same day. Please see notes in Appendix A.

⁶⁷ Personal communication with four local women at Groenwater on 6 November 2018.

⁶⁸ Meeting with Dikgatlong on 9 November 2018. See notes in Appendix A.

⁶⁹ FFC (2012) cited in Mtantato, S and Churr, N. CHAPTER 4 - Understanding and housing demand in South Africa. Submission for the 2015/16 Division of Revenue. Financial and Fiscal Committee.

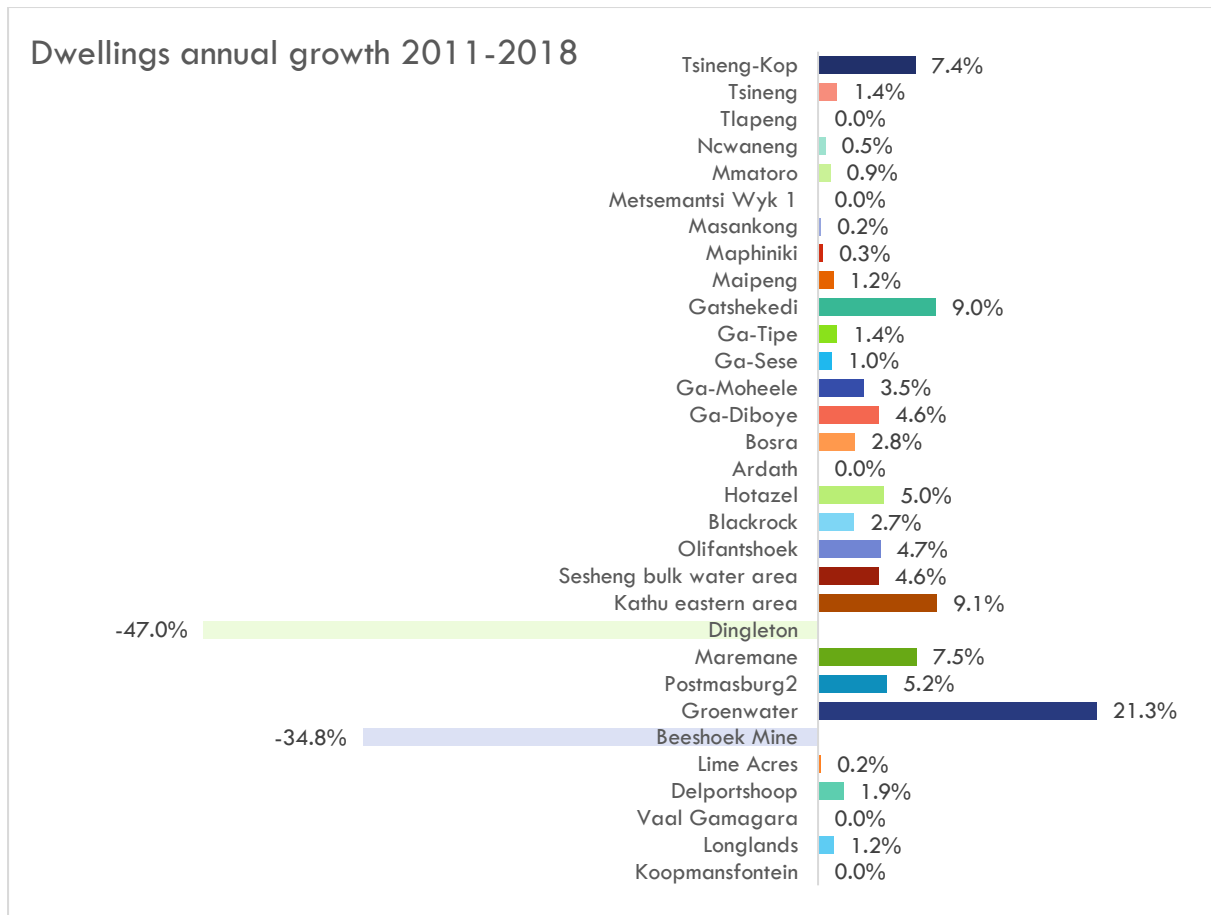


Figure 10. Dwelling growth p.a. from 2011 to 2018⁷⁰

Table 7. Households and population in 2011⁷¹ and estimated in 2018 based on the average household size and dwelling counts

	Households		Average HH size		Population	
	2011	2018	2011	2018	2011	2018
Delportshoop & Longlands	3 264	3 683	4.07	3.86	13 278	14 203
Vaal Gamagara	63	63	3.14	3.00	198	189
Koopmansfontein	37	111	6.73	4.00	249	444
Lime Acres	1 758	1 780	2.51	2.44	4 407	4 351
Groenwater	210	567	3.51	3.35	738	1 901
Postmasburg & Beeshoek	8 112	11 554	3.71	3.54	30 087	40 889
Maremane	196	324	3.51	3.35	689	1 086
Olifantshoek	2 169	2 987	4.72	4.42	10 233	13 193
Kathu, Sesheng & Dingleton	6 747	9 491	3.34	3.23	22 539	30 678
Hotazel	597	838	2.94	2.80	1 755	2 351
Blackrock	153	184	2.65	2.53	405	465
Tsineng and surrounding villages	1 926	2 347	3.65	3.48	7 113	8 170
TOTAL HOUSEHOLDS	25 232	33 929	3.63	3.48	91 691	117 921

⁷⁰ Own calculations

⁷¹ Data source: StatsSA, Census 2011.

4 POPULATION TRENDS AND FUTURE ESTIMATES

Determining future demographics is a major task for long-term plans. Besides general population growth, other influences include household splitting, single-parent households, urbanisation, migration, diseases, natural disasters, immigration policies, conditions in neighbouring states and global trends. Splitting between various household income levels, and a growing middle-class further affects the level of service demanded, which impacts on infrastructure capacities, financial resources, and sustainability.

Some of these features are examined in this analysis of the population served by the VGWSS.

4.1 Historical population trends

Settlements in the VGWS supply area

Between the census years of 1996 and 2001, Koopmansfontein, Vaal Gamagara, Lime Acres, Olifantshoek, Hotazel and Blackrock experienced negative population growth; the lowest being at Vaal Gamagara (-10.27%). The settlements of Delportshoop, Longlands, Postmasburg and Kathu had positive growth rates of 2.0% or higher, whilst at Tsineng and surrounding villages it was less than 1%.⁷² This resulted in average overall growth of the population in the study area of approximately 0.86% p.a.

Between 2001 and 2011 the average population growth was 4.19% p.a., which was mainly attributed to a very high growth rate in Kathu (including Sesheng and Dingleton) of 7.33% p.a. and in Delportshoop/Longlands (4.32%), Lime Acres (3.90%) and Postmasburg (3.54%). During this period, the lowest growth rates were attained at Blackrock (-8.61%) and Koopmansfontein (-4.23%).

Considering the population growth over all three census periods from 1996 to 2011, an average growth of 3.07% p.a. was attained with the lowest at Blackrock and the highest at Kathu.

Table 8. Population growth 1996 to 2011 ⁷³

	Number			Growth rate p.a.		
	1996	2001	2011	1996-2001	2001-2011	1996-2011 (15yrs)
Delportshoop & Longlands	7 873	8 700	13 278	2.02%	4.32%	3.55%
Vaal Gamagara	318	185	198	-10.27%	0.68%	-3.11%
Koopmansfontein	450	384	249	-3.14%	-4.23%	-3.87%
Lime Acres	4 719	3 007	4 407	-8.62%	3.90%	-0.45%
Groenwater/Metsimatale		509	738		3.78%	
Postmasburg & Beeshoek	19 058	21 249	30 087	2.20%	3.54%	3.09%
Maremane			689			
Olifantshoek	7 198	7 022	10 233	-0.49%	3.84%	2.37%
Kathu, Sesheng & Dingleton	9 715	11 108	22 539	2.72%	7.33%	5.77%
Hotazel	1 390	1 220	1 755	-2.58%	3.70%	1.57%
Blackrock	1 353	996	405	-5.94%	-8.61%	-7.73%
Tsineng and surrounding villages	6 500	6 772	7 619	0.82%	1.19%	0.60%
TOTAL POPULATION	58 574	61 151	92 197	0.86%	4.19%	3.03%

⁷² This is based on an overall growth rate of the Joe Morolong Municipality.

⁷³ Data source: StatsSA censuses 1996, 2001 and 2011. Used average LM growth rate to estimate Tsineng and surrounding villages' 1996 population.

Local municipalities in the VGWSS area

Table 9 indicates that the population of the five local municipalities in the VGWS supply area increased by an average of 0.64% per annum between 1996 and 2016. Yet in 2001 the population declined from 1996 levels in all the municipalities except for Gamagara and Tsantsabane. Joe Morolong experienced negative growth from 1996 to 2016.

Figure 11. Population of local municipalities in the VGWS area 1996 to 2011^{74 75}

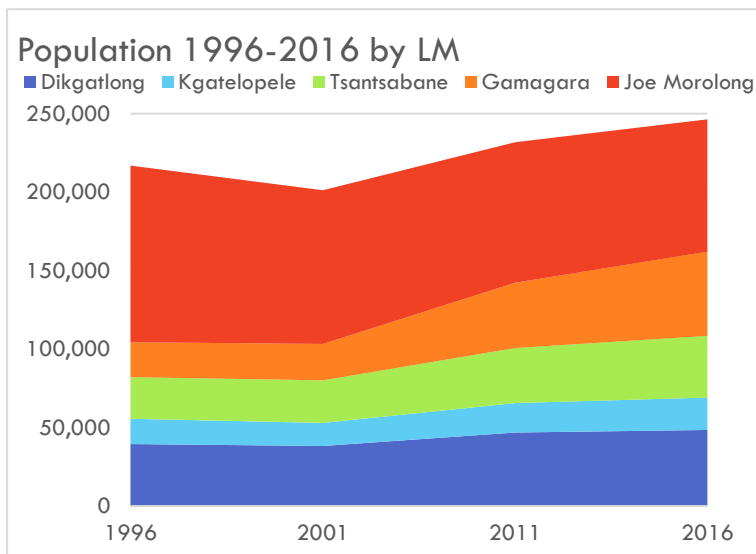


Table 9. Population and annual growth 1996 to 2016 by local municipality⁷⁶

by LM	Population				Growth rate pa			
	1996	2001	2011	2016	1996-2001	2001-2011	2011-2016	1996-2016 (20 yrs.)
Dikgatlong	39 527	38 262	46 841	48 473	-0.65%	2.04%	0.69%	1.03%
Kgatelopele	16 113	14 743	18 687	20 691	-1.76%	2.40%	2.06%	1.26%
Tsantsabane	26 567	27 082	35 093	39 345	0.38%	2.63%	2.31%	1.98%
Gamagara	22 219	23 202	41 617	53 656	0.87%	6.02%	5.21%	4.51%
Joe Morolong	112 435	97 945	89 530	84 201	-2.72%	-0.89%	-1.22%	-1.44%
TOTAL	216 861	201 234	231 768	246 366	-1.48%	1.42%	1.23%	0.64%

⁷⁴ Data source: StatsSA. SuperWeb2. Interactive data Censuses 1996, 2001 and 2011. Community Survey 2016.

⁷⁵ Note that the time series does not have equal intervals.

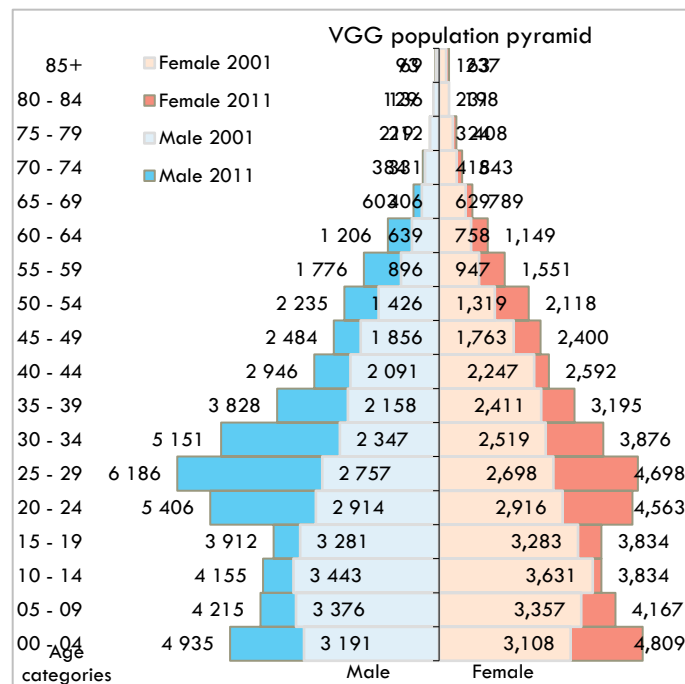
⁷⁶ Data source: StatsSA. SuperWeb2. Interactive data Censuses 1996, 2001 and 2011. Community Survey 2016.

4.2 Population growth factors

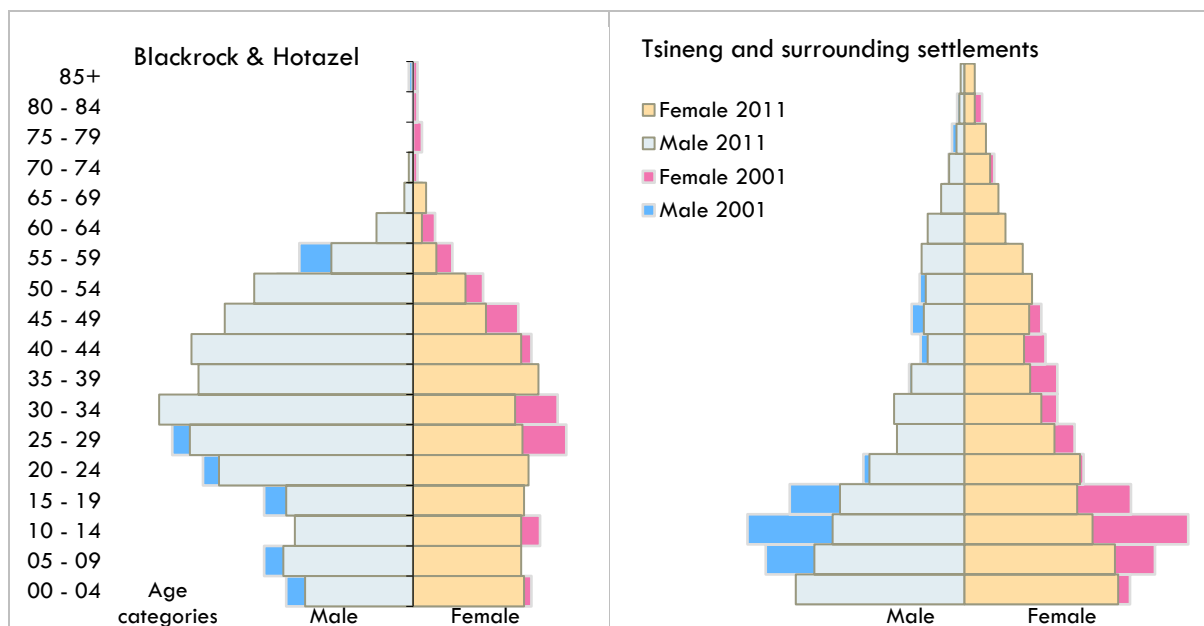
Fertility and mortality

Besides migration, population growth is determined by natural growth, which is a function of fertility and mortality. In the population pyramid of the VGWS study area, the fertility rate does not appear to have decreased because the youngest age group of 0-4-year old category is the broadest among the lowest four age categories. The 2011 population structure bulges from age group 20-34 years, due to young people being attracted to the area because of work opportunities.

Figure 12. Population pyramid of the VGWS study area⁷⁷



The population pyramids of towns with mining economies are distinctly different, e.g. compare Blackrock/Hotazel to Tsineng in the figures below. The Blackrock/Hotazel population pyramid has a narrow base, widening in the economically active age groups (20 to 59 years) due to in migration with rapid outmigration after the age of 60. There are also more males and females. This pyramid is similar in shape to that of Kathu, Sesheng and Dingleton and that of Postmasburg, Groenwater and Lime Acres. Tsineng and surrounding settlements, on the other hand, has the widest part between the age groups of 5 and 14 years, and from age 15 years upwards it tapers inwards as people leave the area after school, especially noted amongst males. The population pyramid of Delportshoop and Longlands illustrates that of a more stable population with little in- and outmigration, and it has the typical shape of a developing country's population structure.



⁷⁷ Date source: StatsSA Census 2011. Interactive data.

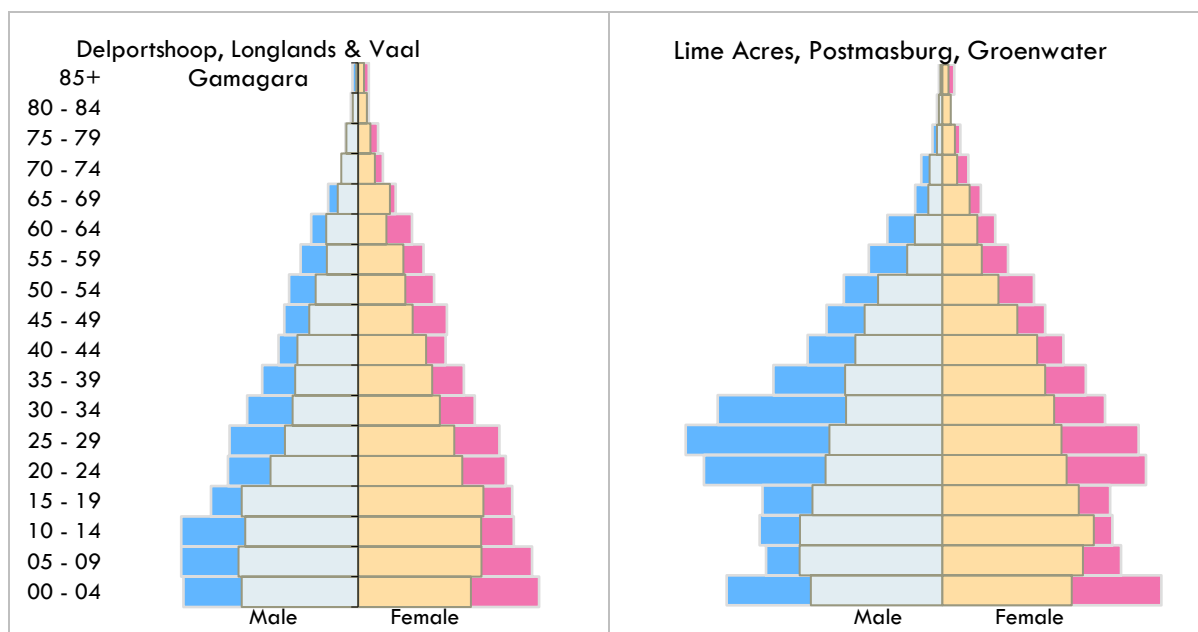


Figure 13. Population pyramid examples of the study area⁷⁸

Overall, the South African population is predominantly female, with a sex ratio of 95 males per 100 females in 2011. By contrast, the VGWSS study area, has a predominance of males, with 109 males per 100 females. Considering age-specific sex ratios, the highest sex ratio of 119 was in the age category 15-34 years, which decreased to 109 in the 35-64 year age category. After the age of 64 years the sex ratio declined to 68 which implies that many males do not stay in the area after retirement age. This indicates a higher level of in-migration by males than females to the area indicative of the mining industry and illustrated in the Blackrock/Hotazel pyramid.

An examination of recorded live births in the magisterial districts that cover the study area indicates that births increased from 8 284 in 1998 to peak in 2016 at 12 920.

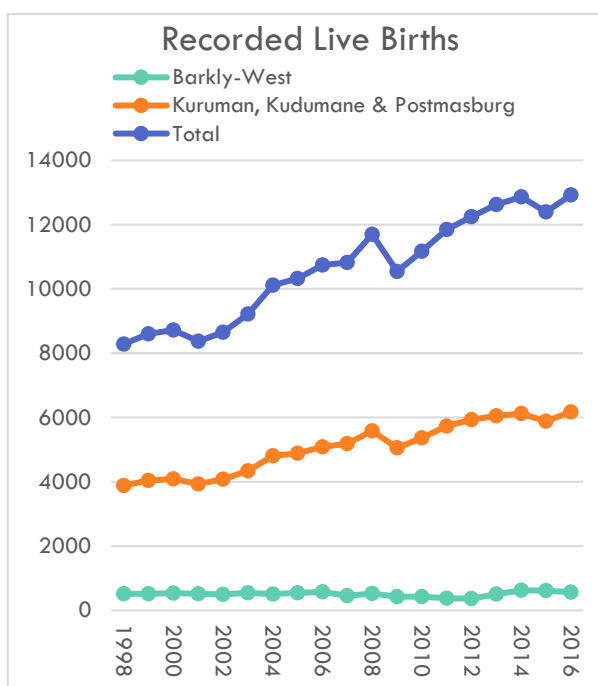


Figure 14. Recorded live births by magisterial district 1998 to 2016⁷⁹

In the period 2007 to 2016 learner numbers in the study area increased from 17 293 to 21 741 respectively, and an annual growth rate of 2.6% is recorded. The highest annual growth rate is recorded in Joe Morolong (3.8%) followed by Gamagara (3.6%) and Tsantsabane (2.5%). Dikgatlong recorded the lowest growth at 0.2% p.a.

⁷⁸ Date source: StatsSA Census 2011. Interactive data.

⁷⁹ Data source: StatsSA. Interactive data. SuperWeb2.

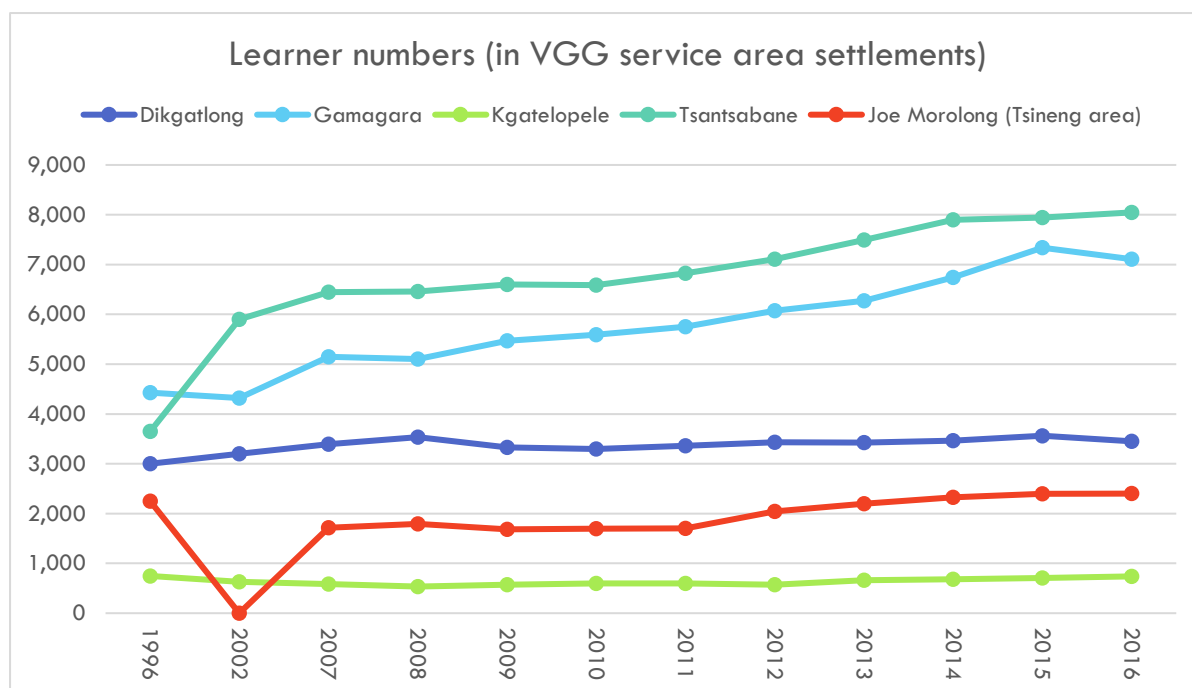


Figure 15. Learner numbers in the VGWSS area 1996, 2002, 2007-2016⁸⁰

Increasing number of births and school populations confirm the increasing population in the study area.

Migration

Migration, together with natural growth, is an aspect of population change; a predominant factor in towns with strong mining economies. Overall, the people of the Northern Cape are relatively immobile and tend to stay in the same place for their lifetime. According to the 2011 Census, 83.5% of the Northern Cape population was living in the current location or born in the place where they currently live and had not moved since 2001 i.e. living in the same place for the ten years prior to the 2011 Census. This is a higher percentage than that found in the study area where 75% of the population had been there at least since 2001 or born later and had not moved.⁸¹

The figure below shows the extent of in-migration into the study area since 2001; out-migration information is unavailable. Overall 22 326 people moved into the study area since 2001 or were born after 2001 and moved there. Kathu (11 385) was the main recipient of in-migration, followed by Postmasburg (4 227). High rates of movement occurred at Hotazel (68%), Kathu (54%) and Lime Acres (52%). The lowest mobility rates occurred at Tsineng and surrounding villages (5%).

⁸⁰ Data source: EMIS. Dept of Education.

⁸¹ StatsSA, Census 2011.

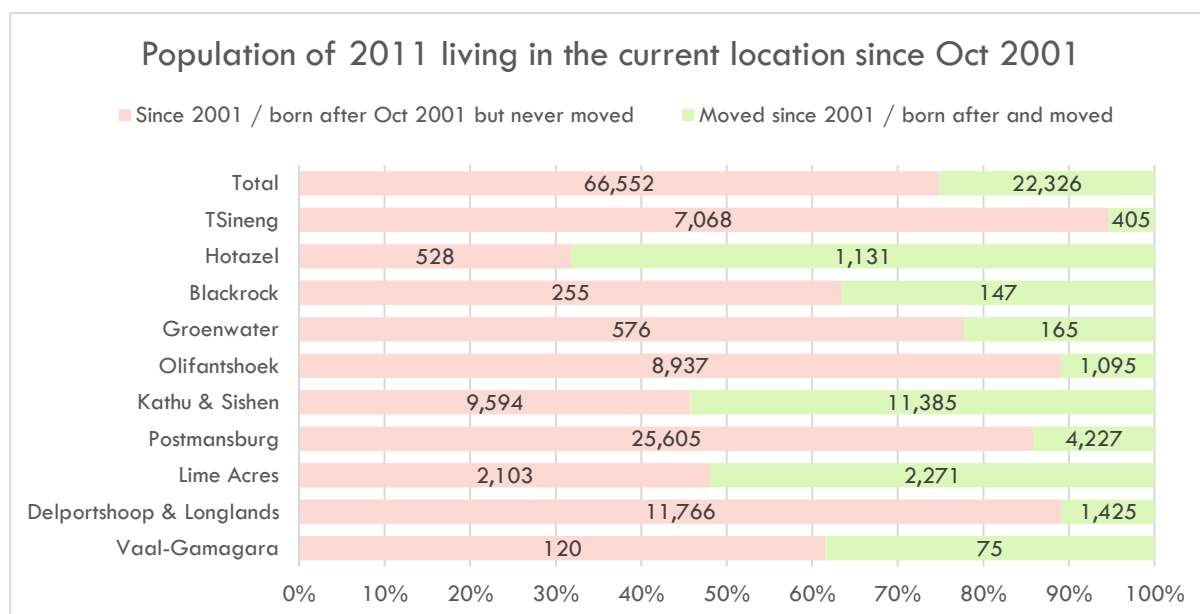


Figure 16. Population of 2011 living in the current location since October 2001⁸²

Although net migration into the Northern Cape province is expected to be relatively small (5 670 between 2016 and 2021), it is positive compared to a net outmigration expected from the Eastern Cape, Limpopo, KwaZulu-Natal and the Free State.⁸³ The study area with its strong pull-factors is likely to attract immigrants from other parts of the Northern Cape and beyond. Migrants will be primarily attracted by employment opportunities that the mining industry provides.

Table 10. Farm population trends 2001 to 2016 by LM⁸⁴

	1996	2001	2011	2016
Dikgatlong	10 485	5 813	3 727	4 052
Kgatelopele	3 181	1 317	568	418
Tsantsabane	2 431	1 516	3 399	4 539
Gamagara	1 407	1 033	992	4 428
Joe Morolong	847	0	4 232	2 551
TOTAL	18 351	9 679	12 918	15 988

It is probable that out-migration from farms to settlements has largely ended, with the main out-migration having taken place during the 1990s and early 2000s.⁸⁵ Farm populations are compared across local municipalities which shows that Dikgatlong and Kgatelopele had declining farm populations between 1996 and 2016. Tsantsabane and Gamagara farm populations increased, which is an unusual trend.

4.3 Future growth expectations in Northern Cape

In a paper on population projections to 2021, Udjo set out the following assumptions for the Northern Cape:⁸⁶

⁸² StatsSA. Census 2011, Interactive data in Super Cross.

⁸³ StatsSA, Mid-year population estimates, 2017. P 15.

⁸⁴ Data source: StatsSA Censuses 2001 and 2011; Community Survey 2016

⁸⁵ Roux. N (2009) Migration and urbanization: Towards A 10-Year Review of the Population Policy Implementation in South Africa (1998-2008). Department of Social Development. [Online]. Available:

<http://stepsa.org/resources/shared-documents/migration-and-urbanisation--dept-of-social> [cited 9 August 2013]. P ii.

⁸⁶ Udjo, EO (2015) Projecting population, numbers of households and dwelling units in South Africa 2011-2021. African Population Studies Vol. 29, No. 1, 2015. [Online]. Available from: <http://aps.journals.ac.za>

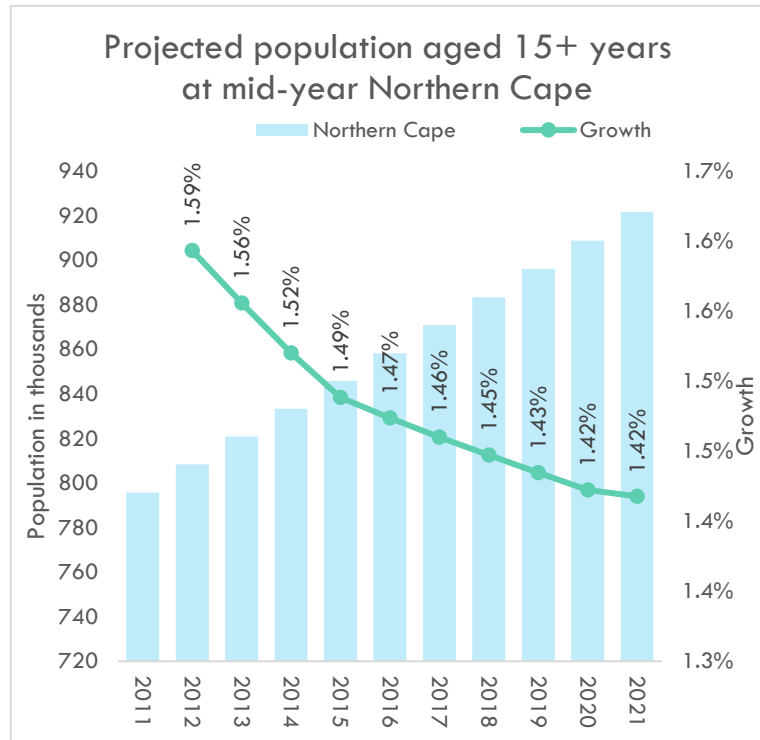
- Fertility rates will remain higher than the replacement rate of 2.2, decreasing from 2.8 in 2011 to 2.38 in 2021. According to a UN report, the South African fertility rate will reduce from a current 2.40 to 2.18 by 2025.⁸⁷
- Life expectancy at birth of Northern Cape people will increase from 59.7 in 2011 to 61.8 in 2021. The UN report estimates that the South African life expectancy will increase from a current 57.1 years to 59.0 years in 2025, with decreasing infant and child mortality contributing to this.⁸⁸

Udjo predicts that the Northern Cape will have a low annual growth rate of 1.48% compared to 1.56% nationally for the population aged 15 years and older during the period 2011-2021.⁸⁹

Figure 17. Projected population aged 15 years and over for Northern Cape (Udjo)⁹⁰

Two additional entities made crude projections of the Northern Cape population, namely:⁹¹

- NDP: 1.1 million in 2011 to 1.4 million in 2030 i.e. growth of 1.28% p.a.
- International Futures (base case): 1.3 million in 2030 and 1.5 million by 2050, implying a growth rate of 0.88% p.a. (2011-2030) and 0.80% p.a. (2011-2050)



The Department of Health made population projections to aid infrastructure planning, and their data shows that the Northern Cape population would reach an estimated 1 225 483 in 2025. Implied growth rates are 0.59% p.a. from 2011 to 2020, and 0.29% p.a. from 2020 to 2025.⁹² These are more conservative than that proposed by Udjo.⁹³

⁸⁷ United Nations, Department of Economic and Social Affairs, Population Division (2013). World Population Prospects: The 2012 Revision, Highlights and Advance Tables. Working Paper No. ESA/P/WP.228. [Online]. Available: http://esa.un.org/unpd/wpp/Documentation/pdf/WPP2012_HIGHLIGHTS.pdf [cited 11 August 2013] P 77.

⁸⁸ United Nations, Department of Economic and Social Affairs, Population Division (2013). World Population Prospects: The 2012 Revision, Highlights and Advance Tables. Working Paper No. ESA/P/WP.228. [Online]. Available: http://esa.un.org/unpd/wpp/Documentation/pdf/WPP2012_HIGHLIGHTS.pdf [cited 11 August 2013] P 77.

⁸⁹ Udjo, EO (2015) Projecting population, numbers of households and dwelling units in South Africa 2011-2021. African Population Studies Vol. 29, No. 1, 2015. [Online]. Available from: <http://aps.journals.ac.za>

⁹⁰ Data source: Udjo, EO (2015) Projecting population, numbers of households and dwelling units in South Africa 2011-2021. African Population Studies Vol. 29, No. 1, 2015. [Online]. Available from: <http://aps.journals.ac.za> P 1517

⁹¹ Go, A., Moyer, J., Rafa, M. and Schünemann, J. (2013) Population Futures: Revisiting South Africa's National Development Plan 2030. [Online]. Available: http://www.issafrica.org/uploads/AF7_15Oct2013V2.pdf

⁹² Data source: Dept of Health (2015) Ten-year infrastructure plan for health facilities – South Africa 2015-2015 v2.5. P 43.

⁹³ To determine the 2021 Northern Cape population, Udjo's data of Northern Cape number of households (395806 on page 1519) was divided by average household size (3.2 on page 1520) This same method was applied to the district populations – source data: Udjo, EO (2015) Projecting population, numbers of households and dwelling units in South Africa 2011-2021. African Population Studies Vol. 29, No. 1, 2015.

An August 2018 presentation by CoGHSTA and HDA focusing on the eradication of informal dwelling backlogs in the province, made population (1.40% p.a.) and household projections (0.76% p.a.) until 2050.⁹⁴

Whilst the models draw different conclusions regarding the magnitude of population growth, they mostly agree that the rate of population growth is declining overall in the province. The projection of CoGHSTA and HDA is high compared to historic Northern Cape annual population growth i.e. -0.4% p.a. 1996-2001, 1.5% p.a. 2001-2011 and 0.8% p.a. 2011-2016,⁹⁵ whilst that of DoH is low.

Figure 18. Northern Cape population growth estimates by source⁹⁶

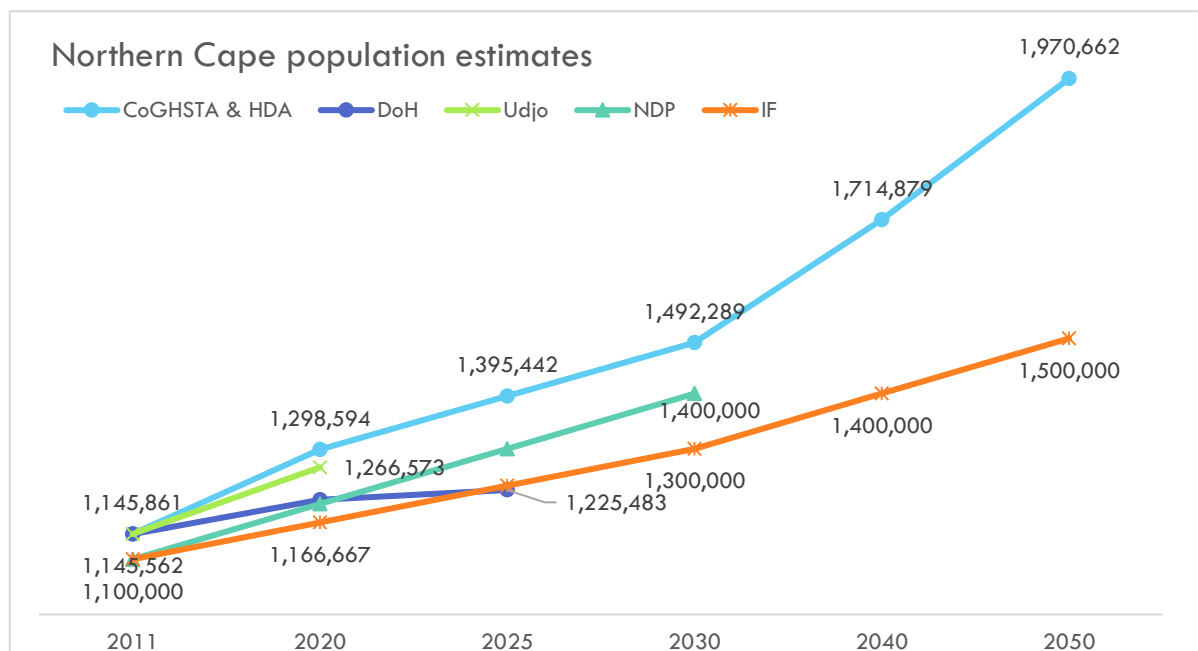
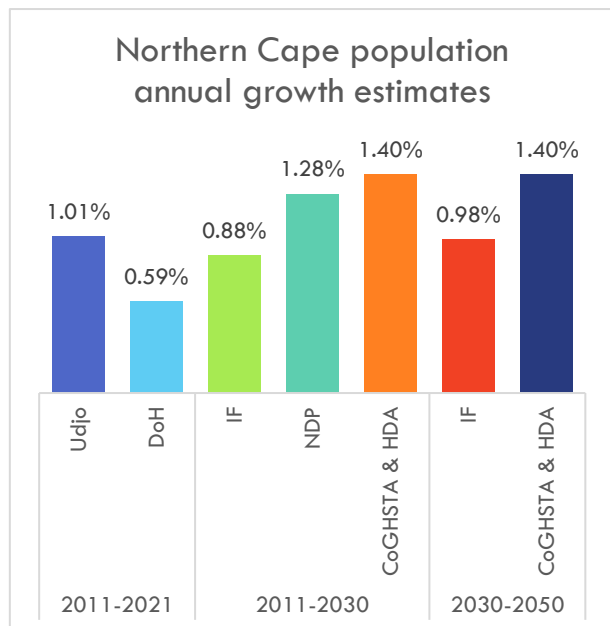


Figure 19. Northern Cape population estimates by source⁹⁷

⁹⁴ CoGHSTA & HDA (2018) Sustainable human settlements - presentation. 22 August 2018. [Online]. Available from: <http://pmg-assets.s3-website-eu-west-1.amazonaws.com/170822COGHSTA.pdf>

⁹⁵ Data source: StatsSA SuperWeb, Censuses 1996, 2001, 2011 and Community Survey 2016.

