water affairs

Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

Progress Reports presented at the third meeting on 21 October 2010 of the Vaal River System Strategy Steering Committee

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1. Water Use Compliance Enforcement (Eradication of Illegal Water Use) in the Vaal River

1. BACKGROUND

The additional water use from possible illegal water use that has been identified up to now is putting the Vaal River system at risk. The total use in the system is already higher than the yield from the system. The only reason why this is not evident is because of higher than normal rainfall during the last number of years resulting in a full system. Even a moderate drought will result in curtailments on the Vaal system. This may have significant economic implications for the country as a whole and therefore this project to control illegal water use must be successfully executed.

The Gauteng and Free State Regional Offices have been undertaking the validation and verification of irrigation water use in the Upper- and Middle Vaal Water Management Areas (WMA) respectively, whilst these processes have now commenced under this project in the Lower Vaal WMA (resorting under the Northern Cape Region). During the validation process a number of possible illegal water users were identified. An estimated volume of 236 million m^3 of water is possibly used illegally for irrigation purposes per annum in the total Vaal catchment. These irrigators are *inter alia* using water that is supplied through expensive water transfer projects built and paid for by the domestic and industrial users of the Vaal River system. Table 1 shows a breakdown of the possible illegal use (from surface and ground water resources) by WMA.

Table 1: Breakdown of possible illegal water use per WMA

WMA	Possible illegal water use (m^3/a)	Possible illegal volume based on:
Upper Vaal	180 000 000	Validation of water use (Verification 44% completed)
Middle Vaal	26 000 000	Validation of water use (Verification 25% completed)
Lower Vaal	30 000 000	Estimated (Validation/Verification to start soon)
Total	236 000 000	

A Professional Service Provider (PSP) has been appointed to assist the Department in addressing the illegal water use in the Vaal System. Services inter alia include the provisioning of Project Management, Completing Validation and Verification, the development of effective and sustainable implementation of Compliance Monitoring and

Enforcement, the development of contingency plans should the desired results not be achieved or take too long, as well as Communication with stakeholders. The project started on 01 June 2010 and the appointment is for three years.

The Departmentôs Director: Water Resources Management Support is the Project Manager and is assisted by the three Regional Offices involved, as well as by other relevant Directorates. A Departmental Project Management Committee is overseeing the project.

2. PROGRESS

2.1 Validation and Verification

The PSP is in the ñInception Phaseò of the abovementioned project at present and the three Regional Offices included in the project were visited by the PSP to introduce the project and to establish the status quo for each WMA. The main deliverable of the ñInception Phaseò is the development of a Project Execution Plan (PEP) and the information gathered during the visits to the Regions will guide the steps and priorities of the PEP. A PEP Workshop was held with the Departmental Project Management Team in September 2010 and the PEP should be completed and presented before the end of October 2010. The status quo in terms of the number of properties involved in the Validation/Verification process is shown in Table 2.

Table 2: Status quo in Vaal River System

Item	Vaal System			
	Upper	**Middle**	**Lower**	**Total**
Irrigation properties	3 723	3 042	1 872	8 637
Validation completed	3 723	3 042	-	6 765
Verification in process	1 374	Under assessment	-	1 374
Verification not started	1 855	Under assessment	-	1 855
Verification completed	494	Under assessment	-	494
Properties - illegal use	857	325	*350*	1 532
Illegal volume (mil m3)	180	26	*30*	236

During the development of the PEP, certain priority areas were identified and these areas are summarised in Table 3. These areas mainly include water sources with a high level of assurance and also those water bodies conveying transfer water.

Table 3: Priority areas

Vaal System		
Upper	**Middle**	**Lower**
Vaal main stem	Vaal main stem	Vaal main stem
Vaal Dam	Vals	Louwna Coetzers Dam
Ash/Liebenbergvlei	Bosluisspruit	Boshoff/Hertzogville
Wilge	Makwassiespruit	Sannieshof
Klein Vaal	Schoonspruit dolomites	

2.2 Regulations

Regulations to enforce the measurement of taking water for irrigation purposes is a further prerequisite for action against partially lawful water users. The process for having such regulations published is far advanced. Internal technical consultations / liaison as well as with the State Legal Advisor has been completed and preliminary (informal) liaison with Organised Agriculture has been undertaken. It is envisaged that, once internal consultations with the Departmentôs Management has been concluded, a submission will be made to the Minister to publish the draft regulations for public comment.

2.3 Compliance Monitoring and Enforcement (CME)

Discussions were held with DWA Regulation / CME and the development of a standard operating procedure that will guide the CME process for the project is in process. During the PEP Workshop it was proposed that a top 100 list be compiled for each WMA in terms of illegal use and that these properties should receive immediate attention. As the Upper Vaal WMA is already at an advanced stage in terms of verification a breakdown of the number of properties based on the possible illegal surface water use for this WMA (excluding groundwater use) is presented in Table 4.

Table 4: Upper Vaal Illegal use - Surface Water

Range	**Number of properties**	**% of total illegal properties**	**Total illegal volume (m3/a)**	**% of total illegal volume**
< 30	207	24.2	2 762 148	1.65

30 -100	216	25.2	12 691 437	7.57
100 - 299	219	25.6	35 810 866	21.37
250 - 499	132	15.4	43 530 854	25.98
500 - 999	62	7.2	41 840 412	24.97
1 - 2 Mil	18	2.1	23 504 424	14.03
> 2 Mil	3	0.4	7 434 222	4.44
Total	**857**	**100**	**167 574 362**	**100.00**

From Table 4 it is evident that 9.7 % (83) of the properties in the Upper Vaal WMA is using some 43 % of the illegal volume. These properties will receive the highest priority. Although the number of properties is not large, they pose a major challenge since most of these users are using legal advisors. Experience has shown that in many cases where possible unlawful water use has been identified in the section 35 verification processes (in terms of the National Water Act) the user will use an attorney, who in many cases then supplies spurious or irrelevant data regarding the lawfulness of the use, to the Department. In some cases this is seen as a contrived effort to frustrate the process for the benefit of the unlawful water user.

The aim of the CME process in the Upper Vaal is to address the users who are using more than 100 000 m3/a illegally (90% of the illegal volume), before the end of 2011.

Detail for the remaining WMAs will be included in the next report when detailed information is available.

2.4 Contingency plans

Work has commenced on identifying possible contingency measures, should the desired results not be achieved, or not achieved in time. These will be discussed with the relevant role players first to prevent unnecessary additional work.

2.5 Communication

A communication strategy is being developed in close consultation with the Department's Communications and Regulation Chief Directorates. Regional communications strategies are also being developed addressing the specific needs in each Region.

3. SUMMARY AND CONCLUSION

In view of the above and of experience gained in the process to date, it is unlikely that the target date of 2011 for the eradication of all unlawful irrigation water use in the Vaal River will be met. Substantial progress has however been made with the most critical activities, i.e. validation and verification of water use in the Upper Vaal WMA and preparations for the publishing of regulations to enforce the measurement of water use for irrigation purposes. This was done under a separate contract for the Upper Vaal, before the PSP for this project covering the whole Vaal River had been appointed.

As stated in paragraph 2.3, the aim is to address 90% of the illegal volume used in the Upper Vaal WMA before the end of 2011. Detail for the Middle and Lower Vaal WMAs will be included in the next progress report, once the required information is available.

A programme for the project with deliverables will be available by the end of October 2010, once the Project Execution Plan has been finalised. Work has however been proceeding in parallel in all three WMAs since the appointment of the PSP for this project in June 2010, based on the experience and momentum generated under the previous projects for the Upper and Middle Vaal WMAs.

2. Gauteng Municipalities Water Conservation and Water Demand Management Progress Report

Introduction

The Large Bulk Water Supply Reconciliation Strategy Study for the Vaal River System Study (DWAF, 2006) has the purpose to develop a strategy for meeting the growing water requirements of the industrial and urban sectors that are served by the Integrated Vaal River System (IVRS). Water conservation and water demand management (WCWDM) have a major potential impact on the future water requirements which were assessed and documented in the report on the **Potential Savings through Water Conservation / Water Demand Management (WC/WDM) in the Upper and Middle Vaal Water Management Areas** (DWAF, 2006b).

The purpose of this report is to provide feedback on the progress made by Gauteng municipalities on the Water Conservation and Water Demand Management (WC/WDM) in order to meet the 15% reduction in urban water demand by 2013.

Strategic Progress

Workshops and meetings

The following workshops and meetings have been held:

Name	Date	Purpose	Outcomes
WCWDM Workshop Seminar held at Rand Water	19 May 2010	Discuss details of Project 15% ito targets, budgets, expected outcomes. Clarify issues with municipalities	Improved understanding by municipalities on target expectations and deliverables
WCWDM task team meeting	6 July 2010	Review progress and deliverables	Updated progress report
WCWDM training workshop	22 July 2010	Provide training to municipalities on targets, water balance calculations, interventions, software, etc	Improved understanding of benchmarking, available software, distribution of cd with templates, manuals, software, etc
Collaboration meetings with municipalities	Various	Review business plans and target setting.	Progress meetings held with : CoJ, EMM, CoT, EMF, Mogale City and Randfontein

Steering committees

The following task teams have been setup.

Name	Representatives	Purpose
WCWDM core team towards up scaling the implementation of project 15% water savings in Gauteng municipalities	DWA WUE and Gauteng Region	Target setting Monitor and audit the implementation of project 15%
WCWDM task Team towards up scaling the implementation and tracking thereof of project 15%	Provincial DLG&H and DWA (HO & RO)	To track the implementation of project 15%
WCWDM technical sub-task team towards up scaling the implementation of project 15% water savings in Gauteng municipalities	DWA WUE and Gauteng Region Rand Water	Business Plan review

Milestones and outcomes

- All municipalities have a much better understanding of the targets, urgency, expected deliverables and feedback required. Implementation is still a concern.

Data updates

The following major updates and changes have been made since the Vaal River WCWDM Potential Assessment completion report submitted in 2006.

- 2008 Refinement and update of projected savings, costs and unit reference values as part of the Vaal River Second Stage Reconciliation Strategy.
- 2009, Update of current water demand and NRW figures.
- 2009, Update of project budgets to 2009 baseline. Project costs inflated by CPIX plus 1%.
- 2009, Inclusion of remaining municipalities not included in the original study. Baseline based on Rand Water study completed for these municipalities in 2006.
- 2010, Update of current water demand and NRW figures.
- 2010, Update of water demand projections to 2009-10 base year incorporating water reduction to date.

Municipal Progress

Active programmes

<table>
<tr><th>Municipality</th><th>Key WC/WDM programmes</th></tr>
<tr><td>City of Johannesburg</td><td>

Pressure management, leak detection and hostel retrofitting projects under ACIP programme.
Consumer education and awareness campaigns (Water Warriors)
Operation Gcinâmanzi, suspended in March 2008, has restarted. Action plan to revisit 40 000 of existing 100 000 installations for connection bypasses, malfunction, etc. by end of 2010. Completion of remaining 60 000 installations set to start in 2011.
Key performance indicators
<table>
<tr><th>Year</th><th>2008/09</th><th>2009/10</th></tr>
<tr><td>Input volume (million m^3/annum)</td><td>505.35</td><td>502.96</td></tr>
<tr><td>NRW volume (million m^3/annum)</td><td>191.53</td><td>192.28</td></tr>
<tr><td>% NRW</td><td>37.9%</td><td>38.2%</td></tr>
<tr><td>Gross litres/capita/day</td><td>359</td><td>319</td></tr>
</table>

Total demand has decreased but losses have increased.
Expected to improve once Operation Gcinâmanzi resumes

</td></tr>
<tr><td>City of Tshwane</td><td>

Metering & monitoring water usage to all informal and un-billed areas.
Meter audits for all industrial areas, with subsequent meter installations and meter replacements.
Meter audits for all parks and irrigated road islands, with subsequent meter installations and meter replacements.
Pressure management in selected areas.
Ad-hoc leak detection and repair activities
Key performance indicators
<table>
<tr><th>Year</th><th>2008/09</th><th>2009/10</th></tr>
<tr><td>Input volume (million m^3/annum)</td><td>274.45</td><td>265.85</td></tr>
<tr><td>NRW volume (million m^3/annum)</td><td>78.27</td><td>70.42</td></tr>
<tr><td>% NRW</td><td>28.5%</td><td>26.5%</td></tr>
<tr><td>Gross litres/capita/day</td><td>329</td><td>294</td></tr>
</table>

Total demand and losses have decreased.

</td></tr>
</table>

<table>
<tr><th>Municipa-lity</th><th>Key WC/WDM programmes</th></tr>
<tr><td>Ekurhuleni</td><td>

Major consumer meter audit and retrofitting programme. This programme is also focusing on the top 500 bulk consumers
Key performance indicators
<table>
<tr><th>Year</th><th>2008/09</th><th>2009/10</th></tr>
<tr><td>Input volume (million m3/annum)</td><td>327.89</td><td>319.75</td></tr>
<tr><td>NRW volume (million m3/annum)</td><td>126.55</td><td>123.46</td></tr>
<tr><td>% NRW</td><td>38.6%</td><td>38.6%</td></tr>
<tr><td>Gross litres/capita/day</td><td>302</td><td>263</td></tr>
</table>

Total demand has decreased but losses have remained the same.

</td></tr>
<tr><td>Emfuleni</td><td>

Consumer meter replacement programme
Sebokeng / Evaton advanced pressure management programme handed back to municipality after 5 year PPP. Audited savings = 46.8million m^3 saving over 5 years
Key performance indicators
<table>
<tr><th>Year</th><th>2008/09</th><th>2009/10</th></tr>
<tr><td>Input volume (million m^3/annum)</td><td>79.32</td><td>79.56</td></tr>
<tr><td>NRW volume (million m^3/annum)</td><td>32.27</td><td>35.31</td></tr>
<tr><td>% NRW</td><td>40.7%</td><td>44.4%</td></tr>
<tr><td>Gross litres/capita/day</td><td>285</td><td>256</td></tr>
</table>

Total demand has remained constant but losses have increased considerably.

</td></tr>
</table>

The other smaller municipalities are also busy with various WCWDM programmes which include:

- Consumer metering and billing
- Customer awareness
- Training and capacity building

Targets and achievements (2005 to 2010)

The total reduction in water consumption and reduction in NRW is summarised in Table 1.

Table 1: Summary of total water and NRW reduction

Municipalities	2009-10 Projected Demand with no WDM (million m^3/a)	2009-10 Actual Demand (million m^3/a)	Total Reduction (No WDM less actual) (million m^3/a)	2004-05 NRW (million m^3/a)	2014-15 Potential savings (million m^3/a)	2009-10 NRW (million m^3/a)	NRW reduction (million m^3/a)
Johannesburg	510.51	502.96	7.56	168.51	110.16	192.28	0
Tshwane	305.34	265.85	39.49	72.15	20.31	70.42	1.73
Ekurhuleni	337.38	319.75	17.64	83.40	28.26	123.46	0
Emfuleni	90.97	79.56	11.41	34.92	26.10	35.31	0
Mogale	27.18	27.26	-0.07	6.12	2.85	8.04	0
Westonaria	5.32	6.40	-1.08	1.75	0.78	1.90	0
Randfontein	9.78	8.74	1.04	2.13	0.36	1.91	0.22
Lesedi	5.55	5.54	0.01	0.50	0.35	1.24	0
Kungwini	25.56	25.00	0.56	6.38	4.97	10.50	0
Nokeng	2.13	2.16	-0.03	0.49	0.24	0.56	0
Merafong City	11.71	10.29	1.42	2.71	1.35	2.68	0.03
Midvaal	11.14	11.28	-0.13	1.93	0.96	2.78	0
Total	**1 342.58**	**1 264.78**	**77.80**	**380.97**	**196.69**	**451.07**	**1.98**

Although total water consumption is 77.8million m^3 below the projected demand for 2009-10, NRW reduced only by 1.98million m^3. The 77.8million m^3, is 40% of the targeted 196million m^3 which is to be achieved by 2015. The main contributors to the reduction in water demand are as follows:

- **City of Tshwane :** Tariff setting and water loss control programme
- **Ekurhuleni :** Consumer metering and billing
- **Emfuleni :** Advanced pressure management project

Other influencing factors include :

- Economic downturn
- High rainfall during Nov 2009 to Feb 2010

Table 1 shows that the reduction in total consumption was achieved by improved efficiency and not reduction in NRW. Although a reduction in demand is required to avoid potential water restrictions, both NRW and efficiency need to improve in order to achieve the targets in a sustainable manner.

Updated targets (2010 to 2015)

Figure 1 shows the 2004-05 versus the 2009-10 targets. The water demand targets were updated to reflect 2009-10 as the base year. The reduction set in 2005 remains the same but the demand curve has been reduced by 77.8million m^3 to allow for the reduction achieved to date.

The 2004-05 target required an annual water demand of 1 330million m^3 by 2015. The revised target, requires an 180million m^3 saving in NRW which will reduce the water demand to approximately 1250million m^3 by 2015.

The original 5 year WDM scenario required an 180million m^3 reduction in NRW after 5 years, increasing to 196million m^3 (2010) after 10 years (2015). Since the NRW has not reduced to date, an 180million m^3 reduction is therefore still required to achieve the NRW targets set.

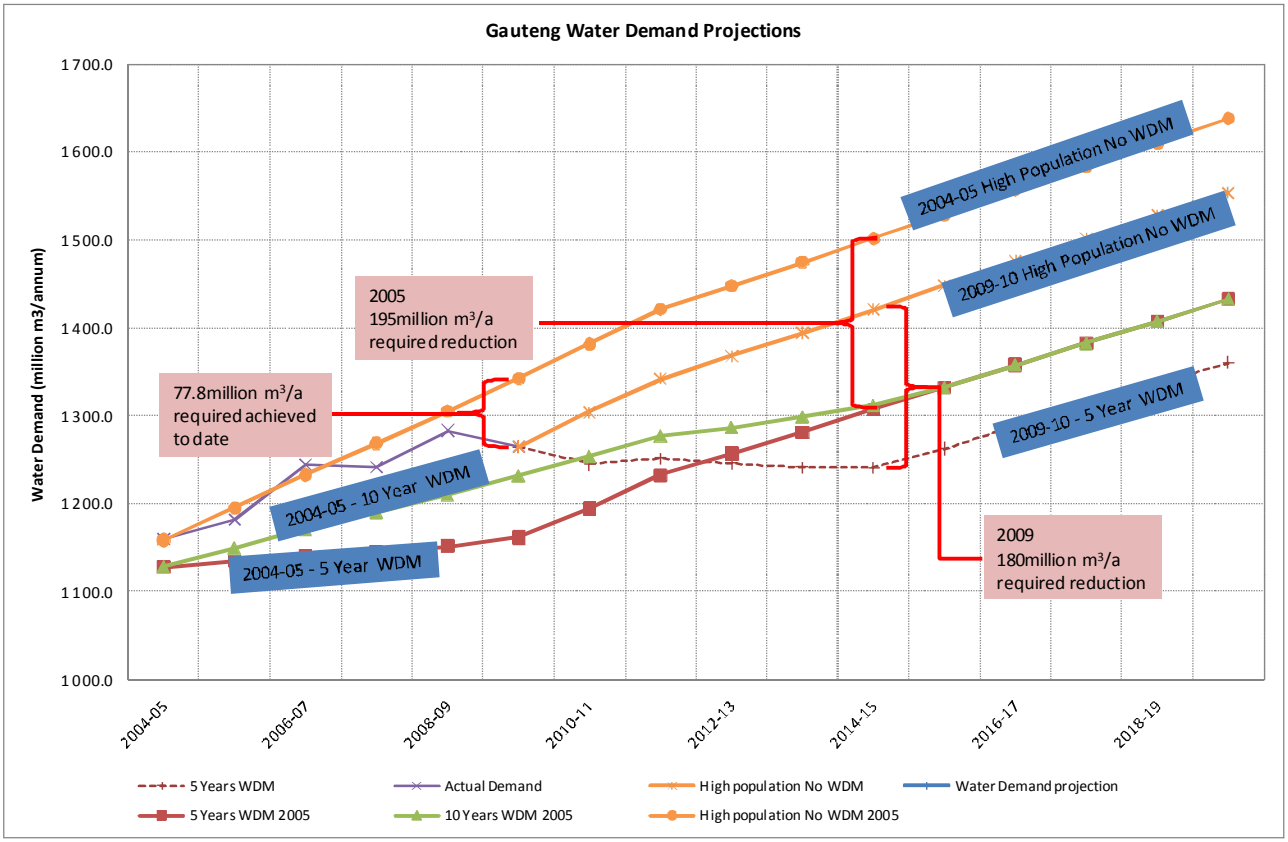


Figure 1: Gauteng municipalities' water demand projection

Figure 2 shows the revised target reduction in water demand versus the actual demand.

In essence, a zero percentage growth in water demand is required over the next 5 years to avoid possible water restrictions.

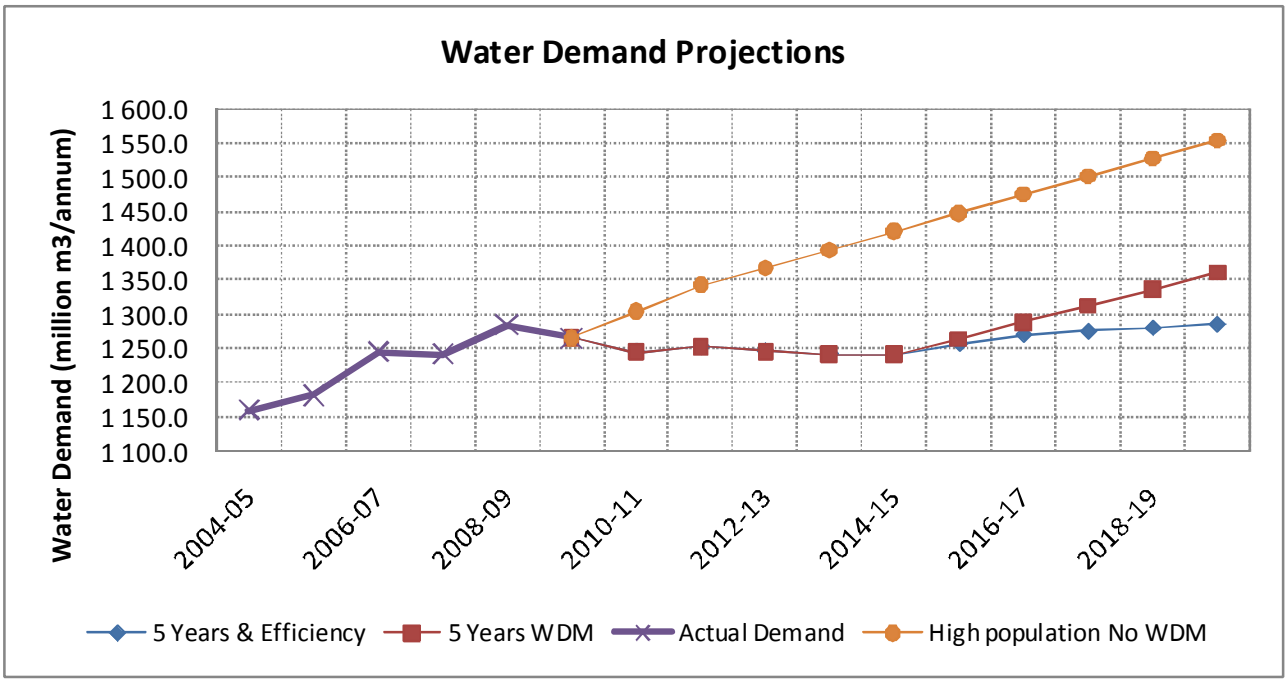


Figure 2: Projected annual reduction

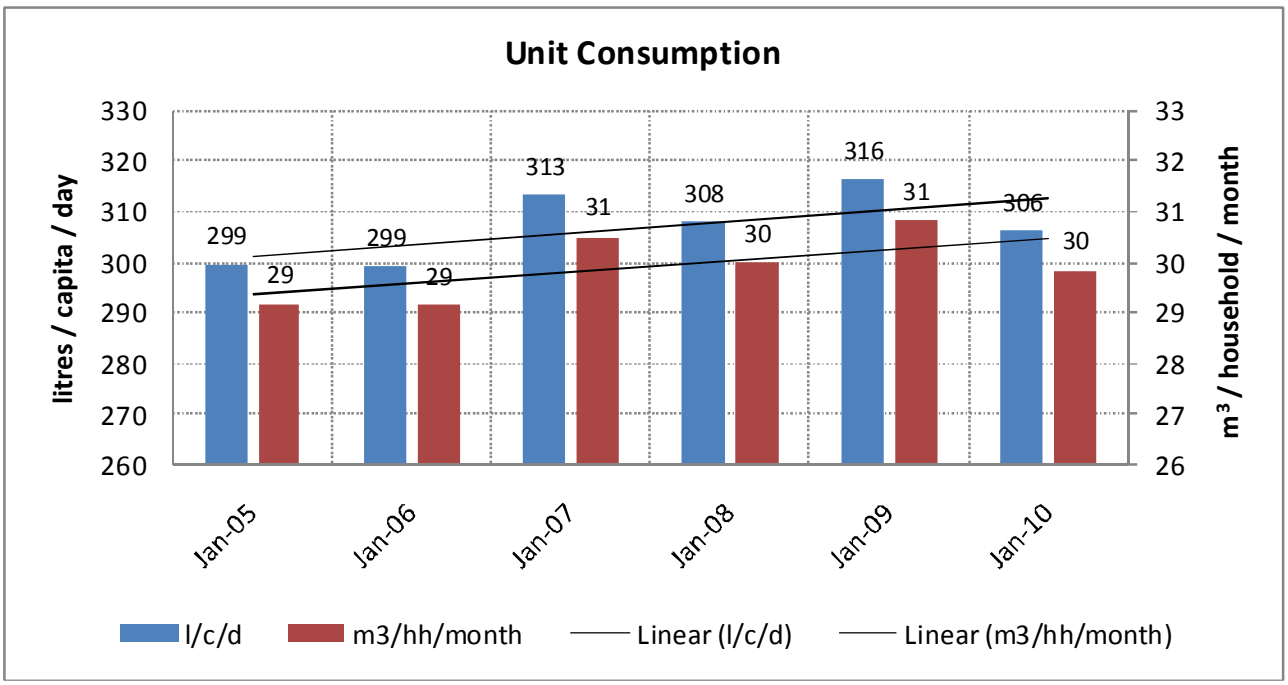


Figure 3: Average unit consumption for Gauteng municipalities

The unit consumption above is based on the total municipal water consumption divided by the total population and number of households as obtained from the DWA: National Information System. There is a reduction in the average litres/capita / day over the past year which is attributed to the total reduced consumption.