⁹⁶ Data source: Udjo, EO (2015) Projecting population, numbers of households and dwelling units in South Africa 2011-2021. African Population Studies Vol. 29, No. 1, 2015. [Online]. Available from: https://www.google.com/search?q=Udjo+Projecting+population,+numbers+of+households+and+dwelling+units+in+South+Africa+2011-2021.+African+Population+Studies+Vol&ie=utf-8&oe=utf-8&client=firefox-b-ab&gfe_rd=cr&dcr=0&ei=ieaKWprPDoPC8gfXs4PADQ; Dept of Health (2015) Ten year infrastructure plan for health facilities – South Africa 2015-2015 v2.5. P 43.; Go, A., Moyer, J., Rafa, M. and Schünemann, J. (2013) Population Futures: Revisiting South Africa's National Development Plan 2030. [Online]. Available: http://www.issafrica.org/uploads/AF7_15Oct2013V2.pdf; CoGHSTA & HDA (2018) Sustainable human settlements - presentation. 22 August 2018. [Online]. Available from: <http://pmg-assets.s3-website-eu-west-1.amazonaws.com/170822COGHSTA.pdf>

⁹⁷ Data source: Udjo, EO (2015) Projecting population, numbers of households and dwelling units in South Africa 2011-2021. African Population Studies Vol. 29, No. 1, 2015. [Online]. Available from:

The figure above displays these projections and shows how wide-ranging these estimates are, especially after 2020.

Population estimates by Udjo and Department of Health are illustrated in the figure below. Whilst the estimates made by these two entities for JTG and ZFM are relatively close, the Frances Baard estimate shows greater variance.

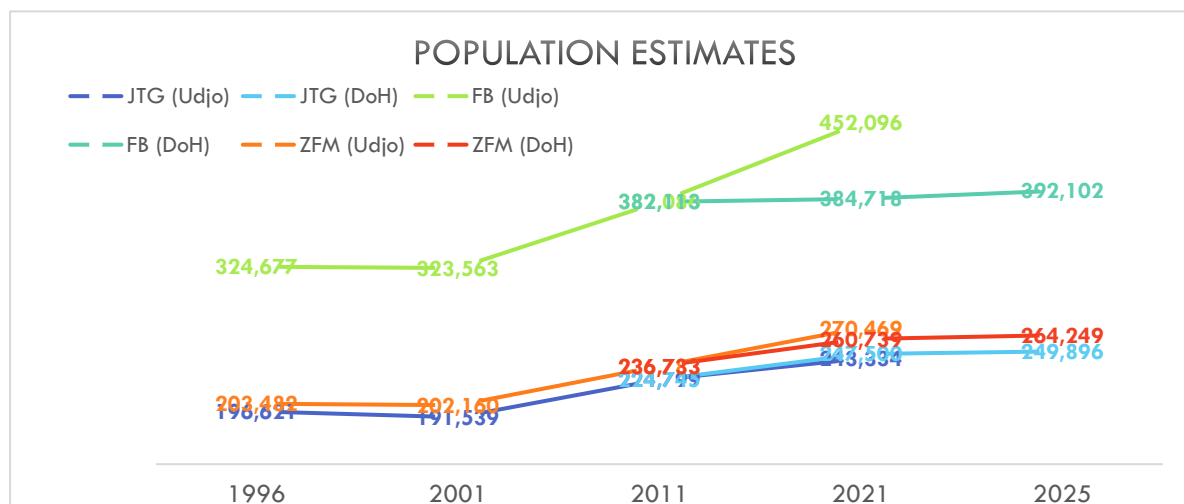


Figure 20. Population estimates for three districts in the study area by Udjo⁹⁸ and DoH⁹⁹

4.4 Population estimates for the study area to 2043

Several organisations construct demographic estimates using complex models based on assumptions about population growth. However, these are typically produced at national and provincial level and at best district level. Whilst these estimates may be applied to the towns in the study area, it does not take local conditions that may result in higher or lower growth rates than the provincial or district averages into account. Thus, the findings of this study regarding population growth include local factors and knowledge to estimate growth rates at a settlement level for the VGWSS.

Besides birth and death rates affecting population growth, which are not recorded at town level; the extent of in- and outmigration within the study area is a major factor. This is more difficult to predict and requires consideration of factors that may attract people to the area as well as those that encourage people to leave. The economic growth rate and perceived economic opportunities of the town i.e. pull factors, compared to surrounding areas, is important; while push factors such as structural changes in agriculture also play a role,¹⁰⁰ e.g.

https://www.google.com/search?q=Udjo+Projecting+population,+numbers+of+households+and+dwelling+units+in+South+Africa+2011-2021.+African+Population+Studies+Vol&ie=utf-8&oe=utf-8&client=firefox-b-ab&gfe_rd=cr&dc=0&ei=ieaKWprPD0PC8qfXs4PADQ; Dept of Health (2015) Ten year infrastructure plan for health facilities – South Africa 2015-2015 v2.5. P 43.; Go, A., Moyer, J., Rafa, M. and Schünemann, J. (2013) Population Futures: Revisiting South Africa's National Development Plan 2030. [Online]. Available: http://www.issafrica.org/uploads/AF7_15Oct2013V2.pdf; CoGHSTA & HDA (2018) Sustainable human settlements - presentation. 22 August 2018. [Online]. Available from: <http://pmg-assets.s3-website-eu-west-1.amazonaws.com/170822COGHSTA.pdf>

⁹⁸ Data based on Udjo (2015). Udjo estimated household numbers per district for 2021 and an average household size was applied by decreasing it at same rate as Udjo's estimate for Northern Cape (3.8 in 2011 to 3.2 in 2021) which was applied to district households to derive estimated population.

⁹⁹ Data sources: Udjo, EO (2015) Projecting population, numbers of households and dwelling units in South Africa 2011-2021. African Population Studies Vol. 29, No. 1, 2015; Dept of Health (2015) Ten-year infrastructure plan for health facilities – South Africa 2015-2015 v2.5. P 43.

¹⁰⁰ Walsh, K (2011) Understanding consumer profile, PDG Occasional Paper Number 2, November 2011. P 5.

Koopmansfontein's influx of farmworkers around 2013-2014.¹⁰¹ The relative size contribution of urbanisation and migration to population growth is not known and is highly unpredictable.

At the simplest level, data extrapolations assume that past trends in growth rate will continue. So, past population growth in a town is merely projected in the future which can be fairly accurate in the short-term. However, over the longer term dynamic factors of fertility, mortality and migration are difficult to consider, and past growth rates are not necessarily a good predictor of future growth.¹⁰² For example, the large-scale antiretroviral rollout in the past few years has decreased mortality rates,¹⁰³ a fact that was inconceivable a decade ago.

While the main cause of future population growth in the study area is likely to be in-migration, a portion of the growth will be attributed to natural growth. Given that most of the influx from farms has already taken place, it is expected that migration from farms will slow. However, the attraction of the opportunities associated with the mining activities in the area make it impossible to predict the rate of migration although it is likely to be the main contributing factor. Further confounding expected growth is the migratory nature of the population, and their ties retained with labour sending areas. Thus, it is questioned to what extent is settlement in Kathu and other mining towns contingent on continued employment in the area? Given international experience, major shifts in employment are likely to promote large-scale departures which is expected in remote mining towns where the mine is the only large-scale employer, and where the town was originally established to serve its employer. With few ties experienced beyond the relationship with the employer there is little reason to remain.¹⁰⁴ Given this potential for high mobility, the risk associated with large-scale out-migration should not be disregarded, but the economic diversification, of Kathu for example, is a positive factor.

Natural growth will contribute to growth due to the large number of women in their reproductive ages of 15-50 years, increasing life expectancy, and declining mortality rates. It is unlikely that the study area's population growth will be less than that of the Northern Cape average since its mines are attractive, and there are few competing pull factors to attract migrants elsewhere.

The VGVSS area's population for the period 2018-2043 is estimated by analysing the fertility, mortality, and net migration trends in the context of local circumstances and assumptions about the future. It is assumed that the study area will be less 'typical' of the Northern Cape and continue to hold attraction for newcomers. However, there are risk and caveats related to these population estimates that should be noted (please see the section below).

Founded on the information detailed above, the 2011 population census data as the base, and the 2018 estimate based on dwelling counts, the population estimates are as follows:

- Mining towns of Lime Acres, Postmasburg, Olifantshoek, Kathu, Hotazel and Blackrock with economies strongly tied to the mining industry, continue to attract migrant job seekers. These towns appeal to those without formal employment as well, which stimulates the expansion of informal areas. For the 2018-2043 period the population is estimated to grow above 2% p.a. except for Blackrock and Lime Acres which have less appeal to migrants.
- Rural town Delporthoop/Longlands, has a stable population with little migration and relative lack of factors to attract and retain economically active persons. This town continues to function as a local service centre as in the past. Its 2018-2043 growth rate average is estimated at 1.72% p.a.
- Private settlement of Vaalgamagara: Very low growth is foreseen (0.25% p.a. 2018-2043)

¹⁰¹ Meeting with Dikgatlong on 9 November 2018. See notes in Appendix A.

¹⁰² Walsh, K (2011) Understanding consumer profile, PDG Occasional Paper Number 2, November 2011. P 5.

¹⁰³ Walsh, K (2011) Understanding consumer profile, PDG Occasional Paper Number 2, November 2011. P 5.

¹⁰⁴ Cloete, JS (2009) Housing options for mineworkers in arid and semi-arid regions: the case of Kathu. University of the Free State. P62.

- Tsineng and surrounding settlements: decline implies that outmigration will continue as young people leave in search of higher education and employment opportunities (0.93% p.a. 2018-2043)
- Restitution settlements of Koopmansfontein and Maremane: Natural growth predominates accompanied by outmigration of school leavers, little immigration, and a slow growth rate of 1.60% p.a. and 1.20% p.a. (average 2018-2043 respectively). Groenwater with its proximity to solar plants and historical high rate of in migration is set at a relatively higher rate (2.84% p.a. 2018-2043)

Linear growth is used to extrapolate the population from 2018 to 2043. The growth rate between 2011 and 2018 is the starting point. A growth rate for the final 5 years of 2038-2043 is selected and values in between are filled using a linear growth function as shown in the table below.

Table 11. Annual growth rates applied to population estimates

	1996-2011	1996-2001	2001-2011	2011-2018	2018-2023	2023-2028	2028-2033	2033-2038	2038-2043	2018-2043
Delpportshoop & Longlands	3.55%	2.79%	3.92%	0.97%	2.44%	2.08%	1.72%	1.36%	1.00%	1.72%
Vaal Gamagara	-3.11%	-10.27%	0.68%	-0.66%	0.50%	0.38%	0.25%	0.13%	0.00%	0.25%
Koopmansfontein	-3.87%	-3.14%	-4.23%	8.61%	3.00%	2.30%	1.60%	0.90%	0.20%	1.60%
Lime Acres	-0.45%	-4.65%	1.71%	-0.18%	1.50%	1.25%	1.00%	0.75%	0.50%	1.00%
Groenwater/Metsimatale		0.00%	3.78%	14.48%	4.50%	3.68%	2.85%	2.03%	1.20%	2.84%
Postmasburg & Beeshoek	3.09%	2.20%	3.54%	4.48%	3.30%	2.98%	2.65%	2.33%	2.00%	2.65%
Maremane		0.00%	0.00%	6.73%	2.20%	1.70%	1.20%	0.70%	0.20%	1.20%
Olifantshoek	2.37%	-0.48%	3.83%	3.70%	3.25%	2.74%	2.22%	1.71%	1.20%	2.22%
Kathu, Sesheng & Dingleton	5.77%	2.72%	7.33%	4.50%	4.24%	3.88%	3.52%	3.16%	2.80%	3.52%
Hotazel	1.57%	-2.58%	3.70%	4.26%	3.77%	3.20%	2.63%	2.07%	1.50%	2.63%
Blackrock	-7.73%	-5.94%	-8.61%	2.00%	1.83%	1.62%	1.41%	1.21%	1.00%	1.41%
Tsineng and surrounding villages	0.60%	5.19%	-1.62%	2.00%	1.66%	1.30%	0.93%	0.57%	0.20%	0.93%
TOTAL (average)	3.03%	1.73%	3.69%	3.66%	3.28%	2.93%	2.59%	2.24%	1.90%	2.59%

Table 12. Population estimates for study area to 2043

	1996	2001	2011	2018	2023	2028	2033	2038	2043
Delpportshoop & Longlands	7 873	9 036	13 278	14 203	16 023	17 760	19 341	20 692	21 748
Vaal Gamagara	318	185	198	189	194	197	200	201	201
Koopmansfontein	450	384	249	444	515	577	624	653	659
Lime Acres	4 719	3 720	4 407	4 351	4 688	4 988	5 243	5 442	5 580
Groenwater/Metsimatale		509	738	1 901	2 369	2 838	3 266	3 610	3 832
Postmasburg & Beeshoek	19 058	21 249	30 087	40 889	48 096	55 689	63 469	71 199	78 609
Maremane			689	1 086	1 211	1 318	1 399	1 448	1 463
Olifantshoek	7 198	7 026	10 233	13 193	15 480	17 717	19 778	21 530	22 853
Kathu, Sesheng & Dingleton	9 715	11 108	22 539	30 678	37 760	45 680	54 308	63 450	72 845
Hotazel	1 390	1 220	1 755	2 351	2 828	3 311	3 770	4 176	4 499
Blackrock	1 353	996	405	465	509	552	592	629	661
Tsineng and surrounding villages	6 500	8 371	7 113	8 170	8 871	9 461	9 909	10 192	10 295
TOTAL POPULATION	58 574	63 804	91 691	117 921	138 544	160 087	181 898	203 223	223 244

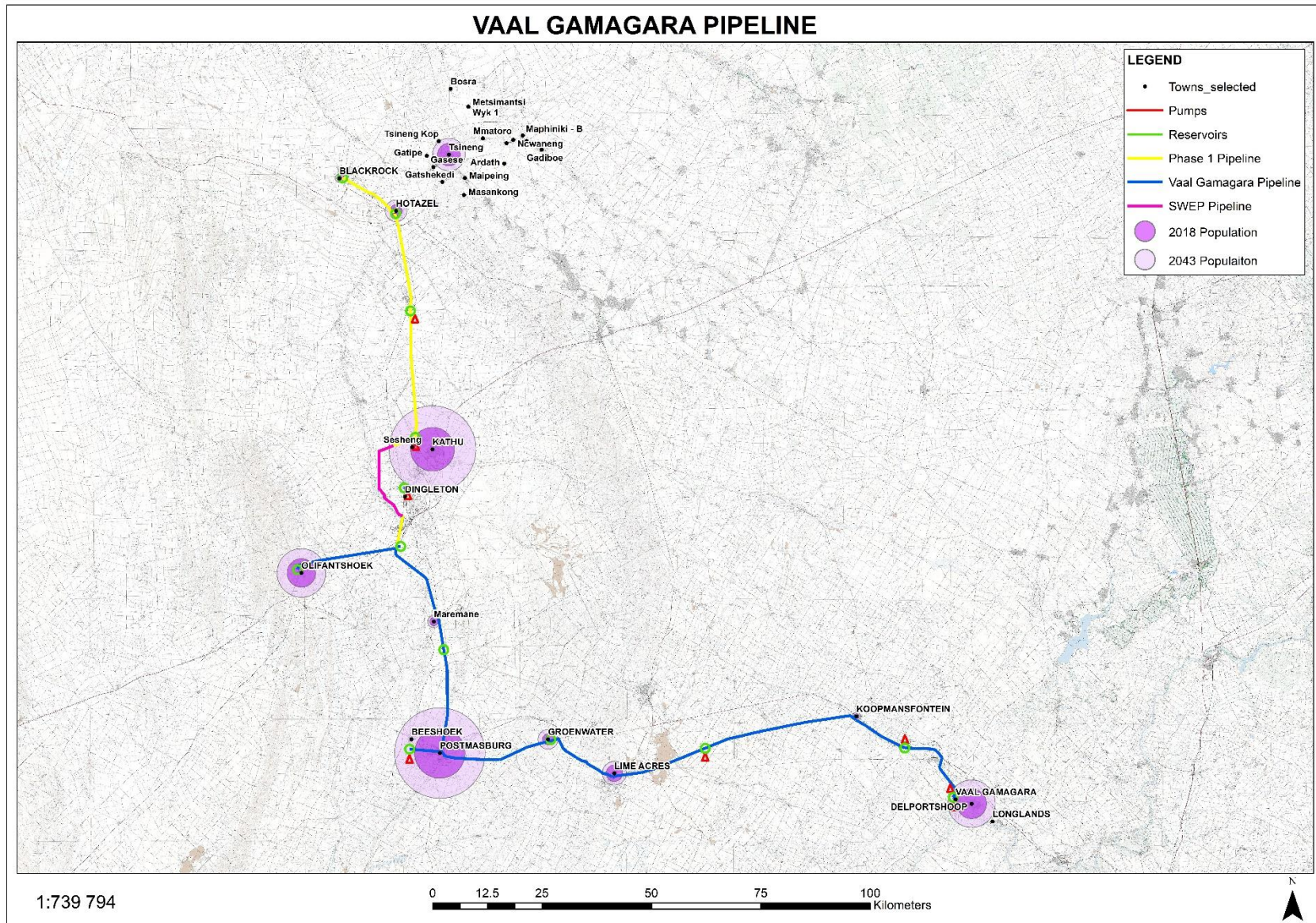


Figure 21. Population in 2018 and 2043 map

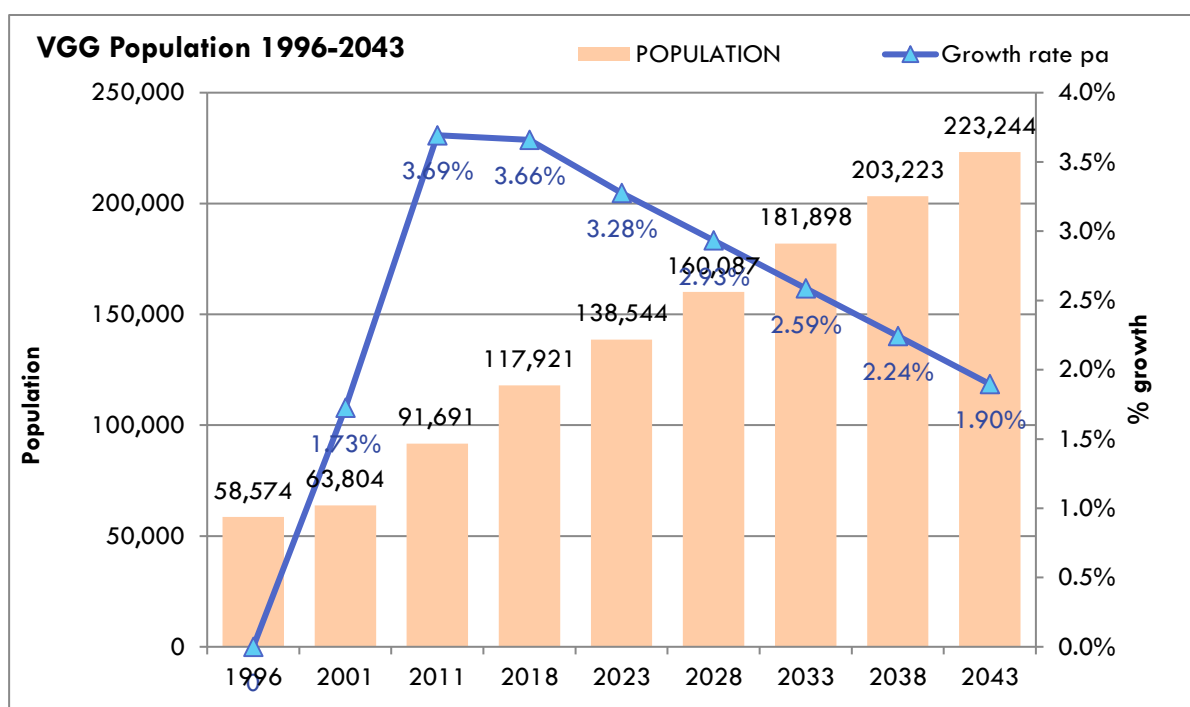


Figure 22. VGGSS population estimate and growth rates to 2043¹⁰⁵

High and low population growth scenarios were made as follows:

- High – growth during 1996-2018 is continued to 2043: e.g. 5.37% p.a. Kathu and 2.79% p.a. Olifantshoek. In cases where the likely growth scenario was lower than the 1.4% p.a. average, as suggested by CoGHSTA/HDA, this was applied, i.e. Vaalgamagara settlement, Koopmansfontein, Lime Acres and Tsineng & surrounding villages.
- Low – grows at the average rate projected by CoGHSTA/HDA for the Northern Cape at 1.4% p.a. (to 2050) until end of period 2043. For Vaalgamagara settlement, Koopmansfontein, Lime Acres and Tsineng & surrounding villages growths lower than 1.4% were applied ranging from 0% to 1.04% p.a.

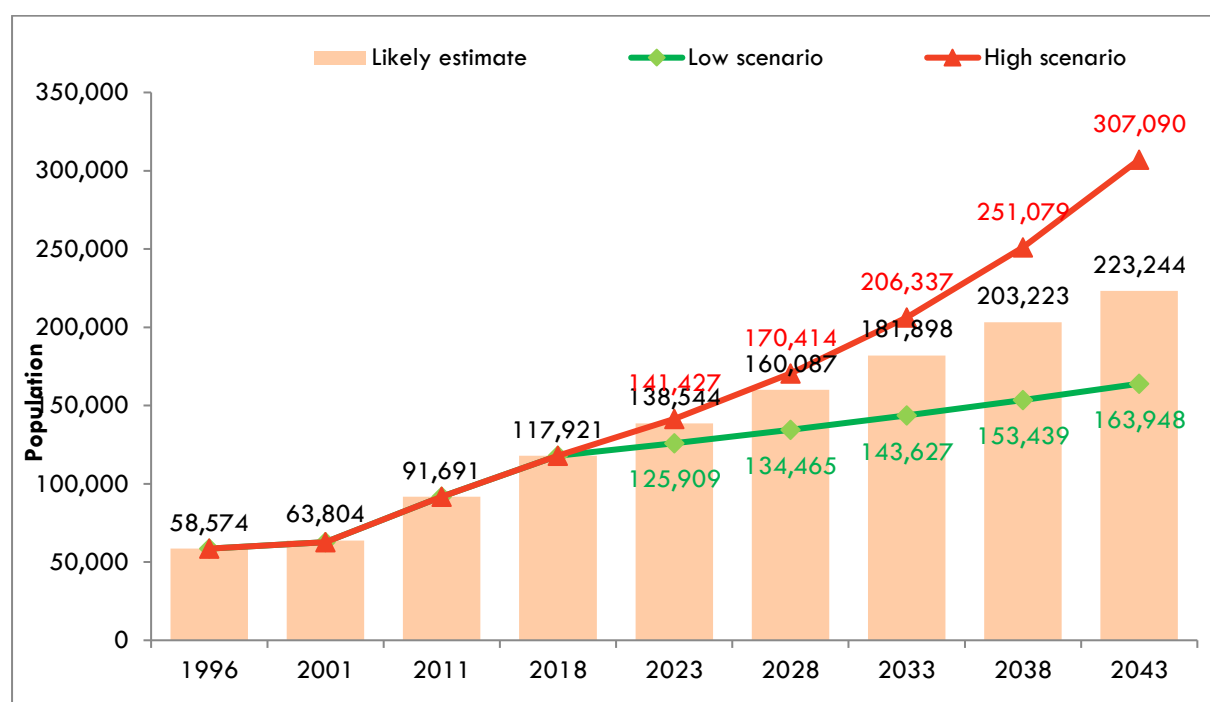
Table 13. High growth scenario for the VGGSS study area

	2018	2023	2028	2033	2038	2043	Growth rate p.a.
HIGH							
Delportshoop & Longlands	14 203	16 242	18 572	21 238	24 285	27 770	2.72%
Vaal Gamagara	189	203	217	233	250	268	1.40%
Koopmansfontein	444	476	510	547	586	629	1.40%
Lime Acres	4 351	4 665	5 000	5 360	5 746	6 160	1.40%
Groenwater/Metsimatale	1 901	2 801	4 128	6 082	8 961	13 204	8.06%
Postmasburg & Beeshoek	40 889	48 636	57 850	68 810	81 846	97 352	3.53%
Maremane	1 086	1 504	2 083	2 884	3 993	5 529	6.73%
Olifantshoek	13 193	15 140	17 375	19 940	22 884	26 262	2.79%
Kathu, Sesheng & Dingleton	30 678	39 840	51 738	67 190	87 257	113 317	5.37%
Hotazel	2 351	2 649	2 985	3 363	3 790	4 271	2.42%
Blackrock	465	514	567	626	691	763	2.00%
Tsineng and surrounding villages	8 170	8 758	9 389	10 065	10 789	11 566	1.40%
TOTAL POPULATION	117 921	141 427	170 414	206 337	251 079	307 090	3.90%

¹⁰⁵ Please see additional charts per settlement in Appendix A.

Table 14. Low growth scenario for the VGWSS study area

	2018	2023	2028	2033	2038	2043	Growth rate p.a.
LOW							
Delportshoop & Longlands	14 203	15 226	16 322	17 497	18 756	20 107	1.40%
Vaal Gamagara	189	189	189	189	189	189	0.00%
Koopmansfontein	444	455	467	478	491	503	0.50%
Lime Acres	4 351	4 351	4 351	4 351	4 351	4 351	0.00%
Groenwater/Metsimatale	1 901	2 038	2 185	2 342	2 511	2 691	1.40%
Postmasburg & Beeshoek	40 889	43 833	46 988	50 371	53 997	57 884	1.40%
Maremane	1 086	1 165	1 248	1 338	1 435	1 538	1.40%
Olifantshoek	13 193	14 142	15 160	16 252	17 422	18 676	1.40%
Kathu, Sesheng & Dingleton	30 678	32 886	35 253	37 791	40 512	43 428	1.40%
Hotazel	2 351	2 520	2 701	2 896	3 104	3 328	1.40%
Blackrock	465	499	535	573	614	658	1.40%
Tsineng and surrounding settlements	8 170	8 606	9 065	9 549	10 058	10 595	1.04%
TOTAL POPULATION	117 921	125 909	134 465	143 627	153 439	163 948	1.33%

Figure 23. VGWSS population estimates and low and high population scenarios to 2043¹⁰⁶¹⁰⁶ Please see additional charts per settlement in Appendix A.

4.5 Population forecasting caveats

The VGWSS study area population is estimated to reach 223 244 by 2043. It should be noted that projections and forecasts are typically based on several simplifying assumptions and are, in part at least, only as reliable as the data on which they are based. These facts should not be understated when considering the population estimates, which attempt to inform long-term planning for the VGWSS.

These population estimates are not intended to provide an indication of actual future figures. Rather the intention is to provide for an understanding of how projections are arrived at in all their limitations.

Population estimates are based on historical and anticipated trends regarding migration, fertility and mortality as discussed above. There is a risk of extrapolating population based on historical trends, and thus these factors are considered in combination with possible future developments and predicted economic growth in the area.

Understanding demographic trends is a key aspect of planning for the provision of appropriate services and infrastructure. Unlike the volatility of economic growth, macro demographic trends are relatively stable over time allowing projections with a reasonable level of certainty for the medium-term. However, forecasts for an area such as the VGWSS, which is highly dependent on a mining economy, are made with less confidence.

5 WATER CONSUMPTION PATTERNS

5.1 International norms

Internationally 100-200 litres per person per day is regarded as sufficient to maintain a high standard of living. According to WHO, between 50 and 100 litres of water per person per day (ℓ/c/d) are needed to ensure that most basic needs are met, and few health concerns arise. Access to 20-25 ℓ/c/d represents a minimum, which raises health concerns because it is insufficient to meet basic hygiene and consumption requirements.¹⁰⁷

Although the basic need for water includes water used for personal hygiene, defining a minimum has limited significance as the volume of water used by households depends on its accessibility, which is determined primarily by distance and time, but also includes reliability and potentially cost. Accessibility can be characterised by service level. The degree to which different levels of service meet requirements to sustain good health and interventions required to ensure health gains are maximised is shown in the table below.¹⁰⁸

Table 15. Summary of water requirements¹⁰⁹

Service level	Access measure	Needs met	Level of health concern
No access (quantity collected often below 5 ℓ/c/d)	More than 1000m or 30 minutes total collection time	Consumption – cannot be assured Hygiene – not possible (unless practised at source)	Very high
Basic access (average quantity unlikely to exceed 20 ℓ/c/d)	Between 100 and 1000m or 5 to 30 minutes total collection time	Consumption – should be assured Hygiene – hand washing and basic food hygiene possible; laundry/bathing difficult to assure unless carried out at source	High
Intermediate access (average quantity about 50 ℓ/c/d)	Water delivered through one tap on-plot (or within 100m or 5 minutes total collection time)	Consumption – assured Hygiene – all basic personal and food hygiene assured; laundry and bathing should also be assured	Low
Optimal access (average quantity 100 ℓ/c/d and above)	Water supplied through multiple taps continuously	Consumption – all needs met Hygiene – all needs should be met	Very low

5.2 Free basic water

In South Africa a free minimum of potable water is provided to registered indigent households. Local authorities have discretion over the total amount of free basic water (FBW) to be provided per household within the national target of 25 ℓ per person per day excluding water for use of waterborne sanitation.¹¹⁰ Based on this amount, and on eight people per household, the volume of 6 kℓ per month was set as a target for a basic level. Furthermore, where waterborne sanitation is used, this basic amount should be increased in the range of 35-40 ℓ

¹⁰⁷ UN Human Rights, UN HABITAT and World Health Organisation. The right to water – fact sheet No. 35. [Online]. Available: (<http://www.ohchr.org/Documents/Publications/FactSheet35en.pdf>)

¹⁰⁸ Howard, G. and Bartman, J. (2003) Domestic Water Quantity, Service Level and Health. World Health Organisation. [Online]. Available: http://www.who.int/water_sanitation_health/diseases/WSH03.02.pdf

¹⁰⁹ Howard, G. and Bartman, J. (2003) Domestic Water Quantity, Service Level and Health. World Health Organisation. [Online]. Available: http://www.who.int/water_sanitation_health/diseases/WSH03.02.pdf

¹¹⁰ Department of Water Affairs and Forestry. 2007. Free Basic Water Implementation Strategy 2007: Consolidating and maintaining. Version 4, April 2007 [Online]. Available: http://www.dwa.gov.za/Dir_WS/wspd/policyinfo.aspx?file=557 [cited 13 June 2013] P 5.

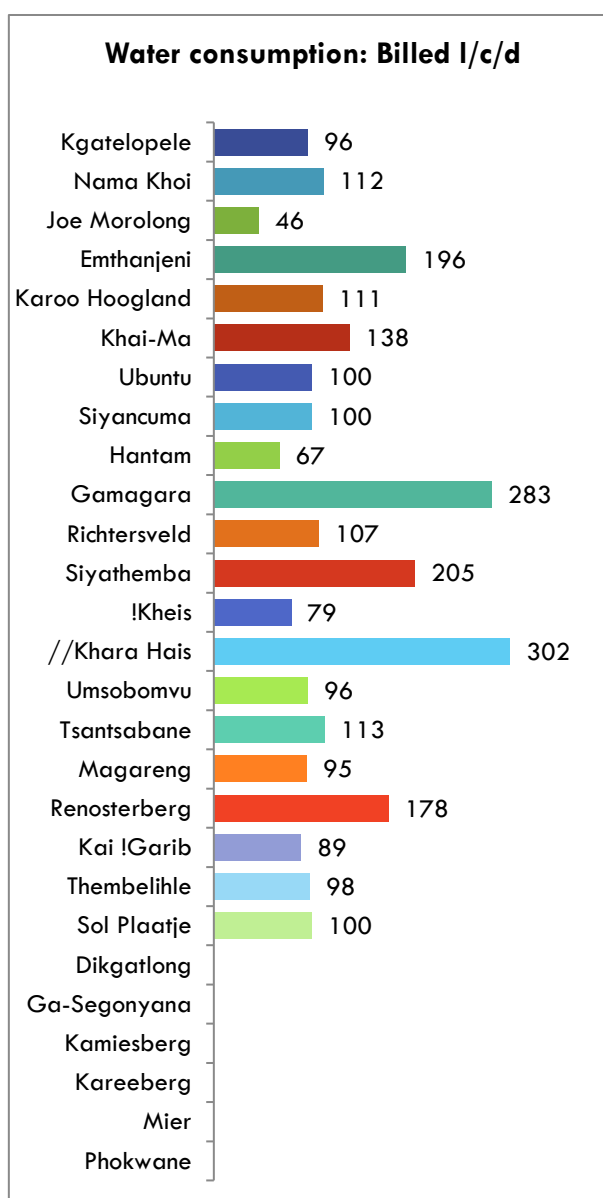
per person per day.¹¹¹ Since the average household size in the Northern Cape is less than 4 persons (3.80)¹¹² this should suffice for the average household. However, 4.0% of households have more than 8 members¹¹³ and there are situations where more than one household shares a consumer unit.

5.3 Water consumption volumes in South Africa

According to water balance data published in 2012, three Water Service Authorities (WSA) have water consumption rates that exceed 200 litres per day based on billed volumes i.e. non-revenue water (NRW) is excluded. The range is from 46 l/c/d at Joe Morolong to 302 l/c/d at //Khara Hais.¹¹⁴

Figure 24. Billed water consumption in litres per capita per day¹¹⁵

A more recent study undertaken by Department of Water and Sanitation which benchmarks water loss, water use efficiency and non-revenue water indicates that 233 litres per capita per day is the average for South African municipalities. The table below illustrates the estimated national water balance for 2015/16 per province. The highest and lowest figure for each key performance indicator are highlighted in red and green respectively. Water balance information was analysed for 107 municipalities, which submit information on a regular basis. The per capita consumption per day is based on the system input volume divided by the population served. The system input volume includes commercial and industrial demand.¹¹⁶



¹¹¹ Department of Water Affairs and Forestry. 2007. Free Basic Water Implementation Strategy 2007: Consolidating and maintaining. Version 4, April 2007 [Online]. Available:

http://www.dwa.gov.za/Dir_WS/wspd/policyinfo.aspx?file=557 [cited 13 June 2013] P 5.

¹¹² Statistics South Africa. Census 2011.

¹¹³ Statistics South Africa. Census 2011.

¹¹⁴ Department of Water Affairs (2014) Northern Cape Provincial Water Sector Plan, 3rd draft report, 17 June 2014.

¹¹⁵ Data source: Mckenzie, R., Siqalaba, NZ and Wegelin, WA. (2012) The State of Non-Revenue Water in South Africa. Report to the Water Research Commission by WRP Consulting Engineers (Pty) Ltd.

¹¹⁶ Dept of Water and Sanitation (2017) Benchmarking of Water Loss, Water Use Efficiency and Non-Revenue Water in South African Municipalities (2004/05 to 2015/16) p iii. [Online]. Available from: <https://africacheck.org/wp-content/uploads/2018/04/National-benchmark-2017-09-12-final.pdf>

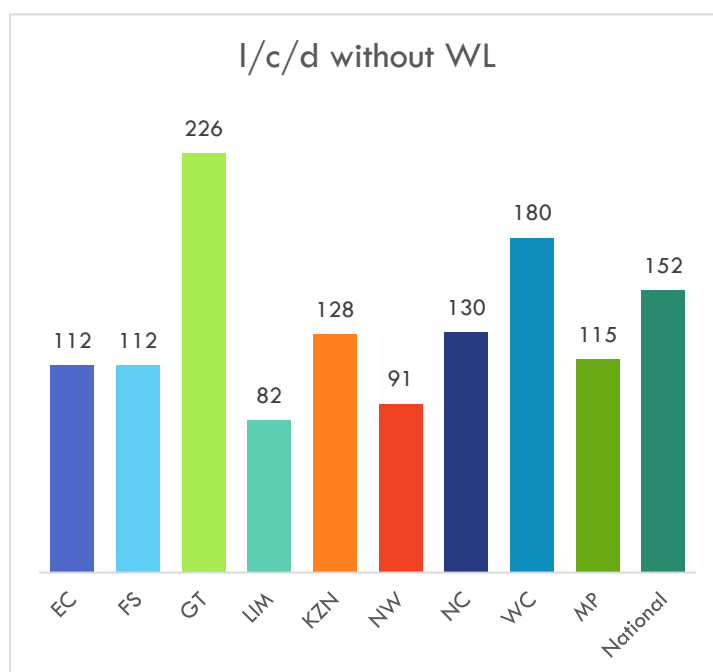
Table 16. Percentage of non-revenue water (NRW), water loss (WL), litres per capita per day (ℓ/c/d) and infrastructure leakage index (ILI) ¹¹⁷

Province	Population	SIV (m ³ /annum)	NRW (m ³ /annum)	% NRW	% WL	SIV ℓ/c/d	ILI
EC	4 477 918	332 151 376	158 647 165	47.8%	45.0%	200	4.8
FS	2 723 028	207 835 805	106 908 574	51.4%	46.6%	209	4.8
GT	12 978 281	1 473 100 700	528 839 540	35.9%	27.4%	305	5.8
LIM	4 225 967	281 235 907	155 016 679	55.1%	55.1%	182	1.3
KZN	8 491 508	697 751 184	327 444 107	46.9%	43.0%	225	6.2
NW	3 039 995	206 496 825	105 577 898	51.1%	51.1%	186	4.7
NC	1 085 944	94 205 305	45 418 308	48.2%	45.5%	238	7.1
WC	6 108 993	482 695 411	102 720 237	21.3%	16.7%	201	2.4
MP	3 622 506	270 990 713	129 852 490	47.9%	43.9%	205	4.3
National	46 754 140	4 046 463 225	1 659 588 711	41.0%	35.9%	233	5.3

The Northern Cape is the smallest water user in the country, and Gauteng the largest. Limpopo has the highest percentage NRW and water losses, but these figures are contradicted by a low litre per capita per day (ℓ/c/d) and infrastructure leakage Index (ILI). Overall, the Western Cape is the best performing province. The litres per capita consumption is based on total system input volume (SIV) and Gauteng has the highest per capita consumption due to the high number of wet industries in the supply area.

The Northern Cape average is 238 ℓ/c/d and it has a water loss percentage of 45.5% and the highest infrastructure leakage index in the country. If these water losses can be reduced from 45.5 to 15%, an average of 149 ℓ/c/d is attained. If water loss is excluded in the equation, then the consumption in the Northern Cape is 130 ℓ/c/d on average. Across the country it varies from 82 ℓ/c/d in Limpopo to 226 ℓ/c/d in Gauteng as seen in the figure below.

Figure 25. Water consumption excluding water loss by province in litres per capita per day¹¹⁸



Since 2006 system input volume has consistently increased and the NRW has been increasing since 2013. Water losses seemed to improve up to 2014 but subsequently deteriorated to 2012 levels. Without WCDM these municipalities are unlikely to achieve their targets set in 2017. ¹¹⁹

The 2017 and 2022 targets are based on the projected water demand and population figures. The figure below shows that the per capita consumption reduced from 2009 to 2013, which

¹¹⁷ Dept of Water and Sanitation (2017) Benchmarking of Water Loss, Water Use Efficiency and Non-Revenue Water in South African Municipalities (2004/05 to 2015/16) p iii. [Online]. Available from: <https://africacheck.org/wp-content/uploads/2018/04/National-benchmark-2017-09-12-final.pdf>

¹¹⁸ Own calculation based on data: Dept of Water and Sanitation (2017) Benchmarking of Water Loss, Water Use Efficiency and Non-Revenue Water in South African Municipalities (2004/05 to 2015/16) P iii. [Online]. Available from: <https://africacheck.org/wp-content/uploads/2018/04/National-benchmark-2017-09-12-final.pdf>

¹¹⁹ Dept of Water and Sanitation (2017) Benchmarking of Water Loss, Water Use Efficiency and Non-Revenue Water in South African Municipalities (2004/05 to 2015/16) P iii. [Online]. Available from: <https://africacheck.org/wp-content/uploads/2018/04/National-benchmark-2017-09-12-final.pdf>

could be an indication of the WCDM interventions taking effect in the province. Nevertheless, WCDM efforts must be escalated since these figures are significantly above international benchmarks of approximately 180 l/c/d and the country is one of the 30 driest in the world.¹²⁰

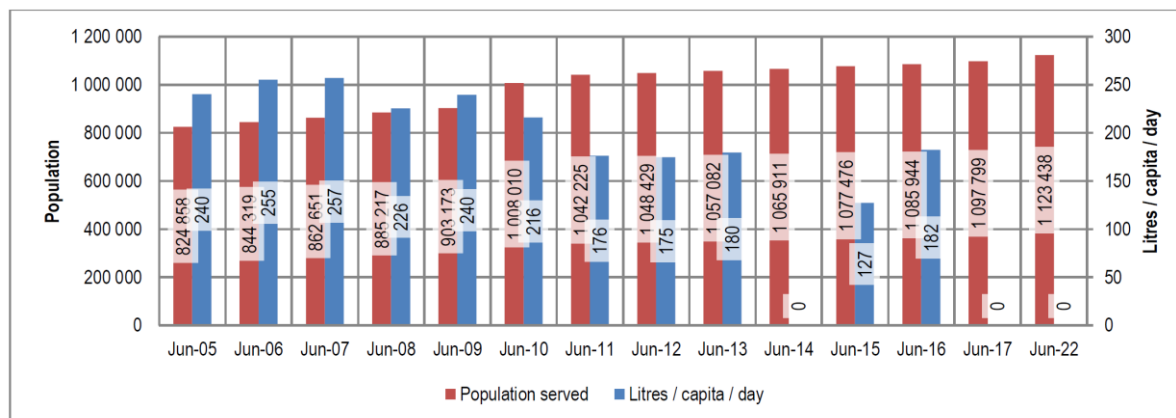


Figure 26. Population served and litres per capita per day in Northern Cape¹²¹

According to the benchmarking report, the Northern Cape managed to maintain their system input, NRW and per capita consumption in the past five to six years. The estimated 2015/16 water balance indicates water losses of 42.0 million m³/a (44.6%) and NRW of 44.5 million m³/a (47.3%) across Northern Cape municipalities. The water balance is stated to have a medium confidence level, but it is highly influenced by //Khara Hais (Upington) and Sol Plaatje (Kimberley) which accounts for approximately 67% of the demand. The Department of Water and Sanitation states that increased efforts are required by municipalities to implement WCDM to ensure targets are achieved and water restrictions are mitigated in the driest province. There is significant opportunity to improve reporting levels, and data accuracy, as well as reduce system input, NRW and water losses in the Northern Cape.¹²²

According to SALGA's *Annual Report of Water Services in South Africa 2015*, the national system input volume average (based on population) is 199 l/c/d (based on 99 datasets i.e. 66% of WSA).¹²³ This is slightly higher than the 196 l/c/d recorded in 2013.¹²⁴ It is reported that Joe Morolong was the best in category B4 with 485 l/c/d and 55 kl per household per month¹²⁵, whilst Hantam, another Northern Cape municipality, was the best in category B3 at 68 l/c/d and 11 kl per household per month.¹²⁶ This is based on system input volumes which

¹²⁰ Dept of Water and Sanitation (2017) Benchmarking of Water Loss, Water Use Efficiency and Non-Revenue Water in South African Municipalities (2004/05 to 2015/16) P iv, 30. [Online]. Available from: <https://africacheck.org/wp-content/uploads/2018/04/National-benchmark-2017-09-12-final.pdf>

¹²¹ Dept of Water and Sanitation (2017) Benchmarking of Water Loss, Water Use Efficiency and Non-Revenue Water in South African Municipalities (2004/05 to 2015/16) P 30. [Online]. Available from: <https://africacheck.org/wp-content/uploads/2018/04/National-benchmark-2017-09-12-final.pdf>

¹²² Dept of Water and Sanitation (2017) Benchmarking of Water Loss, Water Use Efficiency and Non-Revenue Water in South African Municipalities (2004/05 to 2015/16) p vi. [Online]. Available from: <https://africacheck.org/wp-content/uploads/2018/04/National-benchmark-2017-09-12-final.pdf>

¹²³ SALGA. Annual report on water services in South Africa 2015. P 28. [Online]. Available from: http://www.wrc.org.za/Knowledge%20Hub%20Documents/Research%20Reports/MBI%20Report%202015/MBI%20final%20Report%20_WRCSalga%20launch.pdf

¹²⁴ SALGA (2014) Annual report on water services in South Africa 2013. P 25. [Online]. Available from: [http://www.wrc.org.za/Knowledge%20Hub%20Documents/Special%20\(ad-hoc\)%20Publications/MBI_final%20SMALLER.pdf](http://www.wrc.org.za/Knowledge%20Hub%20Documents/Special%20(ad-hoc)%20Publications/MBI_final%20SMALLER.pdf)

¹²⁵ This data for Joe Morolong seems questionable. The 2013 report had Moretele as best in category at 121 l/c/d. Joe Morolong at 485 l/c/d appears very high and maybe too high to be the best in category B4.

¹²⁶ SALGA. Annual report on water services in South Africa 2015. P 28-29. [Online]. Available from: http://www.wrc.org.za/Knowledge%20Hub%20Documents/Research%20Reports/MBI%20Report%202015/MBI%20final%20Report%20_WRCSalga%20launch.pdf

comprises billed authorised consumption (including exported water) and non-revenue water. Non-revenue water includes not only the real and apparent losses but also the unbilled authorised consumption.¹²⁷

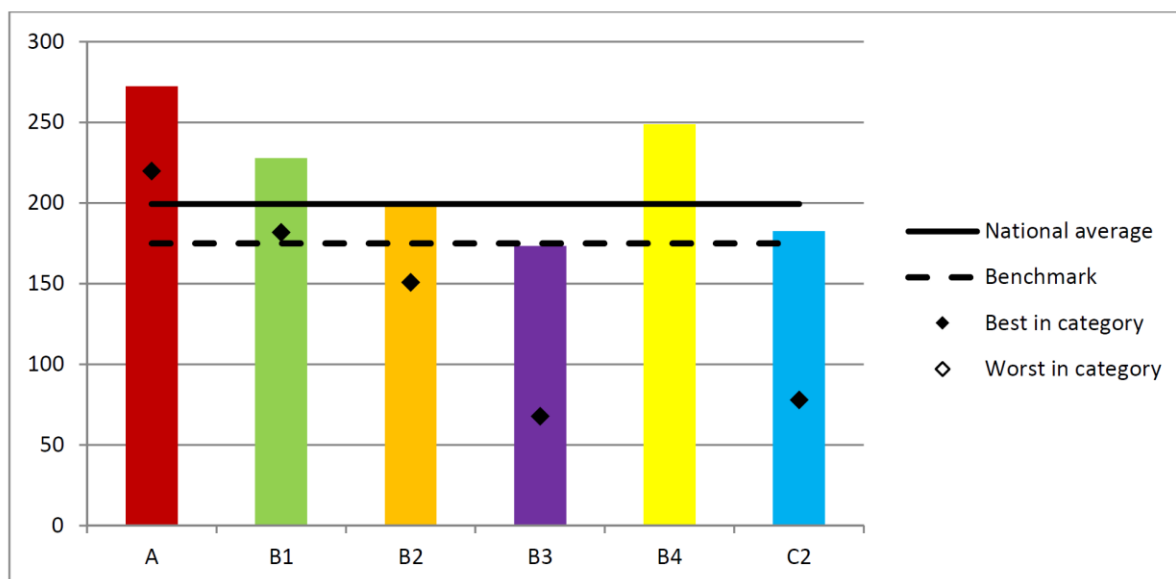


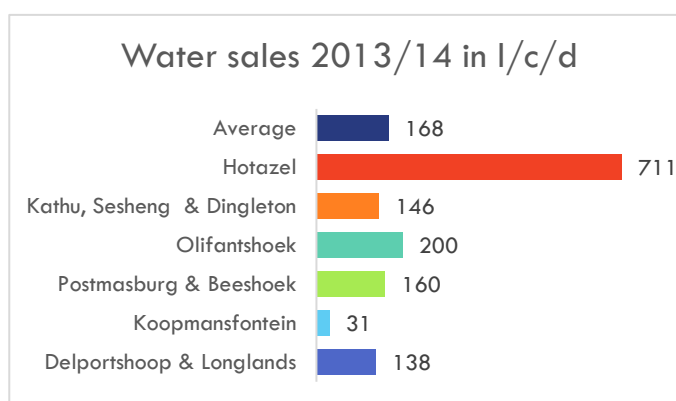
Figure 27. Litres per capita per day based on system input volume/population served¹²⁸

Because South Africa is a water scarce country, a benchmark of 175 l/c/d is proposed. The water demand targets set in the various reconciliation strategies undertaken by DWA across the country targeted the reduction of the system input volume of the IWA water balance. The input volume can only be reduced by increasing efficiency (reducing authorised consumption) and reducing water losses (commercial and physical losses).¹²⁹

5.4 Sedibeng Water sales

Figure 28. Sedibeng water sales expressed in l/c/d¹³⁰

In 2017/18 Sedibeng Water sold 5 million kℓ of water to municipalities, which represents an annual growth of 1% between 2013/14 and 2017/18. The highest increase in water sales occurred at Koopmansfontein which was probably due to an influx of inhabitants who arrived during 2013/14, and now occupy 72



¹²⁷ SALGA. Annual report on water services in South Africa 2015. P 28-29. [Online]. Available from: http://www.wrc.org.za/Knowledge%20Hub%20Documents/Research%20Reports/MBI%20Report%202015/MBI%20final%20Report%20_WRCSalga%20launch.pdf

¹²⁸ SALGA. Annual report on water services in South Africa 2015. P 28. [Online]. Available from: http://www.wrc.org.za/Knowledge%20Hub%20Documents/Research%20Reports/MBI%20Report%202015/MBI%20final%20Report%20_WRCSalga%20launch.pdf

¹²⁹ SALGA. Annual report on water services in South Africa 2015. P 28. [Online]. Available from: http://www.wrc.org.za/Knowledge%20Hub%20Documents/Research%20Reports/MBI%20Report%202015/MBI%20final%20Report%20_WRCSalga%20launch.pdf

¹³⁰ Note that of these towns only Delporshoop/Longlands, Olifantshoek, and Hotazel source water from the VGWSS exclusively.

out of the 111 dwellings.¹³¹ By contrast, Kathu showed a decline in water volume supplied by Sedibeng water (-16.0% p.a.) from over 1.2 million kℓ in 2013/14 to 0.6 million in 2017/18 i.e. 50% reduction. This, however, does not represent an overall decrease in water consumption at Kathu since they also source water from their own boreholes and receive water from the mines' dewatering activities. Olifantshoek, which relies entirely on water supplied by Sedibeng, showed a water consumption increase of 1.4% p.a. Consumption at Hotazel increased by 8.8% p.a. from 4.6 million kℓ to 6.4 million kℓ. The very high litres per capita per day consumed at Hotazel remains unexplained, and a field visit showed no indication of high water usage in the town.¹³² According to Joe Morolong¹³³ and South32¹³⁴, Sedibeng Water supplies water to Joe Morolong which is used solely by the town of Hotazel and the offices and workshops of South32 but excludes mining operations as the Wessels and Mamatwan mines are supplied separately.

Table 17. Sedibeng water sales in 2013/14 and 2017/18 ℓ/c/d and kℓ per household per month (based on 2011 population and households¹³⁵)

Settlement	2011		Water sales 2013/14			Water sales 2017/18	Water sales growth p.a. (2013/14-2017/18)
	Population	Households	in kℓ	ℓ/c/d	kℓ/HH/pm		
Delportshoop & Longlands	13 278	3 264	667 182	138	17	750 300	3.0%
Koopmansfontein	249	37	2 786	31	6	7 831	29.5%
Postmasburg & Beeshoek	30 087	8 112	1 755 898	160	18	2 233 573	6.2%
Olifantshoek	10 233	2 169	747 206	200	29	788 420	1.4%
Kathu, Sesheng & Dingleton	22 539	6 747	1 200 450	146	15	596 887	-16.0%
Hotazel	1 755	597	455 401	711	64	638 698	8.8%
TOTAL	78 830	21 122	4 828 923	168	19	5 015 709	1.0%

5.5 Water demands for new development in Kathu

Water demand calculations for the development of Kathu Extensions 6/7/8/9/10, prepared for the township establishment motivation report, totalled 3 million ℓ/d for 5148 stands. This implies an average of 592 ℓ/d per stand and, based on 3.5 persons per household, could amount to about 169 ℓ/c/d¹³⁶.

Table 18. Number of stands and litres per day¹³⁷ converted to ℓ/d per stand and litres per capita per day at an assumed household size of 3.5¹³⁸

Kathu Ext	Stands	ℓ/d AADD	ℓ/d per stand	ℓ/c/d on assumed HH size of 3.5
6	1 194	809 599	678	194
7	1 143	603 725	528	151
8	1 004	797 828	795	227
9	671	319 616	476	136
10	1 136	516 670	455	130
TOTAL	5 148	3 047 438	592	169

¹³¹ Personal communication with Sinah Veldsman on 12 November 2018. A group of women, who were part of the community works programme (CWP) were there at the time, agreed with her.

¹³² Field visit on 6 November 2018: The properties are very small and very few have gardens. No private swimming pools were noted. The church garden uses borehole water.

¹³³ Personal communication with Masego Bele, acting CFO Joe Morolong, on 6 November 2018 and with Mogomosti Moagi, an account at Joe Morolong, on 7 November 2018.

¹³⁴ Personal communication with Mr Harry Clingen (0537422289), South32, on 6 November 2018.

¹³⁵ Data source: StatsSA Census 2011, Sedibeng Water sales 2013/14 and 2017/18 volumes to local municipalities

¹³⁶ Although not all stands are occupied by households

¹³⁷ Maxim (2018) Motivation report - Proposed Township Establishment Kathu Extensions 6,7,8,9 and 10, removal of restrictive title conditions, consolidation and subdivision on Portions 1 and 2 of the farm Kalahari Gholf en Jag Landgoed No. 775, Division Kuruman, Northern Cape Province. P 117. [Online] available

<https://www.sahra.org.za/sahris/sites/default/files/additionaldocs/8-75-1%20Memorandum%20Kathu%20Extensions%206-10.pdf>

¹³⁸ Own calculations

5.6 Water volume consumed in Sesheng

A study of water consumption was undertaken for the Sesheng bulk water project in 2015. Based on the volume of water used by residential users and the number of residential properties where water was metered, a volume of water consumed per capita per day was determined. It should be noted that in Sesheng, water meters are only located in Mapoteng. Please see adjacent figure.

The average water consumed per capita per day is 123 litres in the Sesheng water management area. This means that the average residential property in Mapoteng uses 24.2 kℓ per month.

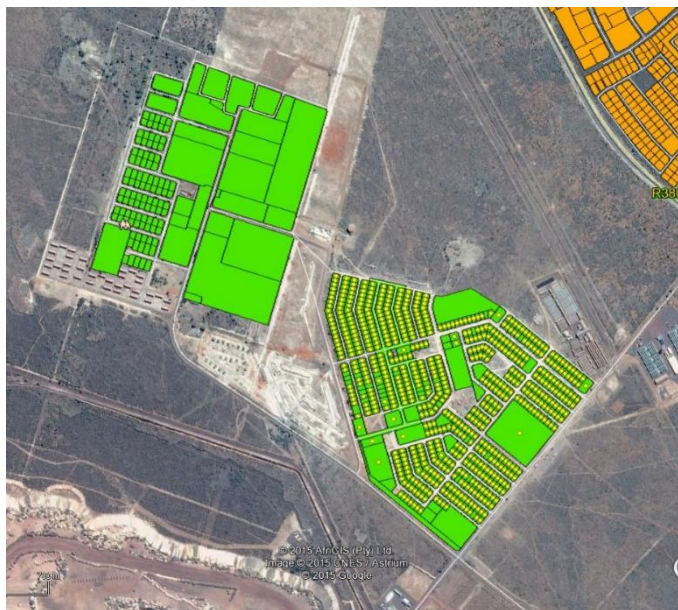


Figure 29. Location of water meters (yellow dots) in Sesheng¹³⁹

Table 19. Purified water consumption by residential consumers in Sesheng (Mapoteng) in 2014/15¹⁴⁰

	Sesheng (Mapoteng)
Total water use in kℓ/d by residential properties	548.4
Number of residential properties where water is metered	679
Average water use per day per property in l/d	808
Average number of persons per property	6.58
Average water use per person in ℓ/c/d	123

6 WATER DEMAND

The VGWS is currently operating at full design capacity of 20 million kℓ per annum. Raw water purchased for the 2016/2017 FY was 21 116 643 kℓ of which 20 059 418 kℓ was produced (sold). Raw water is abstracted from the Vaal River and supplemented with groundwater supplied from the dewatering operations at Kolomela (Beeshoek) and the Sishen mines.

The raw water is treated at the Vaal Gamagara water treatment plant near Delportshoop and distributed through a bulk pipeline all the way to Blackrock which is 430 km from the plant.¹⁴¹ The water is sold to different user groups/sectors such as agriculture, mining & industrial, municipalities, solar plants, government and parastatals and the Kalahari East Water User Association (KEWUA).

¹³⁹ Squires, A. KATHU WATER CONSUMPTION – INITIAL FINDINGS, Sesheng Bulk Water Project. 18 August 2015 – 1st draft for discussion and comment.

¹⁴⁰ Squires, A. KATHU WATER CONSUMPTION – INITIAL FINDINGS, Sesheng Bulk Water Project. 18 August 2015 – 1st draft for discussion and comment.

¹⁴¹ Sedibeng Water – Annual Report 2016-2017

6.1 Water use sectors

The VGWSS supplies water to the following sectors:

- Local municipalities: Dikgatlong, Kgatelopele, Tsantsabane, Gamagara and Joe Morolong
- Mines and industries: Petra Diamonds, Mokala Manganese, Huatian SA Mining, Bishop Mine PMG Mining, Assmang Beeshoek & Khumani Iron Ore Mines, Kolomela Mine, Lehating Mining, Mineral Explore Mining Solutions, COZA Mining, Tshipi e Ntlw Manganese, Assmang Nchwaning & Gloria Mines, Kalagadi Manganese, Kudumane Manganese Recourses, United Manganese of Kalahari, South32 Wessels & Mamatwan Mines, Diro Manganese/Diro Iron Ore and Morokwa Manganese Mine Pty Ltd
- Solar projects: Redstone, Lesedi, Jasper, Adams and Kathu Solar Park
- Water supply schemes: Kalahari East water supply scheme
- Government and parastatal institutions: Lohatla Military Base, Transnet and Eskom
- Agriculture: Mainly stock watering along the scheme, and domestic use

The expected future water demand for the local municipalities was derived from the future economic, and population growth expectations as explained in the previous sections of the report. The government/parastatals and agricultural water demand was obtained from information submitted to Ingerop. Cognisance has been taken of the off-take volumes submitted by mines and solar plants to Sedibeng water during 2018.

By analysing the estimated water use of the municipalities and secondary data about agriculture, government & parastatal and mining use, the water demand volume per user, and per user group was refined for planning purposes.

Municipalities

The following municipalities are currently supplied with water from the VGWSS: Dikgatlong (Delpportshoop & Longlands, and Koopmansfontein), Tsantsabane (Postmasburg), Gamagara (Olifantshoek, and Kathu¹⁴²), Joe Morolong (Hotazel). Water is also supplied to the settlements of Lime Acres and Blackrock where the acquisition and distribution of the water is done by Petra Diamonds and Assmang (Black Rock Mining Organisation) respectively. Both these settlements' water requirements are included in the mining and industrial sector as Petra and Assmang. The water supply to the Vaal Gamagara settlement is done by Sedibeng Water themselves.

Groenwater/Metsimatale, Maremane and the Tsineng and surrounding villages are possible new water users to the upgraded scheme. These settlements' water demands are included in the demand analysis.

Municipalities with additional water sources

The towns of Postmasburg and Kathu have additional groundwater sources augmenting their supply from the VGWS. Tsineng and surrounding villages, should they form part of the upgraded scheme, are currently being supplied by localized groundwater sources which could be intergraded into the larger SD4 development.

The suburb of Postdene in Postmasburg is supplied solely from groundwater and the remaining town area's demand is supplemented with about 10% groundwater.¹⁴³ Postdene accounts for 23% of the water consumption of Postmasburg and by adding the 10% supplied to the rest of

¹⁴² Includes Sesheng.

¹⁴³ Meeting with the Tsantsabane LM on 6 November 2018. See notes in Appendix A.

Postmasburg and estimated 70% of the demand is reliant on the supply from the VGWSS. Thus, in the water demand calculations for Postmasburg, an estimated 30% supply from groundwater sources was assumed. Applied to the water demand calculation, it correlates with the 2017/2018 Sedibeng Water sales as indicated in Table 21.

Kathu's water requirement from the VGWSS is being augmented by means of municipal owned groundwater and groundwater supplied to the municipality by Sishen mine's dewatering processes. The water sources of Kathu are summarized in the table below.

Table 20. Kathu water sources

Source	Capacity kℓ/h	Capacity million kℓ/a	% Use of Total Water
Khai-Appel Boreholes	318	2.786	18%
Kathu Central Boreholes	313	2.742	7%
Vaal Gamagara Water Supply Scheme	288	2.523	16%
Sishen mine (via the groundwater dam)	800	7.008	45%
Sishen mine (via softener plant)	245	2.146	14%
TOTAL	1 964	17.205	100%

However, should the 16% anticipated use from the VGWSS be compared to the 2017/2018 water sales, a 50% requirement from the VGWS is more likely.

Groundwater modelling and exploration undertaken as part of the 2015 *Feasibility Study*, indicated that adequate volumes of groundwater can be abstracted from the SD4 resource area to augment and support the VGWSS. The possibility to supply the settlement of Tsineng and several rural villages located directly to the east of the SD4 area from the SD4 groundwater resource was recognised and investigated. Generally, sustainable yields of the localized groundwater sources (sources currently supplying the villages) in the SD4 area are not known and should a regional bulk scheme be established to supply the proposed villages, it is proposed that a detailed groundwater assessment be conducted. For the water demand calculations, a 50% VGWSS supply from the SD4 groundwater source was assumed.

Gamagara and Tsantsabane municipalities indicated that they are in the process of investigating the availability of localized groundwater sources to augment the VGWSS supply mainly to reduce costs. Since no detailed information was made available during discussions with these municipalities, these sources were not considered.

Municipal water consumption

Several water consumption scenarios are undertaken for the domestic water use estimates. As stated in Section 5 about water consumption patterns, 100 ℓ/c/d and above should be sufficient to meet all consumption and hygiene needs. However, the average per capita water use of the VGWSS municipal users is 168 ℓ/c/d, without considering groundwater sources used to supplement the supply from the VGWSS. The water consumption was assumed to be system input per capita not allowing for losses and other supply factors.

For the analysis below, a per capita use of 100 ℓ/c/d, 150 ℓ/c/d and 225 ℓ/c/d was used for most of the towns. However, since the very high per capita use at Hotazel is unexplained, the per capita use is adjusted to the actual per capita use of 895 ℓ/c/d and reduced to 420 ℓ/c/d by the end of the period in 2043. Although a high and low population growth estimates were made, the most likely population estimates are used to calculate the future water demand.

The per capita use of 150 ℓ/c/d with the "most likely" population growth was accepted to determine municipal water demand projections, except for Hotazel which will have to reduce their per capita use considerably. The high population growth scenario with a per capita use of 150 ℓ/c/d is indicated in the graph below as a solid line. A 21.4% increase in water demand

is evident as a result amounting to an increase of 1.72 million kℓ/a increase compared to the 150 ℓ/c/d with the most likely population growth estimate.

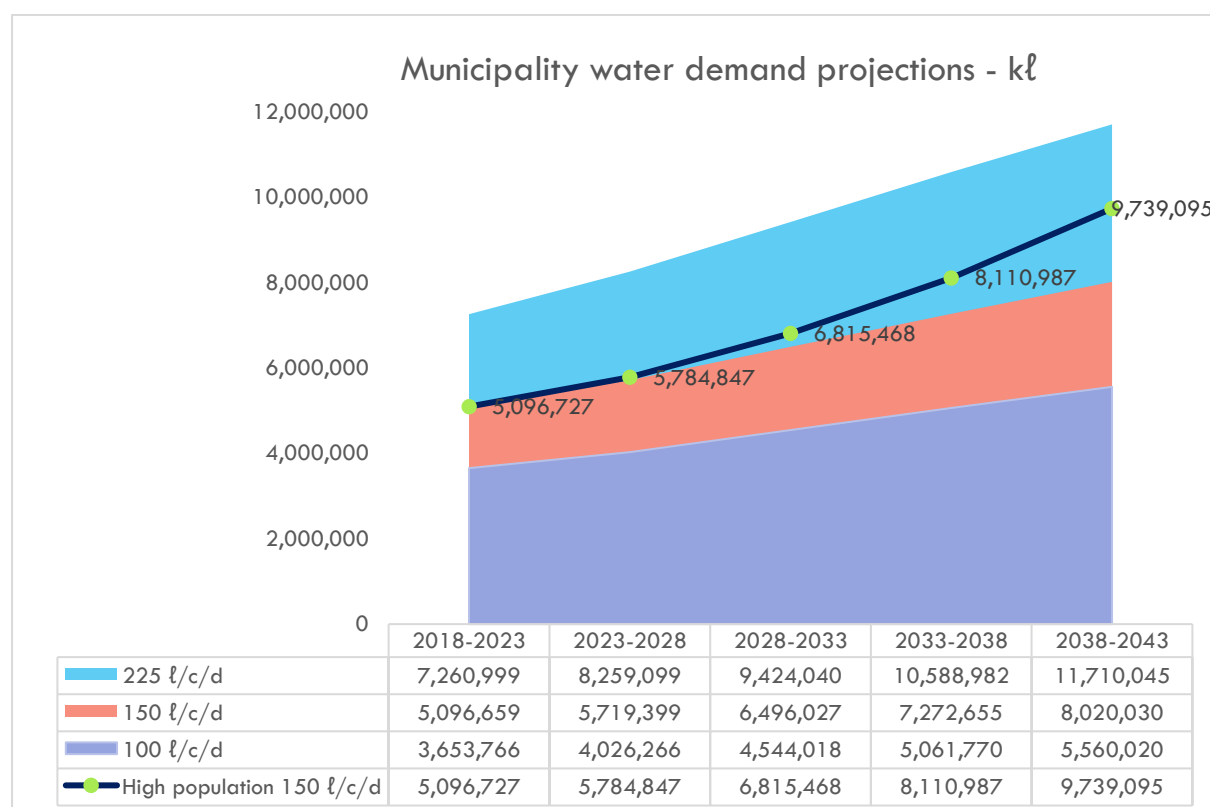


Figure 30. Municipal water demand projections in kℓ/a and comparison of 100, 150 and 225 ℓ/c/d

The municipal water sales for the 2016/2017 financial year amounted to 4 934 006 kℓ which correlates well with the 2018-2023 projection of 5.1 million kℓ/a. It is projected that the estimated water demand will increase by 1.83% p.a. from 2018 to 2043 (5.10 million kℓ/a to 8.02 million kℓ/a) as indicated in the table below.

Table 21. Municipal water projections to 2043 in kℓ/a per settlement compared to 2016/17 water sales and authorised abstraction

	Water sales 2016/17	Authorized Abstraction	ℓ/c/d applied	% VGG sourced	2018-2023	2023-2028	2028-2033	2033-2038	2038-2043
Delportshoop & Longlands	600 000	1 000 000	150	100%	777 631	877 246	972 354	1 058 903	1 132 894
Vaal Gamagara	-	-	150	100%	10 348	10 609	10 809	10 945	11 014
Koopmansfontein	3 500	8 000	150	100%	24 309	28 181	31 574	34 182	35 748
Lime Acres	-	-	150	0%					
Groenwater/ Metsimatale	-	-	150	100%	104 094	129 720	155 374	178 813	197 667
Postmasburg	1 883 213	1 780 000	150	70%	1 567 074	1 843 280	2 134 274	2 432 456	2 728 687
Maremane	-	-	150	100%	59 476	66 312	72 144	76 578	79 296
Olifantshoek	785 800	900 000	150	100%	722 292	847 516	970 021	1 082 827	1 178 764
Kathu	778 200	810 000	150	50%	839 797	1 033 681	1 250 480	1 486 683	1 736 942
Hotazel	406 200	770 000	420	100%	767 979	640 000	640 000	640 000	640 000
Blackrock	-	-	150	0%					
Tsineng & villages	-	-	150	50%	223 660	242 855	258 995	271 267	279 019
TOTAL	4 456 913	5 428 000			5 096 659	5 719 399	6 496 027	7 272 655	8 020 030

Mines, industries, parastatals and other

The water demand of the mines, industries, solar plants and parastatals are included in the analysis based on the secondary data derived from off-take information sheets.

Mines and industries

The mines are the largest user group of the VGWSS and are expected to use approximately 56% of the total water estimated for 2043. The *current authorised abstraction* volume for this group is 13.9 million kℓ/a excluding the 3.0 million kℓ/a from Kolomela¹⁴⁴. Kolomela is a water positive mine and supplies dewatering water to the Beeshoek mine and to the VGWSS.

The mines' water use is likely to decrease from 15.8 million kℓ/a to 11.1 million kℓ/a according to the information sheets submitted. However, this decrease could be due to their 10 to 15-year planning horizons and due to uncertainties and risks as stated previously. Therefore, the maximum water use stated by each mine is used for the projected period even if water demand decreases were submitted.

The future water demand according to information submitted by the mines is summarized in table below.

Table 22. Mine and industry water demand projections in kℓ/a per entity to 2043¹⁴⁵

	2018-2023	2023-2028	2028-2033	2033-2038	2038-2043	% Potable	Potable Volume
Assmang Beeshoek Iron Ore Mine	1 761 134	1 672 050	1 672 050	1 672 050	1 672 050	0%	0
Bishop Mine PMG Mining Pty Ltd	42 000	42 000	42 000	0	0	15%	6 300
Black Rock Mining Operations	1 320 000	1 320 000	1 320 000	1 320 000	1 320 000	100%	1 320 000
COZA Mining Pty Ltd	102 930	102 930	102 930	102 930	102 930	20%	20 586
Diro Manganese and Iron	168 904	168 904	168 904	0	0	0%	0
Huatian SA Mining & Investment	800 000	800 000	800 000	800 000	800 000	100%	800 000
Kalagadi Manganese	900 000	104 400	104 400	104 400	104 400	70%	630 000
Khumani Iron Ore - Assmang Ltd	5 076 983	5 986 650	5 986 650	5 986 650	5 986 650	1%	59 867
Kolomela Mine	0	0	0	0	0	0%	0
Kudumane Manganese	50 000	50 000	50 000	50 000	50 000	15%	7 500
Lehating Mining Pty Ltd	17 400	8 700	0	0	0	70%	12 180
Mamatwan Mine	431 872	472 360	431 872	431 872	0	50%	236 180
Mineral Explore Mining Solutions	201 000	201 000	201 000	201 000	201 000	20%	40 200
Mokala Manganese Pty Ltd	12 684	12 684	12 684	12 684	12 684	100%	12 684
Morokwa Manganese Mine	865	1 000	1 160	1 345	1 560	1%	16
Petra Diamonds - Finch Mine	3 997 926	3 997 926	2 800 000	0	0	100%	3 997 926
Tshipi e Ntlw Manganese	288 000	288 000	288 000	288 000	288 000	20%	57 600
United Manganese of Kalahari	480 000	480 000	480 000	480 000	480 000	25%	120 000
Wessels Mine	96 877	113 973	113 973	142 467	142 467	90%	128 220
TOTAL	15 659 491	15 822 577	14 575 623	11 593 398	11 161 741		
TOTAL (No decline)¹⁴⁶	15 659 491	15 822 577	15 822 577	15 822 577	15 822 577	47%	7 449 259

¹⁴⁴ Record received from Sedibeng Water by email

¹⁴⁵ Data source: Information forms submitted to Sedibeng Water during 2018.

¹⁴⁶ The highest use is estimated in 2023-2028 – this use was assumed to continue to 2043

Assmang Beeshoek indicated that their demand would be 1.7 million kℓ/a. Kolomela is supplying Beeshoek with dewatering water as per agreement between Sedibeng Water and both these mines.

Although Kolomela is supplying Beeshoek with dewatering water, this volume is included in the volume supplied by VGWSS to mines and industries as per agreement between these three parties.¹⁴⁷ According to the agreement, Kolomela supplies water to Beeshoek on behalf of Sedibeng Water and are therefore included as indicated.

The mines indicated the proportion of potable water required is 47% of the total estimated demand. The raw water is mainly used for processing and dust suppression and do not require a potable quality.

Solar Plants

Several solar plants are supplied with water from the pipeline and these are (refer to Appendix C for a detail description of the solar plants):

- Kathu Solar Park CPS
- Jasper PV
- Lesedi PV (also known as Oakleaf Investment Holdings and Solar Reserve SA Pty Ltd)
- Adams (Enertronica SA)

Redstone is under construction and is situated adjacent to the Lesedi and Jasper plants.

Water use at solar plants

The 2017/18 water supply to solar plants from the VGWSS was about 71 000 kℓ/a. With the addition of Redstone, which is under construction, this will increase to an estimated 0.5 million kℓ/a of which 99% is required to be of a potable quality.

Table 23. Solar plants water demand projections

	2018-2023	2023-2028	2028-2033	2033-2038	2038-2043	% Potable	Potable (2028)
Redstone Solar	275 000	275 000	275 000	275 000	275 000	100%	275 000
Jasper Power Plant	3 000	3 000	3 000	3 000	3 000	5%	1 50
Kathu Solar Park	160 000	160 000	160 000	160 000	160 000	100%	160 000
Oakleaf (Lesedi)	4 000	4 000	4 000	0	0	100%	4 000
Adams Solar Plant	6 500	6 500	6 500	6 500	6 500	100%	6 500
TOTAL	448 500	448 500	448 500	444 500	444 500	99%	448 500

Government/ parastatal and other entities

The government water user includes the Lohatla army base located about 20 km from Postmasburg, Eskom, and Transnet. The Kalahari East water supply scheme is supplied from the VGWSS which is managed by KEWUA. the maximum volume required for these users is approximately 4.0 million kℓ/a.

¹⁴⁷ Letter dated 06 September 2012: Re: increase in tariff at which surplus groundwater is beneficially released by Sishen Iron Ore Mine to Sedibeng Water, as well as supply to Beeshoek Mine.

Table 24. Governmental and parastatal water demand projections in kℓ/a

	2018-2023	2023-2028	2028-2033	2033-2038	2038-2043	% Potable	Potable
DPW – Lohatla	481 819	481 819	481 819	481 819	481 819	100%	481 819
Eskom	140	140	140	140	140	100%	140
Kalahari East WUA	3 250 000	3 300 000	3 540 000	3 540 000	3 540 000	100%	3 540 000
Transnet	12 437	12 437	12 437	12 437	12 437	100%	12 437
TOTAL	3 744 396	3 794 396	4 034 396	4 034 396	4 034 396	100%	4 034 396

Small agricultural use

Along the VGWSS are agricultural users with an annual abstraction volume of 37 080 k/a. The demand of these users is assumed to remain constant over the planning period.