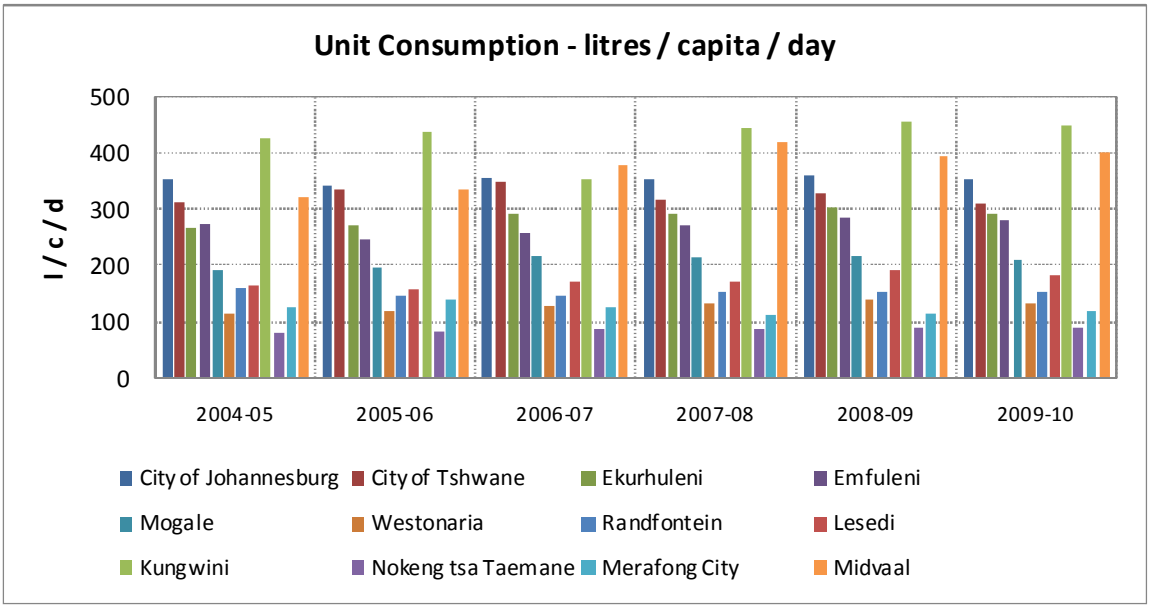


Figure 4: Litres / capita / day unit consumption per municipality

The average consumption in the four big municipalities is 308l/c/d whereas the average for the other municipalities is only 216l/c/d. Johannesburg has the highest average consumption of 352l/c/d for the metros although the municipality has very few wet industries. Ekurhuleni has the most wet industries of the three metros but the lowest average consumption of 291l/c/d. The average consumption for Kungwini is very high but their number still need verification and Midvaal is high due to the Heineken beer factory.

Despite the reduction of 77.8million m^3 reduction in the water demand, non-revenue water remains high at 35.7% as shown in Figures 5 and 6.

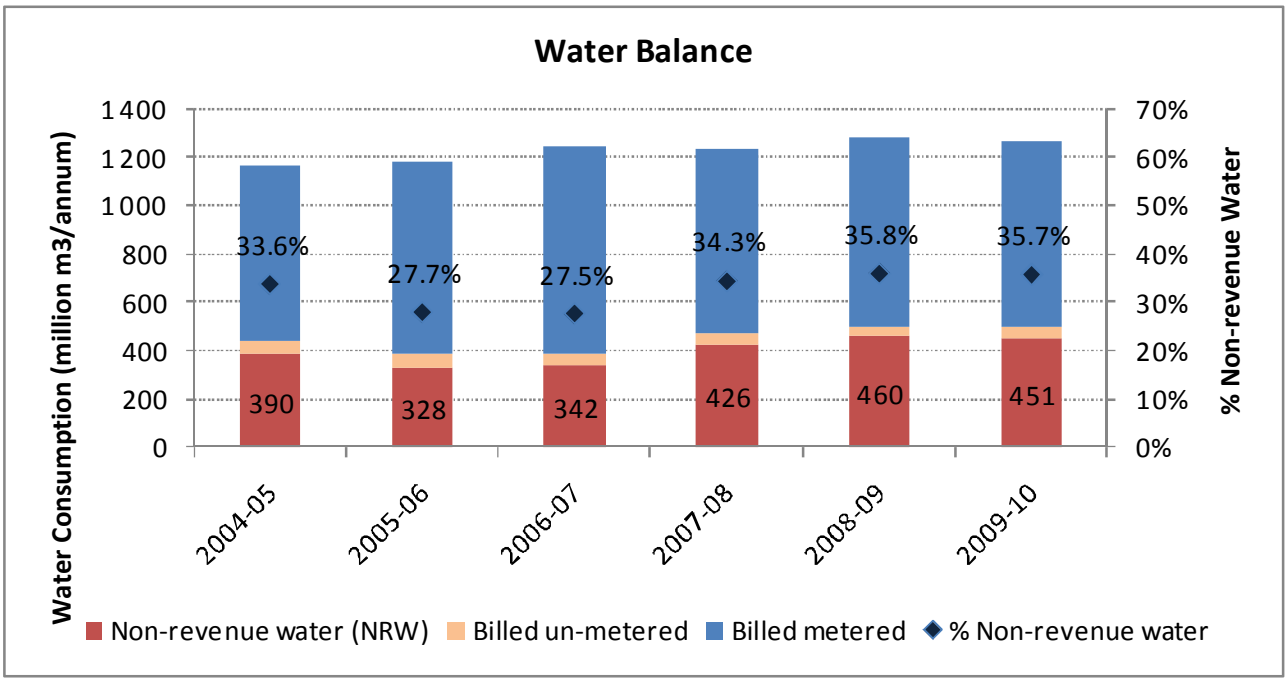


Figure 5: Gauteng Water Balance

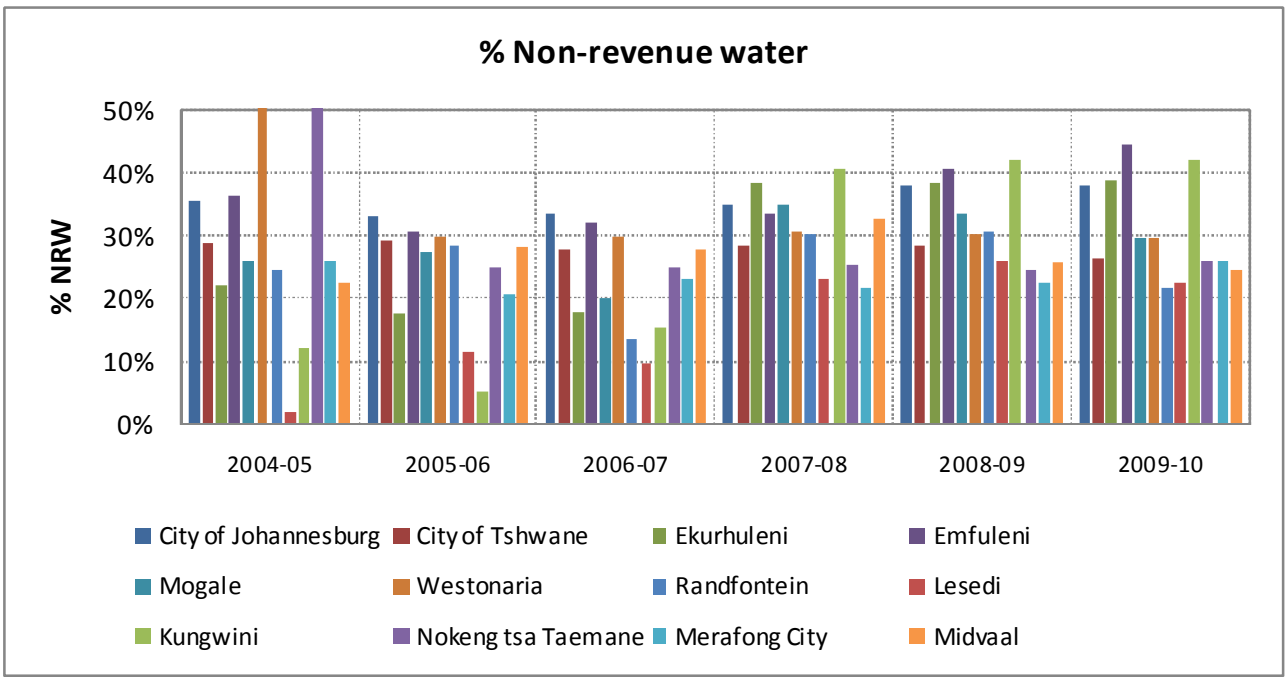


Figure 6: NRW per municipality

Funding

- According to municipalities, funding remains the main key stumbling block for implementation

Possible funding sources

- Accelerated community Infrastructure Programme (ACIP) ï R33 million to City of Johannesburg
- Rand Water ï R 4million to Emfuleni, Ekurhuleni and Lesedi (none confirmed)
- DBSA and the Swedish International Development Cooperation Agency (SIDA) ï Phase 3 of the regional (SADC) WDM programme
- Reduction of Non-revenue water through metering, billing and revenue collection from municipal end users.

Conclusions

- The total water demand for the Gauteng municipalities has decreased by 77.8million m^3 below the projected demand (no WCWDM interventions).
- Despite the total reduction, the non-revenue water has remained constant.
- Almost 50% of the savings were achieved in Tshwane municipality who has an active WDM programme and aggressive tariff setting to promote efficient use.

- City of Johannesburg, the biggest potential contributor to the total savings has restarted their water loss project in Soweto which should have a considerable impact. This programme has been suspended since 2007 following the court case on pre-paid meters.

Planned actions and way forward

- Municipalities must increase their drive on the implementation of Project 15%
- Regular meetings with municipalities to monitor progress and performance ï municipalities to report regularly
- Update performance targets to 2009 base year.
- Update progress on total consumption and reduction of non-revenue water.

2A. Johannesburg Water Progress Report

1. STRATEGIC PRIORITY

Strategy and governance

2**. PURPOSE**

The purpose of this report is to provide an update on the progress of Water Conservation/ Water Demand Management interventions in the City of Johannesburg.

3. **BACKGROUND**

The Vaal River System Strategy Steering Committee, on the 24 February 2010 resolved that:

"The four big Gauteng municipalities must report directly to the SSC on the progress of WC/WDM and not through the Directorate: Water Use Efficiency.

4. DISCUSSION

The City of Johannesburg has a population of approximately 3.8 million people residing in 1.1 million households that are expected to consume increasingly more water as a result of growth, economically as well as socially. The City is also the biggest water consumer out of the Vaal River catchment area, thus making water conservation and water demand management increasingly important.

The City of Johannesburg initiated its first formal Water Conservation Policy in 1987 and was published in a report entitled "Water Conservation Policy and Proposals for Implementation", report number WC 0062-01-00-0897.

Since 1997, considerable progress has been made in the area of water conservation with the main emphasis on Water Demand Management in the main distribution system. Numerous initiatives have been undertaken in the supply area by both the Johannesburg Water and Rand Water who supplies the potable bulk water.

In the beginning of 2008 when the revised Water Demand Management and Conservation strategy was approved the annual water demand was 493,000 mega litres. Historically the annual demand growth is 3.93%. Thus at this growth rate the annual demand in 10 years time would be 724,000 mega litres per annum which could not be supplied by the Vaal Catchment with out any augmentation.

4.1 2010/11 Water Demand Management Program

Based on the budget available for water demand management for the 10/11 financial year only the following interventions are implemented or existing ones maintained:

- Direct Measurable Interventions

- - Pressure Management (Maintenance of existing smart controlled stations and implementation of one new smart controlled station)
- - Mains Replacement
- - Active and passive leakage control

- Indirect Measurable Interventions
  - Sectorisation (Maintaining existing water management zones)
  - Management meters (Maintaining existing water management zones)
  - Management/ Monitoring performance targets (Monthly UFW calculation)

- Consumer Demand Management
  - Tariff Structures
  - Accurate meter reading, billing & cost recovery

Budget requirements

The table below indicates the budget required to implement the WDM interventions and the actual budget allocated from both Capex and Opex.

	09/10	10/11
Allocation	195,400,000	287,300,000
Implementation costs	307,630,000	302,980,000

4.2 Progress on the WDM program

4.2.1 Water Mains Replacements

One of the contributing factors to the high water demand within the City of Johannesburg is the age of the water reticulation infrastructure as well as the materials used to manufacture pipes in the past. This is causing pipes to burst more frequently and also makes maintenance of the pipes difficult.

Johannesburg Water has approximately 11 300 km of water reticulation mains with great variability in the condition of the pipe. Due to the unavailability of a comprehensive Infrastructure Asset Management Plan different ways were looked at to identify old water infrastructure as an interim solution. One method used for determining the status or condition of the water reticulation mains within Johannesburg Water supply was to do an analysis of the number of water pipe bursts per water pipe asset and then to sum it up into the number of water pipe bursts per kilometre per suburb.

Once the frequency of burst pipes in a particular section of pipe becomes excessive (>4 bursts/km), it is often an indication that the pipe has reached the end of its useful life and needs to be replaced. Thus the frequency of burst pipes will then assist to prioritize areas where the pipe condition is in a bad state and requires replacement. In the past, water mains in the Johannesburg Water's supply area were

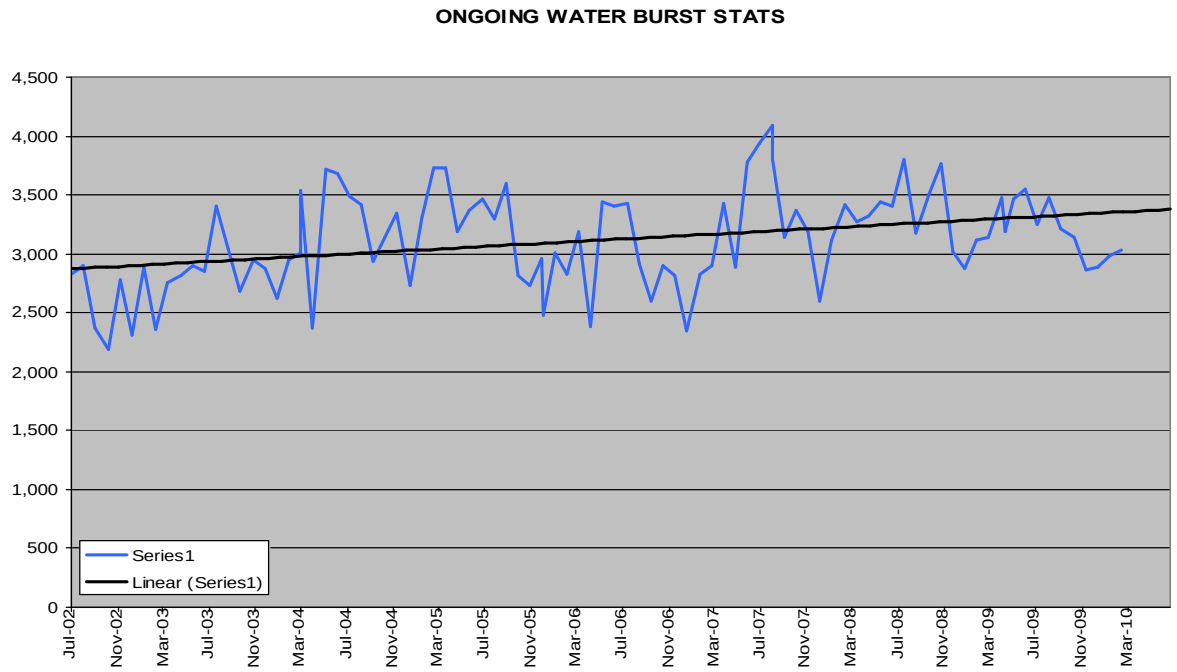
replaced on an ad hoc emergency basis. This however changed towards the end of 2007 and a project was initiated whereby water mains were replaced on a priority basis predominantly based on burst frequencies and pipe material.

Following the above process thirty three (33) suburbs were prioritized for block mains replacement as the starting point. The projects were then rolled out in a phased approach and currently 50% of the originally identified suburbs have been completed. The impact or effectiveness of the project is measured by comparing the number of pipe bursts experienced before the project with the number of pipe bursts experienced after completion of the project.

The success of this project was based in the reduction of burst frequencies in the suburbs identified before and after implementation, including the impact it should make on the water demand for the identified areas. A minimum of 12 months worth of data was used and to date there is a 90% reduction in the number of pipe bursts experienced.

The challenge for this project is the availability of funding to implement the infrastructure renewal to such a scale that it will represent at least 2% of the total infrastructure every year. With the current implementation rate we only achieved a 1% replacement rate.

Figure 1: Graph indicating the reduction of overall water bursts experienced



4.2.2 Pressure Management

14/4/12/14/1: Vaal River System Strategy Steering Committee – Meeting 3

This programme is aimed at reducing high night time pressures to decrease back ground leaks (leaks that is uneconomical to fix) and to limit unnecessary pipe bursts caused by the high pressures.

Pressure Management is implemented in the Parktown 2 Reservoir District as well as the Sandton Bulk Supply Lines. The pressure reducing valve and associated fittings at the Parktown 2 district installation is complete, although the chamber is complete certain outstanding modification will take place to cater for road reinstatement and storm water control.

The process of procuring the advanced pressure reducing equipment is in progress and the installation of the advanced pressure reducing equipment will be done as soon as the modifications on the chamber are completed towards October 2010. The pressure reducing installation at the Sandton Bulk Supply lines is complete and commissioned. The impact on the water demand at this installation is currently being measured and results should be reported on in the coming months.

Thirty Five (35) smart controlled pressure management systems are currently operational in the water reticulation network of Johannesburg Water (Pty) Ltd since 2000. The smart controlled pressure reducing valves installed have two modes of operation: 1) Time based with the controller set to automatically reduce the pressure during certain predetermined time slots and 2) A flow modulator that adjusts the pressures based on demand flow rates.

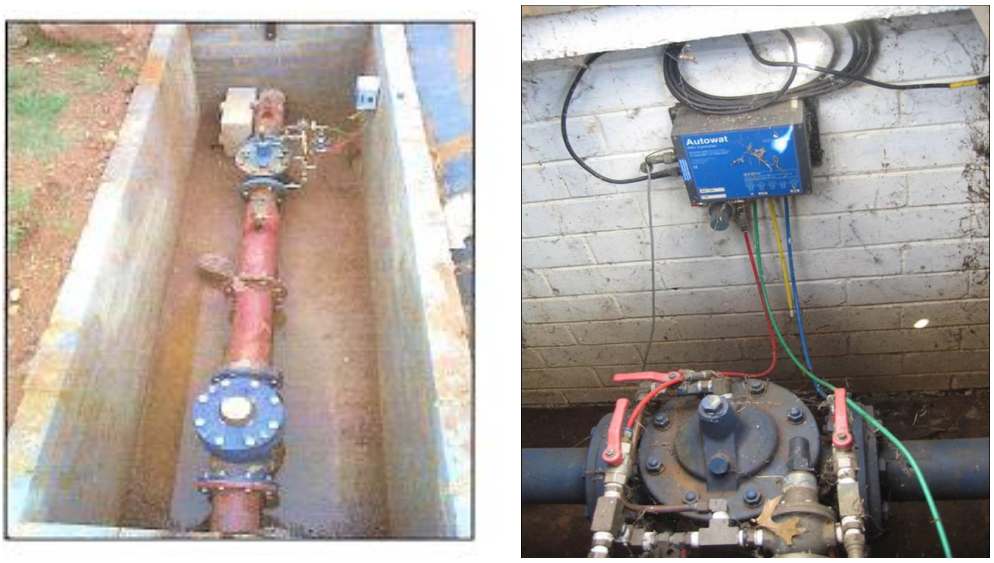


Figure 2: Smart Pressure Reducing Installations

Based on savings, the payback period for the installation of the smart controlled pressure management systems was less than 12 months. The total savings equals R1.5 million per annum for the installations installed since 2000.

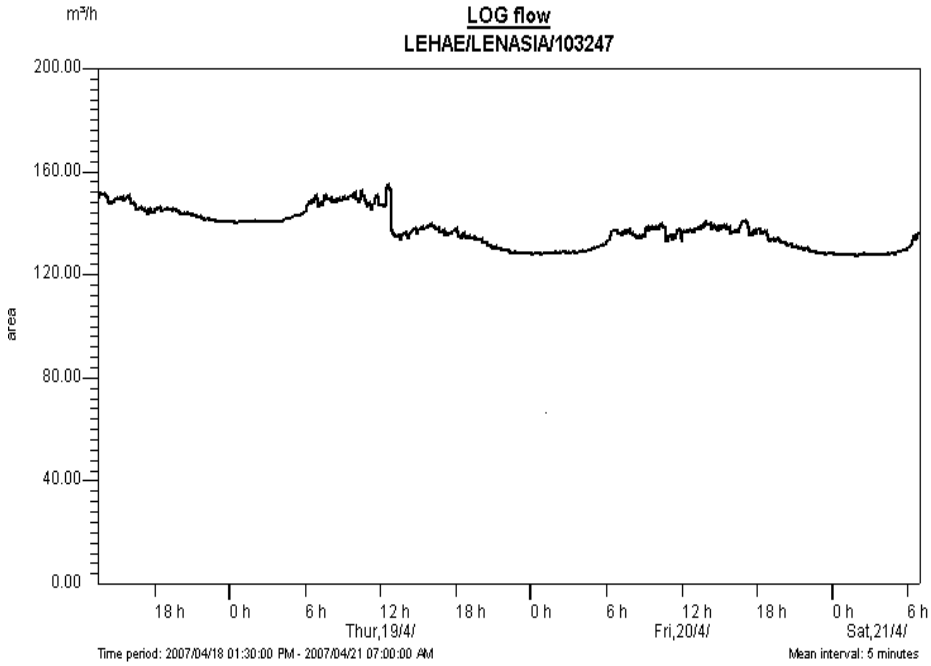


Figure 3: Flow Logging - Before

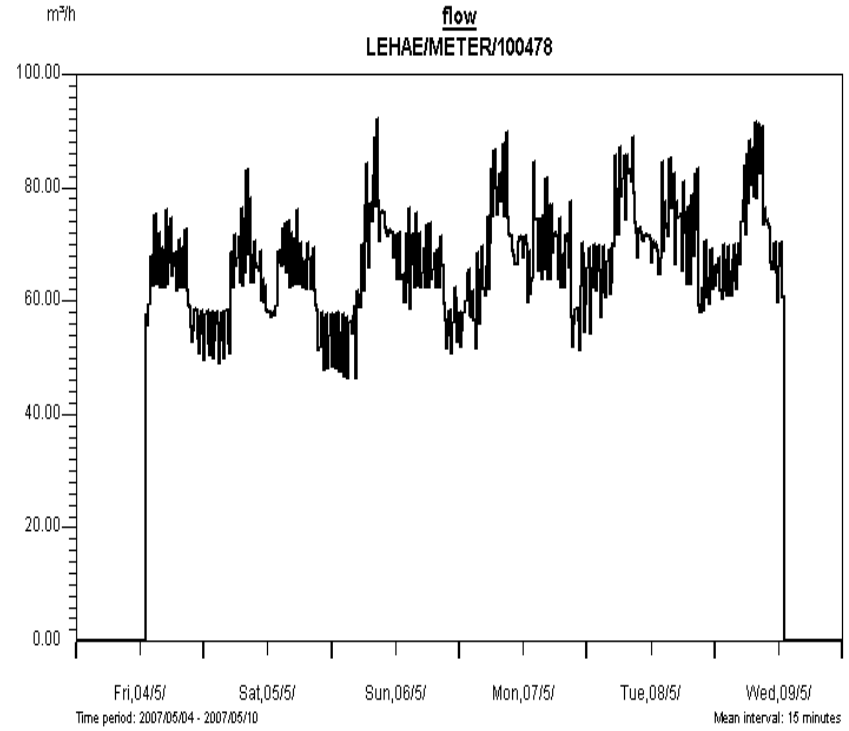


Figure 4: Flow Logging - After

Figures 3 and 4 represent the data collected for flow loggings before and after pressure management implementation of a low income residential area. This area has a high volume of on-property leaks to such an extent that the flow into the area before pressure management was the same during the day and night (Figure 3). After the installation of the smart controlled pressure reducing valve, the flow into the areas reduced substantially especially during the night times (Figure 4). The average flow before implementation was 135m3/hour and after 70m3/hour. This represents a decrease of 65m3/hour on the average flow.

The overall impact on the water demand through pressure management is estimated at 4500Ml per annum.

4.2.3 Leak Detection

Active leakage control is when the organisation have dedicated teams responsible for the location and reporting of water leaks experienced within their infrastructure. Passive leakage control is when you are relaying on the public/consumers to report infrastructure failures to which you then react.

Johannesburg Water has a 24-hour customer call centre at which all problems relating to the water infrastructure e.g. burst pipes, leaking fittings etc are reported. These problems are then captured on a service request via the SAP Plant Maintenance Software System according to the appropriate problem code. The service request is then forwarded to the relevant depot to attend to the problem.

At the depot the service request is then converted to a works order and issued to a repair team for execution. Once the problem is resolved and the service to the area or customer is restored the works order is completed and resolved on the system via SAP Plant Maintenance Software System.

The response times of the process from the creation of the service request by the call centre operator until restoration of a water service to an area or consumer is measured and reported on a monthly basis. Response times vary depending on the problem that occurred with in the system, for instance burst water pipes should be repaired and services restored within 48 hours. Performance targets are also set per activity and for the 2010 year the target was 84% for the repair of burst water mains. This means that the relevant depot should repair and restore services within 48 hours, for 84% of all reported incidents such as burst pipes. Similarly the response time and performance target for the repair and maintenance of meters was 4 days and 84% respectively.

Overall performance over the past four financial years increased for burst water pipes from 80% in 2006 to 89% in 2010. The same goes for the repair and maintenance of water meters where the performance increased from below 80% to 93% in the 2010 year.

Proactive leak detection is also carried out in an effort to identify all unreported leaks as well as invisible leaks. To programme the leak detection activities discrete water districts are established and minimum night flows (MNF) are monitored on a monthly basis. The minimum night flow is considered to be high when the ratio between it and the average flow into the area is higher than 0.3.

The areas with high ratios are then targeted with intensive leak detection surveys. Johannesburg Water has 15 full time leak detection teams surveying the water reticulation mains on a daily basis. The leak detection teams cover over 10,000 km of water mains per year doing leak detection. The leak detection is carried out in two phases, the first phase entails surveying the area to pick up any visible leaks and the second phase is the use of acoustic equipment like listening sticks, ground microphones and correlators are used to pick up invisible leaks.

The leaks detected are reported onto the SAP Plan Maintenance system to be fixed. The leaks are repaired at a rate depending on the response times of the depot as discussed in detail above. Effective active and passive leakage control managed to reduce the demand in one of the operational area of Johannesburg to such extend that the demand growth trend is zero as indicated in Figures 5 and 6.

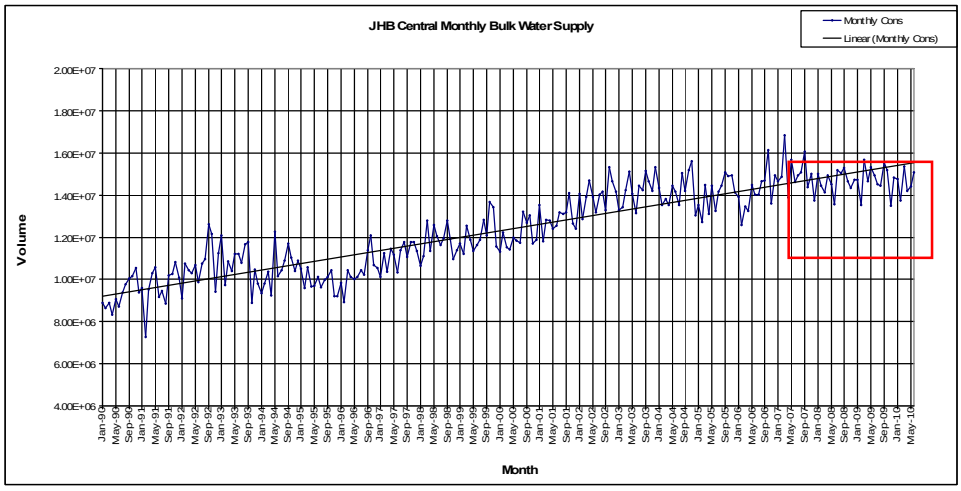


Figure 5: Bulk Water Supply into Johannesburg Central (20 years), the blocked area is elaborated in figure 6.