6.2 Summary of water demand projections

The current water demand of 20 million kℓ/a will increase to approximately 28.4 million kℓ/a by the year 2043. It is projected that the mining sector will remain the largest consumer; consuming approximately 56% of the water, whereas the municipalities, government & parastatals (including KEWUA) and solar plants will utilise 28%, 14% and 2% respectively by 2043.

Table 25. Future water demand projections 2038-2043 by user group

	Water use sectors	2038-2043 in kℓ/a	% distribution
Economic	Mine and Industry	15 822 578	55.8%
	Solar Plants	448 500	1.6%
	Subtotal	16 271 078	57.4%
Social	Municipality	8 020 030	28.3%
	Gov & parastatals	4 034 396	14.2%
	Agriculture	37 080	0.1%
	Subtotal	12 091 506	42.6%
TOTAL		28 362 584	100.0%

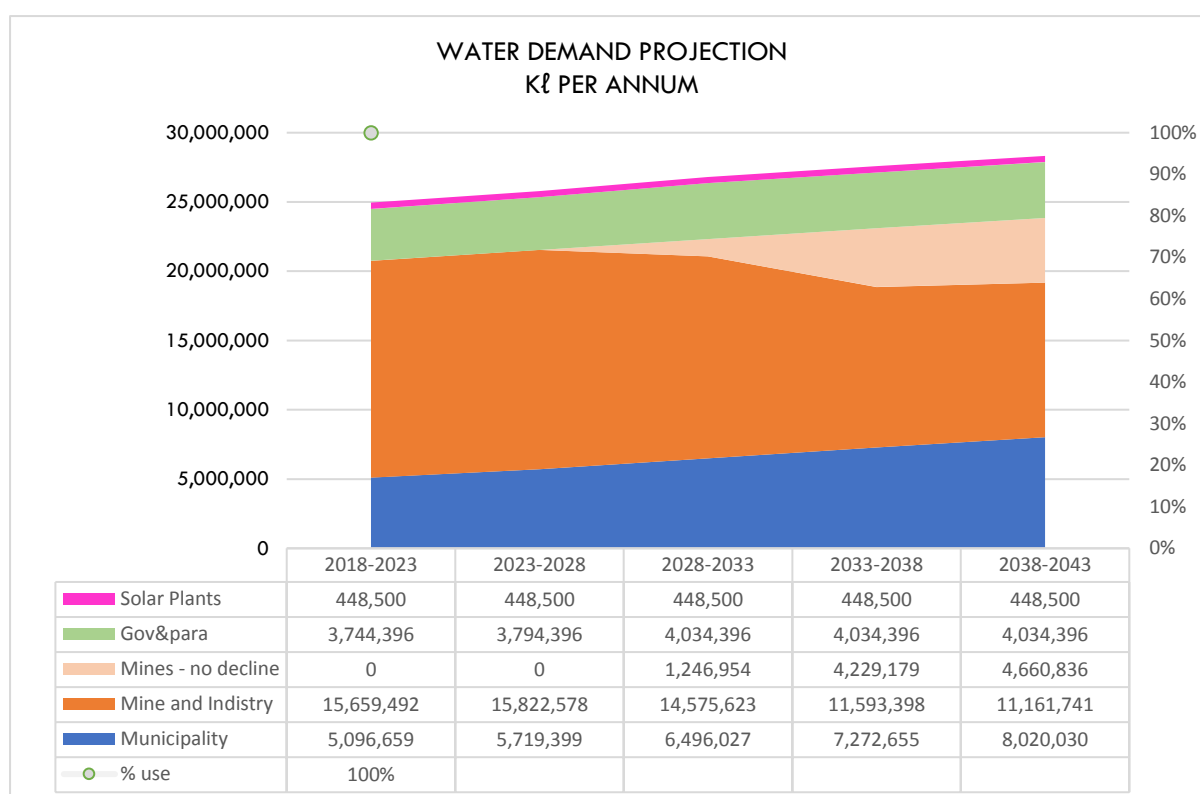


Figure 31. Total water demand projections for the VGWSS

The water demand of municipalities supplied by the VGWSS are anticipated to increase from 5.0 million kℓ/a currently to 8.02 million kℓ/a in 2043 with a projected increase in population from 117 921 to 223 244 over the same period.

The mines' water use is likely to decrease from 15.8 million kℓ/a to 11.2 million kℓ/a by 2043. However, for planning purposes the water demand is held constant at 15.8 million kℓ/a until 2043.

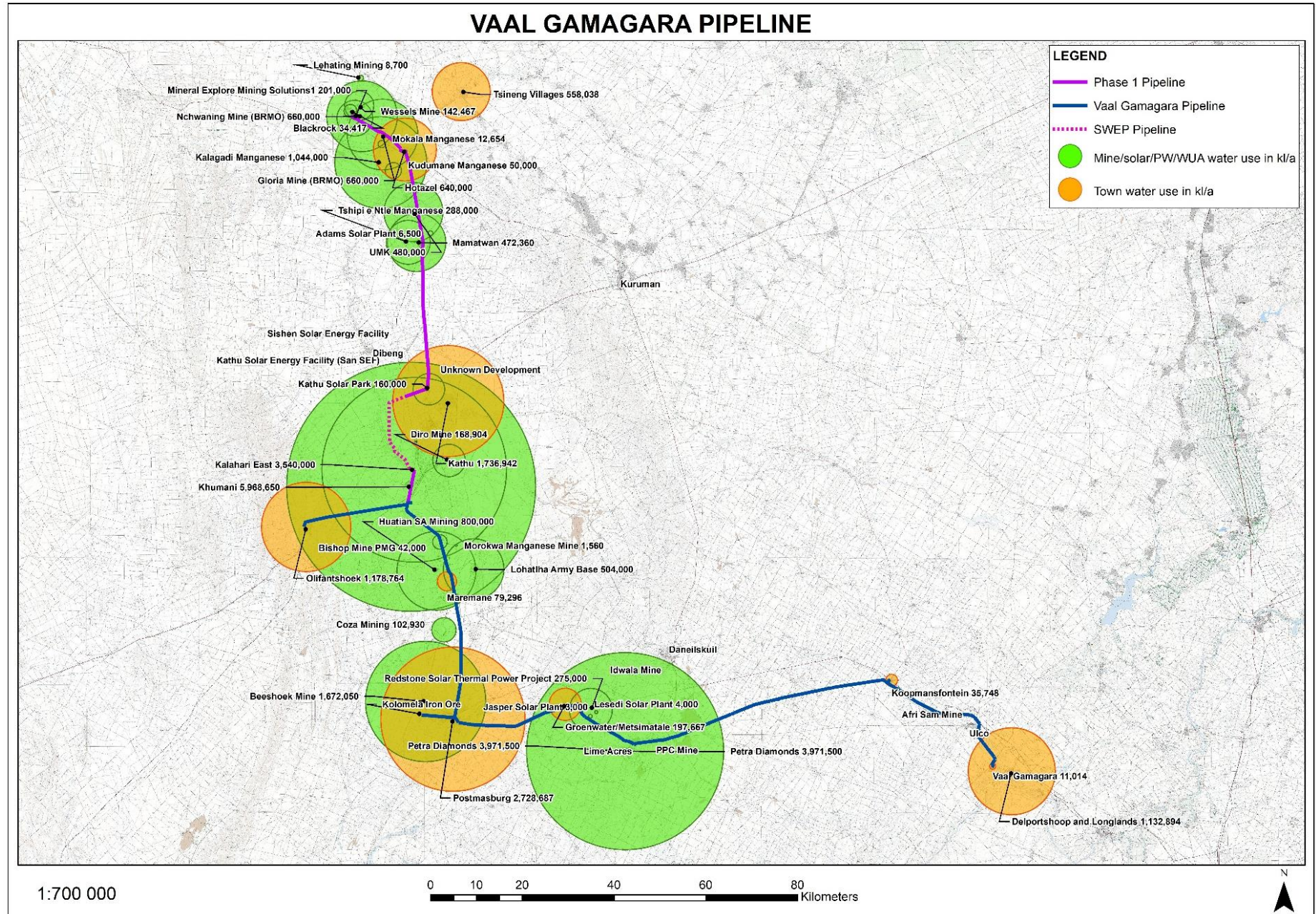
The solar plants also indicated a slight decrease from 2038 onwards and the same principle as for the mines is applied.

Not much growth in water demand is anticipated for the government and parastatal users. For the Kalahari East water supply scheme, its full design capacity of 3.54 million kℓ/a is allowed from 2028 onwards. As for the agricultural users, demand was kept constant.

Table 26. Total water demand projections for the VGWSS

	2018-2023	2023-2028	2028-2033	2033-2038	2038-2043
Mine and Industry	15 659 492	15 822 578	15 822 578	15 822 578	15 822 578
Solar Plants	448 500	448 500	448 500	448 500	448 500
Municipality	5 096 659	5 719 399	6 496 027	7 272 655	8 020 030
Gov & parastatals	3 744 396	3 794 396	4 034 396	4 034 396	4 034 396
Agriculture	37 080	37 080	37 080	37 080	37 080
TOTAL	24 986 127	25 821 953	26 838 580	27 615 209	28 362 584

The total annual water demand for 2043 amounts to 28 362 584 kℓ which excludes system and/or distribution losses and peak factors. It also excludes any additional water users that may apply for water in the future.



7 WATER SOURCES

Three water sources are identified in the study area, namely surface water from the Vaal River, augmentation from groundwater sources (SD1, SD2 and SD4) and dewatering groundwater from mining activities.

7.1 Surface water

Vaal River water is supplied through the VGWSS to water users and managed by Sedibeng Water. It was assumed the current water allocation from the river is adequate and should an additional volume be required, water rights from Sedibeng Water's upstream allocation could be transferred. The water treatment plant near Delportshoop has a capacity of 13.27 million kl/a.

7.2 Groundwater

SD groundwater

The initial groundwater study undertaken during the feasibility phase focused on determining the sustainability of sources for towns supplied by groundwater and identified resources for development to augment the VGWSS water supply in the short to medium term (2010 to 2015). Based on the resource potential of resource groupings and shortfalls identified in the short to medium term capacity of the VGWSS, four large scale source development (SD) target areas were identified (refer to figure below).

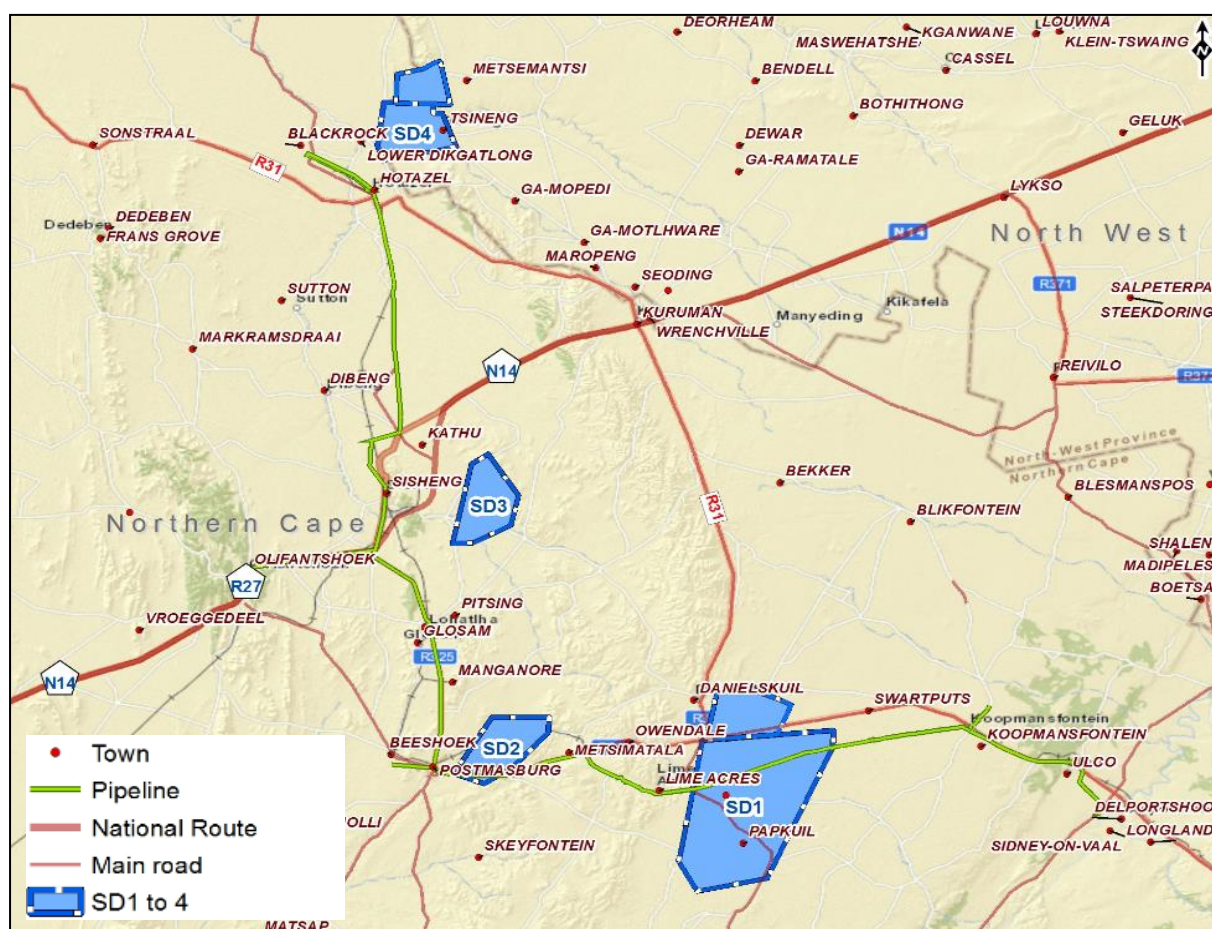


Figure 33. Large scale groundwater sources

The possibility of augmenting Vaal River water with the SD groundwater sources as a long-term option was initially not investigated. However, this was later investigated in more detail.

The drilling and testing of the exploration boreholes was concluded at the end of March 2014, which included SD1, SD2 and SD4. The groundwater source near Kathu, SD3 was omitted from the investigation due to the sensitivity of the area. A large portion of the area falls within the military base of Lohatla which has access and security constraints.

SD1 groundwater development area

Based on the desktop studies, field investigations and resource assessment activities undertaken during the Feasibility Study phase conclusions are made for the SD1 area. Twenty-two (22) production boreholes can be utilized to abstract 5 329 584 kℓ/a on a sustainable basis over the long term and 1 314 000 kℓ/a over a short term / peak supply for four months per annum (6 643 584 kℓ/a combined peak supply) to augment VGWSS water. The recommended well field abstractions for SD1 are summarised in the table below.

Table 27. Recommended well field abstractions for SD1

Well Field	Number of BH	Yield ℓ/s	Long Term kℓ/a	Short Term kℓ/a	Long + Short Term kℓ/a
WF1	5	75	1 419 120	499 320	1 918 440
WF2	10	128	2 596 464	578 160	3 174 624
WF3	4	45	1 051 200	131 400	1 182 600
WF4	3	14	262 800	105 120	367 920
Total	-	262	5 329 584	1 314 000	6 643 584

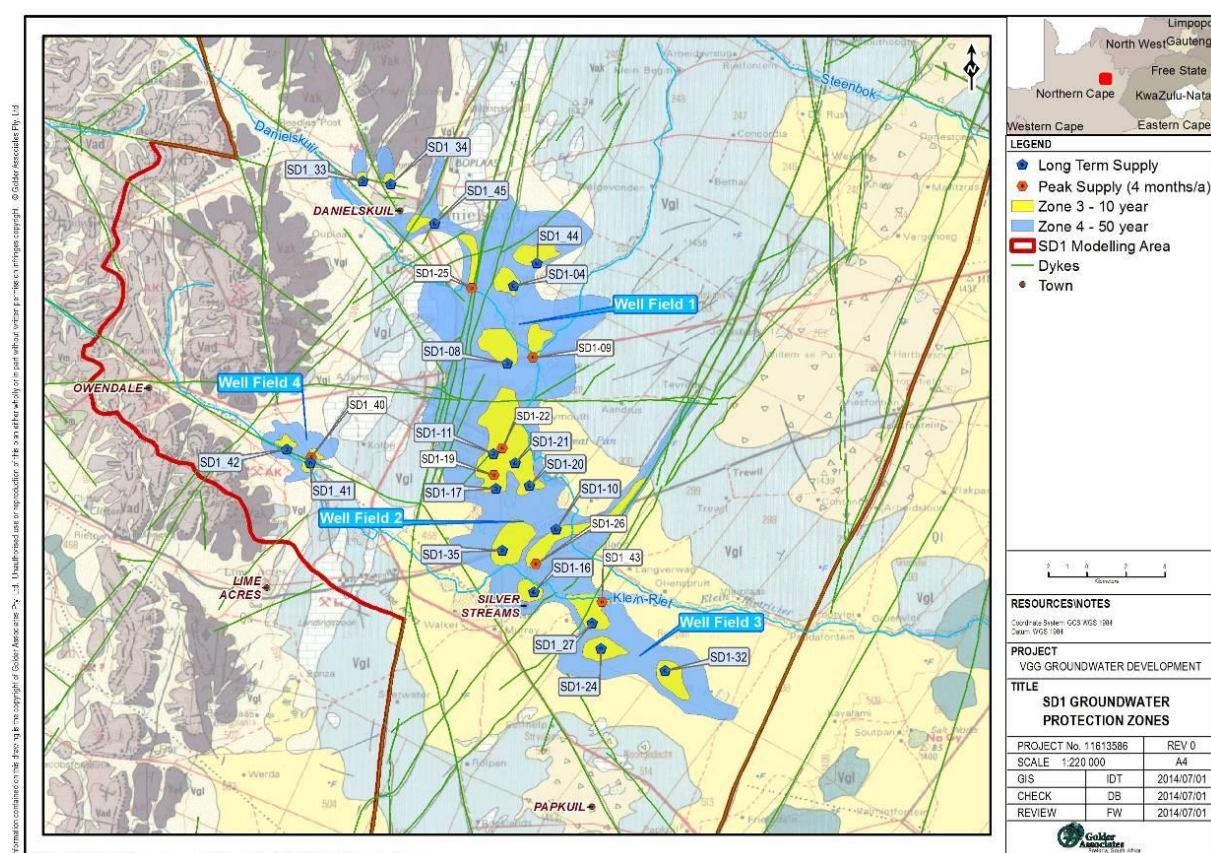


Figure 34. Groundwater protection zones for SD1 – 22 boreholes

SD2 groundwater development area

For the SD2 area the implementation of 21 production boreholes to abstract 3 689 712 kℓ/a on a sustainable basis over the long term and 1 808 064 kℓ/a over a peak supply for four months (5 497 776 kℓ/a combined) to augment water supply to the VGWSS was recommended. The recommended well field abstractions for SD2 are listed in the table below.

Table 28. Recommended well field abstractions for SD2

Well Field	Number of BH	Yield ℓ/s	Long Term kℓ/a	Peak Supply kℓ/a	Long + Peak Supply Term kℓ/a
South	12	119	2901312	693792	3595104
South-West	1	10	0	262800	262800
North	6	37	630720	536112	1166832
North-West	2	15	157680	315360	473040
Total	21	181	3 689 712	1 808 064	5 497 776

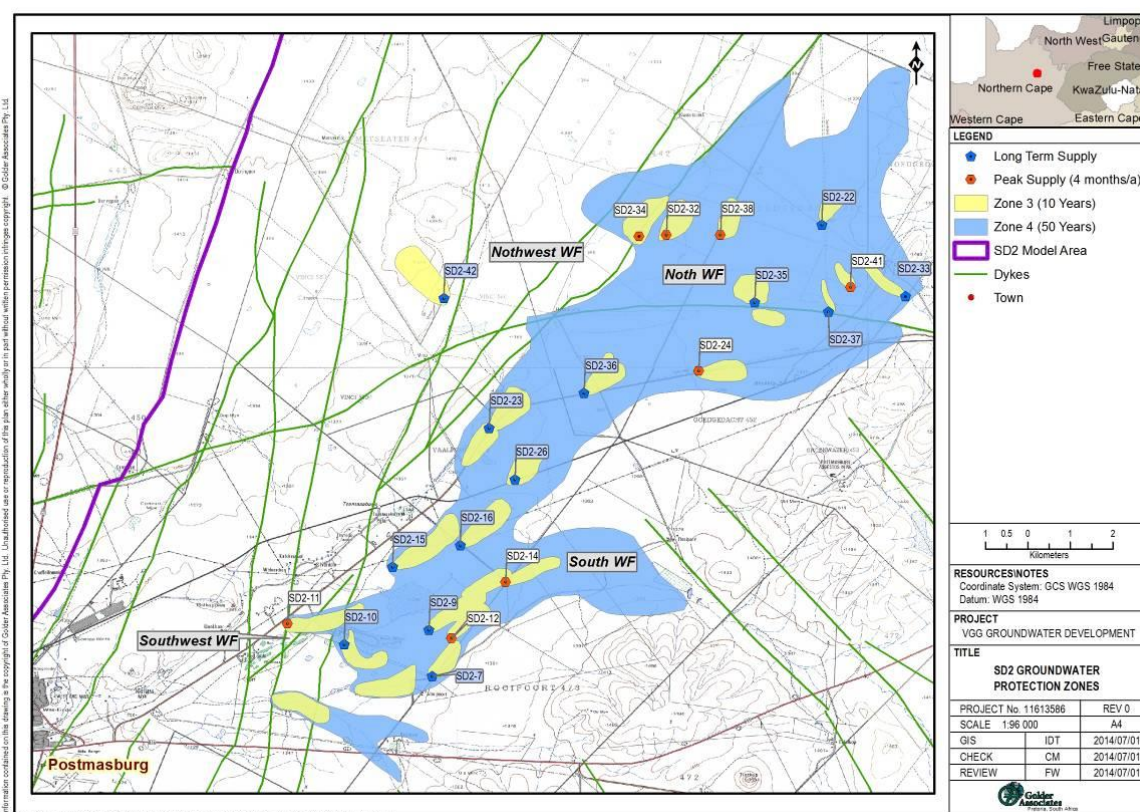


Figure 35. Groundwater protection zones for SD2 – 21 boreholes

SD 4 groundwater development area

Although 22 production boreholes are available in the SD4 area, due to practical considerations, 15 boreholes are to be developed to abstract 2 575 440 kℓ/annum on a sustainable basis over the long term to augment water supply to the VGWSS. Licencing applications for a total of 22 boreholes was recommended. Should the source be developed in phases, the recommended phases are indicated in the table below.

Table 29. Recommended well field abstractions for SD4

Well Field	Number of BH	Yield ℓ/s	Implementation Phase	Phase I $k\ell/a$	Phase II $k\ell/a$	Combined Phase I and phase II $k\ell/a$
WF1	3	18	Phase I	473 040	0	473 040
WF2	2	15	Phase I	289 080	0	289 080
WF6	3	18	Phase I	551 880	0	551 880
WF3	2	15	Phase II	0	210 240	210 240
WF4	2	17	Phase II	0	236 520	236 520
WF5	3	15	Phase II	0	420 480	420 480
Total	15	98		1 314 000	867 240	2 181 240

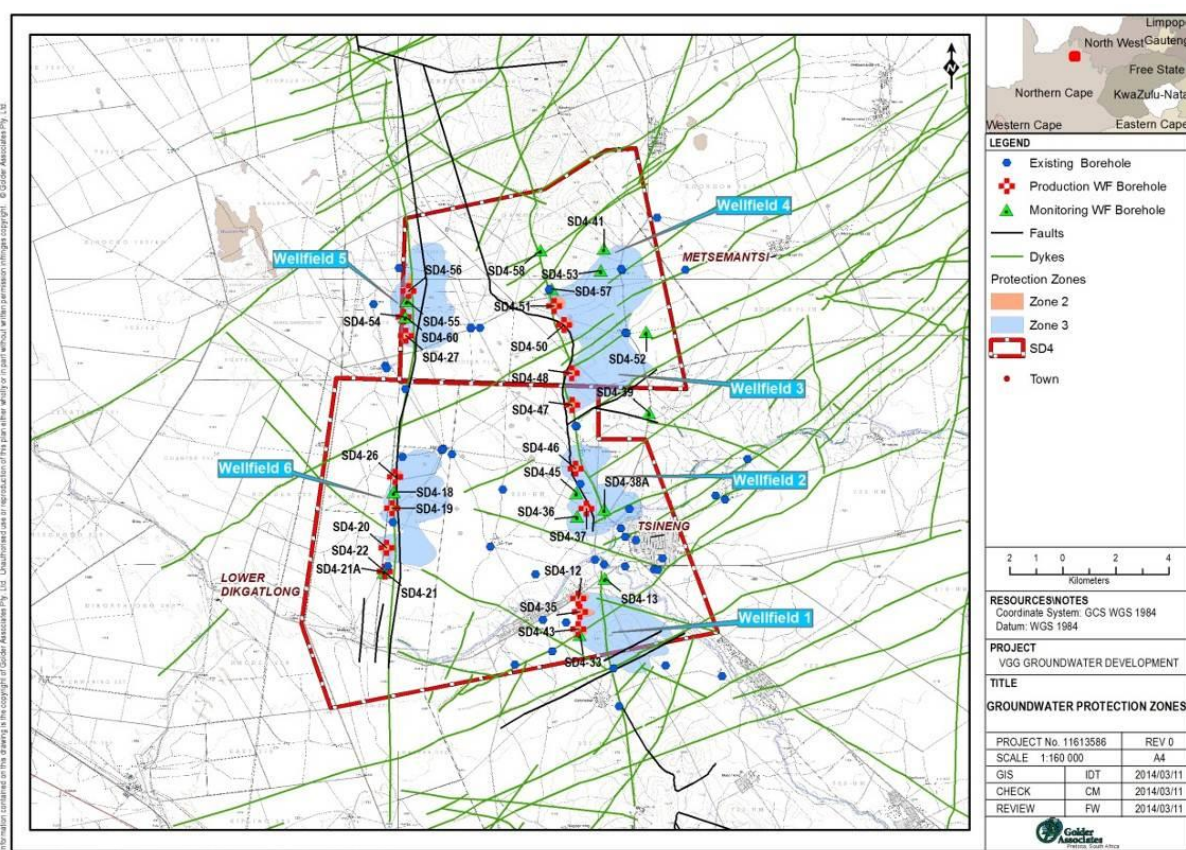


Figure 36. Groundwater protection zones for SD4 – 15 boreholes

Dewatering by mines

Dewatering is required to decrease water from groundwater inflow into mining pits for safe mining. Water from dewatering activities is supplied into the VGWSS network, to Beeshoek Mine and to Gamagara Municipality. The two dewatering systems that supply water to the VGWSS are:

1. Kumba Iron Ore's Kolomela Mine near Postmasburg
2. Kumba Iron Ore's Sishen Mine near Kathu

During the 2011 Feasibility Study the de-watering water from mining operations was assumed to only provide relief to operational and water cost issues because of legal, institutional and operational constraints in supplying water to the VGWSS on a sustainable basis. However, Sedibeng Water decided that this source could not be left unutilized and the reliability of this

source had to be quantified to determine the sustainable yield that can be delivered to the VGWSS.

Sishen mine dewatering

Sishen mine only dewaterers to assure safe mining conditions. Quantifying the most likely yield available to the VGWSS was mainly done based on an analysis of historic dewatering volumes.

The dewatering from Sishen mine is firstly applied to the operational requirements of the mine itself, while the remainder is delivered to Kathu town and the VGWSS. Currently, water is supplied to Kathu town before being delivered into the VGWSS. However, this is contrary to the DWS proposed water use licence agreement where water must be supplied to the VGWSS firstly, and secondly to Kathu. The proposed condition of the WUL states:¹⁴⁸

"The water removed from underground shall be used for mining and beneficiation as per Appendix II of this license. The balance of the water shall be disposed into the Vaal Gamagara Water supply scheme at a required flow of not less than 300 m³/h or the total volume of 2.628 Mm³/a as priority and then to the Gamagara Municipality water reticulation system for Kathu town."

Dewatering yields were obtained from Sishen mine for the period January 2015 to August 2018 and analysed based on dewatering volumes supplied to Kathu first and the surplus water supplied to the VGWSS (as the dewatering is utilized currently).

Table 30. Dewatering volumes from Sishen mine in kℓ/a¹⁴⁹

Year	Total volume	Sishen Use	Kathu town	VGWSS
2015	13 253 760	6 027 840	6 027 840	1 198 080
2016	14 272 560	6 119 640	6 119 640	2 033 280
2017	14 405 760	6 569 280	6 569 280	1 267 200
2018	14 785 200	6 401 520	6 401 520	1 982 640

In the past, approximately 40% to 45% of the total dewatering was used by Sishen themselves, with the same amount supplied to Kathu town and the remaining 10% to 20% supplied to the VGWSS. The dewatering volumes fluctuate from a minimum of 34 kℓ/h to 406 kℓ/h on average per month. The average supply rate over the four years is 184 kℓ/h which is well below the 300 kℓ/h stated in the WUL agreement. Refer to the figure below.

¹⁴⁸ DWS. Draft WUL. Email received from G v Dyk, 11 Oct 2018.

¹⁴⁹ Note: the volumes from September 2018 to December 2018 were assumed based on the average for the year.

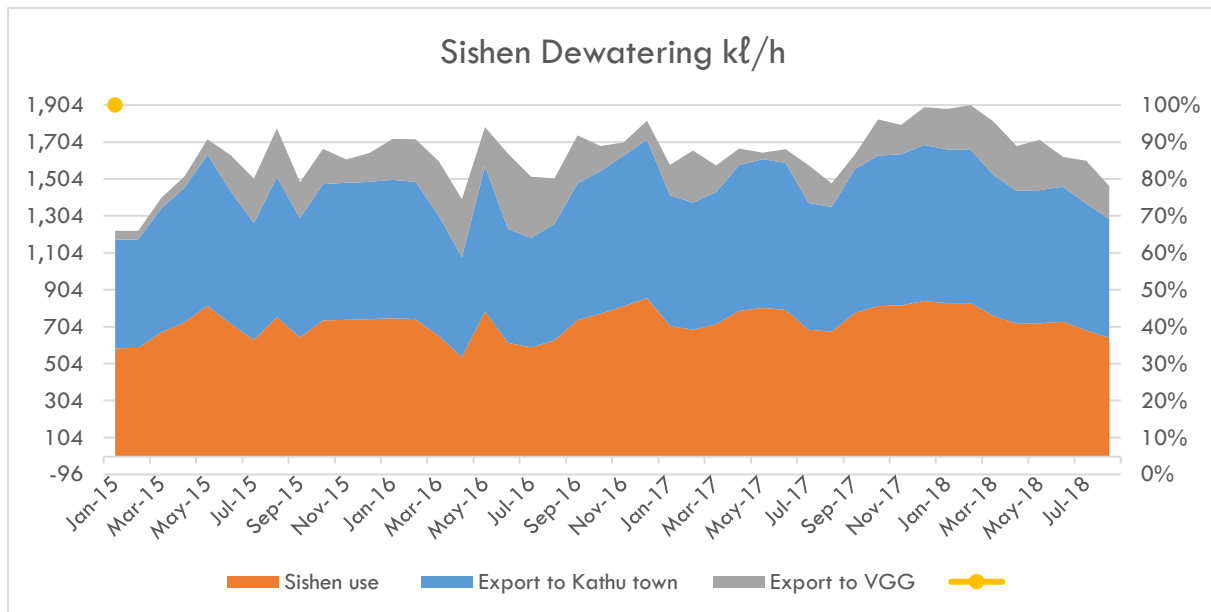


Figure 37. Sishen dewatering volumes Jan 2015 to Jul 2018 in kℓ/h

A continuous probability distribution analysis was conducted to determine, from past dewatering volumes, what the probability would be for Sishen to supply a certain volume water to the VGWSS. The graph below indicates that the probability of Sishen to supply 300 kℓ/h (2.63 million kℓ/a) to the VGWSS is 9%.

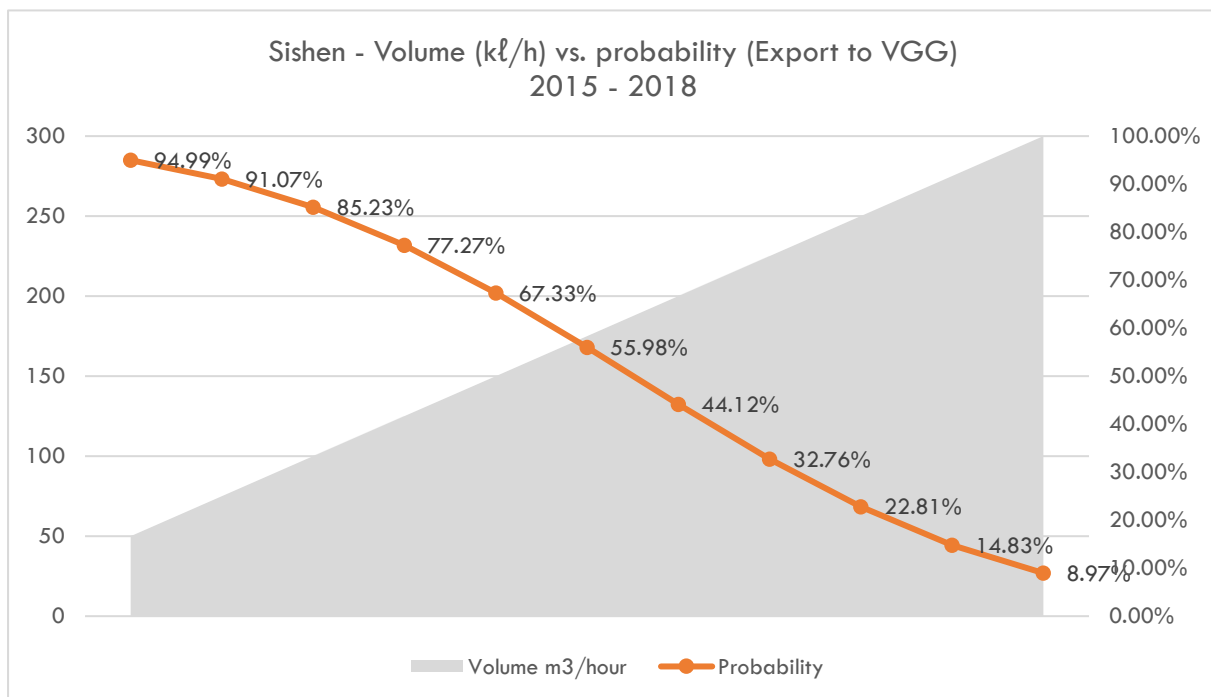


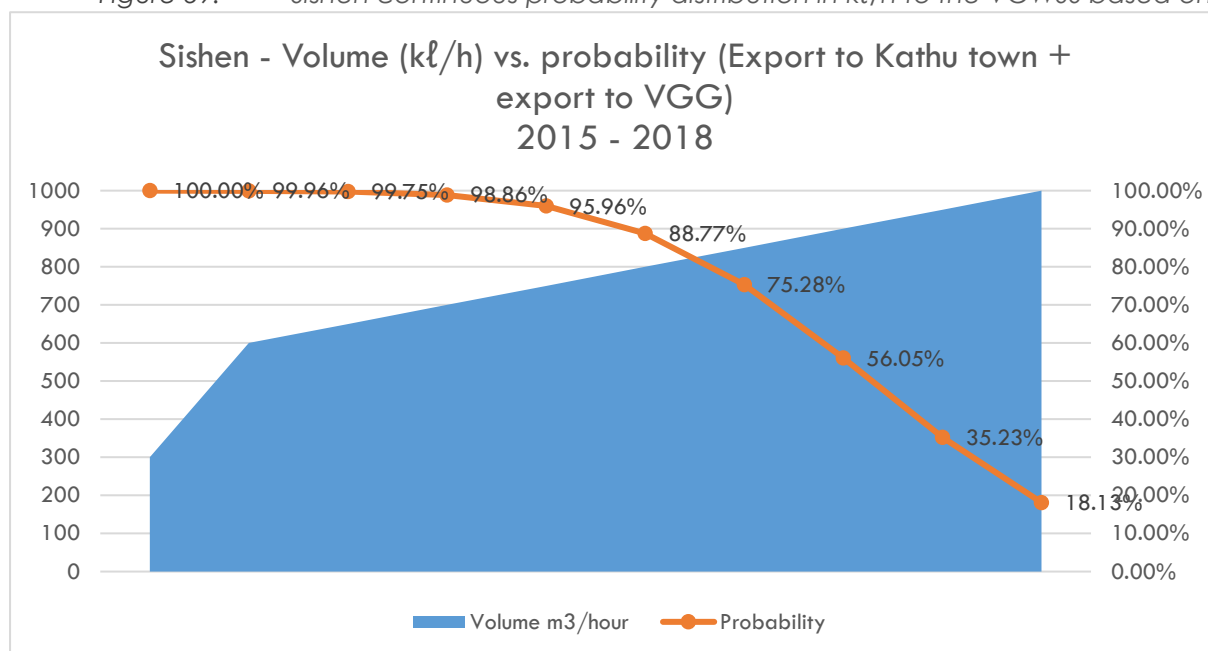
Figure 38. Sishen continuous probability distribution in kℓ/h to the VGWSS

The probability based on past supply data of Sishen to supply 100 kℓ/h (approximately 0.9 million kℓ/a on average) is 65%, which is more likely.

Should the WUL condition be implemented where the dewatering is supplied to the VGWSS first, the probability of supply at a rate of 300 kℓ/h increases from 9% to almost 100% (certain) as indicated in the graph below. This will, however, increase the water demand of the VGWSS as the dewatering portion of Kathu's demand will theoretically have to be supplied via the VGWSS. The VGWSS will 'receive' the dewatering water and supply it to Kathu town. The

dewatering volume will still be supplied by Sishen directly to Kathu on behalf of Sedibeng Water and it does form part of the volume of the main supply pipeline. This volume thus does not need to be included in the sizing/design of the scheme.