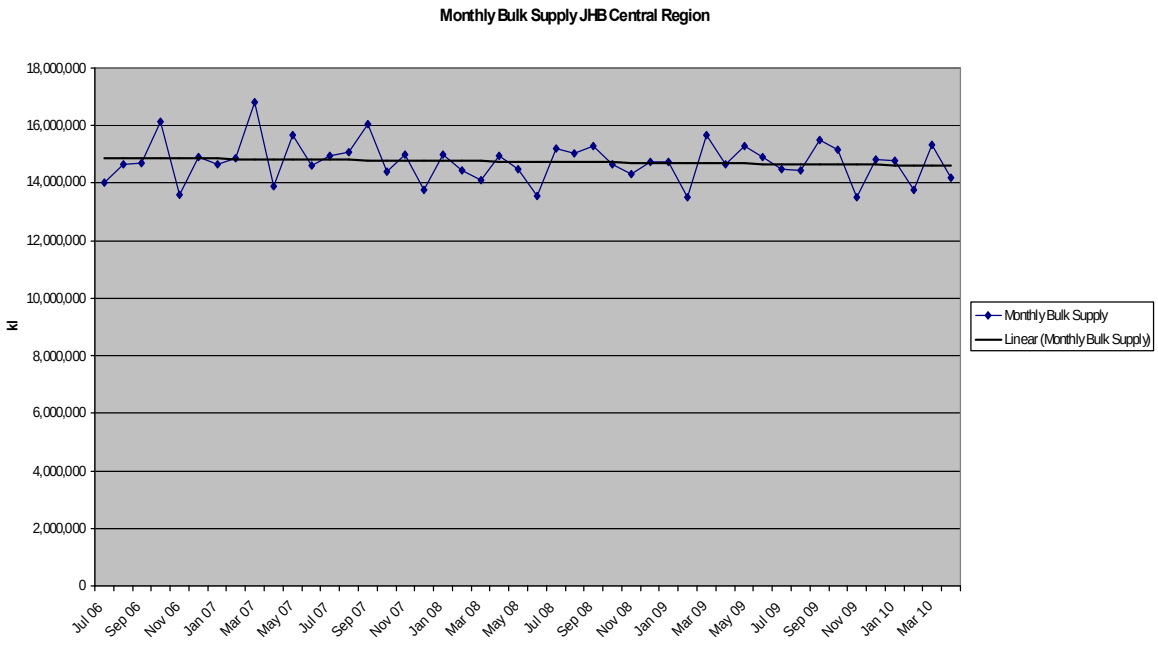


Figure 6: Bulk Water Supply into Johannesburg Central Operational Region (4 years)

Active leak detection initiatives are also being implemented by outsourced contractors in the Parktown 1/Linksfield district and Yeoville district. Active leak detection is being carried out and leaks are being repaired by the nominated contractors. This project was put on hold during the World Cup and the contractor did not repair any leaks detected during the first two weeks of July 2010. After that the work resumed and leaks detected are fixed as and when required. Part of this project is to verify the discreetness of the water district. This exercise started in August 2010 and should be completed in October 2010.

Challenges experienced to effectively sustain the active and passive leakage control programme relate to the skills capacity shortage in South Africa. The recent centralisation of the call centre and doing away with dedicated water technical call centre impacted drastically on the response times and the ability of consumers logging failures, however this is a short term challenge that is being resolved.

The overall impact on the water demand through active leakage detection is estimated at 1360Ml per annum.

4.2.4 Retrofitting

Opportunities to reduce losses have been identified in public (government) buildings, schools and hostels which should be targeted for further retrofitting and on property leak repairs. A recent investigation by the Department of Housing indicated that the plumbing (Water and Sewer) of hostels are in a poor condition. Leaks are experienced on the majority of the water fittings and

blockages are also experienced frequently. Maintenance is almost non-existent therefore water losses due to unattended leaks are great. Billing records indicates that hostels consume up to 40 Ml per month. The Retrofitting project on Hostels is at the implementation stage for the 2 hostels in Alexandra and the tender stage with the one hostel in Soweto. It is anticipated that these retrofitting projects should start with physical work in October 2010.

The overall impact on the water demand through retrofitting is estimated at 1000Ml per annum.

4.2.5 Reservoir and Tower Monitoring

The City of Johannesburg through its Water Service Provider Johannesburg Water implemented a 24 hour 7 day a week manned control room. This control room continuously monitors the levels and flows of 86 Reservoirs and 33 Towers. This is done with the assistance of a state of the art Telemetry/SCADA system installed at all the sites.

This system aids in the detection of overflows. The result is that the maintenance teams can be called out to attend to a possible reservoir inlet control failure before it gets to the extent that the reservoir is overflowing. The implementation of this system limited physical water losses due to reservoir and tower overflows to almost zero. Figure 6 illustrates a typical screen view that the control room has of all the reservoir and tower sites in the City of Johannesburg.

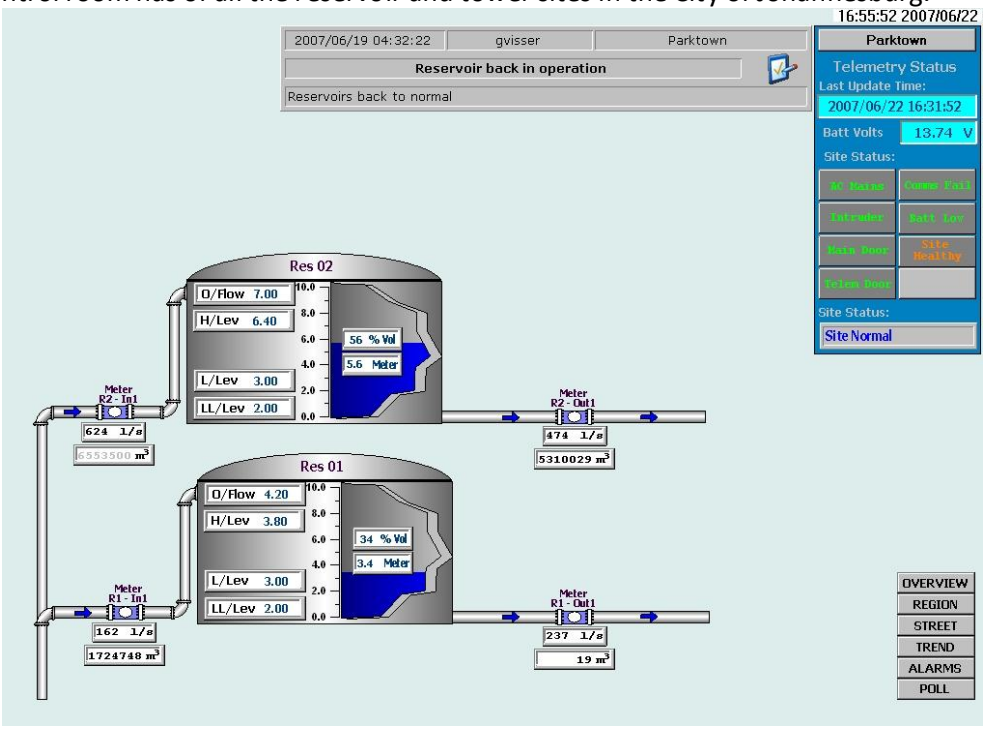


Figure 7: Typical screen shot of reservoir mimic

4.2.6 Soweto Infrastructure Upgrades

This project is executed in the Soweto area. The objectives of the project were as follows:

- Reduction of Unaccounted for Water
- Rehabilitation of the water network
- Provision of a better level of service in the form of larger diameter pipes laid in the road reserves as opposed to mid-block mains.
- Improving the level of integrity of technical information systems for Soweto
- Reduction on consumer demand
- Change of deemed consumption of customers to metered consumption of customers with the installation of pre-paid meters.
- Improving the level of integrity of customer records and captured information
- Creation of SMME's within the community
- Reduction of storm water into sewer systems at source
- Educate consumers and create awareness as to the efficient and conservative use of water
- Obtain buy-in by residents/consumers of their water consumption
- Improvement of overall payment percentages for water and sewerage

The Soweto Infrastructure Upgrade and Renewal (SIUR) programme has been on hold since 7 May 2008 following the Mazibuko Court Judgement. The appeal was heard at the Supreme Court of Appeal (SCA) from 23 to 25 February 2009. The SCA judgement has been appealed and was heard at the Constitutional Court (CC) on 02 September 2009.

The CC judgment was passed on 8 October 2009, whereby the judgment of the High Court and Supreme Court of Appeal were set aside. On prepayment water meters, the CC held (contrary to the High Court and the Supreme Court of Appeal) that the national legislation and the City's by-laws authorise the latter to introduce pre-paid water meters as part of SIUR project. The CC further ruled that the installation of the meters was neither unfair nor discriminatory.

The resumption rollout strategy was presented to the Mayoral Committee of 23 July 2009 and approved with an understanding that it should be reviewed depending on the outcome of the CC. A report to this affect has been compiled, and the revised roll-out strategy was approved by the Board of Directors on 19 November 2009. The revised roll-out strategy was presented to and approved by the Mayoral Committee on 14 January 2010.

The suspension has impacted negatively on the achieved reduction in water loses due to most of the households by-passing the meters. This has also been confirmed by the drop in water sales from average of R1.7 mil to almost R300, 000.00 per month and therefore influenced the UFW negatively. The projected project contribution to UWF was 1.8% for 2009/10 FY. This could not be achieved as the project was not implemented in the year under review.

The approved implementation strategy focuses on redressing the aftermath of the project suspension. The Project resumption is scheduled for October 2010, preceded by an intensive public participation

campaign. The stakeholder and public meetings has since commenced in December 2009 with stakeholder participation which was then followed by intensive public participation which is underway. The community facilitators were trained to conduct door to door campaigns in July 2010. The door to door campaigns commenced in August 2010 to get the residents consent.

The technical roll-out plan will be completed around the 31 January 2012.

5. CONCLUSION

Water Conservation and Water Demand Management is an important subject for the City of Johannesburg because future demands will not be sustained by the future available supplies. Although the City started with various projects and pilot studies since the late nineties it realised the importance to continue with similar projects and the sustainability thereof.

Water mains replacement is very effective in reducing the number of burst experienced on old infrastructure. This contributes to the reduction of water lost on the transmission and distribution mains. The pressure management initiatives reduced the water supply into the targeted areas and also proven to be successful in areas experiencing on property leaks.

The active and passive leakage control implemented resulted in positive results although a decrease in the trend of water supply is not present. The fact that the growth in demand is zero is having a positive impact. The monitoring taking place on the reservoir and tower sites proofed to be successful and the overflows is limited to almost zero.

At the current rate of implementation, the set water savings target will not be achieved due to the deficit in the allocation of funding. It is suggested that the water tariffs be increased by a certain percentage to accommodate the Water Demand component.

Author: Mbalie Matiwane

Tel: **(011) 688-1422**

Date: **07 October 2010**

3. Utilisation of Treated Effluent

1 Introduction

The Reconciliation Strategy and Integrated Water Quality Management Plan (IWQMP) for the Vaal River System identified that excess water will accumulate in Bloemhof Dam over time as the return flow volumes grow. The studies also highlighted the benefits of re-using the mine water discharge volumes for potable use. The analysis showed that the removal of the mine water discharge volume from the system reduced the volume of dilution water required to be released from Vaal Dam to maintain the TDS concentration in the Vaal Barrage at 600 mg/L. The analysis showed that this intervention significantly reduced the growth in the excess water volume in the Vaal River System and influences the augmentation dates of the future water supply schemes.

A feasibility study was recommended in the Vaal studies to develop a plan to re-use the excess return volumes at source. This study forms part of the strategy maintenance project and this section of the report details the progress made thus far with the study.

2 Study Approach

The mine water and treated sewage effluent are both potential sources of water for re-use. The potential uses of the effluent are:-

- Transfers to meet shortfalls in the Crocodile West and Olifants Water Management Areas (WMA);
- Re-use of the mine water in the Vaal River Catchment as potable water. This means treatment of the water and supply into the Rand Water network;
- Re-use treated sewage effluent in the Vaal River System by further treating and supplying through the Rand Water network; and
- The indirect re-use of mine water by treating to meet the instream Resource Water Quality Objectives (RWQO) and discharging back to the river system. This will reduce the volume of dilution water required and improve the instream water quality in the middle reaches of the Vaal River and the receiving tributaries.

The potential uses listed above results in a large number of scenarios that would have to be analysed. A systematic approach was therefore adopted in the study. The results of the system analysis undertaken in the development of the Reconciliation Strategy and the IWQMP showed that the re-use of the mine water with the associated reduction in dilution water volumes significantly reduced the excess water that accumulates in Bloemhof Dam. The removal of the mine water also improved the water quality of some of the tributaries and the Vaal River main stem. The re-use of the mine water was therefore

assessed first. If the mine water re-use model run results shows that there is still excess water in the system then the re-use of treated sewage effluent will be investigated. The assessment of the re-use of the mine water is presented in this progress report.

The following tasks have been completed:-

- The available information on the mine water has been collected and reviewed. The data was used to develop a timeline for the implementation of the mine water treatment projects;
- Scenarios were developed for assessment in the Water Resource Planning Model (WRPM); and
- The results of the WRPM runs were assessed to determine if there is a buildup of excess water in Bloemhof Dam, the impact on the water balance of the Vaal River System and the changes in the water quality status in the middle reaches of the Vaal River from the Barrage to Bloemhof Dam.

3 Mine water discharge information

There are a number of discharges taking place from the various mining basins in the Vaal River System. The water is being pumped from the mine workings to keep them dewatered. In the Far West Rand, Eastern and the Kosh Basin, there are still operational mines which are pumping water from the workings to keep them dewatered. This water is used on surface in the mining processes with the balance discharged to the environment. The Western Basin is decanting into the Crocodile West Catchment. The decant water is currently being neutralised and metals removed before discharge. The Central Basin is filling up after pumping was stopped in October 2008. Aurora Mining is the last operational mine in the East Basin and is continuing to operate the pumping system to keep the mine dry. Aurora Mining is in financial difficulty and there is uncertainty around how much longer the mine will continue to dewater the workings. At this stage the mining operations have ceased so the full volume is discharged to the Blesbokspruit with minimal water being used on the mine.