Figure 39. Sishen continuous probability distribution in kℓ/h to the VGWSS based on



supplying VGWSS first

Kolomela mine dewatering

As is the case with Sishen mine, Kolomela mine dewaterers to assure safe mining conditions. Kolomela utilizes the dewatering first for mining and supplies the remainder to Beeshoek mine and the VGWSS. An agreement has been signed with Sedibeng Water to supply Beeshoek mine with water on behalf of Kolomela mine to compensate for water lost because of dewatering impacts. The agreement allows for the supply of water at an average rate of 320 m³/h to Beeshoek mine and Kolomela pays an administrative fee to Sedibeng for the supply of this water.¹⁵⁰ Their WUL agreement with DWS details:¹⁵¹

"The Licensee is authorized to remove a total of seventeen million cubic meters per annum (17,000,000 m³/a) of water found underground from the 14 boreholes at an average of forty-three thousand four hundred and seventy cubic meter per day (43,470 m³/d) for disposal into the Vaal Gamagara Pipeline."

This relates to an average supply rate of 1 900 to 1 811 kℓ/h to the VGWSS. However, the historical dewatering rates, supplied by Kolomela mine, are much less than the rate noted in the WUL. The historic supply rates are indicated in table below. The average supply rate to the VGWSS over the past four years is 1 070 kℓ/h. This could be due to capacity limitations of the VGWSS since Kolomela is allowed, via their WUL, to artificial recharge aquifers with the excess dewatering water.

¹⁵⁰ Letter dated 28 November 2012 – Water supplied through Sedibeng Water on behalf of Kolomela mine

¹⁵¹ DWS. Licence in terms of Chapter 4 of the National Water Act 1998. Licence number 10/A738/ABCGIJ/2774. Date: 1 Dec 2014. Appendix VI.

From the total dewatering, 50% to 65% is supplied to the VGWSS and the rest is distributed to Kolomela and Beeshoek mines at 25% to 16% respectively.

Table 31. Dewatering volumes for Kolomela mine in kℓ/a¹⁵²

Year	Total volume	Kolomela Use	Beeshoek mine	VGWSS
2015	17 094 966	5 369 138	2 764 800	8 961 028
2016	15 173 849	2 466 943	2 764 800	9 942 106
2017	15 996 372	2 344 682	2 764 800	10 886 890
2018	13 001 250	2 512 911	2 764 800	7 723 539

The dewatering volumes from Kolomela do not fluctuate as much as the supply rates of Sishen. A minimum of 728 kℓ/h was recorded, whilst the average per month is 1 103 kℓ/h and the maximum is 1 482 kℓ/h.

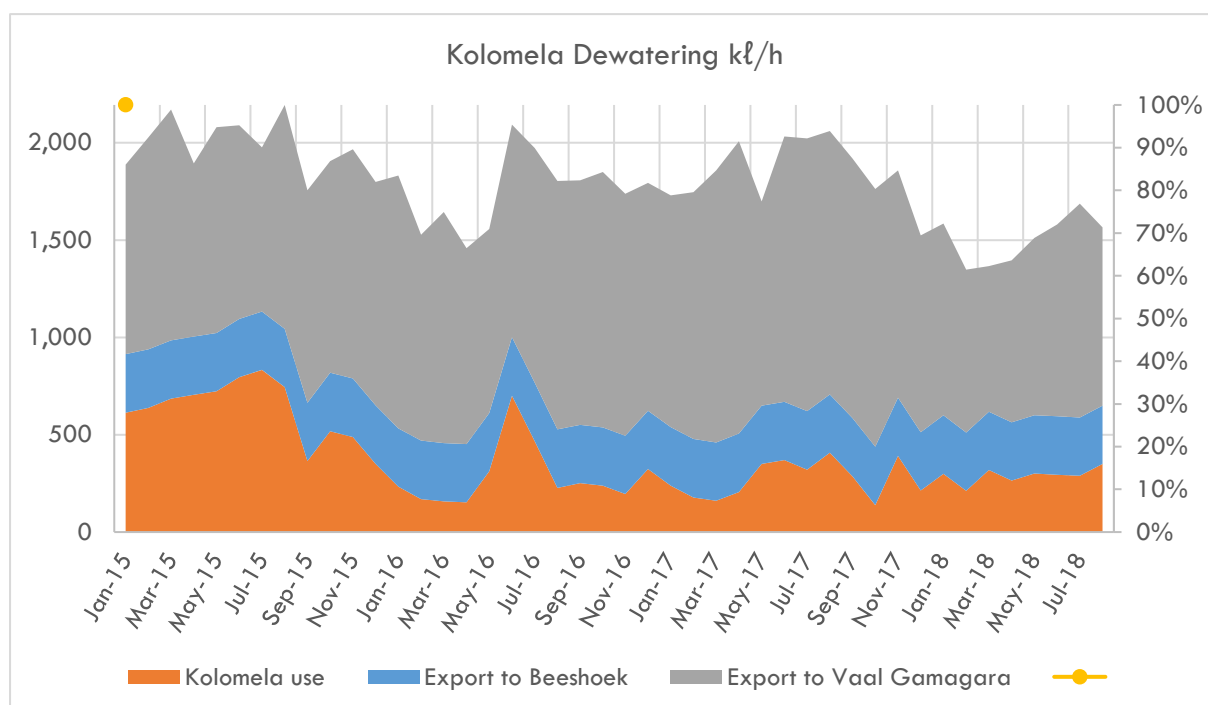


Figure 40. Kolomela dewatering volumes in kℓ/h

The continuous probability distribution analysis of Kolomela dewatering supply is indicated in the chart below, and the probability for Kolomela to supply 750 kℓ/h (6.57 million kℓ/a) is 98.3% and at 1 200 kℓ/h (10,5 million kℓ/a) is 33%.

¹⁵² Note: the volumes from September 2018 to December 2018 were assumed on the average for the year.

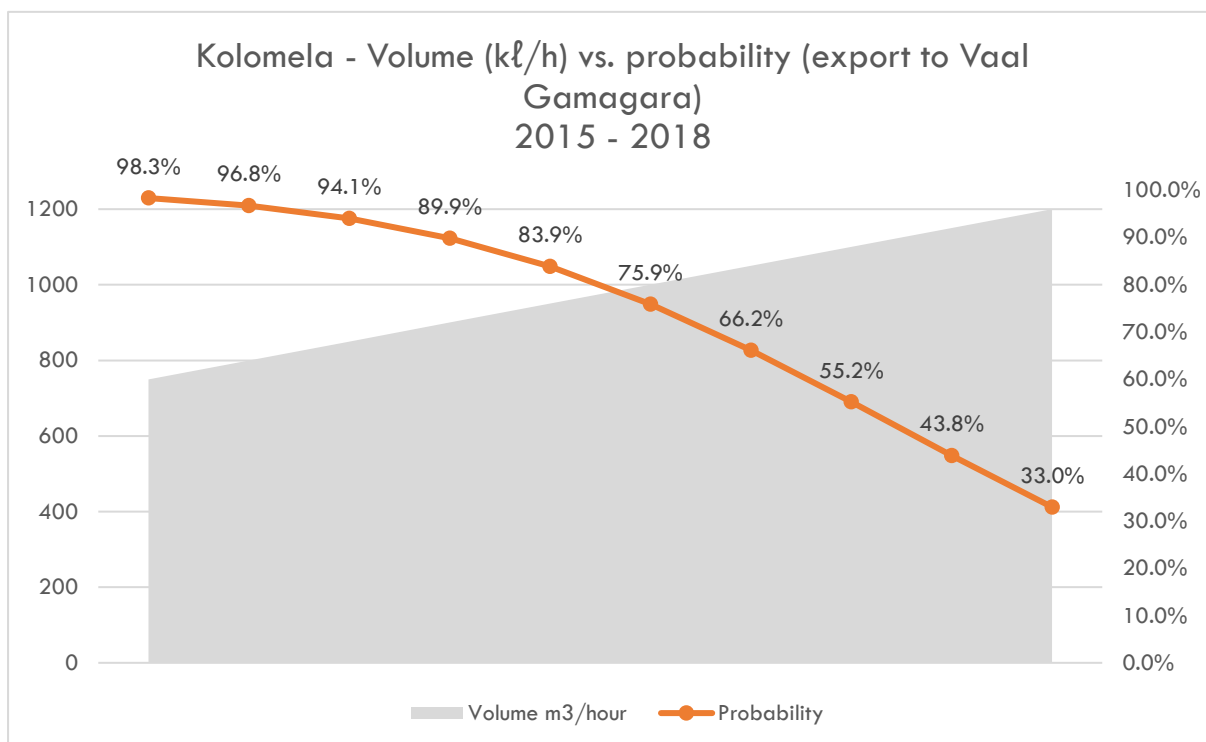


Figure 41. Kolomela continuous probability distribution in kl/h

Water sources summary

The total water production for the 2017/18 financial year of Sedibeng Water is shown in the chart below. The water source distribution during the given year was 33% from the Vaal River, 59% from Kolomela dewatering and 8% from Sishen dewatering.

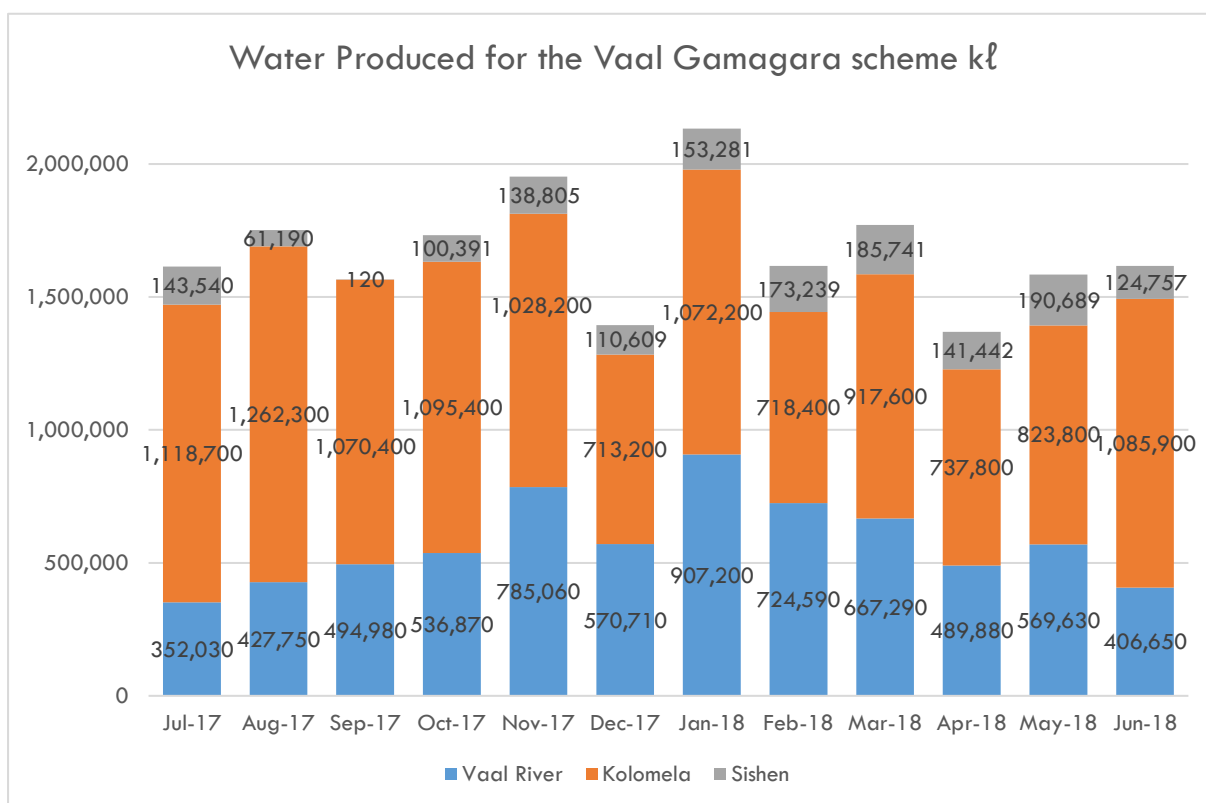


Figure 42. Water production 2017/18 in kl per month

8 WATER BALANCE

An analysis of the availability and sustainability of the water sources and a quantification of the future water demand projections is combined in this section by means of the water balance. The consider water sources include the Vaal River via the water treatment plant, SD groundwater sources to be equipped and the dewatering volumes from Kolomela and Sishen mines.

The water demand projections for 2038 to 2043 are indicated in the table below. The scheme needs to supply 28.4 million kℓ/a on average to the different user groups with the mines using the most water.

Table 32. Future water demand projections 2038-2043 by user group

	Water use sectors	2038-2043 in kℓ/a	% distribution
Economic	Mine and Industry	15 822 578	55.8%
	Solar Plants	448 500	1.6%
	Subtotal	16 271 078	57.4%
Social	Municipality	8 020 030	28.3%
	Gov & parastatals	4 034 396	14.2%
	Agriculture	37 080	0.1%
	Subtotal	12 091 506	42.6%
TOTAL		28 362 584	100.0%

For the SD groundwater sources, a sustainable long-term yield as well as a long- and short-term combined yield are presented. However, for planning purposes, only the sustainable long-term yield will be considered.

Table 33. SD groundwater sustainable yield

	Long term	Long and short term
SD1	5 329 584	6 643 584
SD2	3 689 712	5 497 776
SD4	2 181 240	2 181 240
TOTAL	11 200 536	14 322 600

The sustainability of the dewatering sources of Sishen and Kolomela mines is difficult to quantify since the mines dewater not to supply but for safe mining. Should a probability of 98% of supply be required for future design, the Sishen supply would be less than 400 000 kℓ/a and Kolomela approximately 6.57 million kℓ/a. However, the WUL requires Sishen to supply on average 2.628 million kℓ and Kolomela 15.86 million kℓ/a to the VGWSS respectively. Both these yield scenarios are analysed.

The maximum volume water from the Vaal River is assumed at the capacity of the water treatment plant which is 13.27 million kℓ/a.

8.1 Systems description

The VGWSS system is analysed according to the proposed future layout of the scheme as illustrated in schematic presentations below. The analysis is conducted on an average system supply and demand levels and a detailed analysis is required for the design phases.

The analysis does not consider the condition of the scheme which requires refurbishment as recommended in previous assessments. Note should be taken that the system capacity could be reduced and become redundant soon given the age of the scheme.

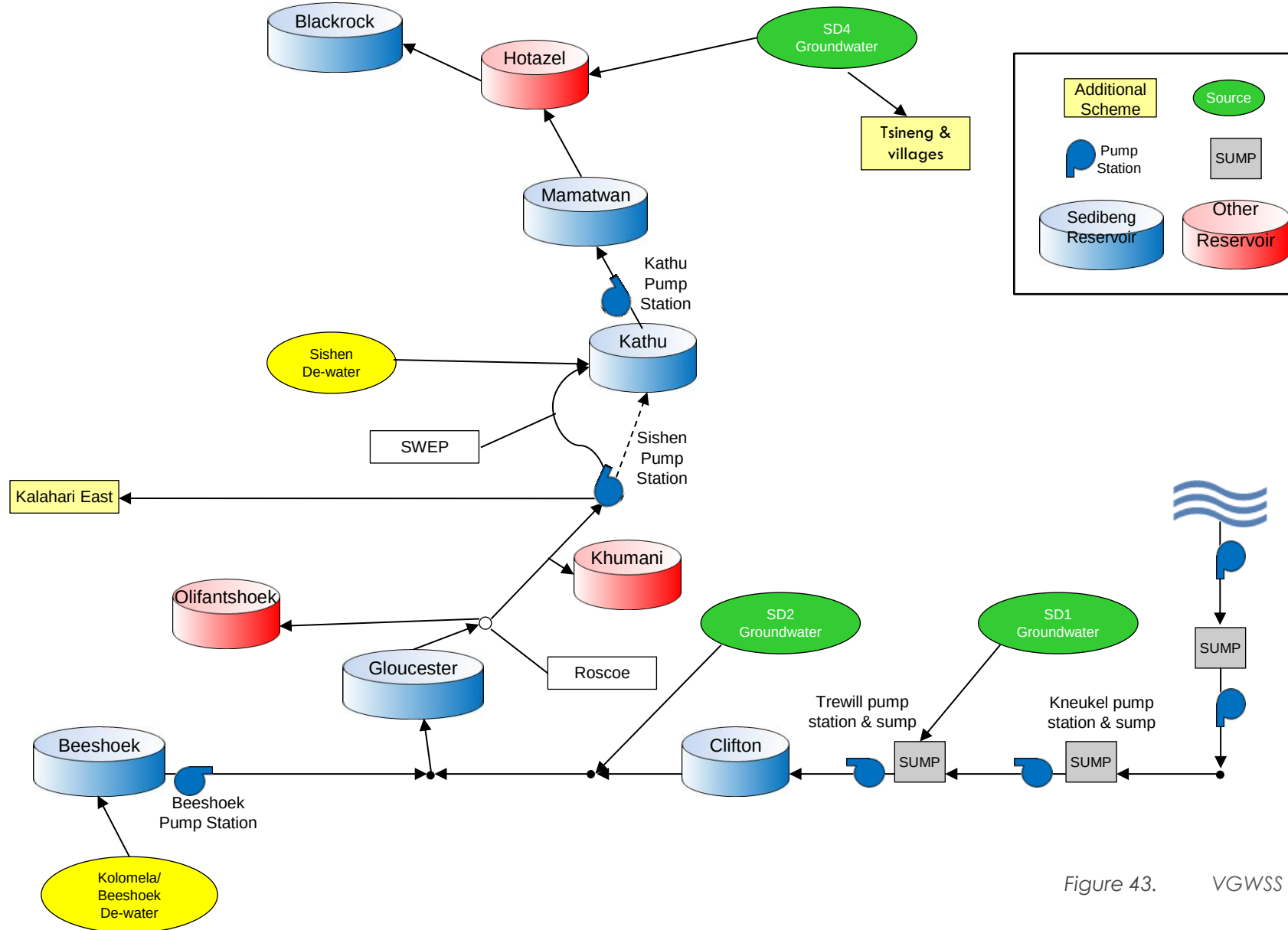


Figure 43. VGWSS scheme layout

For the water balance analysis, the scheme was divided into three subsystems namely:

- Subsystem 1: Vaal Gamagara water treatment plant to Groenwater
- Subsystem 2: Beeshoek pump station to Kathu reservoir and pump station
- Subsystem 3: Kathu reservoir and pump station to Blackrock

The systems are analysed for the proposed future demand projections against the available sources within the given system.

System 1 – Vaal River to Groenwater

Subsystem 1 is from the water treatment plant at Delportshoop to Groenwater (just to before Postmasburg). This system consists of a rising main line with the main pumps at the water treatment plant, two booster pumps stations at Kneukel and Trewill up to Clifton reservoir, and a gravity line to Postmasburg.

Water sources

The current capacity of the water treatment plant is 13.27 million kℓ/a which is abstracted from the Vaal River near Delportshoop.

It is assumed that the Vaal River water will remain the primary source of the current and future water supply in this system. The SD1 groundwater source, once developed will augment the Vaal River water and it is expected that this water will be injected into the system before or at the Clifton reservoir to be utilized downstream of this reservoir.

Water demand profile

The anticipated water demand in this system is 5.7 million kℓ/a with Petra Diamonds (4.0 million kℓ/a) being the largest user and Longlands & Delportshoop (1.13 million kℓ/a) the second largest. Longlands & Delportshoop are east of the main scheme and can only be supplied by means of the water from the WTW.

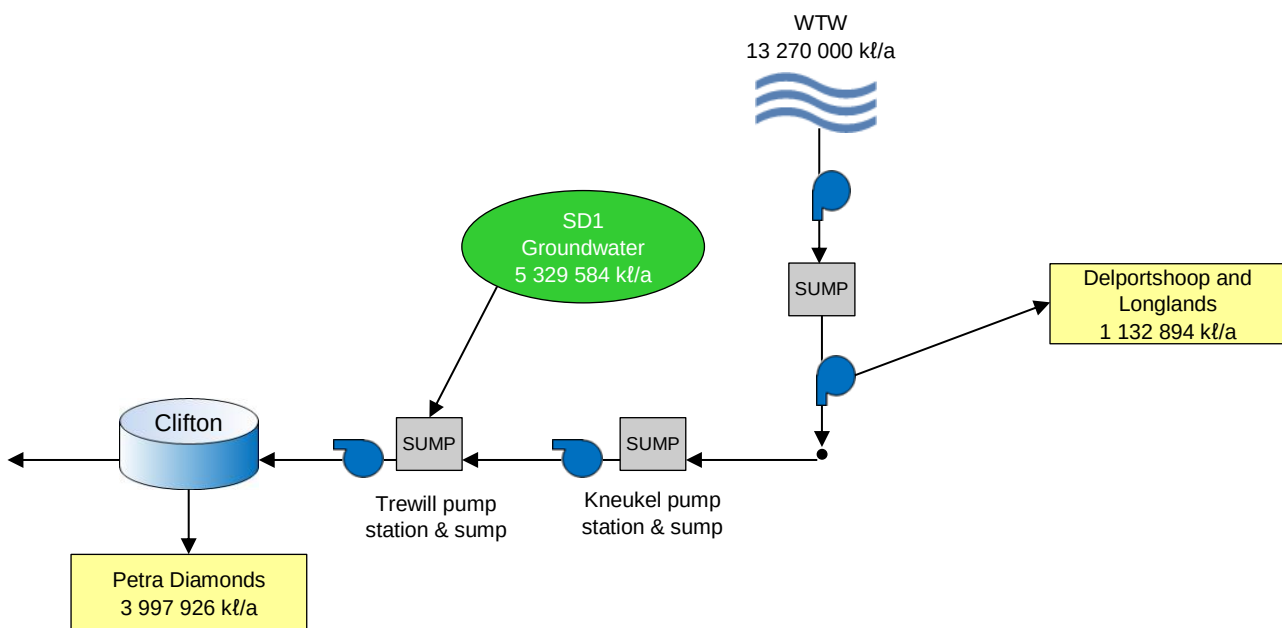


Figure 44. System 1

Infrastructure

The water abstracted from the Vaal River is purified at Sedibeng Water's treatment near Delportshoop. From the water treatment plant, water is pumped via a 20 km long 687 mm diameter pipeline to the Kneukel sump and pump station from where it is pumped via a 48.7 km long 687 mm diameter pipeline to the Trewill sump and pump station. From the Trewill pump station the water is pumped in two 29.45 km long parallel pipelines, a 508 mm and a 355 mm diameter pipeline, to the Clifton reservoir. The Koopmansfontein off-take length is 6.5 km of 110 mm diameter pipe. Water is supplied to Delportshoop and Longlands via a 20 km 355 mm pipe line in the opposite direction from the main scheme.

A 10 Mℓ WTW reservoir serves as a sump for the Vaal Gamagara pump station. The main reservoir cluster is at Clifton, located 98 km from Delportshoop along the pipeline, where four identical structures provide a total storage of 27 Mℓ. Identical 0.9 Mℓ sumps are located at Kneukel and at Trewill pump stations.

The main pump stations supplying the Clifton reservoir are located at the water treatment plant near Delportshoop, at Kneukel 20 km along the pipeline and at Trewill a further 48.7 km along the pipeline, each with three pumps, one of which is a standby. From the Clifton reservoir water is conveyed in a 36.6 km long 762 mm diameter and 23.5 km long 660 mm diameter pipeline to Gloucester reservoir under gravity.

System 2 – Postmasburg to Kathu

Subsystem 2 comprises the gravity line from Clifton reservoir, the pump line from the stage two pumps at Beeshoek, the pipeline to Gloucester reservoir and the gravity feed line to Kathu reservoir located at the Kathu booster pump station.

These components are included in a single subsystem because the system will initially either be supplied by the stage 2 Beeshoek pumps or be gravity fed with Vaal River water from the Clifton reservoirs. A further potential source to be developed is the ground water source SD2.

Water sources

The dewatering water at both Kolomela and Sishen will be utilized in this system with the possible addition of the SD2 groundwater source. These sources will be augmented by "spill over" water from System 1 comprising of the Vaal River water and SD1.

Water demand profile

This system has the largest future water demand amounting to 18.22 million kℓ/a for 2043. The largest water users are Khumani mine (5.98 million kℓ/a), Kalahari East WUA (3.54 million kℓ/a), and the towns of Postmasburg (2.73 million kℓ/a), Kathu (1.74 million kℓ/a), and Beeshoek Mine (1.67 million kℓ/a).

The Beeshoek mine's demand is included as a demand from the system although it is being supplied by means of Kolomela dewatering on behalf of Sedibeng Water.

Infrastructure

Vaal River water is conveyed from Clifton reservoir in a 36.6 km long 762 mm diameter and 23.5 km long 660 mm diameter pipeline to Gloucester reservoir under gravity. The Gloucester reservoir serves as a pressure break tank. From Gloucester water is conveyed under gravity to the rest of the system, initially through a 27.1 km long 900 mm pipeline up to the Olifantshoek branch, then a 14.1 km long section of 508 mm diameter pipeline and a 15.9 km section of 700 mm diameter pipeline up to Kathu (this section is currently being upgraded). A 23.5 km

long 254 mm diameter pipeline serves Olifantshoek from a connection on the main line at Roscoe.

The existing supply from Beeshoek is via a 7.2 km long 435 mm diameter pipeline that connects to the main pipeline at Postmasburg. This system was recently upgraded with a new pump station and 650 mm diameter supply line. Pressure control is applied in the main line upstream of the connection point. Pressure control is applied at four points on the main pipeline. Approximately 3.3 km upstream of the Beeshoek pump line connection to the main line a PRV with setting 110 m reduces the pressure to avoid the Beeshoek pumps having to pump at the static head provided by the Clifton reservoir level. The Gloucester reservoir with a capacity of 6.75 Ml is located a 60 km from the Clifton reservoirs.

External pump stations that affect the operation of the scheme are located at Beeshoek that supply groundwater into the main pipeline and the Kalahari East pumps that extract directly from the main pipeline. The recently upgraded Beeshoek pump station can deliver up to 1 800 kℓ per hour to Gloucester reservoir at a point on the main pipeline located 23.5 km upstream of the reservoir.

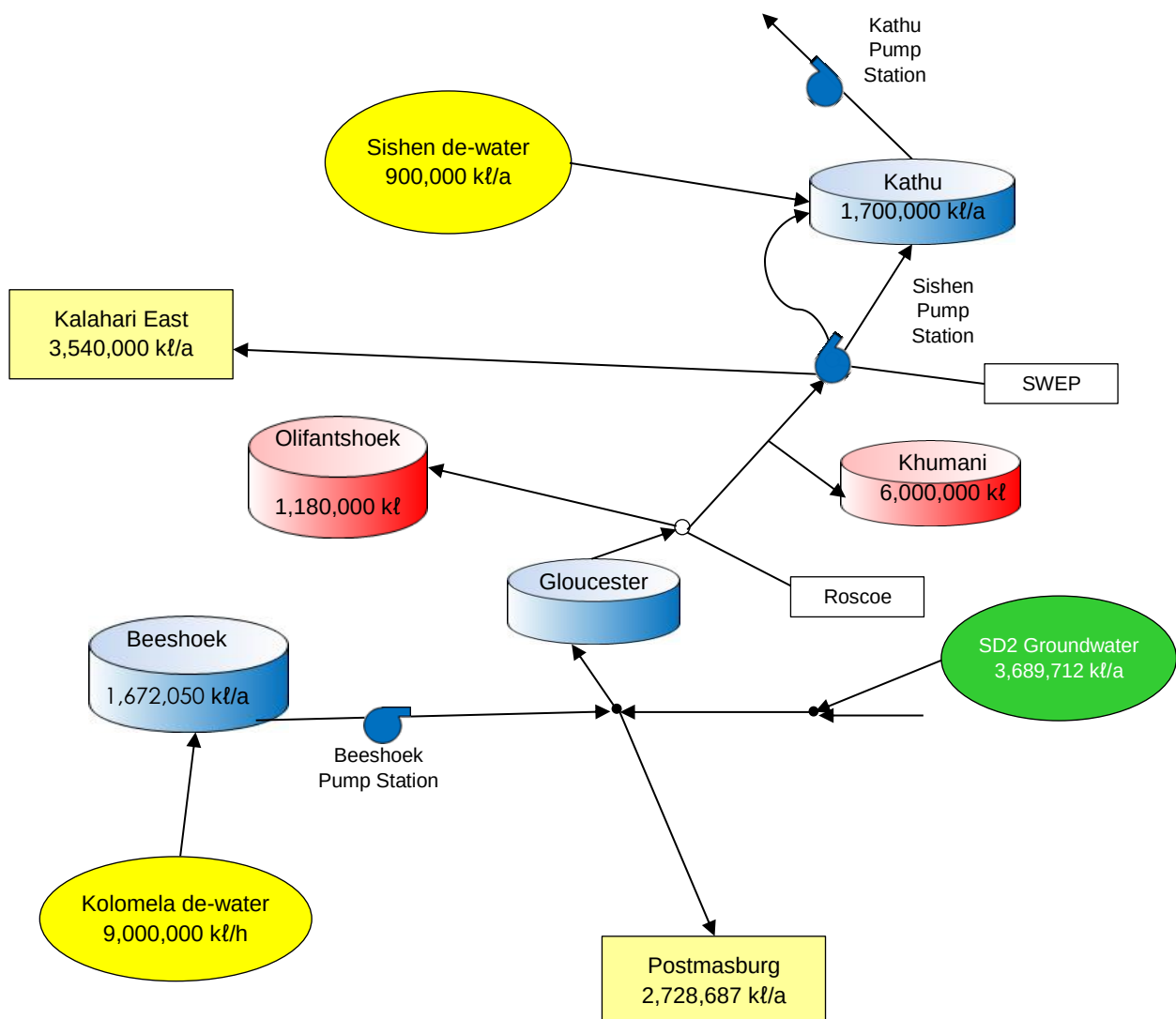


Figure 45. System 2

System 3 – Kathu to Black Rock

Subsystem 3 is the most northerly existing system, which has its origin at Kathu pump station and ends at the reservoir in Blackrock.

Water sources

This system is supplied by means the water from the previous two systems as well as the possible supply from the SD4 well field north of Hotazel.

Water demand profile

The estimated 2043 water demand for this system is 5.24 million kℓ/a. The Black Rock Mining Operations (Assmang's Nchwaning & Gloria Mines) with a future demand of 1.32 million kℓ/a, Kalagadi Manganese (0.9 million kℓ/a) and Hotazel (0.768 million kℓ/a) are expected to be the largest users.

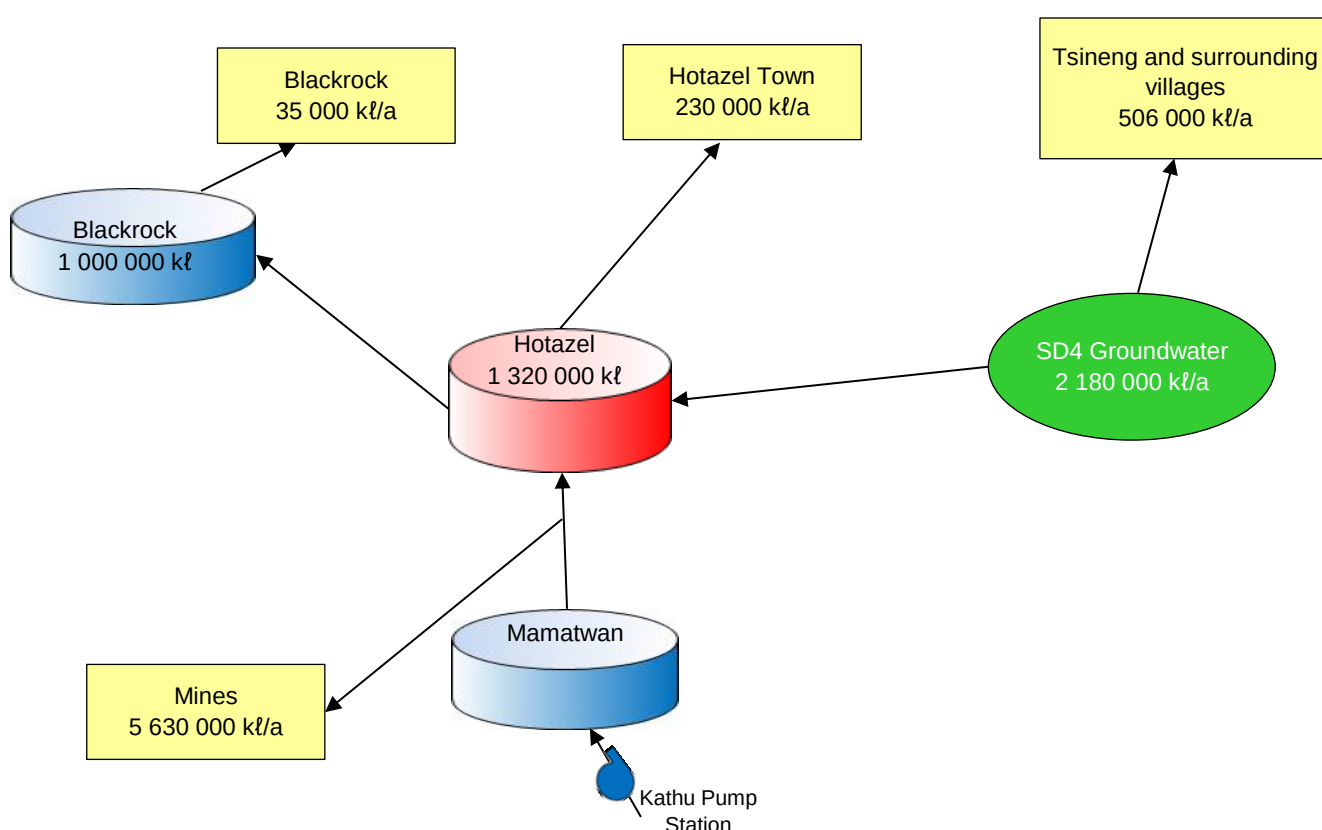


Figure 46. System 3

Infrastructure

From Kathu the supply to Hotazel is via a 52.2 km long 324 mm diameter pipeline. From Hotazel to Blackrock it is a 14.7 km 305 mm diameter pipeline with an additional 220 mm diameter pipeline in parallel. Note that this section is being upgraded.

Booster pump facilities are located at Kathu and Mamatwan, both currently out of commission. The Kathu facility is to be re-commissioned.

The Sishen pump station delivers directly into the main pipeline that passes the mine. This pump station is to be decommissioned with a new pumping facility to be established to deliver the Sishen groundwater through the Kathu supply line.

Approximately 4.5 km south of the existing Sishen pump station a PRV with setting 65 m reduces the pressure against which the Sishen pumps must operate. The pressure against which the Kathu pumps must operate is reduced by a PRV with setting 65 m directly upstream of the pump station. The northernmost section of the scheme is protected against excessive static pressure by a PRV with setting 60 m directly north of the connection to Hotazel. At the latter three PRV locations, pressure sustaining is applied directly upstream.

The 4.4 Mℓ Kathu reservoir serves as a sump for the Kathu booster pump station, which is currently not in operation, but in the process of being commissioned again.

An external pump station that affects the operation of the scheme is located at Sishen, supplying groundwater into the main pipeline. The Sishen pump station delivers up to 150 kℓ/h directly into the main pipeline at a point located approximately 15.9 km upstream of the Kathu take-off along the pipeline. The section of the pipeline between this point and Kathu as well as the pump station are currently planned to be relocated to accommodate mining activities, with a new delivery point located on the supply line to Kathu.

The 4.56 Mℓ Mamatwan reservoir is used as a sump for the Mamatwan booster pump station, currently not in commission. The 2.5 Mℓ Black Rock reservoir is located at the northernmost point of the scheme.

8.2 Water balance

Water demand projections per system are given in the tables below. The water demand was compared to the source to compile water demands per system.

Table 34. Water demand – System 1

	2018-2023	2023-2028	2028-2033	2033-2038	2038-2043
Municipality	916 382	1 045 756	1 170 112	1 282 844	1 377 323
Mine and Industry	3 997 926	3 997 926	3 997 926	3 997 926	3 997 926
Solar Plants	282 000	282 000	282 000	282 000	282 000
Gov & parastatals	12 577	12 577	12 577	12 577	12 577
Agriculture	12 551	12 551	12 551	12 551	12 551
TOTAL	5 221 436	5 350 811	5 475 167	5 587 899	5 682 377

Table 35. Water demand - System 2

	2018-2023	2023-2028	2028-2033	2033-2038	2038-2043
Municipality	3 188 639	3 790 789	4 426 919	5 078 544	5 723 689
Mine and Industry	7 692 801	8 513 384	8 513 384	8 513 384	8 513 384
Solar Plants					
Gov & parastatals	481 819	481 819	481 819	481 819	481 819
KEWUA	3 250 000	3 300 000	3 540 000	3 540 000	3 540 000
TOTAL	14 613 258	16 085 992	16 962 122	17 613 747	18 258 892

Table 36. Water demand - System 3

	2018-2023	2023-2028	2028-2033	2033-2038	2038-2043
Municipality	991 639	882 855	898 995	911 267	919 019
Mine and Industry	4 057 848	3 311 267	3 311 267	3 311 267	3 311 267
Solar Plants	166 500	166 500	166 500	166 500	166 500
Gov & parastatals					
Agriculture	24 529	24 529	24 529	24 529	24 529
TOTAL	5 240 516	4 385 151	4 401 292	4 413 564	4 421 315

Scenario 1

Scenario 1 looked at the minimum SD ground water required to meet the water demand, hence reliant on the maximum capacity of the water treatment plant and the mine dewatering. The following assumptions are applicable:

- Water treatment plant operates at capacity of 13.27 million kℓ/a if required
- Kolomela supplies 9.0 million kℓ/a (75% probability) to the VGWSS
- Sishen supplies 2.63 million kℓ/a (as per WUL) to the VGWSS

Table 37. Scenario 1: SD sources minimum

	2018 - 2023	2023-2028	2028-2033	2033-2038	2038-2043
System 1 demand	5 221 436	5 350 811	5 211 788	5 211 788	5 211 788
Water treatment plant SD1	13 270 000	13 270 000	13 270 000	13 270 000	13 270 000
System 2 demand	12 852 125	14 413 942	15 290 072	15 941 697	16 586 841
Spill-over from previous system	6 462 641	7 093 308	7 969 439	8 058 212	8 058 212
Kolomela dewatering	9 000 000	9 000 000	9 000 000	9 000 000	9 000 000
Sishen dewatering SD2	1 044 077	1 804 119	2 541 227	2 630 000	2 630 000
System 3 demand	5 240 516	4 309 367	4 309 367	4 309 367	4 309 367
Spill-over from previous system SD4	5 240 516	4 309 367	4 309 367	3 746 515	3 101 370
				562 851	1 207 996
SURPLUS (should be 0)	0	0	0	0	0

In this scenario, little SD sources are required initially. The system only requires SD4 water from 2033 onwards, at 0.56 million kℓ/a and gradually increasing to 1.21 million kℓ/a until year 2043. This scenario has the lowest water supply reliability from a source point of view since the probability of the dewatering is 42% (not considering the probability that the other sources will be unable to supply the required volume).