The discharges from the east, west and central basins are of the poorest quality and the highest volumes and will have the greatest impact on the Vaal River System. The balance of the mine discharges are from operational mines at lower volumes and marginal water quality in relation to the local RWQO. These discharges do not contribute significantly to the excess water volumes in the Vaal River System in terms of the discharge volumes and the need for dilution water. These discharges will be managed through water use licencing. The study therefore focuses on the re-use of the mine water from the Eastern, Central and Western Basins.

The mines prepared an interim mine water management proposal that has been presented to the Department. For the purpose of the investigations that were done so far as part of this study, it was assumed that the Department is going to adopt this proposal in the short term until the long term desalination and re-use options have been investigated in a feasibility study to be undertaken by the

Department. The interim mine water management proposal involves pumping the Western Basin decant into the Central Basin. The Central and Western Basin water will be pumped from the Central Basin to the existing neutralisation plant. The neutralisation plant will be upgraded to neutralise the water before discharge. The current pumping, neutralisation and discharge of the Eastern Basin mine water will continue as is.

The information on the discharge volumes and qualities are listed below for the Western, Central and Eastern Basins.

Western Basin

- The Western Basin is decanting at 15 ML/d with a TDS concentration of 6 500 mg/L.
- The decant is currently being neutralised and discharged to the Tweelopiesspruit.

Central Basin

- Pumping stopped in the Central Basin in October 2008.
- The Environmental Critical Level (ECL) will be reached between March 2012 and October 2012 and the decant level between July 2012 and December 2012 depending on rainfall conditions. This does not include the Western Basin water.
- The decant volume will be 55 ML/d at an estimated TDS concentration of 6 500 mg/L.
- The decant water is likely to be acid.
- The decant will discharge into the Klip River.

Eastern Basin

- Aurora Mining Company is currently pumping 82 ML/d from underground. Some of the mine water is used on surface in the mine processes with the balance neutralised before discharge. The TDS concentration of the discharge water is 2 100 mg/L.
- Aurora Mining Company is in financial difficulties and the time frame for the continued operation of mining in the Eastern Basin is uncertain. The use of the mine water on surface by Aurora Mining Company has probably ceased.
- The ECL will be reached in 62 months and the decant level after 64 months once pumping is ceased assuming average rainfall conditions.
- The decant volume is expected to be 82 ML/d.
- The water quality is expected to deteriorate as the mine fills up. The TDS concentration is expected to increase from the current 2 100 mg/L to a TDS concentration similar to the Western and Central Basins viz 6 500 mg/L.

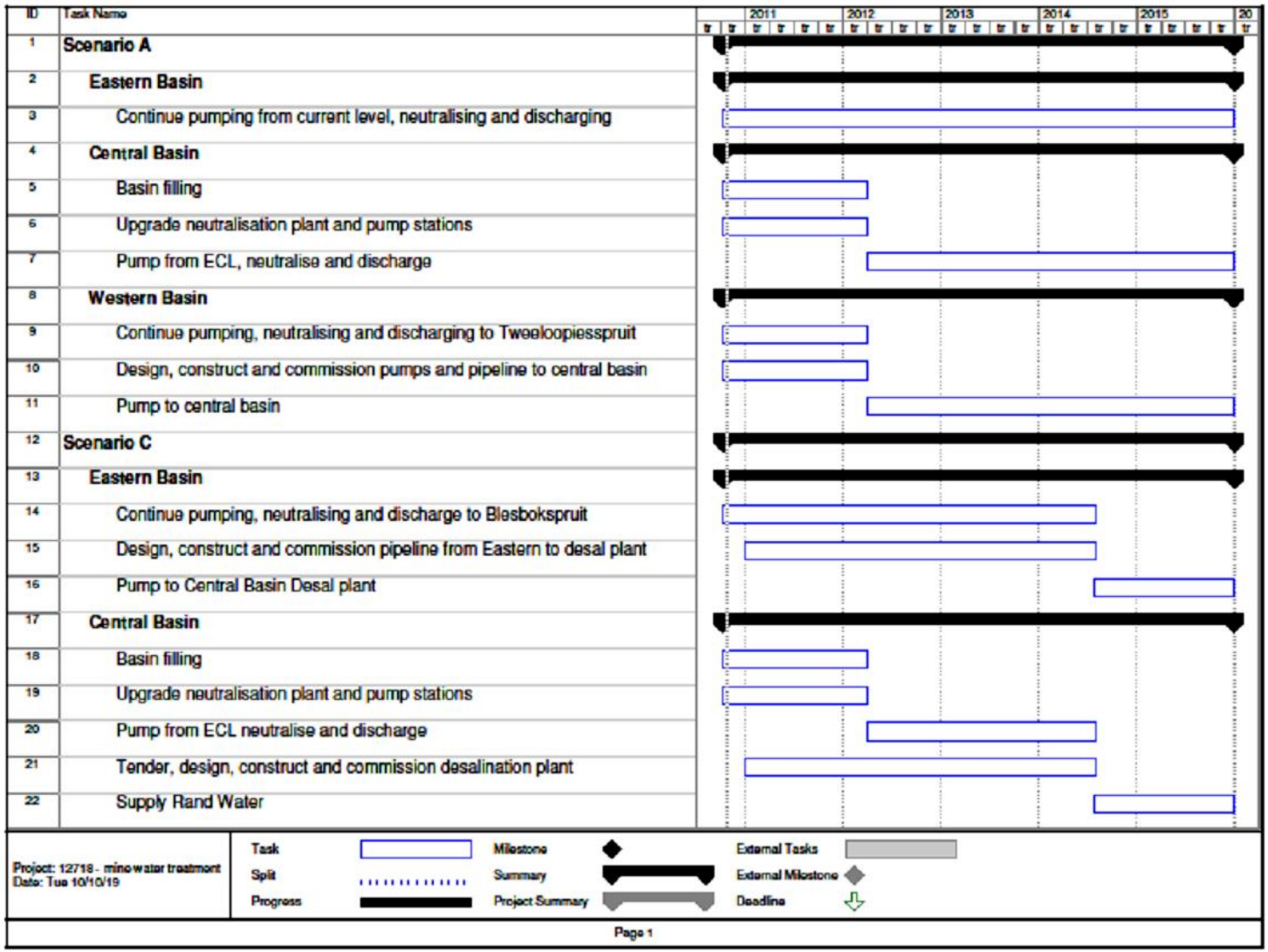
4 Description of Scenarios

The scenarios formulated are made up of a combination of the water requirement projection, transfer of treated sewage effluent to the Crocodile West Catchment and mine water treatment. The description of the water requirement projections are described in the water balance section. The components making up the scenarios are given in **Table 2** and the time line for the mine water treatment is shown in **Error! Reference source not found.**. The time lines are shown to December 2015 although the pumping and treatment will continue in perpetuity. Scenario B is not shown as the mine water management actions are the same as Scenario A. The time line for Scenarios D and E are not shown as they are the same as Scenario C. For Scenario E the water is treated and discharged rather than supplied as potable water to Rand Water.

Table 2 : Summary of scenarios

Scenario	Water Requirement Projection	Eastern Basin	Central Basin	Western Basin	Comment
A	High	Pumping is continued from the current level at 82 ML/d and discharged at a TDS concentration of 2 100 mg/L to the Blesbokspruit after neutralisation.	Pumping will start once the water level in the workings reaches the ECL in about March 2012. By March 2012, the decant from the Western Basin will be piped to the Central Basin. A total of 70 ML/d will be pumped from the Central Basin neutralised and discharged at 6 500 mg/L.	The status quo in the Western Basin is assumed to continue ie the 15 ML/d is discharged to the Tweelopiesspruit after neutralisation until March 2012 when it will be discharged into the Central Basin	This scenario assumes that if Aurora Mining stops pumping then the state/mines will step in and continue pumping from the current pumping level. By pumping from the current level, the current TDS concentration of 2 100 mg/L is assumed to be maintained. No water pumped from underground is used on surface ie the full 82 ML/d is discharged. This scenario represents the case of minimum mine water treatment and continued discharge
B	15% WCDM and unlawful	Same as Scenario A	Same as Scenario A	Same as Scenario A	A base case with the target

	irrigation removed				water requirement projection.
C	Same as Scenario B	Scenario A continues until July 2014 when the desalination plant at the Central Basin will be completed. After July 2014 the 82 ML/d from the Eastern Basin will be pumped to the treatment plant located at the Central Basin.	As for Scenario A, until the treatment plant is completed in July 2014. In July 2014 water is treated to 200 mg/L TDS concentration for supply as potable water into the Rand Water network. The capacity of the plant will be 152 ML/d.	Same as Scenario A	This Scenario represents the removal of the mine water discharges from the system. The mine water is treated and used as potable water in the Rand Water System
D	Same as C	Same as C	Same as C	Same as A	Water is transferred from the Vaal River System to the Olifants to meet shortfalls in the Olifants WMA
E	Same as Scenario B	As for Scenario C	As for Scenario C except that the water will be treated and discharged at 450 mg/L TDS.	Same as Scenario A	This scenario assesses the case of desalination of mine water to the RWQO and discharge of the treated water to the river system.


ID
Task Name
2011
2012
2013
2014
2015
1 Scenario A
2 Eastern Basin
3 Continue pumping from current level, neutralising and discharging
4 Central Basin
5 Basin filling
6 Upgrade neutralisation plant and pump stations
7 Pump from ECL, neutralise and discharge
8 Western Basin
9 Continue pumping, neutralising and discharging to Tweeloopiesspruit
10 Design, construct and commission pumps and pipeline to central basin
11 Pump to central basin
12 Scenario C
13 Eastern Basin
14 Continue pumping, neutralising and discharge to Blesbokspruit
15 Design, construct and commission pipeline from Eastern to desal plant
16 Pump to Central Basin Desal plant
17 Central Basin
18 Basin filling
19 Upgrade neutralisation plant and pump stations
20 Pump from ECL neutralise and discharge
21 Tender, design, construct and commission desalination plant
22 Supply Rand Water
Project: 12718 - mine water treatment
Date: Tue 10/10/19
Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline
Page 1

5 Results of model runs

The results related to the impact of the mine water re-use options on the water balance and timing of the future augmentation schemes are discussed in the water balance section. The impact on the volume stored in Bloemhof Dam and the instream water qualities are presented in this section.

The impact of the re-use of mine water on the storage volumes in Bloemhof Dam is clearly shown in **Figure 7** and **Figure 8**. The accumulation of excess water in the dam for Scenario A is shown in **Figure 7**. The implementation of the mine water re-use scheme shows that the accumulation is reduced significantly (See Figure 8). The graph shows that excess water will start accumulating from about 2026 when the re-use of treated sewage effluent will have to be considered. The volume of treated sewage effluent available for re-use is related to the water requirements of the Olifants and the Crocodile West Catchments. These volumes are still being finalised in two parallel studies being undertaken by the Department. Once these volumes have been finalised, the WRPM can be rerun to determine when the re-use of treated sewage effluent will be required. The results show that there is no immediate need to further investigate the re-use of treated sewage effluent.

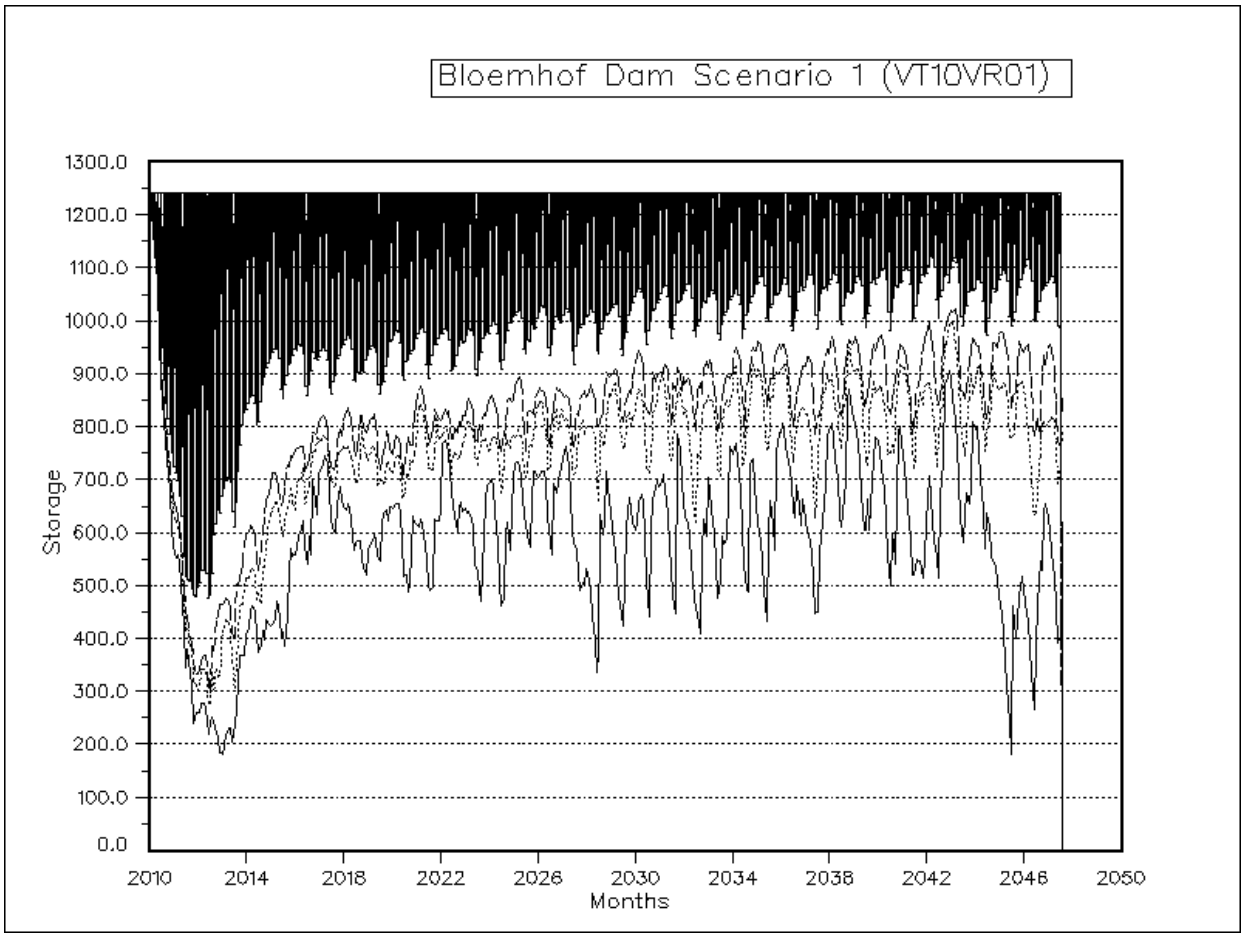


Figure 7 : Box plot of storage volumes in Bloemhof Dam over time for Scenario A

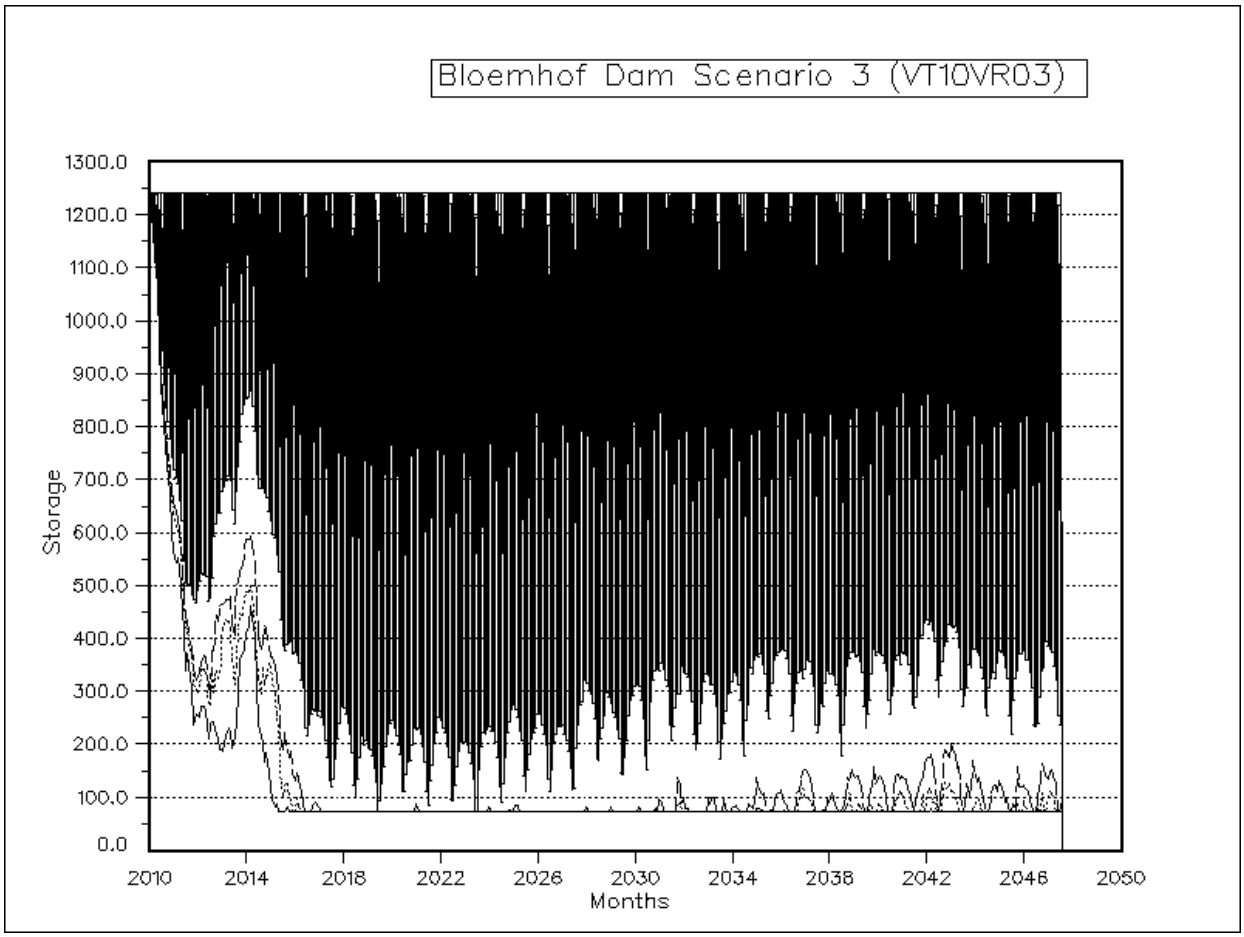


Figure 8: Box plot of storage volumes in Bloemhof Dam over time for Scenario C

The impact of the mine water re-use options on the instream TDS concentrations are shown in Table 3. The 95 percentile TDS concentration was determined at key points from the results of the 101 sequences simulated using the WRPM. The key points selected were the Vaal Barrage, Midvaal Water offtake at Orkney, Sedibeng Water offtake at Balkfontein, Bloemhof Dam and the abstraction from the Vaal Harts Weir. The Resource Water Quality Objective (RWQO) set in the IWQMP for the Vaal River System is also shown in Table 3.

The following conclusions can be made as a result of the study:-

- The concentrations for Scenario B are lower than those for Scenario A. This is due to the higher return flows and therefore larger excess water volumes accumulating in Bloemhof Dam associated with the high water requirement projection for Scenario A. The release of dilution water does not take place when Bloemhof Dam is spilling.
- The re-use of mine water results in a significant improvement in the TDS concentrations in the Vaal River as well as the Klip and Suikerbosrand Rivers. The simulations show that the TDS

concentrations meet the RWQO at the Vaal Barrage, Bloemhof Dam and the Vaal Harts Weir. The TDS concentrations in the middle reaches of the Vaal River are approaching the RWQO.

Table 3: Simulated 95 Percentile TDS concentrations (mg/L) at key points in the Vaal River system

Point	Scenario				RWQO
	A	B	C*	E	
Vaal Barrage	825	730	569	615	600
Midvaal offtake	748	636	622	618	600
Sedibeng offtake	859	688	648	742	600
Bloemhof Dam	813	775	602	842	750
Vaal Harts Weir	832	800	629	881	750
Klipspruit	1240	1022	596	725	600
Suikerbosrand	1075	1084	651	691	650

*Scenario D results the same as Scenario C

6 GENERAL INFORMATION

Detail progress reports on the water resource management strategies can be found at the following link: http://www.dwa.gov.za/Projects/VaalWRMS/documents.aspx

The Study Manager for this project is Mr Seef Rademeyer, Chief Engineer at the Directorate: National Water Resource Planning (Central).

4. Implementation of Infrastructural Augmentation Option

(There was an oral discussion on this point)

5. IMPLEMENTATION OF THE INTEGRATED WATER QUALITY MANAGEMENT STRATEGY FOR THE VAAL RIVER SYSTEM

(WATER QUALITY PLANNING REPORT BY: J.J. VAN WYK)

Edition 2
October 2010

Sub-Directorate Water Quality Planning

Directorate Water Resource Planning Systems,

Chief Directorate Integrated Water Resource Planning,

Department of Water Affairs,

Private Bag X313,

Pretoria, 0001

Republic of South Africa

1. DOCUMENT PURPOSE

The purpose of the document is to:

- provide written report-back to the Vaal River Strategy Steering Committee in respect of the implementation of the Integrated Water Quality Management Strategy for the Vaal River System.

2. ABBREVIATED SCOPE OF THE STRATEGY

The Vaal River Integrated Water Quality Management Strategy is being rolled-out for the inter-dependant water resource systems of the Upper, Middle and Lower Vaal Water Management Areas (WMAs) and the associated Modder-Riet Catchment, and aims to achieve the following:

- Maintaining or improving the water quality of the water resources within the System for the benefit of all recognized water users and beneficial water uses in order to assist in securing ecologically sustainable development, while also promoting justifiable social and economic development;
- Managing the water resources of the System in order to comply with the determined integrated Resource Water Quality Objectives (RWQOs). The said RWQOs are to constitute the basis for the management of the water quality of the System;
- Controlling the salinity, eutrophication and microbiological contamination levels in the System, and major tributaries, as the key water quality issues identified;
- Improving source management controls and measures as a means to limit and control point and diffuse sources that significantly impact on the water resources of the System; and
- Improving management of the water resources of the System by more effective monitoring, assessment, reporting and management participation.

3. STRATEGY FOCUS AREAS

Water quality issues had been identified during a water quality status assessment of the Vaal River System. All the identified issues have been grouped into four focus areas; these being-

- salinity;
- eutrophication;
- microbiological pollution; and
- institutional challenges.

The Vaal River Integrated Water Quality Management Strategy is structured such that each of these focus-areas receives explicit attention.

4. STRATEGY MATRIX

A synopsis of the Vaal River Integrated Water Quality Management Strategy is given in *Appendix A.* The purpose of Appendix A is to assign responsibility and to report progress on key elements of the integrated strategy.

5. PROGRESS ON SELECTED ACTIONS

The following key actions are singled out for reporting here:

➔ **Nutrient Modelling:**	▪ An Inception Report to model nutrients (potentially with the Qual2K nutrient model) in the Vaal River System had been completed recently. ▪ Modelling is to support the establishment of a Thematic Strategy for Eutrophication Management. ▪ However, funding needs to be confirmed and a tender process initiated in order to proceed with the study, as it is not acceptable to utilize more than one contract on a single study any longer;
➔ **Flow manipulation:**	▪ The Terms of Reference to investigate the effect and merit of flow manipulation aimed at managing and preventing the occurrence of algal blooms in the Middle Vaal River had been submitted to Management. ▪ The Terms of Reference was not approved by Management and Management needs to be engaged now to address concerns. ▪ The aim is not to release more water from up-stream impoundments, but to investigate the pattern of release, taking due cognisance of committed abstraction requirements ▪ The flow manipulation study should integrate with the aforementioned nutrient modelling study;
➔ **Salinity Modelling:**	▪ A study aimed at the calibration of the WQT Salinity Model for the Orange River System and integration with the Water Resource Planning Model (WRPM) in order to enable integrated salinity management in the Vaal and Orange River Systems had been approved by the Director-General. ▪ The next step is to engage the Departmental procurement process where after the successful Professional Services Provider (PSP) is, hopefully, to be appointed.
➔ **Coal Mining:**	▪ It is planned to investigate the application of lessons-learned in the Upper Olifants River Basin to the Upper Vaal WMA, specifically in order to manage and curb the expected adverse mining impacts that are likely to manifest should pro-active interventions not be implemented timeously in order to protect the strategically important water resources of the Upper Vaal WMA.. ▪ Two meetings were held with the Gauteng Regional Office to discuss the particular study. ▪ The Terms of Reference is currently being compiled.
➔ **Acid Mine Drainage:**	▪ In view of the urgency with the Acid Mine Drainage (AMD) in the Witwatersrand, an Inter-Ministerial Committee (IMC) has been established by Cabinet in order to promptly address the current challenges with the AMD. ▪ A team of experts was subsequently appointed to reappraise the risks, assess what has been done by various institutions, assess available solutions and technology, interrogate and assess viability and costs of critical short term interventions, develop integrated lasting and sustainable medium and long-term solutions and measures, and to explore possible partnerships with the private sector. ▪ Due to this, the Department of Water Affairs decided not to initiate the *pre-feasibility study to address the handling of underground mine water on the Witwatersrand*.
➔ **Integrated Management:**	▪ A Terms of Reference is currently being compiled to initiate a study to establish an Integrated Water Quality Management Strategy for the Upper and Lower Orange Water Management Areas. ▪ The intention is to eventually have one integrated management strategy for the entire Orange River Basin, including the Vaal River Catchment.

6. FUNCTIONAL INTEGRATION

As there are various departmental role-players designated to fulfil different, but supporting functions that collectively make up Water Quality Management in the Department, the challenge, firstly, in the Vaal River System is to ensure that all these efforts are directed towards common goals in a coordinated fashion. The Vaal River Strategy Steering Committee is an attempt to direct, co-ordinate and harmonize all Water Resource Management efforts, specifically also the water quality management efforts, within the Vaal River System in a coherent manner.

7. CONCLUSION

Effective water quality management constitutes a prerequisite for sustainable development and growth in the supply area of the Vaal River System. Implementation of the strategy needs to be effected in an iterative fashion focusing on priority issues first.

8. REFERENCES

Directorate National Water Resource Planning. Department of Water Affairs and Forestry, South Africa, October 2008. INTEGRATED WATER QUALITY MANAGEMENT PLAN FOR THE VAAL RIVER SYSTEM: Water Quality Management Strategy. Report Number: P RSA C000/00/2305/7.