This scenario illustrates the situation of the VGWSS should the SD sources not be developed, and the capacity of water treatment plant not increased. Basically, operated as current with high dependence on the dewatering to cater for the growth in future demand.

Scenario 2

Scenario 2 limits the dewatering as a source. The scheme is mostly reliant on the water treatment plant and the SD groundwater sources. The assumptions are:

- Water treatment plant operates at a capacity of 13.27 million kℓ/a if required
- All three SD groundwater sources are in operation in 2023
- Dewatering supplements the Vaal River and SD groundwater sources

This scenario is the most reliable for supplying the required water demand because the minimum amount of dewatering is used. However, until the SD groundwater is in operation, the dewatering is utilized. The volume of dewatering required from 2023 onwards, when SD sources are expected to be in operation, has a high probability of supply (98%), in contrast to a 78% probability for the period 2018 to 2023. In the event the dewatering fails completely, the other sources (water treatment plant and SD) would be able to supply at least 92% of the 2043 VGWSS's demand.

Table 38. Scenario 2: Dewatering minimum

	2018 – 2023	2023-2028	2028-2033	2033-2038	2038-2043
System 1 demand	5 221 436	5 350 811	5 475 167	5 587 899	5 682 377
Water treatment plant SD1	13 270 000	12 950 607 5 329 584	13 270 000 5 329 584	13 270 000 5 329 584	13 270 000 5 329 584
System 2 demand	12 852 125	14 413 942	15 290 072	15 941 697	16 586 841
Spill-over from previous system	6 893 345	12 929 380	13 124 417	13 011 685	12 917 207
Kolomela dewatering	9 144 077		397 234	1 173 863	1 321 238
Sishen dewatering SD2	900 000	3 689 712	300 000 3 689 712	300 000 3 689 712	900 000 3 689 712
System 3 demand	5 240 516	4 385 151	4 401 292	4 413 564	4 421 315
Spill-over from previous system SD4	5 240 516	2 205 151 2 180 000	2 221 291 2 180 000	2 233 564 2 180 000	2 241 315 2 180 000
SURPLUS (should be 0)	0	0	0	0	0

This scenario, on the contrary, illustrates that with the development of the SD source, little dewatering is required which bring about a more stable scheme than that describe in scenario 1. Without the upgrading of the water treatment plant, dewatering will still have to be utilized but on a much higher probability of supply.

Scenario 3

Scenario 3 is the most likely way the sources would be utilized. The assumptions are:

- Implement SD sources to be in operation by: SD4 in 2023, SD2 in 2028 and SD3 in 2033
- Surety of supply of the dewatering to be higher than 98% when SD sources are operational
- Minimum yield from the water treatment works of approximately 1.3 million kℓ/a to supply users downstream from SD1

Table 39. Scenario 3: Most likely

	2018 - 2023	2023-2028	2028-2033	2033-2038	2038-2043
System 1 demand	5 221 436	5 350 811	5 475 167	5 587 899	5 682 377
Water treatment plant SD1	13 270 000	13 095 941	13 095 941	8 945 913 5 329 584	9 693 288 5 329 584
System 2 demand	12 852 125	14 413 942	15 290 072	15 941 697	16 586 841
Spill-over from previous system	8 048 564	7 745 130	7 620 774	8 687 598	9 340 495
Kolomela dewatering	9 144 077	7 973 962	5 300 877	4 897 950	4 897 950
Sishen dewatering SD2	900 000	900 000	900 000 3 689 712	900 000 3 689 712	900 000 3 689 712
System 3 demand	5 240 516	4 385 151	4 401 292	4 413 564	4 421 315
Spill-over from previous system SD4	5 240 516	2 205 151 2 180 000	2 221 291 2 180 000	2 233 564 2 180 000	2 241 315 2 180 000
SURPLUS (should be 0)	0	0	0	0	0

The use of the dewatering is decreased as the SD groundwater sources become operational. Except for the period 2018 – 2023, the probability of supply of the dewatering is 98%. The graph below illustrates Scenario 3.

This scenario is likely the manner the scheme would be operated. The phasing of the SD developments is also more probable than as was assumed with scenario 2 where all the SD sources should be operational by 2023. The Vaal River water and the dewatering water can supplement each other for example as more dewatering is available, less Vaal River and/or SD groundwater is needed.

The reason for reducing the Vaal River water volume is to take advantage of utilizing cheaper water closer to the demand first and then to augment with the more expensive Vaal River water.

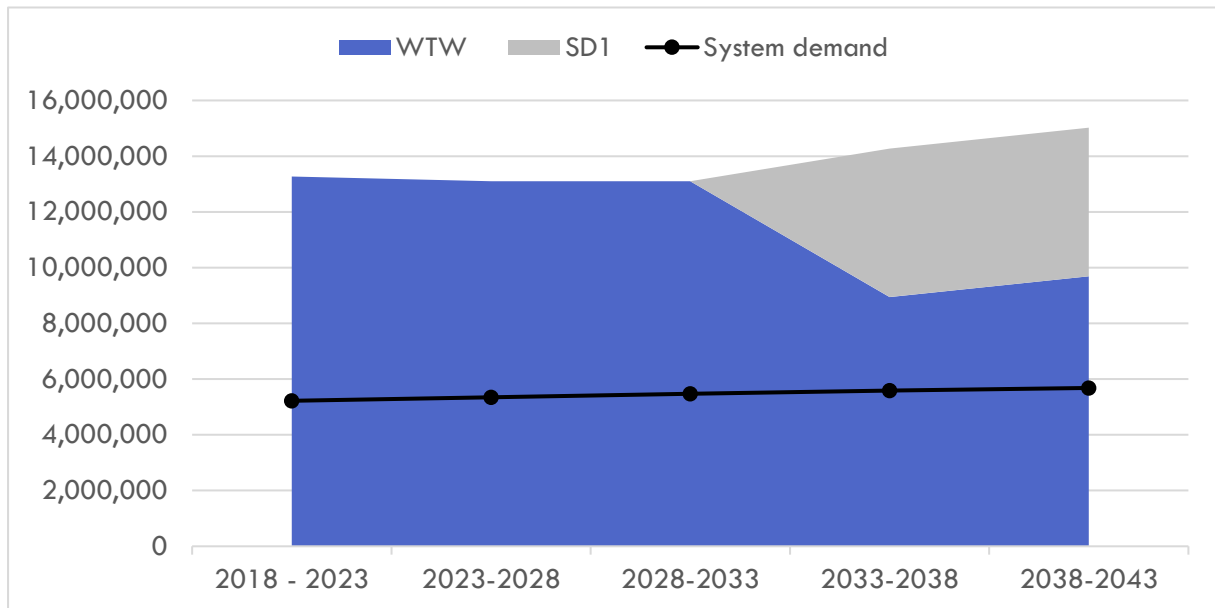


Figure 47. Scenario 3 - System 1 in kℓ/a

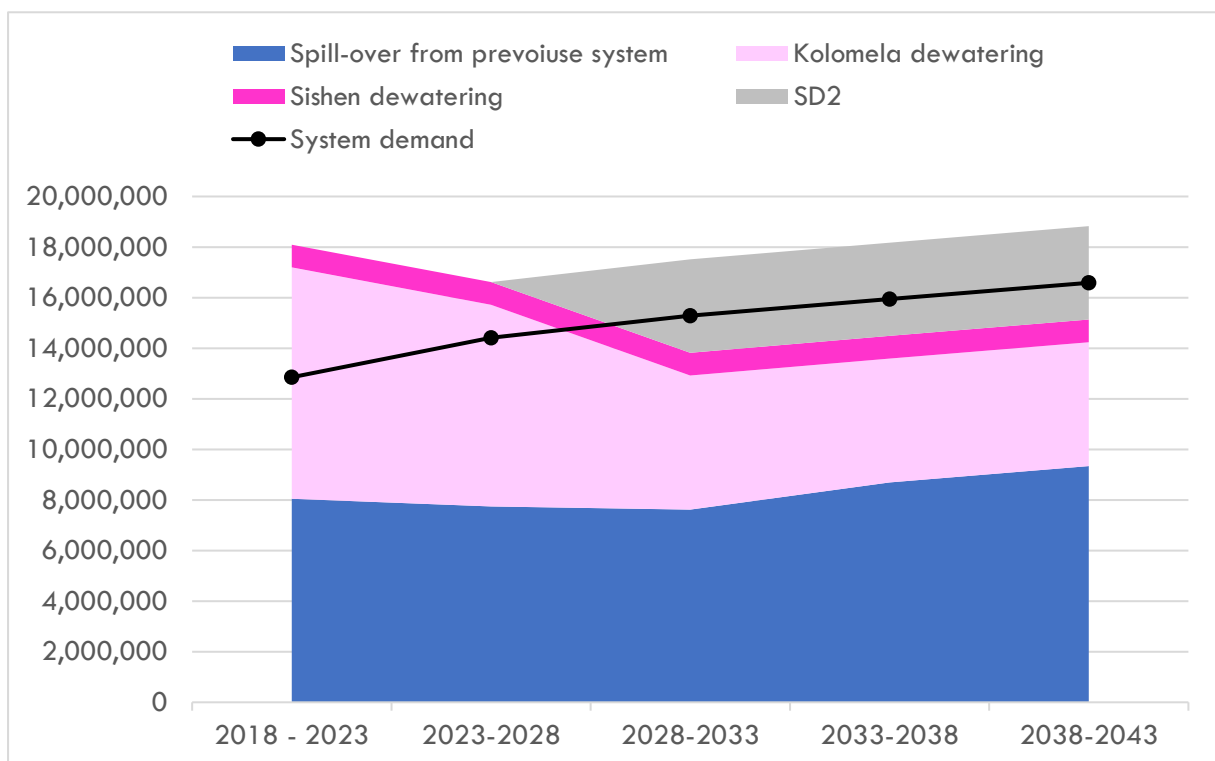


Figure 48. Scenario 3 - System 2 in kℓ/a

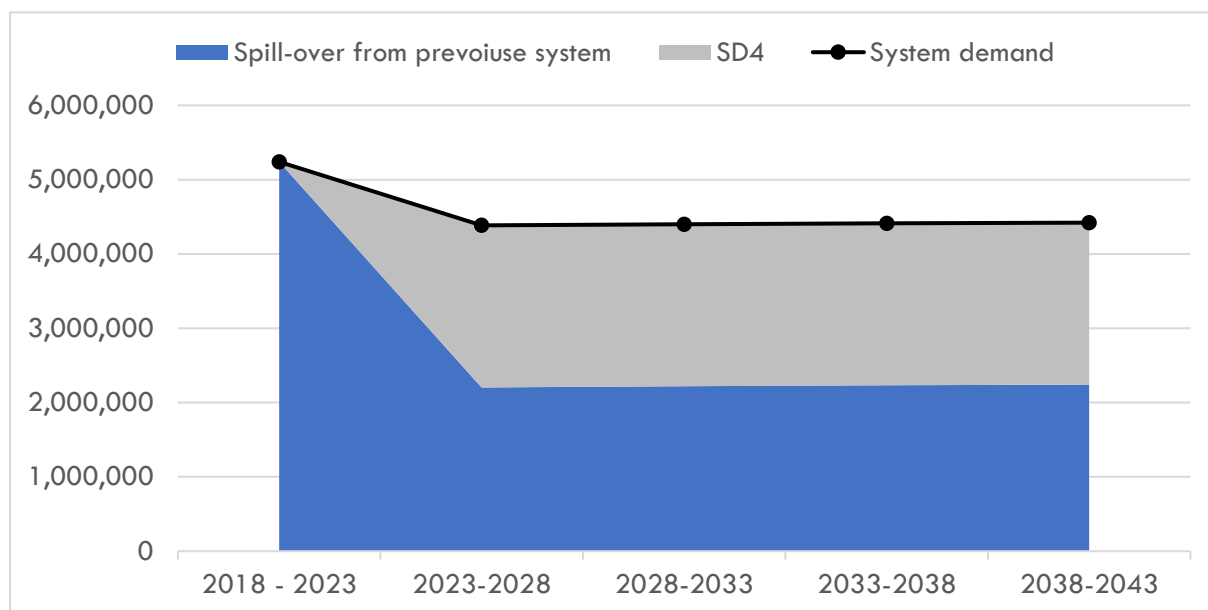


Figure 49. Scenario 3 – System 3 in kℓ/a

9 CONCLUSION

The population in the study area is estimated to reach about 223 244 people by 2043, with an average annual growth rate of 2.59% from 2018 onwards. This almost doubles the population in 25 years. However, not all the settlements served along the pipeline are expected to grow at the same rate. Towns that have strong mining economies such as Kathu, Postmasburg, and Hotazel are likely to have of the highest growth rates, as well as Groenwater which is the preferred place of residence of those working at nearby solar plants. Delportshoop/Longlands, Vaalgamagara, and the Tsineng area settlements are likely to have stable populations with relative lack of factors to attract and retain economically active persons, unlike the mining towns.

Water consumption patterns among the settlements solely dependent on a water supply from the VGWSS vary between 138 l/c/d at Delportshoop to over 700 l/c/d at Hotazel. Thus, for the purposes of the study per capita use of 150 l/c/d was selected to project water demands to 2043. Some towns supplement water from the VGWSS with own boreholes and taking this into account, it is estimated that the municipalities will require 8.02 million kℓ/a from the VGWSS by 2038. Estimates for other users are: mines 15.8 million kℓ/a, solar plants 0.5 million kℓ/a, and Kalahari East WUA, government, parastatal entities another 4 million kℓ/a. Thus, the VGWSS's current water supply of 20 million kℓ/a is estimated to increase to approximately 26,7 million kℓ/a in 2043. This excludes distribution losses, peak factors and new users.

Table 40. *Future water demand projections 2038-2043 by user group*

	Water use sectors	2038-2043 in kℓ/a	% distribution
Economic	Mine and Industry	15 822 578	55.8%
	Solar Plants	448 500	1.6%
	Subtotal	16 271 078	57.4%
Social	Municipality	8 020 030	28.3%
	Gov & parastatals	4 034 396	14.2%
	Agriculture	37 080	0.1%
	Subtotal	12 091 506	42.6%
TOTAL		28 362 584	100.0%

According to the holistic water balance overview, the scheme should be able to meet, on average per annum, the future water demand provided dewatering water is obtainable on a similar manner as in the past, the SD groundwater sources are developed, and the water treatment plant is able to be operated at current capacity in the future.

Since the probability of supply of the dewatering sources is relatively low, the development and utilization of the SD groundwater sources is required to increase the total reliability of the scheme. In the unlikely event that the dewatering supply ceases(zero), the scheme should still be able to supply 92% of the 2043 demand with the SD groundwater and the Vaal River as sources.

Vaal Gamagara Water Supply Scheme



Updated demographics and water balance to 2043

Compiled for:

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Appendixes

28 November 2018

Content

A. MEETINGS HELD WITH MUNICIPALITIES	1
A.1 Gamagara Municipality	1
A.2 Joe Morolong Municipality.....	7
A.3 Tsantsabane Municipality	13
A.4 Dikgatlong Municipality	19
B. DWELLING COUNTS	24
B.1 Dwelling count data	24
B.2 Examples of dwelling counts.....	25
C. SOLAR PLANTS	28
<i>Solar plants with VGWSS supply.....</i>	<i>28</i>
<i>Solar plants with groundwater supply</i>	<i>30</i>
<i>Summary of water use at solar plants</i>	<i>32</i>

A. MEETINGS HELD WITH MUNICIPALITIES

Four meetings were held with local municipalities who supply water to towns and settlements along the pipeline route as follows:

- Gamagara on 4 October 2018
- Joe Morolong on 6 November 2018
- Tsantsabane on 6 November 2018
- Dikgatlong on 9 November 2018

Notes taken at these meetings and feedback from points arising are recorded below. These notes, together with the presentation, were distributed electronically to the above municipalities on 13 November 2018.

A.1 Gamagara Municipality

A meeting was held with Gamagara municipality on 4 October 2018 at 11:30 to discuss two iX/Worley Parsons projects relating to water supply:

- Vaal Gamagara water Supply Scheme (VGWSS) population and water demand estimates water demand, and water sources to update estimates for the design of Phase 2
- Sesheng Bulk Water Study - A clarification meeting to discuss the project needs and way forward

The notes below pertain only to the VGWSS part of the discussion.

Attendance

Name	Organization	Email	Telephone
Kagiso Ositang	Gamagara LM	ositangk@gamagara.co.za	0647576853
Gideon Olifant	Gamagara LM	olifantg@gamagara.co.za	0835974897
Gregory Kannemeyer	Gamagara LM	Kannemeyerg@gamagara.co.za	0797933200/0537236000
Ambrose Khumalo	iX engineers	ambrose.k@ixengineers.co.za	
Adeline Squires	Setplan	adeline@setplan.com	+27837010190

Presentation

Adeline presented population estimates to 2042, and current/future water demand and supply. Please find the presentation attached.

Comments and inputs from the Gamagara members

Population estimates

- Most of the Kathu area 27a occupied by shacks is a result of influx of people from outside Kathu e.g. from Joe Morolong, losing quite a lot of people, and from Ga-Segonyana. Joe Morolong loses people to Ga-Segonyana as well
- There are many renters, and there are also houses accommodating contractors with large numbers of people per dwelling
- Increasing demand for guest houses
- Continuous influx of people stimulated by solar projects
- Miners also live within a 50 km radius of Kathu including Kuruman which has appeal for those who prefer traditional living
- Dibeng is also preferred by some residents as a place to live and who commute to mines in the area

- Commuting takes place in taxis and buses provided by the mines, but most use own transport
- Mines offer employees an option of either accommodation or transport
- Past growth of 7.33% is too high to extrapolate into the future for Kathu
- Corridor study had one million people in the corridor by 2025

Key developments

- Kathu is an attractive place to migrate to because of the many amenities offered for example a private dual medium school operated by Curro with hostel facilities has recently opened which has a capacity for 1600 learners (about 50% filled in 2017). It caters for children from three months old up to grade 12. Other amenities in Kathu include the private hospital and the mall.
- Kathu Solar Plant has been built and another plant is being built near Dibeng at a cost of R18 million (more than the pipeline)
- Kuruman has little private land for expansion (mainly only municipal land) and has bulk infrastructure constraints unlike Kathu which has much private land on which to expand and Kathu plans for bulk supply expansions
- 10 warehouses being developed at the N14 circle on Bestwood side
- Approximately 1265 houses (low and medium income) at Area 27a (as per the Sesheng Bulk Water Supply study area layout drawing) are planned to be developed by HDA and approximately 5600 households are planned for Kathu North on land bought by CoGHSTA. A contractor has been appointed for the Area 27a and construction is planned to commence in November 2018.
- 117 stands developed in Olifantshoek
- Gamagara had 15 mines in 2012, but lost count now
- The possibility of a smelter is a very political issue affecting international interests; no smelter yet
- No water intensive projects that are known at this stage; developers only come to the municipality when they need water and electricity
- No SDF update of version 2010

Water sources and demand

- The municipality is planning on utilising the Khâi-Appel boreholes (two existing boreholes plus proposed three new boreholes) to supply the Sesheng BWS project via the EF Link Line. Borehole yields need to be confirmed and water demand analysis conducted.
- A service provider (Kimopax – Colin Monokofala) has been appointed by Gamagara to do geo-hydrological assessments for Sesheng and Olifantshoek. Three (3) additional boreholes at Khâi-Appel aquifer were proposed for assessment. Two are currently operational at Khâi-Appel.
- Sedibeng is currently supplying less than the agreed amount to Olifantshoek. It is hoped that at least 45% of demand will be provided by boreholes in future. Plan for a borehole/VGG supply of 50/50 mix. These boreholes are very deep > 100m. No geohydrology report available, but it may be possible to meet 100% of the demand.
- Olifantshoek 3.5 Mℓ reservoir is still in use for the old town area and a new 7 Mℓ concrete reservoir has been built for the township and started operating in beginning of 2018
- Olifantshoek is now fully served with waterborne sewerage, although the old town still uses septic tanks
- There are no water conservation and water demand management plans in place and a plan for Olifantshoek should be drafted for this budget year, and one for Kathu the 2019/20 year

- Water Research Commission report of 2013 pointed out the high per capita water use in Gamagara
- Kathu still has a dual water system which must be phased out, but funds are required
- After the closure of the Sishen mine (2033-2035) the dewatering will continue, and it will be supplied to Kathu possibly via Sedibeng
- The mine does not want to commit about the amount of water it can supply because its business is mining; some time back they were not supplying water
- The use of water for Kathu should be prioritised as follows: 1. Khâi-Appel, 2. Link line fed from mine dewatering and 3. VGG – Sedibeng

Follow up

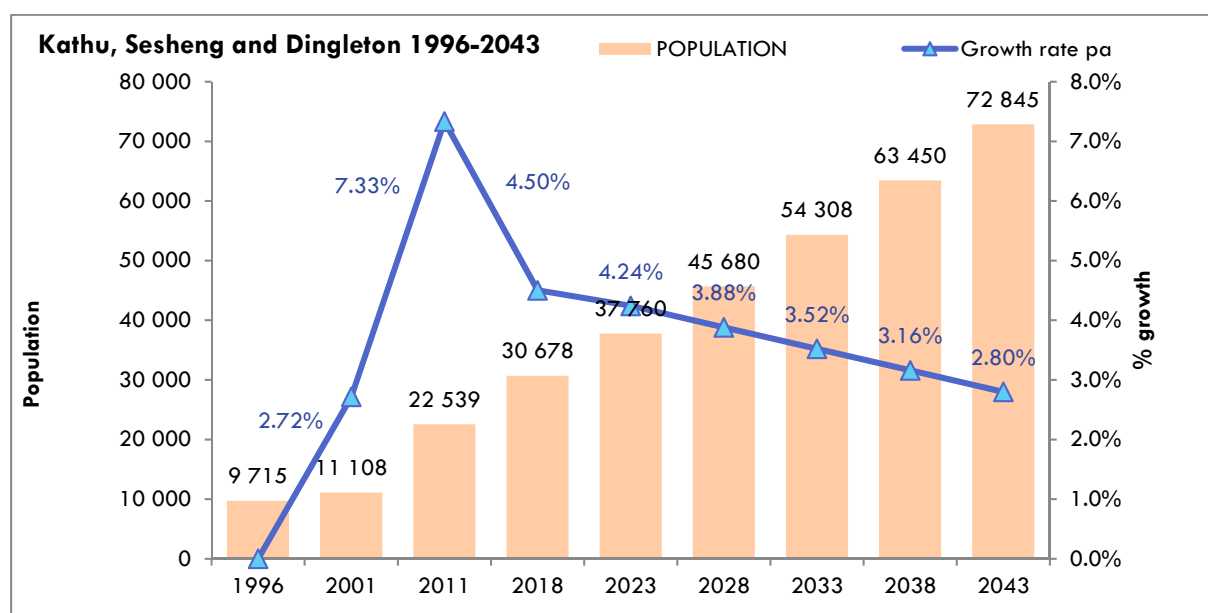
- ix to contact Kimopax (011 3129785) to enquire when the borehole assessments at Khâi Appel and Olifantshoek will be concluded
- Revise the population of Kathu upwards (63 930 in 2042 per presentation); Olifantshoek downwards (25 680 presentation)
- Check the Gamagara Corridor study for estimates about 1 million people
- See CoGHSTA project (>5000 erven) - Kathu Extension 6/7/8/9/10

Feedback post meeting

(a) Borehole assessments – no reports are yet available from Kimopax regarding borehole yields

(b) Population estimate Kathu

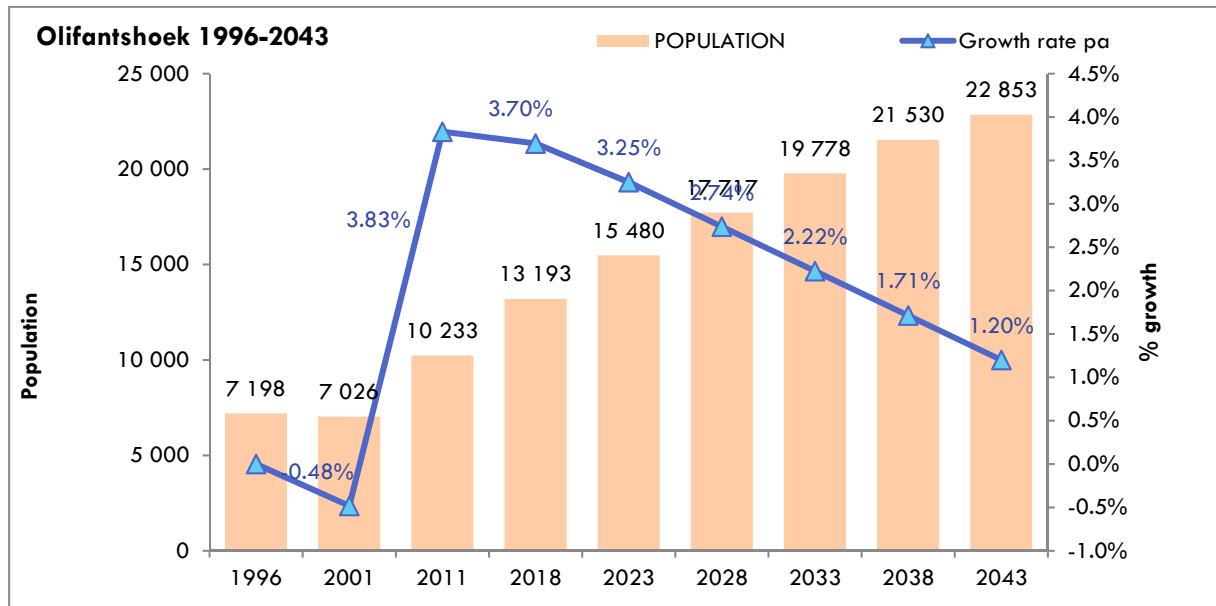
Population revised upwards to 72 845 with an average growth between 2018 and 2043 of 3.52% p.a. This (45 680 in 2028 in figure below) is close to the high population estimated by Kayamandi for the feasibility study (45 478 in 2030). A high demand for housing is driving the housing projects e.g. informal area in Sesheng being upgraded to accommodate 1265 sites and Kathu Extensions 6/7/8/9/10 to accommodate 5277 erven. The scale of the town and recent developments makes Kathu an attractive place to live.



(c) Olifantshoek population estimate

Population was adjusted downwards to 22 955 in 2043.

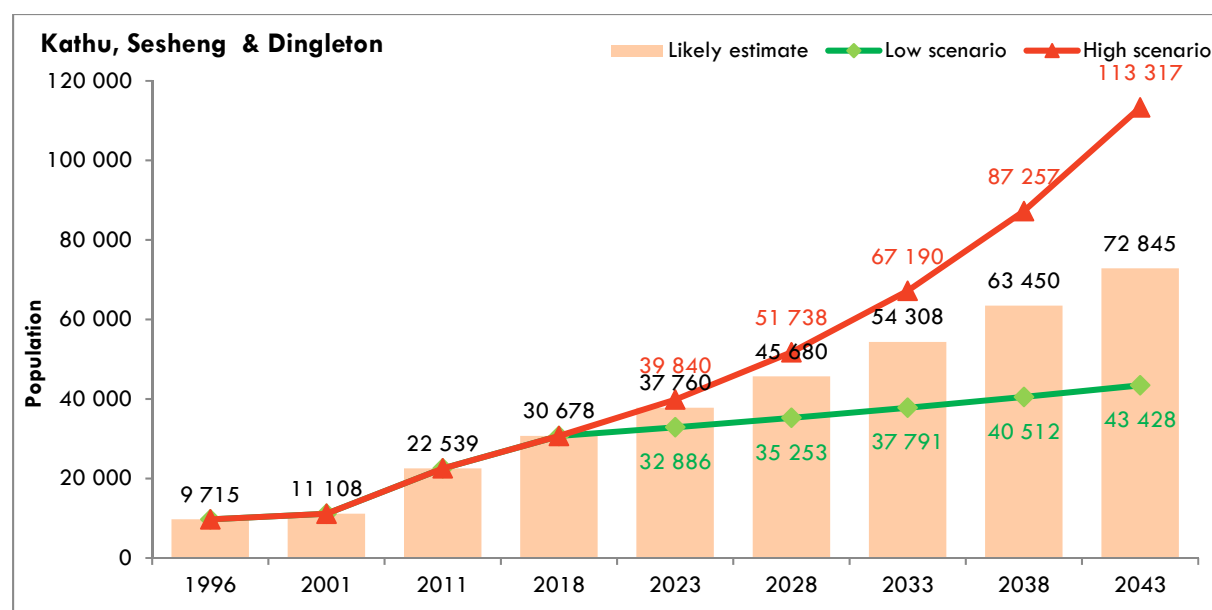
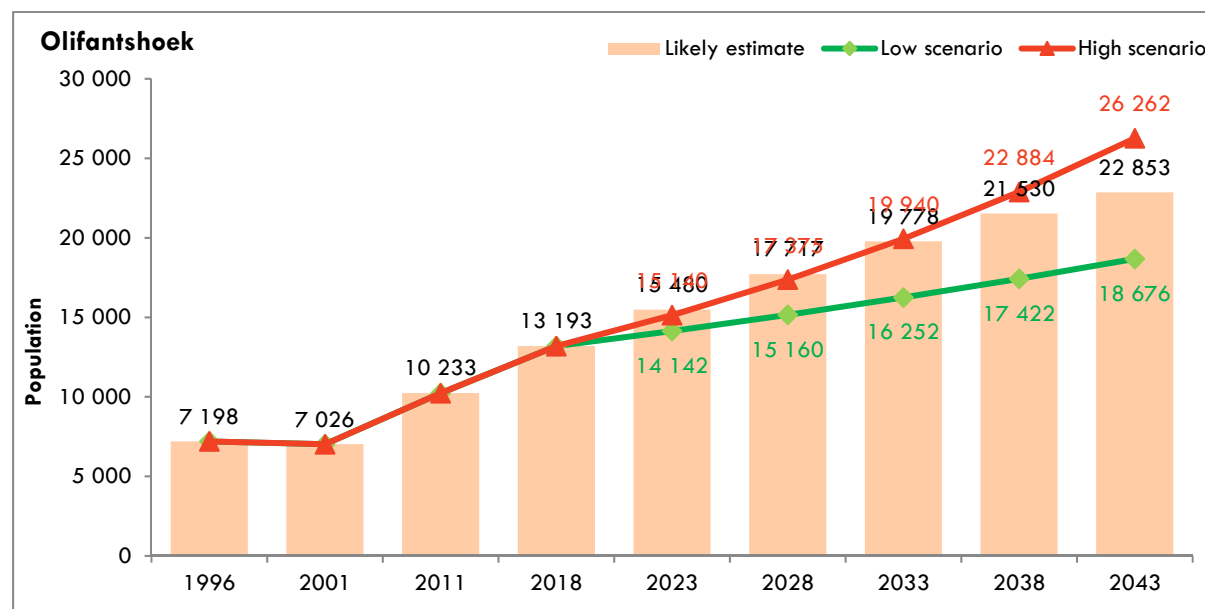
A linear growth is used to extrapolate the population from 2018 to 2043 as follows. The growth rate between 2011 and 2018 is the starting point. A growth rate for the final 5 years of 2038-2043 is selected and values in between are filled using a linear growth function. For example, the figure below shows Olifantshoek's growth between 2011-2018 is 3.70% p.a. with a growth rate of 1.20% selected for the final five years. The average between 2018 and 2043 is 2.22% p.a.



(d) High and low population growth scenarios

Population growth scenarios were made for Kathu and Olifantshoek as follows:

- High – growth seen between 1996-2018 is continued to 2043 (5.37% p.a. Kathu and 2.79% p.a. Olifantshoek)
- Low – grows at the average rate projected by CoGHSTA/HDA for the Northern Cape at 1.4% p.a. (to 2050) until end of period 2043



- (e) Gamagara Corridor Study – No reference could be found to population of one million living in the corridor in the future. The water demand section of the study referred to the VGWSS feasibility study of 2011 where population projections were made by Kayamandi.

(f) Population estimates and water demand analysis for Kathu Extensions 6/7/8/9/10

Water demand calculations for each extension were prepared for the township establishment motivation report which totalled 3 million ℓ/d for 5148 stands. This implies an average of 592 ℓ/d per stand and based on 3.5 persons per household could amount to about 169 $\ell/c/d$ ¹.

Table 1. Number of stands and litres per day² converted to ℓ/d per stand litres per capita per day at an assumed household size of 3.5³

Kathu Ext	Stands	ℓ/d AADD	ℓ/d per stand	$\ell/c/d$ on assumed HH size of 3.5
6	1 194	809 599	678	194
7	1 143	603 725	528	151
8	1 004	797 828	795	227
9	671	319 616	476	136
10	1 136	516 670	455	130
TOTAL	5 148	3 047 438	592	169

It is noted that the population and household estimates in Figure 7 of the Kathu Extensions 6/7/8/9/10 Motivation Report⁴ refer to only to the eastern part of Kathu i.e. it excludes the Sesheng and Mapoteng areas. This same report provides population estimates for Gamagara LM to the year 2028 projected at an annual growth rate of 5.2% in scenario 1, while scenario 2 assumes that the population and household growth has peaked and stabilises at an average of 2 540 additional people per annum i.e. 4.0% p.a. 2018-2023 and 3.3% p.a. 2023-2028.⁵

Likely population growth Kathu and Olifantshoek (3.52% and 2.22% respectively) is lower than that set out by Maxim in scenario 1 (5.2%).

¹ Although not all stands are occupied by households

² Maxim (2018) Motivation report - Proposed Township Establishment Kathu Extensions 6,7,8,9 and 10, removal of restrictive title conditions, consolidation and subdivision on Portions 1 and 2 of the farm Kalahari Golf en Jag Landgoed No. 775, Division Kuruman, Northern Cape Province. P 117. [Online] available <https://www.sahra.org.za/sahris/sites/default/files/additionaldocs/8-75-1%20Memorandum%20Kathu%20Extensions%206-10.pdf>

³ Own calculations

⁴ P 10.

⁵ Date source: Maxim (2018) Motivation report - Proposed Township Establishment Kathu Extensions 6,7,8,9 and 10, removal of restrictive title conditions, consolidation and subdivision on Portions 1 and 2 of the farm Kalahari Golf en Jag Landgoed No. 775, Division Kuruman, Northern Cape Province. P 11. [Online] available <https://www.sahra.org.za/sahris/sites/default/files/additionaldocs/8-75-1%20Memorandum%20Kathu%20Extensions%206-10.pdf>

A.2 Joe Morolong Municipality

A meeting was held with Joe Morolong municipality on 6 November 2018 at 8 am to discuss the Vaal Gamagara Water Supply Scheme (VGWSS) population and water demand estimates.

Attendance

Name	Organization	Email	Telephone
T Tlhoale (MM)	Joe Morolong LM	mm@joemorolong.gov.za	0823313477
TJ Gopeste (corp serv)	Joe Morolong LM	corpserv@joemorolong.gov.za	0828201889
G Molola (PMU & acting tech dir)	Joe Morolong LM	mothesigiven@yahoo.com	0724004807
F Meyer (tech - water)	Joe Morolong LM	frederick.meyer40@yahoo.com	0714534346
V Phiri	Joe Morolong LM	vphiri@joemorolong.gov.za	0828201750
Elmar Deyssel	iX engineers	e.deyssel@ixengineers.co.za	+27828730880
Adeline Squires	Setplan	adeline@setplan.com	+27837010190

The acting CFO, Masego Bele, came in after the meeting to discuss the water supply to Hotazel. mmmokubung@joemorolong.gov.za

Presentation

Adeline presented population estimates to 2043, and water supply and demand. Please find the presentation attached.

Comments and inputs from the Joe Morolong members

Population estimates

- Retrenchments took place in 2008-2009 because of the decreased Chinese demand for iron ore/manganese
- Settlements in Joe Morolong are home to mining employees, and it is a safety net to have a home in Joe Morolong which can be used if retrenched and for retirement
- Agree with the population growth rates applied, since Joe Morolong will 'never beat Kathu'
- Splitting of intergeneration households does take place resulting in smaller household sizes
- Performance of the mines determines immigration

Key developments

- Developments are affected by Eskom supply and upgraded roads where people want to settle, but the growth of settlements is determined by the rate at which tribal authorities allocate land in an area
- Blackrock Mine Organisation built houses in Kuruman (and Kathu) and provides transport to its mines; limited future expansion possibilities at Blackrock
- Hotazel is 'better' than Blackrock because it has schools and recreation facilities. Hotazel's development has been driven by South32's housing plan. For the purposes of planning Hotazel and Blackrock can be clustered together because they are about 5 km from each other. But the mines build house for employees e.g. Assmang builds in Blackrock so it may be problematic to cluster them. Development in these towns is driven by mines' housing demand.
- Joe Morolong's spatial development plan (SDF) was developed knowing that the Sedibeng bulk water supply was planned
- Sinter plant is built

Water resources and demand

- For planning purposes yard taps should be provided because household connections are the preferred level of supply. Can this project assist with household connections?
- Communal standpipes are mostly provided in the rural villages and some of these operate with prepaid tokens
- Cost recovery is a great risk as well as vandalism
- Prepaid meters at households will reduce water loss and vandalism
- No income from water sales generally
- Sedibeng Water supplies Joe Morolong with water and the total volume is sold to South 32 for use by the Hotazel town
- Current borehole supply is insufficient and Tsineng area settlements will need bulk sources
- Recent boreholes drilled by Joe Morolong deliver 1 to 2 l/s
- There are no plans to supply Hotazel or Blackrock with boreholes, but the Tsineng area will be supplied by boreholes. If there is a water shortage from these boreholes, then Sedibeng supply can be considered but it depends on a cost benefit analysis.
- There was a plan to supply Heuningvlei with the pipeline, but it depends on what it will cost and whether it is sustainable
- Domestic water consumption must include use by livestock and the watering of food plots – a reality of the area
- There are water demand management plans in place – Mr Ketile
- Need to ensure financial sustainability and O&M; the mines' SLP only provide for capital projects and make no provision for O&M costs
- Challenges for Joe Morolong water supply include:
 - how to save water and curb water losses
 - how to do water balance (only way is through household connections)
 - MIG funding is limited therefore one needs to use boreholes nearby, whilst with RBIG one can explore further afield

Follow up

- High water use at Hotazel follow up with South32
- Sinter plant details

Feedback post meeting

(g) Sinter plant near Hotazel

In 2012 Kalagadi Manganese, officially opened a 2.4-million-ton-a-year sinter plant, said to be the world's largest, near Hotazel.⁶

The plan is for the three-million tons of ore a year from the mine to serve as feedstock to produce 2.4-million tons a year of sinter, of which 1.7-million tons a year would be marketed and 700 000 t/y smelted into high-carbon ferromanganese at the proposed smelter at the Coega Industrial Development Zone.⁷

⁶ Van Wyngaardt, M. Kalagadi Manganese launches Northern Cape sinter plant, 6 December 2012. Creamer Media Contributing Editor Online [Online]. Available from: <http://www.engineeringnews.co.za/article/kalagadi-manganese-launches-northern-cape-sinter-plant-2012-12-06>

⁷ Ibid

The sintering process consists of mixing, agglomeration and semi-smelting of manganese ore, fine coke, fluxes and recycled dust into sintered product. A circular cooling process and recovery of waste gases forms part of the closed loop system. The sintered and cooled product is reduced to required sizes and shipped to the smelter and other overseas export markets, while the grain is recycled back into the system.⁸

(h) Hotazel water supply and consumption

Elmar spoke to Mr Harry Clingen (0537422289) telephonically at South32 after the meeting who confirmed that the water supplied by Joe Morolong is used by the town of Hotazel only, which includes offices and workshops of South 32, but no mining operations (Wessels and Mamatwan mines are supplied separately). An email follow-up to Mr Clingen was sent on 13 November 2018.

A drive around Hotazel showed no indication of high water usage. The properties are very small and very few have gardens. No private swimming pools were noted. The church garden uses borehole water.

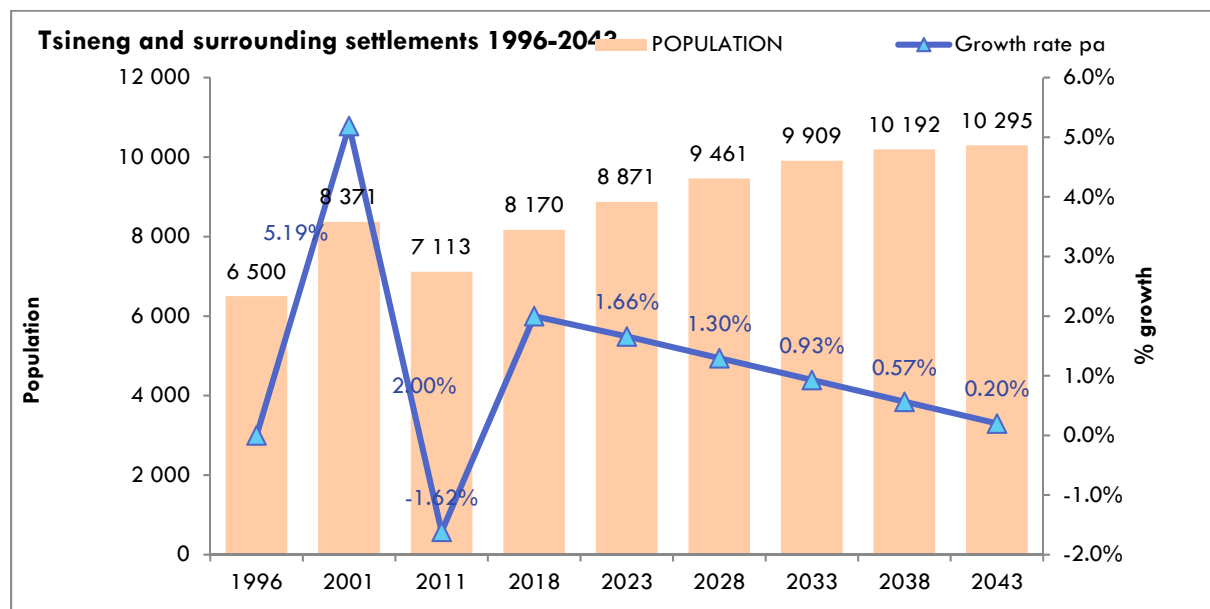
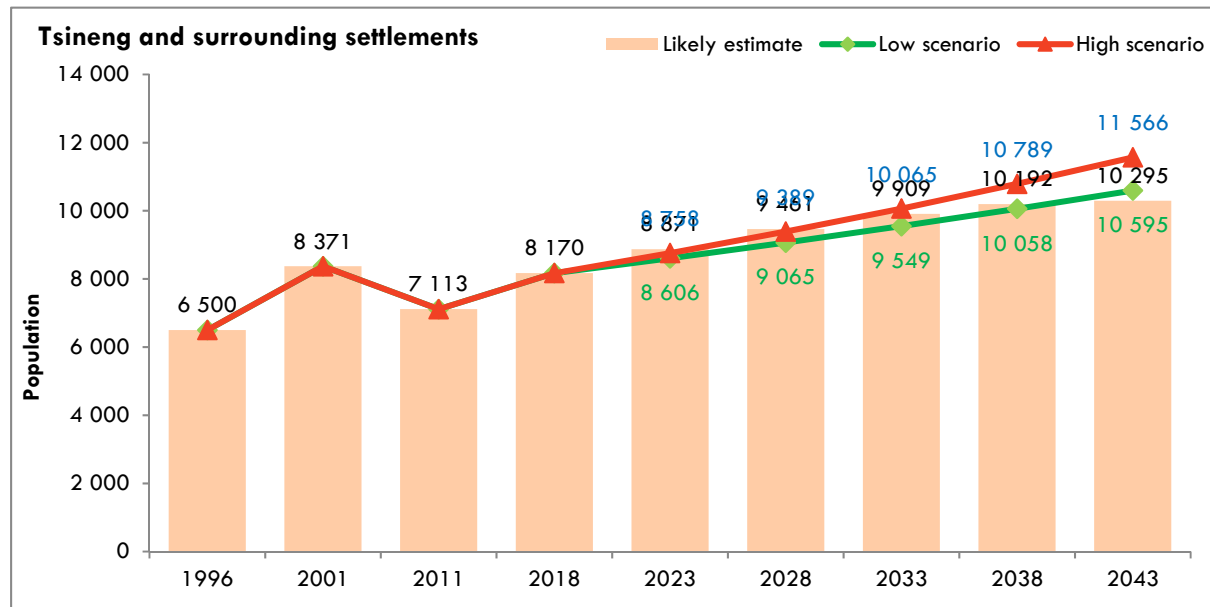
Mogomosti Moagi, an accountant at Joe Morolong, called on 7 November 2018 and further explained that South 32 is invoiced by Joe Morolong and the mine deducts water use from employees. There is a meter at the reservoir. According to the contract between Joe Morolong and Sedibeng Water 85% of the water must be used, and if not, it is charged regardless of the quantity used. Joe Morolong does not supply Blackrock with water.

⁸ Ibid

- (i) High and low population growth scenarios are shown below, and the likely estimate was adjusted upwards.

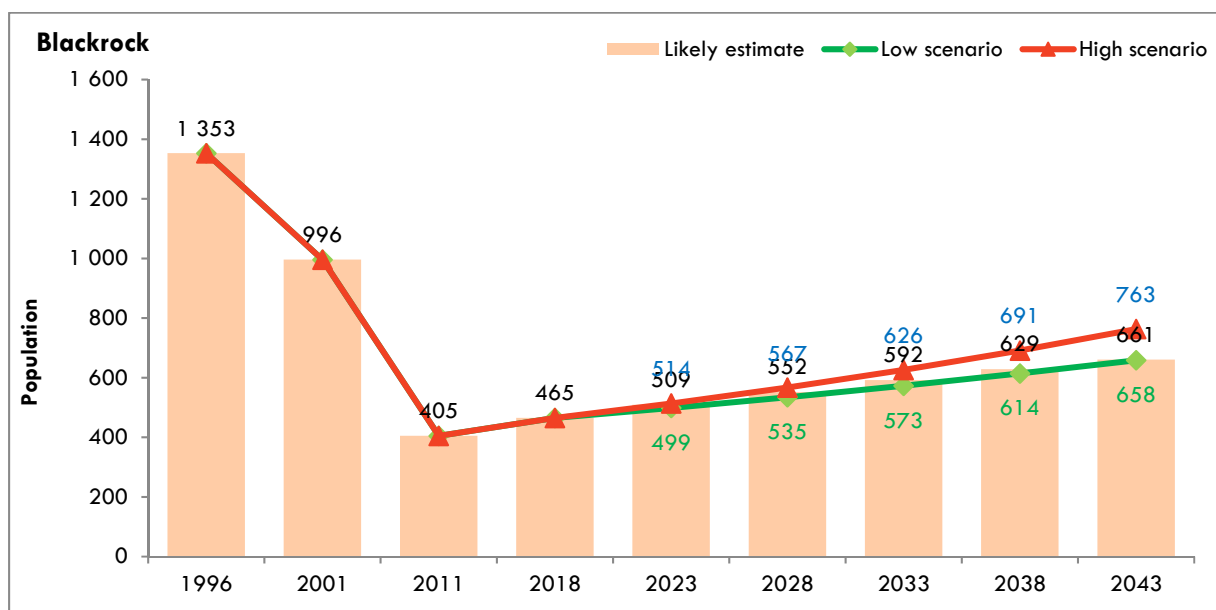
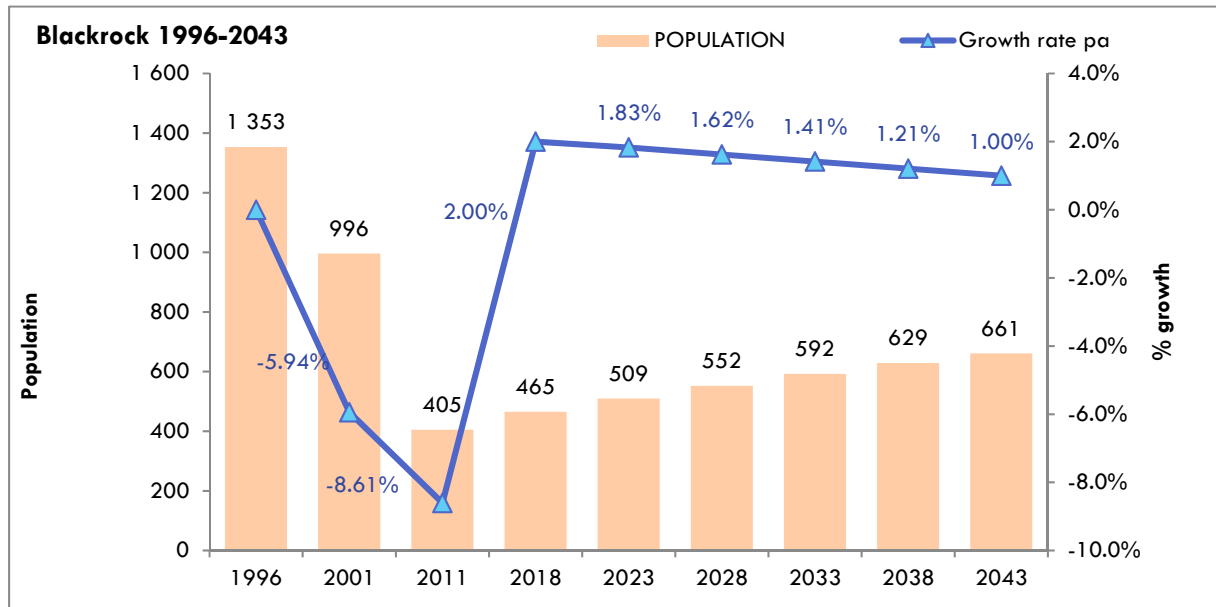
Tsineng and surrounding settlements population growth scenarios were made as follows:

- Low – growth seen between 1996-2018 is continued to 2043 (1.04% p.a.)
- High – grows at the average rate projected by CoGHSTA/HDA for the Northern Cape at 1.4% p.a. (to 2050) until end of period 2043
- Likely – growth between 2011 and 2018 of 2.00% p.a. declines to 0.20% p.a. at the end of the period, at an average of 0.93% p.a. from 2018 to 2043



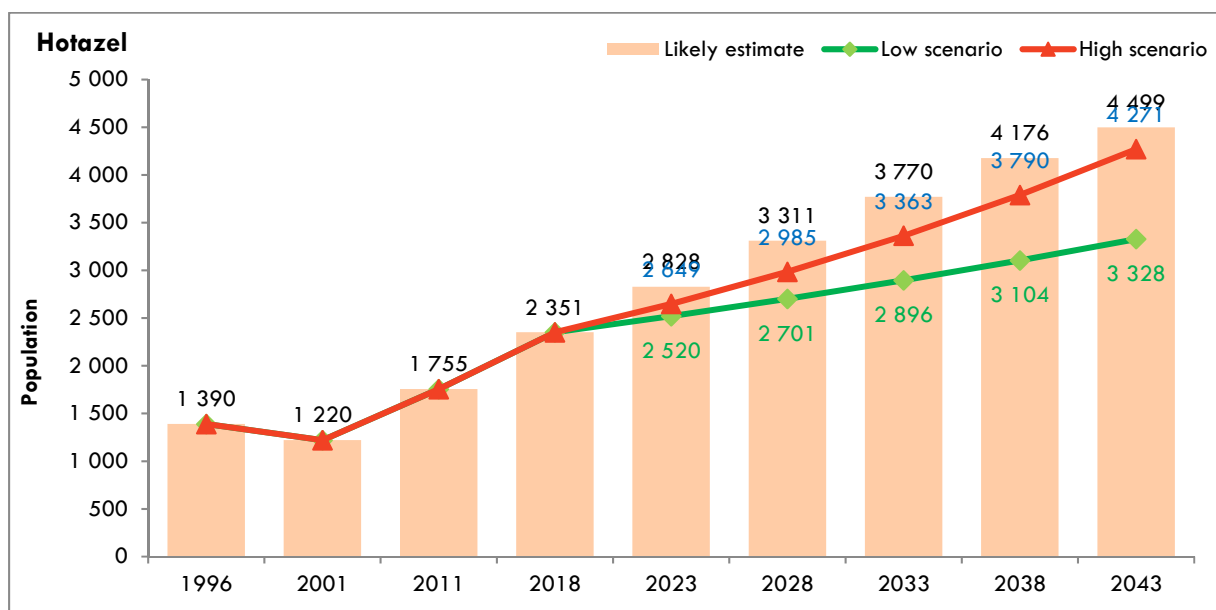
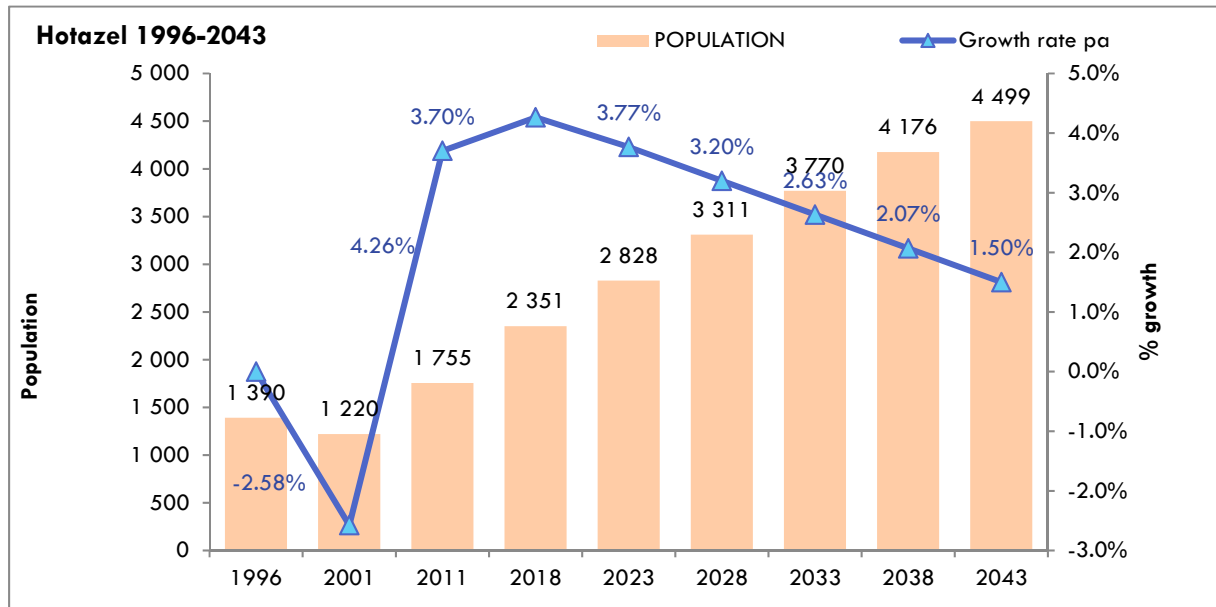
Blackrock population growth scenarios were made as follows:

- High – growth seen between 1996-2018 is continued to 2043 (2.00% p.a.)
- Low – grows at the average rate projected by CoGHSTA/HDA for the Northern Cape at 1.4% p.a. (to 2050) until end of period 2043
- Likely – growth between 2011 and 2018 of 2.00% p.a. declines to 1.00% p.a. at the end of the period, at an average of 1.41% p.a. from 2018 to 2043



Hotazel population growth scenarios were made as follows:

- High – growth between 1996-2018 is continued to 2043 (average 2.42% p.a.)
- Low – grows at the average rate projected by CoGHSTA/HDA for the Northern Cape at 1.4% p.a. (to 2050) until end of period 2043
- Likely – growth between 2011 and 2018 of 4.26% p.a. declines to 1.5% p.a. at the end of the period, at an average of 2.63% p.a. from 2018 to 2043



A.3 Tsantsabane Municipality

A meeting was held with Tsantsabane municipality on 6 November 2018 at 2 pm to discuss population and water demand estimates to 2043 for the Vaal Gamagara Water Supply Scheme (VGWSS).

Attendance

Name	Organization	Email	Telephone
Tintshalo Mabobo	Tsantsabane LM	tintshalo.mabobo@gmail.com	+27733006140
Jacques Majiedt	Tsantsabane LM	Majiedtjp@gmail.com	+2782496994
Elmar Deyssel	iX engineers	e.deyssel@ixengineers.co.za	+27828730880
Adeline Squires	Setplan	adeline@setplan.com	+27837010190

Presentation

Adeline presented population estimates to 2043, and current and future water demand. Please find attached.

Comments and inputs from the Tsantsabane members

Population estimates

- Dwelling growth rate of Groenwater seems high
- Influx into Groenwater took place especially after the electrification in 2012/13 when the area became more attractive, but recently it has stabilised around 570 plots. People are only allocated a site if they are prepared to stay there, and as a result it is occupied by many old people.
- Groenwater 567 plots counted in Oct 2018 for VIP toilets
- Small informal settlement also called Maremane, but distinct from the land restitution case area called Maremane, is new and they also want services although this is not necessarily supported by the municipality
- Agree with the development and growth potential of Postmasburg and Maremane as stated in presentation, but Groenwater too high for the long-term. Maremane unlikely to grow much in the future. Postmasburg can possibly experience higher growth.

Key developments

- Redstone Solar, which is currently under construction, will require water
- All the UDS toilets are being upgraded to waterborne, and there is a question about whether there is enough water from Sedibeng
- Kolomela mine is developing housing for the new mine
- Housing developments are underway in Postdene, Airfield, and Recreation opposite the Showgrounds, as well as a small development by Transnet
- 8000 stands have been approved and finalised at Greenfields, Boichoko, Mt View (Koppie) and a 11 Ml reservoir is planned – this is in situ upgrading of informal areas
- Maremane - busy with town planning

Water resources and demand

- Postdene is supplied with borehole water (100%), and the town area's VGWSS water is supplemented with about 10% ground water
- Try to have a yearly water conservation and demand management programme, although these are not well supported by the councillors, and therefore its only undertaken by the management team. Councillors need to support it with a lot of advocacy.

- Prepaid meters are only fitted at mine owned houses, thus the LM has payment issues with most other consumers
- It can be argued that the mines dewatering 'belongs' to the municipality, because groundwater is reduced due to the dewatering activities, which results in the municipality having to purchase water from Sedibeng. The mine dewatering is delivered to Sedibeng rather than to the municipality. Tsantsabane's situation is unlike that of Kathu, where Kathu receives water before it is fed into the VGWSS pipeline.
- There are six operational boreholes in town and more in Postdene. Two boreholes were drilled about a month ago that are not yet equipped, and another two are planned for Boichoko. Borehole abstraction is expected to continue in the future. This is needed because Sedibeng cuts water supply to the municipality (restricted supply) because of poor payment. Coordination meetings are held monthly with Sedibeng Water to discuss issues of supply and payment.
- Groenwater is a sandy area with good underground water although not good for the community (poor quality?) thus there is possibly no choice other than to join the pipeline. However, the payment issue needs to be resolved.
- Maremane has six boreholes but there is 'something not right' and more boreholes are being drilled presently. At times Lohatla experiences water problems related to their reservoir operational issues and then they send water tankers to fill in Postmasburg at no cost.
- 160 ℓ/c/d from the VGWSS although it should be less in future, but first the account with Sedibeng water needs to be settled
- Payment of water by households is a BIG issue

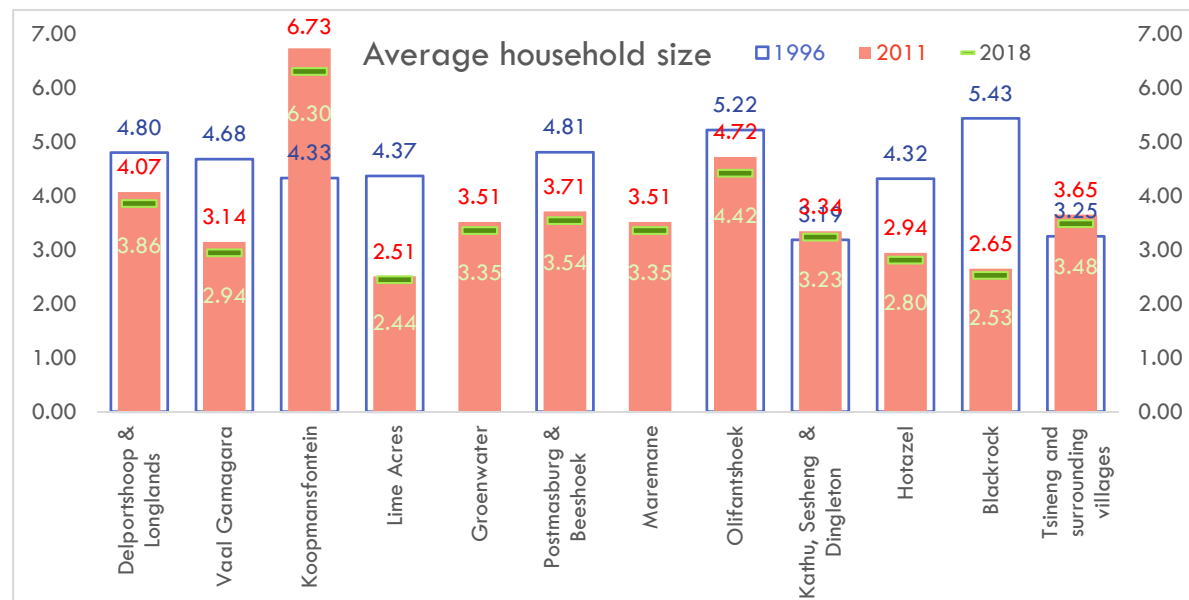
Follow up

- Add Postmasburg to household size chart
- Check dwelling count (810) in Groenwater against the 567 plots counted by municipality in Oct 2018
- Adjust population growth at Groenwater accordingly, and at Maremane
- Apply 100% borehole water supply to Postdene i.e. no water from the VGWSS
- Consider the possibility of Groenwater and Maremane being supplied by the VGWSS

Feedback post meeting

Based on the discussion at the meeting on 6 November the following revisions and edits have been made.

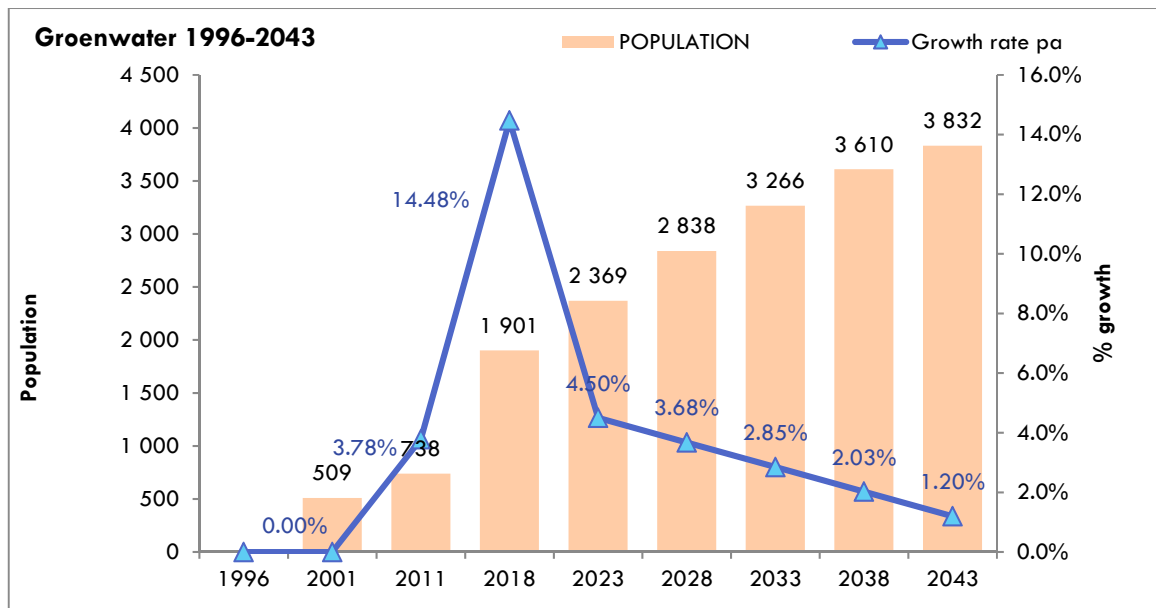
(a) Postmasburg added to household size chart. Please see below.



(b) Groenwater dwelling count

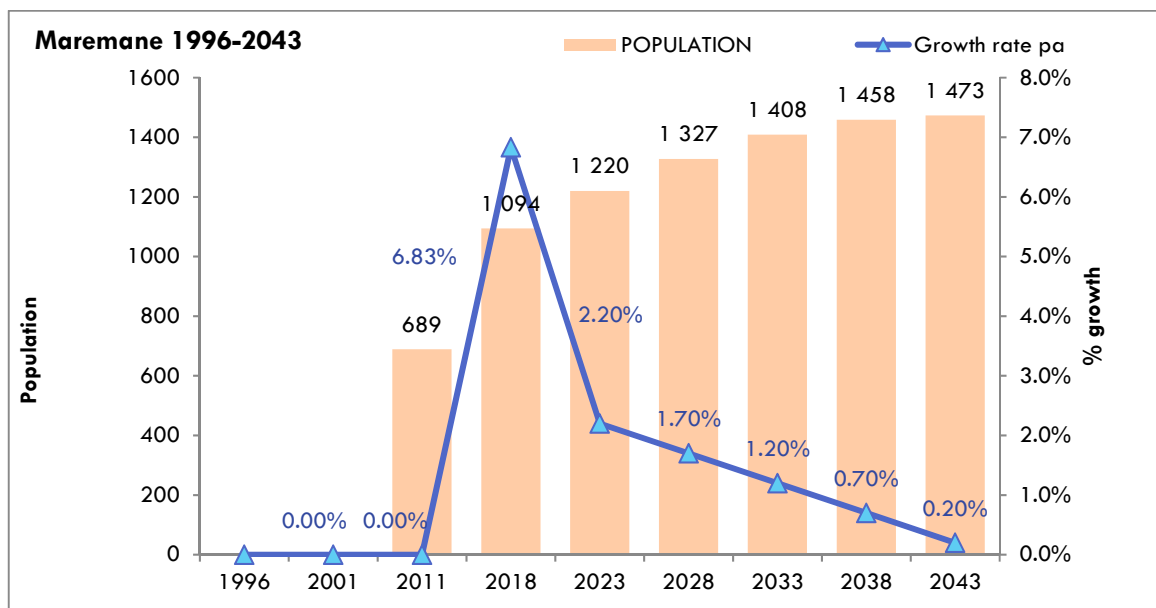
Adeline and Elmar visited Groenwater to check the dwelling counts after the meeting on 6 November 2018. The reason why there is a difference between the dwelling counts (810) and the VIP count is because there are many plots with more than one dwelling. It is common for a plot to have a formal household and a shack located on it. Local women confirmed that plots with two dwellings were occupied by one household. Therefore, an increase in dwelling numbers does not translate into an increase in the number of households. (This issue does not seem to occur at Postmasburg, where most of the new dwellings are in areas that have expanded rather than being infill.)

Households increased from 210 in 2011 to 567 in 2018, while dwellings increased to 810. Given the opinion of the municipality that the growth in Groenwater will 'stabilise', the population growth between 2018 and 2043 was reduced to an estimated population of 3 832 in 2043 (from 4 565 in presentation). Please see revised chart below.



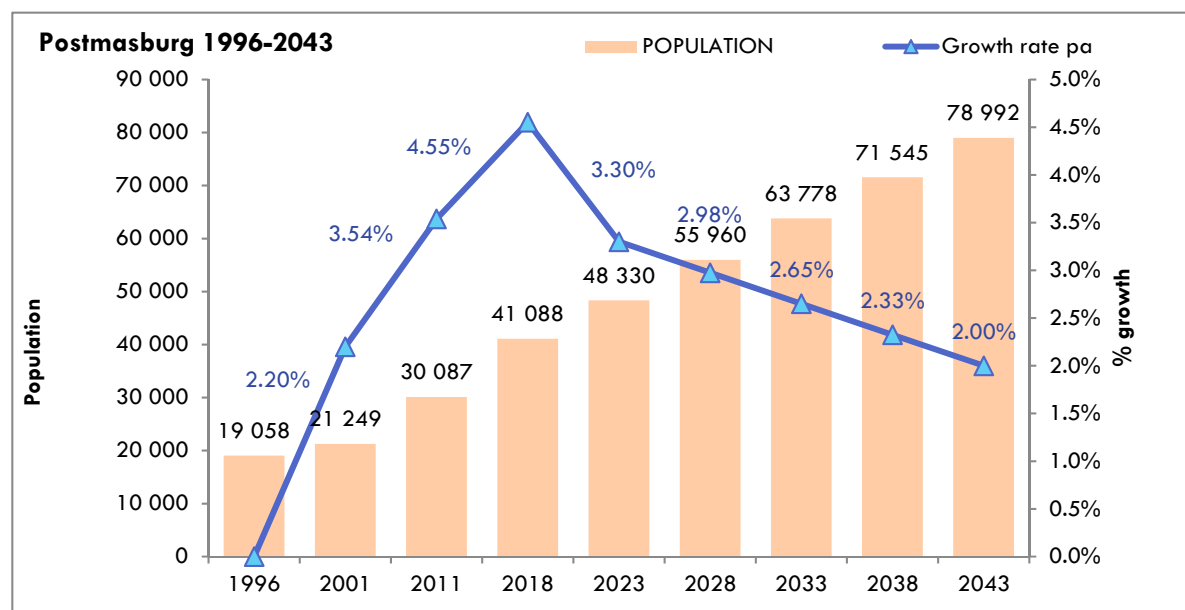
(c) Maremane population

Maremane's population growth was also adjusted downwards to reflect a continuous decreasing growth rate with an average of 1.2% p.a. 2018-2043, thus its population has been slightly increased by 2043.



(d) Postmasburg and Beeshoek

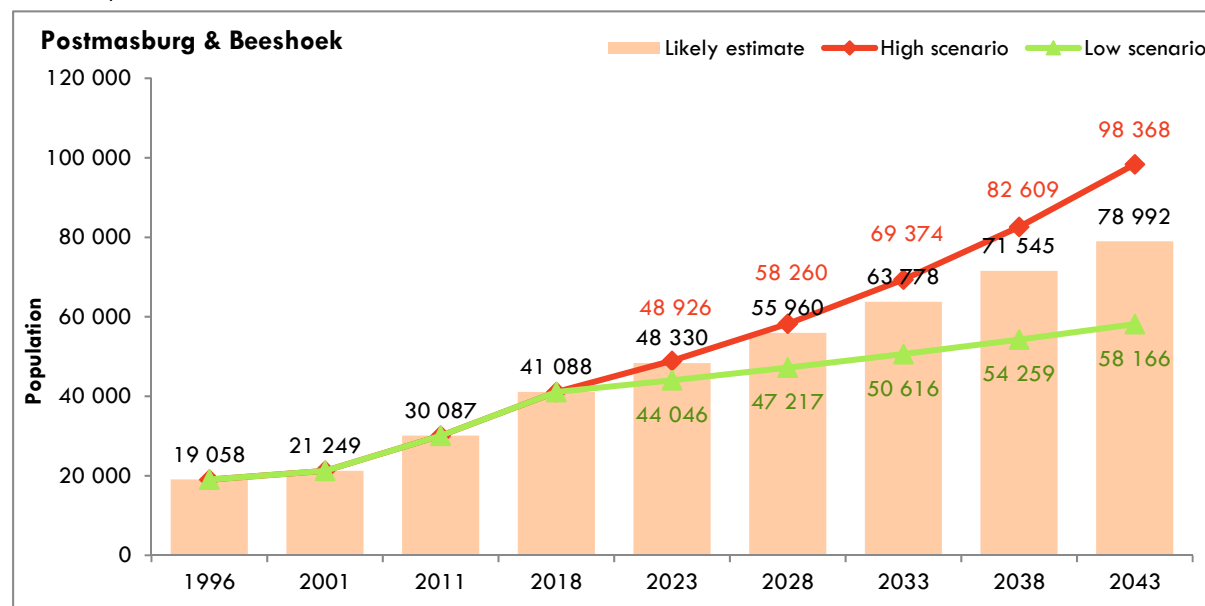
Postmasburg's population was adjusted as well to reflect a higher growth rate and population in 2043 (from 72 534 in presentation to 78 992 in figure below).

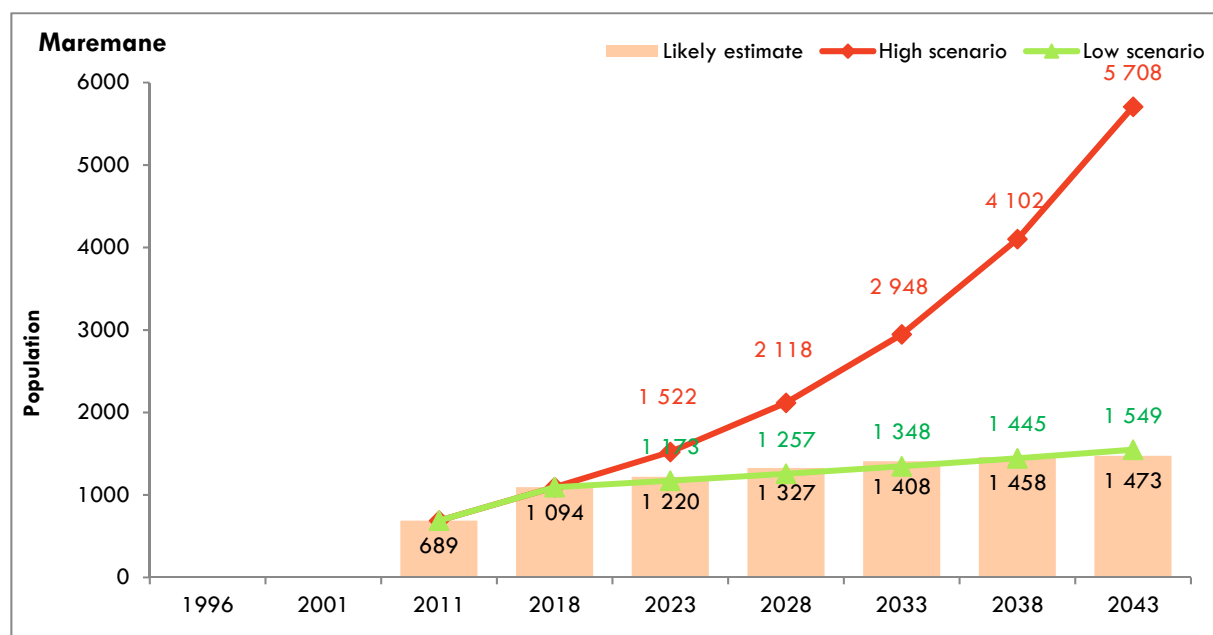
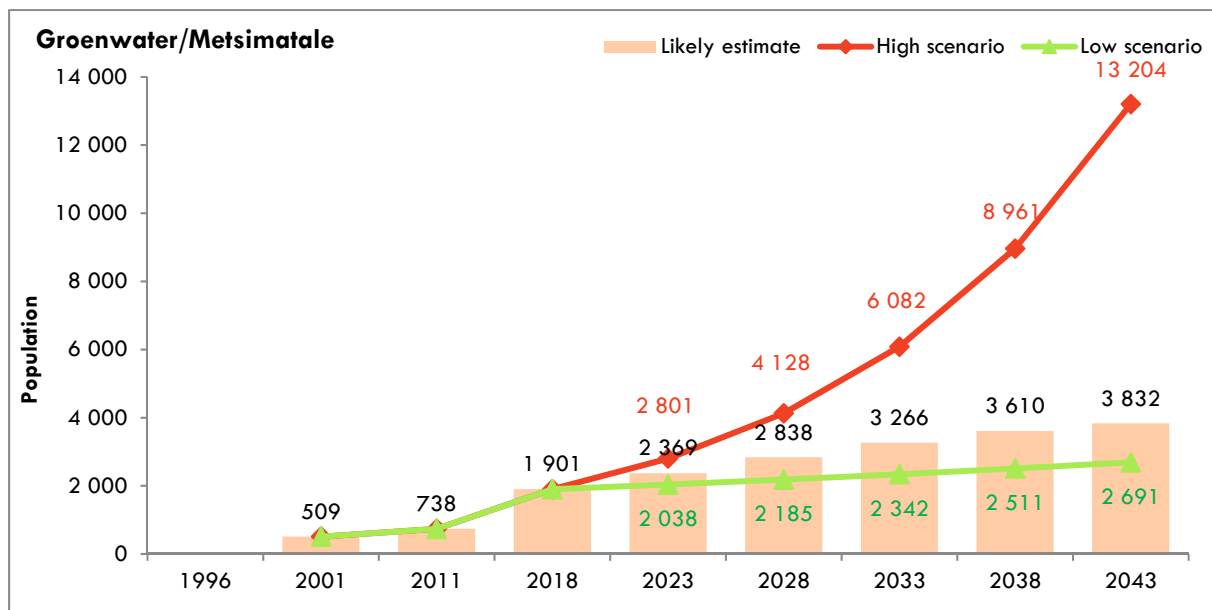


(e) High and low population growth scenarios

Population growth scenarios were made as follows:

- High – growth seen between 1996-2018 continued to 2043
- Low – grows at the rate projected by CoGHSTA/HDA for the Northern Cape at 1.4% p.a. to 2050





- (f) Postdene to use 100% own groundwater, and the possibility of Groenwater and Maremane joining the VGWSS will be modelled.

A.4 Dikgatlong Municipality

A meeting was held with Dikgatlong municipality on 9 November 2018 at 9am to discuss the Vaal Gamagara Water Supply Scheme (VGWSS) population and water demand estimates.

Attendance

Name	Organization	Email	Telephone
Thabo Swartz	Dikgatlong LM	jsroos05@gmail.comj	0829183899
Mbulelo Duba	Frances Baard DM	Mbulelo.duba@fbdm.co.za	0718710268
Barend	Dikgatlong LM		0827769127
Elmar Deyssel	iX engineers	e.deyssel@ixengineers.co.za	+27828730880
Adeline Squires	Setplan	adeline@setplan.com	+27837010190

Presentation

Adeline presented population estimates to 2043, and water supply and demand. Please see attached presentation.

Comments and inputs from the Dikgatlong members

Population estimates

- Postmasburg and Kathu will undoubtedly receive immigrants; even people from Barkly West move there because of the mining economy
- Koopmansfontein may have positive growth because of the 300 erven surveyed, the alluvial mining taking place, and the experimental farm that is managed by the CPA, also, a Dept of Agric farm. Koopmansfontein is a land claim settlement which originally was owned by Transnet, and at that time it had 43 plots. All 300 surveyed plots are occupied as a result from an influx of farmworkers from nearby farms that are transported to work daily. There is also an alluvial diamond mine in this area.
- Vaal Gamagara settlement is private, and the municipality does not service it. Little or no growth is expected, and it has limited attraction.
- Longlands has 702 serviced erven
- Delporthoop people migrate to Kimberley and to Barkly West, and they also work at AfriSam near Ulco

Key developments

- RDP houses (217) with services are being built - a new development at Delporthoop '7nde Laan'
- When RDP houses are erected, the shacks are usually kept even if they are moved on the plot which are used by the by family or rented out
- 266 stands are being developed in an extension of Rooikoppies but are not yet serviced
- 300 erven are surveyed in Koopmansfontein without infrastructure and services
- Underground diamond mine Van Wyk's Diamond Mine on the farm Good Hope has closed, but alluvial operations continue in the municipal area. No large-scale mining operations at present.

Water resources and demand

- Water is lost due to old infrastructure
- O&M is lacking 'wait till something is broken', need an O&M plan

- No groundwater supplements the VGWSS water supply to Delportshoop, Longlands and Koopmansfontein. Boreholes supply villages such as Gong Gong, Moddergat and Keisieskama.
- Longlands and Delportshoop have reservoirs
- No water conservation demand management plan in place at Delportshoop, Longlands or Koopmansfontein. Zone valves and meters have been installed in other areas as well as smaller toilet cisterns. These projects were undertaken with the ACIP grant.

Follow up

- Review the population growth of Delportshoop and Longlands
- Review the population growth at Koopmansfontein given the 300 erven

Feedback post meeting

(g) Site visit to Koopmansfontein and Vaal Gamagara settlement on 12 November 2018

There are 39 brick houses and 72 shacks (total 111) that are occupied according to a local informant, Sinah Veldsman.⁹ This was confirmed by visual inspection (7 x 8 rows of shacks and a few more along the rail line). Formal houses have services, whilst some shacks have VIP toilets without water or electricity. Furthermore, Sinah stated that the number of surveyed erven totals 103. These erven are not apparent on the SG diagrams dated January 2018.

Vaal Gamagara settlement is a private formal development and it is unlikely that any new dwellings will be built. Three unoccupied houses were noted at the time of the visit.

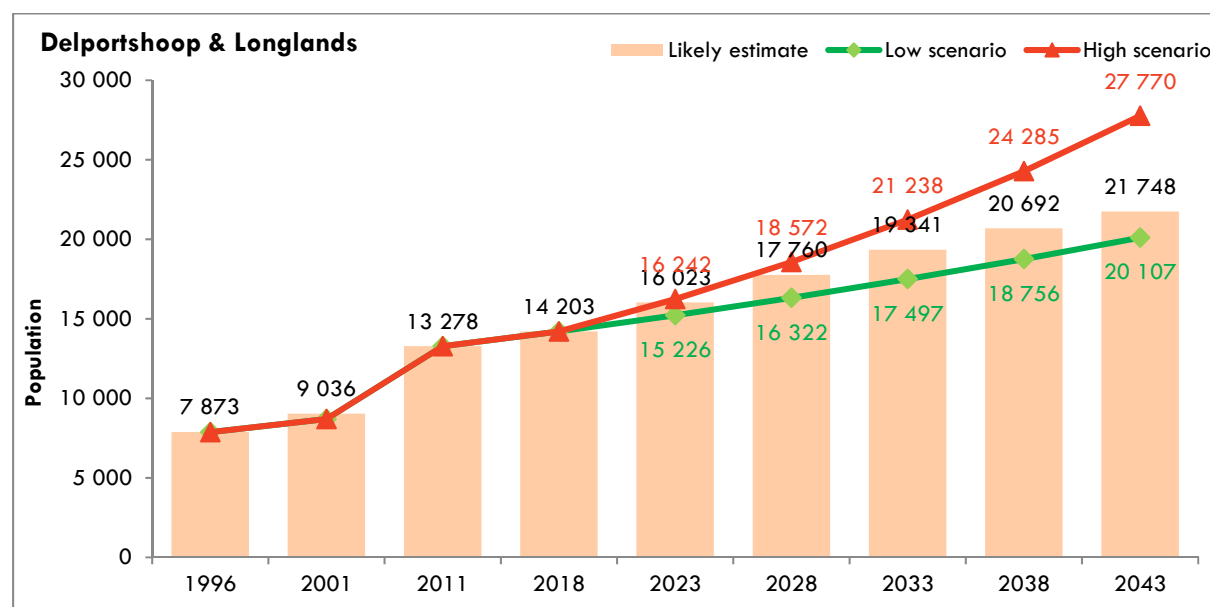
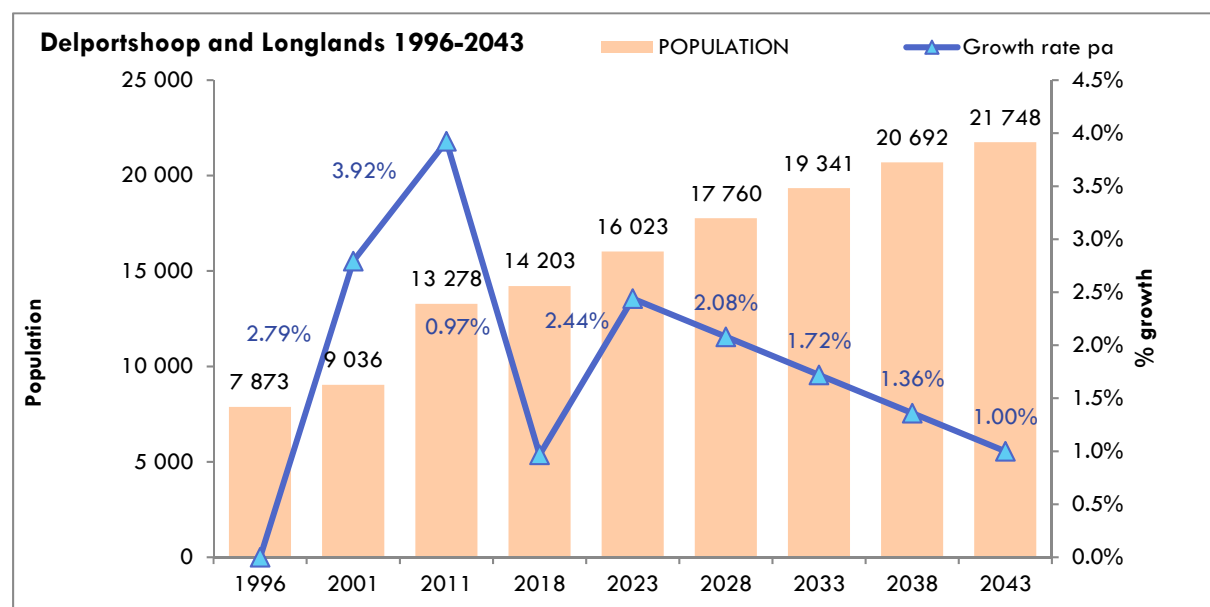
Revisions to the population estimates were made accordingly.

⁹ Personal communication with Sinah Veldsman on 12 November 2018. A group of women who were part of the community works programme (CWP) who were there at the time agreed with her.

(h) Population estimates revisions and high/low scenarios are added as follows:

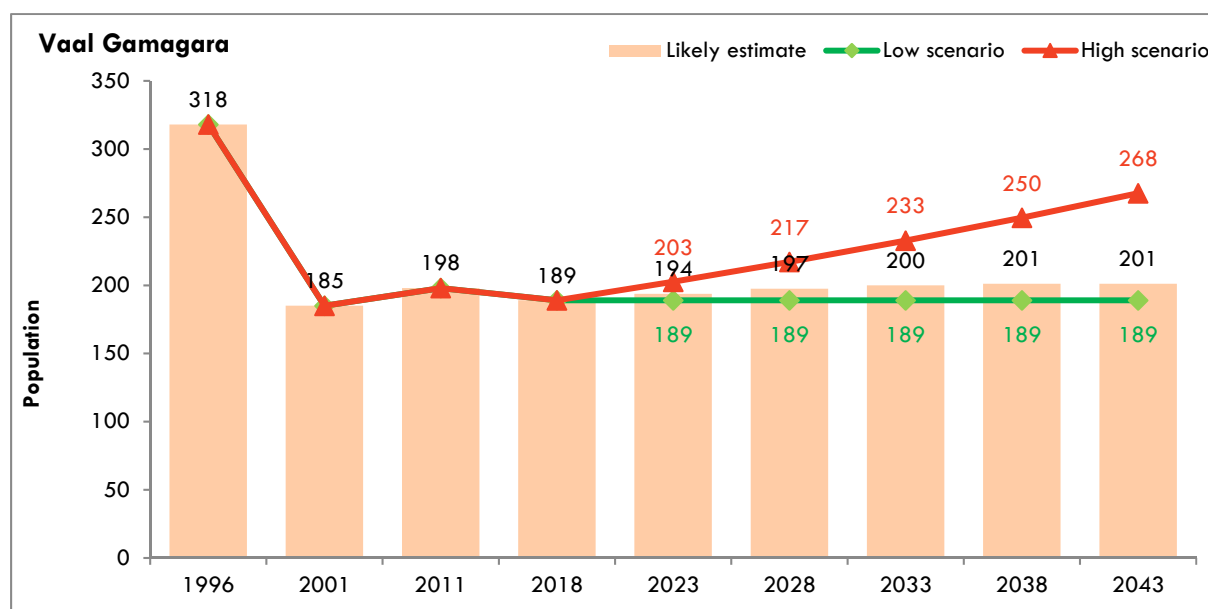
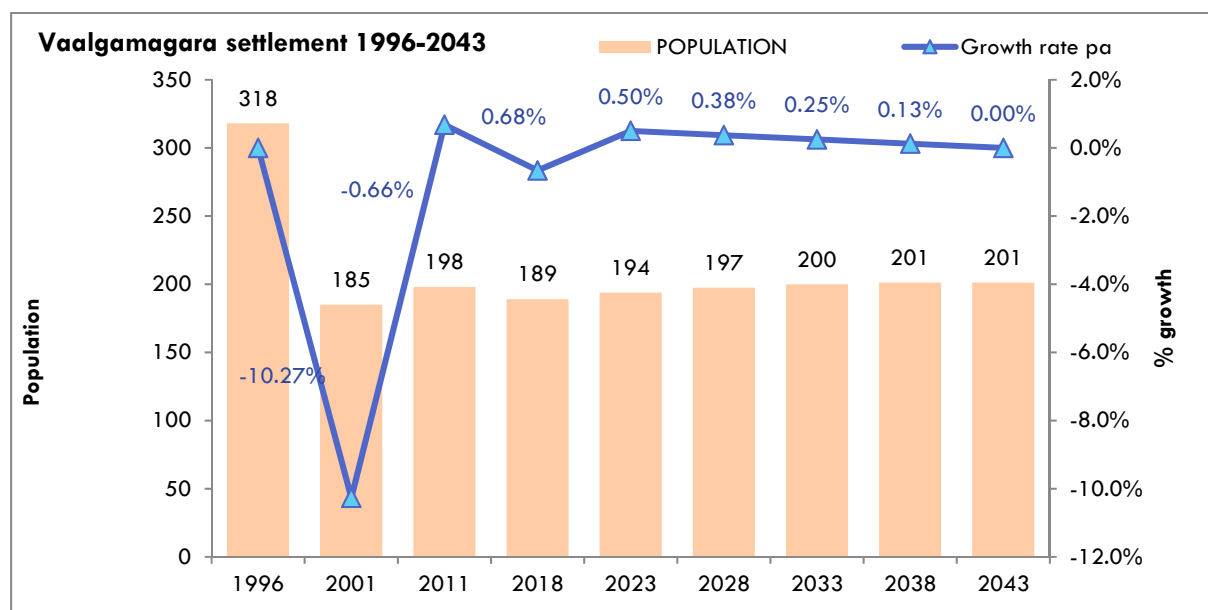
Delportshoop an Longlands:

- Likely - growth rate adjusted to decline from 2.44% p.a. to 1.00% p.a. over the 2018-2043 period (average of 1.72% p.a.)
- High – growth seen between 1996-2018 is continued to 2043 (2.72% p.a.)
- Low – grows at the average rate projected by CoGHSTA/HDA for the Northern Cape at 1.4% p.a. (to 2050) until end of period in 2043



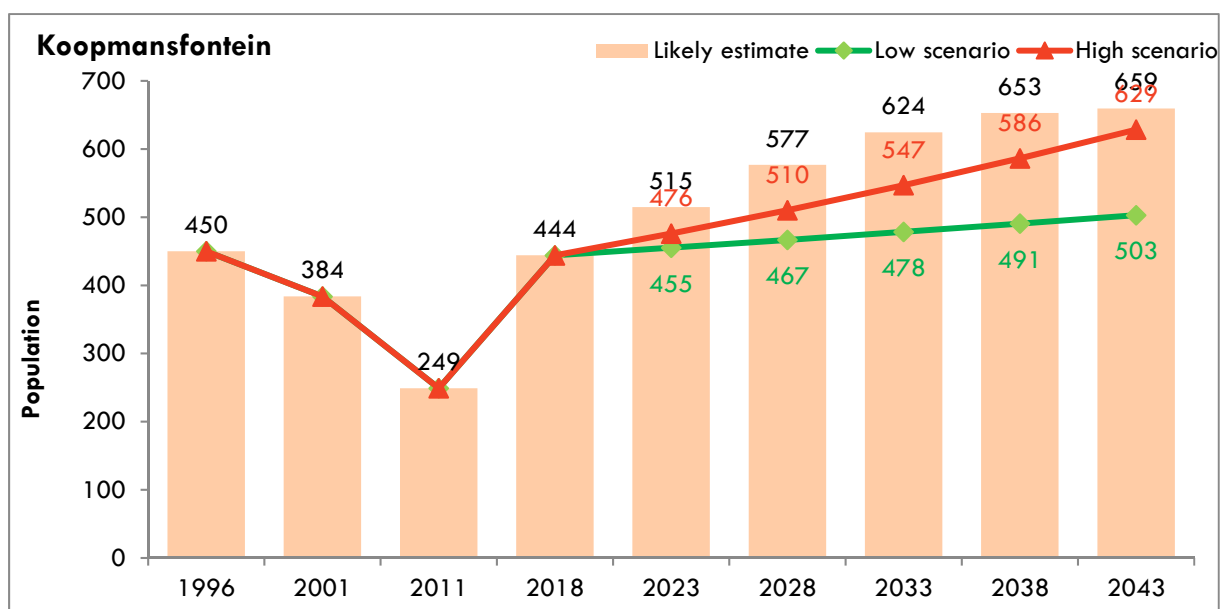
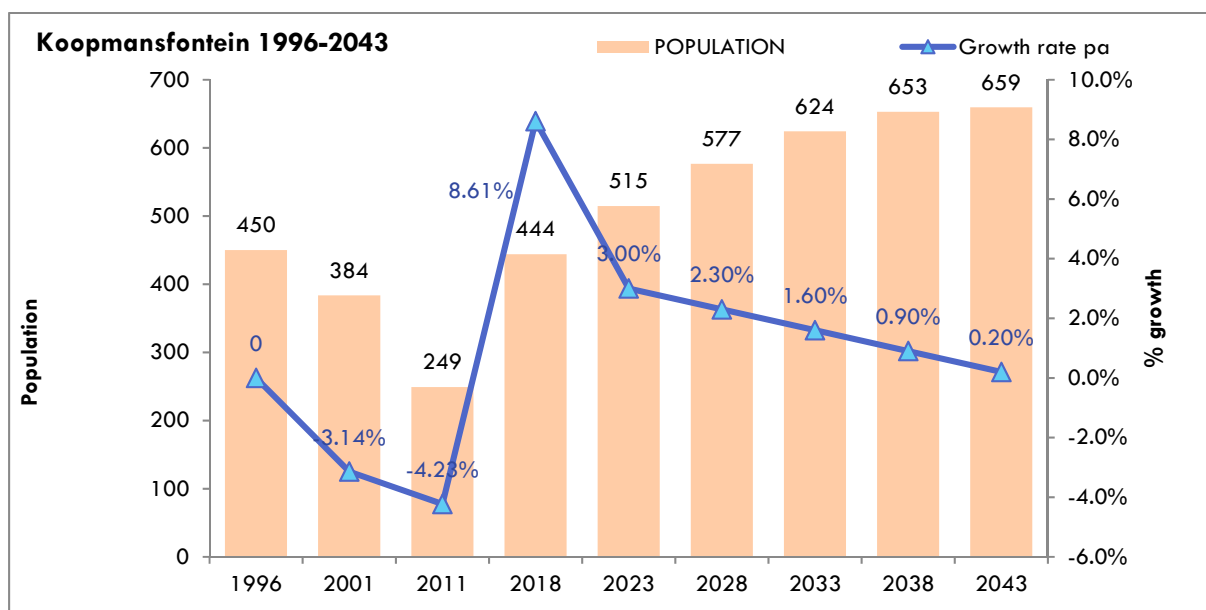
Vaalgamagara settlement:

- Likely – although the 2011 to 2018 growth seemed negative (-0.66% p.a.), a growth of 0.50% p.a. is applied to 2018-2023 declining to 0.00% p.a. at the end of period (average 0.25% p.a.)
- Low – no growth is foreseen (0.00% p.a.)
- High – grows at the average rate projected by CoGHSTA/HDA for the Northern Cape at 1.4% p.a. (to 2050) until end of period in 2043



Koopmansfontein settlement:

- Likely – growth between 2011 to 2018 was high due to an influx of people from surrounding farms (8.61% p.a.), and a growth of 3.00% p.a. is applied to 2018-2023 declining to 0.20% p.a. at the end of period (average 1.60% p.a.)
- Low – growth of 0.50% p.a. is applied
- High – grows at the average rate projected by CoGHSTA/HDA for the Northern Cape at 1.4% p.a. (to 2050) until end of period in 2043



B. DWELLING COUNTS

B.1 Dwelling count data

Table 1. Dwelling counts and photography dates to calculate total estimated dwellings in 2018¹⁰

Name of settlement	Households 2011	Date of aerial photo closest to Oct 2011 ¹¹	Date of latest aerial photo	Number of years between aerial photo dates	Additional dwellings at date closest to 2011 (counted on maps)	Growth of dwellings per year	Period 2011 to end date	Total dwellings at end date	Annual growth 2011 to latest aerial date	Total estimated dwellings in 2018
Delpportshoop	2 478	01/07/2009	04/06/2016	6.8	340	50	4.6	2 708	1.9%	2 835
Longlands	786	19/09/2009	21/06/2017	7.6	74	10	5.6	841	1.2%	854
Koopmansfontein	37	01/07/2009	21/03/2017	7.6	0	0	5.4	37	0.0%	37
Vaal Gamagara	63	01/07/2009	06/04/2016	6.7	0	0	4.5	63	0.0%	63
Lime Acres	1 755	01/07/2009	15/07/2018	8.9	32	4	6.7	1 779	0.2%	1 780
Groenwater	210	01/07/2009	25/08/2017	8.0	601	75	5.8	645	21.3%	810
Beeshoek Mine	210	10/07/2013	05/05/2018	4.8	-197	-41	6.5	13	-34.8%	11
Postmasburg	8 112	01/07/2009	12/12/2017	8.3	4 053	486	6.1	11 085	5.2%	11 600
Maremane	196	01/07/2009	07/02/2016	6.5	109	17	4.3	268	7.5%	326
Dingleton	867	29/06/2011	05/05/2018	6.8	-816	-121	6.5	14	-47.0%	10
Sesheng bulk water area	2 706	29/06/2011	05/05/2018	6.8	960	142	6.5	3 630	4.6%	3 712
Kathu eastern area	3 177	29/06/2011	29/07/2017	6.0	2 145	358	5.7	5 232	9.1%	5 832
Olifantshoek	2 169	01/07/2009	06/09/2017	8.1	932	116	5.8	2 845	4.7%	3 001
Blackrock	153	01/07/2009	14/09/2017	8.1	36	4	5.9	179	2.7%	185
Hotazel	597	01/07/2009	11/04/2017	7.7	258	34	5.5	780	5.0%	842
Ardath	5									5
Bosra	141	01/07/2009	26/07/2018	8.9	38	4	6.7	170	2.8%	171
Ga-Diboye	156	01/07/2009	26/07/2018	8.9	74	8	6.7	212	4.6%	214
Ga-Moheele	36	01/07/2010	11/04/2017	6.7	9	1	5.5	43	3.5%	46
Ga-Sese	261	01/07/2010	11/04/2017	6.7	18	3	5.5	276	1.0%	280
Ga-Tipe	143	01/07/2010	11/04/2017	6.7	14	2	5.5	154	1.4%	158
Gatshekedi	45	01/07/2010	11/04/2017	6.7	33	5	5.5	72	9.0%	82
Maipeng	252	01/07/2010	11/04/2017	6.7	20	3	5.5	268	1.2%	273
Maphiniki	177	01/07/2010	06/02/2017	6.5	4	1	5.3	180	0.3%	181
Masankong	72	01/07/2010	11/04/2017	6.7	1	0	5.5	73	0.2%	73
Metsemantsi Wyk 1	21	01/07/2010	26/07/2018	8.0	0	0	6.7	21	0.0%	21
Mmatoro	33	01/07/2010	19/01/2017	6.5	2	0	5.2	35	0.9%	35
Ncwaneng	57	01/07/2010	19/01/2017	6.5	2	0	5.2	59	0.5%	59
Tlapeng	39	01/07/2010	27/03/2017	6.6	0	0	5.4	39	0.0%	39
Tsineng	627	01/07/2010	17/03/2017	6.6	62	9	5.4	677	1.4%	693
Tsineng-Kop	12	01/07/2010	27/03/2017	6.6	7	1	5.4	18	7.4%	20
TOTAL	25 593						Growth p.a.		4.2%	34 249

¹⁰ Own calculations and 2011 StatsSA Census 2011.

¹¹ Assumed mid-year since 2009 and 2010 day and month unavailable.

B.2 Examples of dwelling counts

DELPORTSHOOP (2016)

50 798 157
50 (340)
50
72



GROENWATER (25/8/2017) (224)



KATHU 5/5/2018 474



OlifantsHoek (6/7/2017) (187)



HOTAZEL (11/4/2017) 203



TSINENG PLAN 1 (3/27/2017) 7



C.SOLAR PLANTS

Solar plants with VGWSS supply

Several solar plants are supplied with water from the pipeline and these are (see adjacent figures):

- Kathu Solar Park CPS (molten salt plant)
- Jasper PV 96 MW built in 2014 with 325 000 PV modules
- Lesedi PV (also known as Oakleaf Investment Holdings and Solar Reserve SA Pty Ltd)¹² located on Farm 469 Humansrus adjacent to Jasper
- Adams (Enertronica SA)

Figure 1. Jasper and Lesedi plants built, and



Redstone (under construction)¹³

Figure 2. Adams Solar Plant next to Tshipi Mine¹⁴

PV and CPV plants have the advantage over CSP of not requiring as much water for operations, since there is no steam cycle associated with either technology. Water usage is limited to periodic washing of the modules, which is a function of the amount of dust that collects over time and tolerance for loss in performance due to soiled modules.¹⁵



¹²

[http://www.nersa.org.za/Admin/Document/Editor/file/Consultations/Electricity/Presentations/Lesedi%20Power%20Company%20\(Oakleaf%20Investments%20Holdings%2079%20\(Pty\)%20Ltd.pdf](http://www.nersa.org.za/Admin/Document/Editor/file/Consultations/Electricity/Presentations/Lesedi%20Power%20Company%20(Oakleaf%20Investments%20Holdings%2079%20(Pty)%20Ltd.pdf)

¹³ https://www.solarreserve.com/en/newsroom/photos/redstone-solar-thermal-power-plant/redstone_us2.gif/view

¹⁴ Map source: <http://www.energy.org.za/map-south-african-generation-projects>

¹⁵ <http://www.energy.gov.za/SPark/SA%20SOLAR%20PARK%20Indicative%20Master%20Plan.pdf>

Redstone Solar PV is a planned plant to be located adjacent to Jasper and Lesedi as shown in the figure above.

ACWA Power Solar Reserve (Redstone Solar Thermal Power Plant) will generate electric power by focusing the sun's energy on a tower-mounted receiver using heliostats. The system uses approximately 10 000 heliostats, which are arranged concentrically around the central receiver tower. During the electricity generation process, the hot molten salt is sent to the heat exchanger and is used to generate steam, which produces electricity in a conventional steam turbine cycle. After leaving the steam generator, the salt is sent to the cold salt storage tank and the cycle repeats itself. The steam turbine will be sized for the power generation plant to reach a net electrical output of 100 MW.¹⁶

Section 21(b) of the Act: Storing of water				
1. Storage of Water				
1.1 The Licensee is authorised to store a maximum quantity of five thousand cubic metres (5 000 m ³) of raw water in a carbon steel tank as indicated in Table 1.				
Table 1: Section 21 (b) water uses:				
Water use(s)	Purpose	Volume (m ³ /a) / Dimensions	Property Description	Co-ordinates
Storage of water from Vaal Gamagara pipeline in carbon steel tank	For a 100 MW Concentrated Solar Power (CSP) generation plant	5 000 m ³ (capacity)	Portion 0 of Farm 469	28°17'54.72"S 23°22'1.40"E

Figure 3. Storage of water by Redstone according to the WUL¹⁷

A letter dated 3 May 2018 confirms that Redstone will use approximately 5000m³ from VGWSS,¹⁸

"This communicate serves as confirmation that the ACWA Power Solar Reserve Redstone Solar Thermal Power Plant RF (Pty) Ltd, will provide in the water supply requirements of the ACWA Power Solar Reserve Redstone Solar Photovoltaic Power Plant (PV Project). A potable water supply of approximately 5,000m³ per annum will be allocated for use by the PV Project, from the authorised Sedibeng, Vaal Gamagara Water Supply Agreement."

However, this conflicts with the volume of 275 000 m³/a requested from Sedibeng Water according to the 2018 forms received.

¹⁶ Dept Water and Sanitation. LICENCE IN TERMS OF CHAPTER 4 OF THE NATIONAL WATER ACT, 1998 (ACT NO 36 OF 1998) (THE ACT), 15 January 2016. [Online] available

<https://www.sahra.org.za/sahris/sites/default/files/additionaldocs/16-01-15%20Redstone%20CSP%20WUL.pdf>

¹⁷ Dept Water and Sanitation. LICENCE IN TERMS OF CHAPTER 4 OF THE NATIONAL WATER ACT, 1998 (ACT NO 36 OF 1998) (THE ACT), 15 January 2016. P.6. [Online] available

<https://www.sahra.org.za/sahris/sites/default/files/additionaldocs/16-01-15%20Redstone%20CSP%20WUL.pdf>

¹⁸ <https://www.sahra.org.za/sahris/sites/default/files/additionaldocs/18-05-03%20Redstone%20PV%20Water%20Authorisation.pdf>

1. CONSTRUCTION AND OPERATION

- 1.1 The Licensee shall carry out and complete all the activities, including the construction and operation of the facilities listed in Table 4, according to the Report and according to the final plans submitted with the Integrated Water Use Licence Application as approved by the Provincial Head or Responsible Authority.

Table 4: Geographical positions of all the waste water management facilities

Water use(s)	Purpose	Volume (m ³ /a)/ Dimensions	Property Description	Co-ordinates
Disposal of power generation residue into Evaporation Pond 1	Disposal of heated waste water, brine and domestic effluent	164m ³ per day 60,000 m ³ /annum 15% safety margin on design volumes (Capacity)	Portion 0 of Farm 469	28° 18' 31.1"S 23° 21' 27.6"E 28° 18' 37.2"S 23° 21' 22.9"E 28° 18' 43.9"S 23° 21' 34.3"E 28° 18' 37.8"S 23° 21' 38.9"E
Disposal of power generation residue into Evaporation Pond 2	Disposal of heated waste water, brine and domestic effluent	164m ³ per day 60,000 m ³ /annum 15% safety margin on design volumes (Capacity)	Portion 0 of Farm 469	28° 18' 31.1"S 23° 21' 27.6"E 28° 18' 37.2"S 23° 21' 22.9"E 28° 18' 43.9"S 23° 21' 34.3"E 28° 18' 37.8"S 23° 21' 38.9"E
Disposal of power generation residue into Evaporation Pond 3	Disposal of heated waste water, brine and domestic effluent	164m ³ per day 60,000 m ³ /annum 15% safety margin on design volumes (Capacity)	Portion 0 of Farm 469	28° 18' 31.1"S 23° 21' 27.6"E 28° 18' 37.2"S 23° 21' 22.9"E 28° 18' 43.9"S 23° 21' 34.3"E 28° 18' 37.8"S 23° 21' 38.9"E

Figure 4. Water disposal by Redstone according to the WUL¹⁹

Solar plants with groundwater supply

Two solar plants are located approximately 10 km from the pipeline. Currently these plants are not supplied from the pipeline and are briefly described below.

Kathu Solar Energy Facility (previously known as San Solar Energy Facility)²⁰

Kathu Solar is situated adjacent to Sishen Solar but located on Portion 4 of Farm Wincanton (472); and listed as ReiaSolar or Renewable Energy Investments South Africa (REISA). Located near Deben, this solar energy facility proposes to generate 75 MW of electricity (94 MW installed capacity).²¹ The solar project achieved commercial operation in August 2014, less

¹⁹ Dept Water and Sanitation. LICENCE IN TERMS OF CHAPTER 4 OF THE NATIONAL WATER ACT, 1998 (ACT NO 36 OF 1998) (THE ACT), 15 January 2016. P16. [Online] available

<https://www.sahra.org.za/sahris/sites/default/files/additionaldocs/16-01-15%20Redstone%20CSP%20WUL.pdf>

²⁰ Contact: +27 21 670 1400 and info@reiasolar.co.za

²¹ <https://www.sahra.org.za/sahris/sites/default/files/additionaldocs/San%20Solar%20FEIR.pdf>

than two years after construction started in November 2012. REISA comprises 343 200 solar modules on 210 hectares.

Renewable Energy Investments SA (RF) Pty Ltd is owned by Old Mutual, various funds managed by African Infrastructure Investment Managers (AIIM), BuiltAfrica Kathu Pty Ltd and the Local Community Trust.²²

Its water use is estimated at 7000m³/a for operations. The main source of water is from boreholes. The developer also has the option to buy non-potable water from Kathu on an ad hoc basis according to the EIA report. Maintenance activities include replacement and cleaning of the panels using water and/or pressurised air.²³



Figure 5. Sishen Solar Facility (indicated with red pin) located on Portion 6 of Farm 472 Wincanton and Kathu Solar Energy Facility (south of red pin), and showing Dibeng to the west

Sishen Solar Energy Facility (photovoltaic)²⁴

The project consists of the construction and operation of a solar PV facility located on Portion 6 of the Farm Wincanton 472 near Deben. It has a total net contracted capacity of 94 MW. The facility is constructed on a 620-ha site. The full generation capacity of the plant is to be sold to Eskom under a 20-year power purchase agreement. Project value was R1.8-billion, and it came online in November 2014. The Sishen plant was developed and built by ACCIONA

²² <https://reisasolar.co.za/solar-field/>

²³ PROPOSED SAN SOLAR ENERGY FACILITY AND ASSOCIATED INFRASTRUCTURE, NORTHERN CAPE PROVINCE, Final EIA Report, December 2012. P 31 [Online]. Available from:

<https://www.sahra.org.za/sahris/sites/default/files/additionaldocs/San%20Solar%20FEIR.pdf>

²⁴ Barradas, S. Sishen solar photovoltaic power project, South Africa. 18th October 2013. Creamer Engineering News. [Online]. Available from: <http://www.engineeringnews.co.za/print-version/sishen-solar-photovoltaic-power-project-south-africa-2013-07-26>

together with local partners.²⁵ The project was planned within a ringfenced in a special-purpose vehicle namely Windfall 59 Properties (RF). Acciona Energy South Africa has a 51% shareholding and Aveng Africa 29%. The Dibeng Trust, established with a local community shareholding and a nonprofit organisation, each acquired a 10% shareholding at financial close.

The plant covers approximately 250 hectares. It has 319 600 modules (photovoltaic panels) supported on 470 horizontal structures (trackers) that are programmed to follow the sun's rays across the sky from west to east daily to optimize the rays.²⁶

Its planned O&M water use is unknown.

Summary of water use at solar plants

The 2017/18 water supply to solar plants from the VGWSS was about 71 000 kℓ/a. With the addition of Redstone, which is under construction, this will increase to an estimated 0.5 million kℓ per annum. Two plants near Deben are estimated to use 14 000 kℓ/a from groundwater sources.

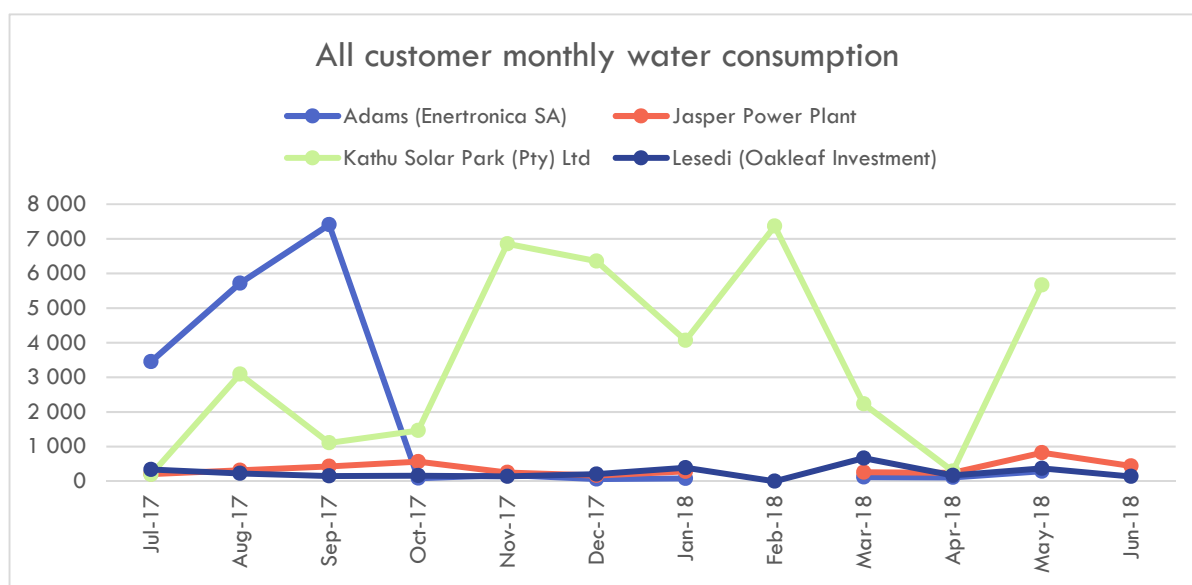


Figure 6. Monthly water consumption at solar plants from VGWSS 2017/18

²⁵ Contact: Acciona, tel +34 91 663 28 50, fax +34 91 663 28 51 or email comunicacion@acciona.es.

²⁶ <https://www.acciona-energia.com/areas-of-activity/photovoltaic/major-projects/sishen-photovoltaic-plant/>

Table 2. Water use of solar plants in kℓ/a (Sedibeng water sales 2017/18 incomplete data Feb & Jun filled in with ave)

[illegible]