Compiled by: **J.J. van Wyk**

Water Quality Planning: Central (Orange and Vaal Rivers System)

Directorate Water Resource Planning Systems

Chief-Directorate Integrated Water Resource Planning

Department of Water Affairs

APPENDIX A
STRATEGY MATRIX

FOCUS AREAS	OBJECTIVES	ACTIONS	RESPONSIBILITIES[i]	STATUS[ii]
1. Salinity	**1.1** The current salinity status in the Vaal Dam and Grootdraai Dam Catchments should be maintained. This will involve careful and diligent management of the upstream mining activities, in particular post closure.	Exploratory discussions are being held with the Regional Office on aspects relating to pro-active planning in respect of mining in the sub-region. A planning study needs to be commissioned to pro-actively address the potential adverse impacts of coal mining in the Grootdraai Dam Catchment and catchments associated with strategic transfers to the Upper Vaal River System. This would include the Calibration and updating of hydrology and the inclusion of the coal mines in the hydrology calibration; the calibration of WQT for sulphate to include the mines; and the updating and application of the WRPM to assess water quality management strategies.	WRPS:WQP (and Gauteng Regional Office)	Busy
		Implementation of the to-be-established "coal mining strategy"	Gauteng Regional Office (and RPW)	**The strategy needs to be completed first**
	1.2 The short term strategy for the middle reaches from Vaal Barrage to Bloemhof Dam is to implement Scenario 1a, *i.e.* the release of dilution water from Vaal Dam to dilute the outflow from the Vaal Barrage	The short term strategy as per Scenario 1a should be implemented *i.e.* the releases of dilution water should continue to be released from Vaal Dam to maintain the outflow from the Vaal Barrage at 600 mg/ℓ	Gauteng Regional Office (and WRPS:SO)	Ongoing

FOCUS AREAS	OBJECTIVES	ACTIONS	RESPONSIBILITIES[i]	STATUS[ii]
	to 600 mg/ℓ. The implementation of this scenario does not meet the initial set of Resource Water Quality Objectives (RWQOs) set for the Vaal River main stem, but does result in an improvement in the water quality in the middle reaches of the Vaal River. The water users will incur economic dis-benefits due to the salinity levels and a waste discharge charge should be used to compensate for these dis-benefits.	The waste discharge charge system (WDCS) is an important component of the water quality management strategy. The charge is proposed to compensate the middle Vaal water users and will be used to change behaviour or raise money to treat the selected saline streams. Progress has been made in formulating the waste discharge charge system. The system was planned to be piloted on the Vaal River System by the Department. The pilot WDCS study still needs to take place to set the foundations for the implementation of the system in the Vaal River. This study needs to take place.	IWRMS (and RPW & Gauteng Regional Office)	Busy ?
		The findings of the WDCS pilot project on the Vaal River System must be implemented on a permanent basis.	Gauteng, Free State & Northern Cape Regional Offices	**Awaiting WDCS**
	1.3 The release of Vaal Dam dilution water is feasible until 2014, after which excess water will accumulate in Bloemhof Dam. By 2014, a plan to use the excess water needs to have been developed. The plan could be to support the lower Orange from Bloemhof Dam, transfer to the Crocodile West catchment or treat and re-use in the Vaal River System. The use of the excess water, which includes the saline mine water streams should be the subject of a feasibility study.	A reconnaissance investigation is required to determine how the excess water is best utilized. This study will investigate transfers to the Crocodile West catchment, treatment and reuse of mine and industrial effluent, and support to the lower Orange River.	NWRP	Completed
		The feasibility study is required to determine the management strategy for the excess water. The study will incorporate mine planning, the latest treatment technologies, design, costing, institutional and funding mechanisms for the schemes.	IMC/ CGS/ ToE	Busy

FOCUS AREAS	OBJECTIVES	ACTIONS	RESPONSIBILITIES[i]	STATUS[ii]
	1.4 The short term RWQOs for the Vaal River main stem and for the tributaries should be established and compliance monitoring reported against the RWQOs. The tributary catchments must be managed to meet the RWQOs established at the downstream point of the catchment.	The set of RWQOs that are proposed in this study for the main stem of the Vaal River and the major tributaries need to be accepted by the Catchment Forums and stakeholders, and implemented. Compliance reporting needs to be done against the RWQO and the implementation of the short term strategy measured against the RWQO.	Gauteng, Free State & Northern Cape Regional Offices	Ongoing
		The Department must continue with licensing, the development of Integrated Waste and Water Management Plans and participation in EIA/ EMP processes. This will ensure that the various strategies of the Department are implemented and the Department has a say in the water management of mines and industries. The set of RWQOs can be used in setting up the licence conditions for discharges.	Gauteng Regional Office (and RPW)	Ongoing
	1.5 The current water quality monitoring program must be expanded, according to the monitoring program developed and detailed in the Task 7 Report produced as part of the IWQM Strategy study.	The improved monitoring program requires the installation of continuous monitoring equipment at key stations in the system as well as expanding the current grab sampling program. This program needs to be implemented as soon as possible. The monitoring program has been developed to include compliance monitoring so that the effectiveness of the short term strategy can be monitored.	RQS and Gauteng, Free State & Northern Cape Regional Offices	**Not yet initiated**

FOCUS AREAS	OBJECTIVES	ACTIONS	RESPONSIBILITIES[i]	STATUS[ii]
	1.6 The planning and engineering design of the next Vaal River System augmentation scheme should be completed. The water quality of the water proposed for transfer should be considered in the final selection of the augmentation scheme.	The necessary studies should be undertaken to select the next augmentation scheme. Once the scheme has been selected the designs should be completed so that the scheme is ready for implementation once clarity on the augmentation date is available.	OA (and WRIB)	Busy
	1.7 The impact of the salinity management strategy selected for the Vaal River on the Orange River must be investigated. Before a final decision is made, consideration must be given to the water quality impact on the Lower Orange River of the preferred management option and the RWQOs established. The impact of the releases to support the Lower Orange River reaches on water quality needs to be investigated as well as the impact of the next augmentation scheme.	Calibration of the WQT Salinity Model for the Orange River System and integration with the Vaal River Planning Model (VRPM).	WRPS:WQP	Busy
		The projects resulting from the feasibility study will need to be implemented. The projects could include the construction of desalination plants and supply infrastructure for treatment and re-use of mine and industrial effluent and transferring excess water for use in the Crocodile West catchment	OA?	**Not yet initiated**
2. Nutrients	**2.1** The Waterval Catchment Management Strategy developed by the Department needs to be implemented.	The strategy, *inter alia*, includes the improved management of the wastewater treatment works to meet the phosphorus RWQO set for the Waterval River. This will reduce the nutrient loads reporting to Vaal Dam and should protect the trophic status of Vaal Dam.	Gauteng Regional Office	Busy

FOCUS AREAS	OBJECTIVES	ACTIONS	RESPONSIBILITIES[i]	STATUS[ii]
	2.2 Flow manipulation along the Middle Vaal during the months of September through October will be used to manage the risk of algal blooms in the middle reaches of the Vaal River from Vaal Barrage to Bloemhof Dam in the short term. The Vaal Dam release will be piloted, the impacts monitored and the release protocols documented. This will involve the release of water from the Vaal Barrage (augmented from Vaal Dam) to reduce residence times and improve mixing. The initial release proposed is- Base flow 15 m^3/s for 28 days - giving a total release volume of 36.3 million m^3; and 100 m^3/s for 48 hours - giving a total release volume of 17.3 million m^3. Total of 53.6 million m^3 will be released during the annual flow manipulation program. The flow manipulation recommended will be considered with the Reserve scenarios to ensure the alignment to the ecological water requirements.	The flow manipulation will be piloted to determine its effectiveness in controlling algal blooms. The pilot will be used to provide input to the protocols for the releases to be applied in the short term to manage the trophic conditions in the middle reaches of the Vaal River.	WRPS:WQP	**ToR sent back by Management**
	2.3 Phosphorus has been selected as the limiting nutrient for the management of Eutrophication in the Vaal River System. A set of RWQOs for phosphorus was developed for the main stem of the Vaal River. The proposed RWQOs are based on an analysis of the available nutrient and algal database.	The Department must continue to use licensing as the tool to achieve the RWQOs set for the Vaal main stem. The licence conditions will be drawn from the phosphorus reduction program and nutrient balance modeling.	Gauteng, Free State & Northern Cape Regional Offices (and RPW)	Ongoing

FOCUS AREAS	OBJECTIVES	ACTIONS	RESPONSIBILITIES[i]	STATUS[ii]
	2.4 The operations and maintenance (O&M) of many of the wastewater treatment works are poor and poor quality effluents are discharged. In many cases, the treatment plants are not able to handle the hydraulic or the organic loads. As a result, the installed treatment technology is not always working to specification. An audit of the wastewater treatment works, especially draining to the Vaal Barrage, is required to determine the works that are not working to specification and develop a program to retrofit and upgrade these works. It is essential to address the issue of insufficient O&M resources in this process.	The wastewater treatment works identified by the Department's Regional Offices that are not meeting licence conditions and are not functioning to specification should be listed. The works should be audited, repairs and retrofitting required determined and a program agreed with the local municipalities to implement the work.	Gauteng, Free State & Northern Cape Regional Offices (and WSR & Local Government)	Busy
		The wastewater treatment plant upgrades and retrofitting planned during the planning and feasibility study should be implemented.	Local Government (and Gauteng, Free State & Northern Cape Regional Offices)	Busy
	2.5 The medium to long term strategy will be the further management of phosphorus by reducing the load discharged from point sources. A better understanding of the nutrient balance in the Vaal Barrage and the Vaal River main stem from the Vaal Barrage to Bloemhof Dam is required, before revised discharge standards can be set. A nutrient balance study is therefore proposed which will result in a better understanding of the sources and fate of nutrients (phosphorus and nitrogen) and will provide the rationale for revising the current 1 mg/ℓ phosphorus discharge standard.	The monitoring required to better understand the nutrient balance will be implemented as part of the monitoring program. The data collected should be used to better understand the nutrient balance and should be used to set up a planning level model for phosphorus. The idea being to apply the model to develop a nutrient management strategy and to determine the phosphorus discharge standard. The economics of Eutrophication will be used in setting of the discharge standard. The results will be used to develop a phosphorus reduction program which will result in achieving the RWQO for phosphorus. The use of phosphorus free soaps and detergents will be considered as part of the program.	WRPS:WQP	**Funding?** **Need D:WRPS's approval**

FOCUS AREAS	OBJECTIVES	ACTIONS	RESPONSIBILITIES[i]	STATUS[ii]
		The further removal of phosphorus from the wastewater and industrial discharges will probably be the use of chemical phosphorus removal as an additional polishing step in the treatment train. The implications on wastewater treatment costs could be high. Therefore a study to investigate the feasibility of installing further phosphorus removal treatment steps at selected works in the Vaal River System is proposed.	RPW (and Gauteng, Free State & Northern Cape Regional Offices)	**Not initiated yet**
	2.6 A perspective is needed on the extent and costs of the measures needed (such as banning phosphorus containing detergents) to reduce the phosphorus loads received at the wastewater treatment works.		RPW (and Gauteng, Free State & Northern Cape Regional Offices)	**Not initiated yet**
	2.7 The results of the Water Research Commission project aimed at developing a perspective on the economics of eutrophication on the water users should be considered. This should include recreational impacts as well as water treatment costs.		RPW (and Gauteng, Free State & Northern Cape Regional Offices)	**Not initiated yet**

FOCUS AREAS	OBJECTIVES	ACTIONS	RESPONSIBILITIES[i]	STATUS[ii]
3. Microbiological	**3.1** The strategy for improving the microbiological water quality is related to getting the wastewater treatment works operating to their specifications and meeting their licence conditions specifically in terms of discharge quality. The strategy is similar to the nutrient management strategy in that the wastewater treatment works must be audited and the "hot spot" areas identified. Plans must be developed in consultation with the local municipalities to retrofit the works in these target areas.	The actions are similar to the nutrient strategy. The auditing, development and retrofitting of the wastewater treatment works should be undertaken as part of the same process as for the assessment of the plants for the removal of nutrients.	Gauteng, Free State & Northern Cape Regional Offices (and WSR & Local Government)	Busy
4. Institutional	**4.1** The implementation of the WQM strategy will have to be aligned to the institutional development process of the Department and the requirements of the National Water Act 36:1998, as Catchment Management Agencies for the Vaal River WMAs are in progressive stages of establishment. The individual CMS's development is in different phases and the continued evolution of the institutional arrangements must be monitored to ensure that the actions of this strategy are included in catchment management planning; resource management priorities and regional economic development strategies.		Gauteng, Free State & Northern Cape Regional Offices (and IO)	Ongoing
	4.2 In implementing this strategy, the Department will specifically have to consider the role of the catchment committees/ organizations and the extent to which they can take responsibility and accountability for specific actions. These organizations could play key roles in communication, co-ordination and providing capacity where necessary.		Gauteng, Free State & Northern Cape Regional Offices (and IO)	Ongoing

FOCUS AREAS	OBJECTIVES	ACTIONS	RESPONSIBILITIES[i]	STATUS[ii]
	4.3 The role of local government is critical to the success of this strategy. This relates primarily to the management of the discharges of wastewater treatment works. A specific agreement or institutional arrangement has to be entered into between the Department and local government regarding this issue. The problem of non-compliant wastewater treatment works cannot be accepted as a "business as usual" anymore.		Local Government (and Gauteng, Free State & Northern Cape Regional Offices)	Ongoing
	4.4 A strategy steering committee is to be established to oversee the further development and implementation of the reconciliation and the water quality management strategies. The details and proposed functions of the strategy steering committee are discussed under implementation. In association with the strategy steering committee the timeframes associated with implementation actions will be specified by the Department (*i.e.* the decision on the management actions, the final RWQOs adopted, the implementation of the RWQOs, etc.).		NWRS (and All)	Ongoing
5. Cross-Cutting	**5.1** Catchment Studies	Sub-catchments need to be prioritized for catchment studies to determine Level 3 RWQOs in support of the Level 1 and 2 RWQOs.	Gauteng, Free State & Northern Cape Regional Offices (and WRPS:WQP)	**Not yet initiated**
	5.2 Management integration	Sub-catchments need to be prioritized and modeled to integrate end-of-pipe requirements with the determined RWQOs.	WRPS:WQP (and Gauteng, Free State & Northern Cape Regional Offices)	**Not yet initiated**

FOCUS AREAS	OBJECTIVES	ACTIONS	RESPONSIBILITIES[i]	STATUS[ii]
	5.3 Compliance Monitoring and Enforcement	A strategy needs to be devised on collaboration between the Green and Blue Scorpions.	CME (RPW & Gauteng, Free State & Northern Cape Regional Offices)	**Not yet initiated**

Vaal Comprehensive Reserve Determination

(There was an oral discussion on this point)

6. Water Balance Update – Revised Reconciliation

1. INTRODUCTION

In support of the Vaal River System Strategy Steering Committee the water balance of the system has been update to reflect the latest information relating to the following:

- Revised water requirement and return flow scenarios.
- Incorporate risk analysis results of scenario simulations based on the Integrated Vaal River System Water Resource Planning Model (WRPM).
- Evaluation of options for the management of mine water (a separate progress report presents the specific planning options being considered for the management of the mine water).
- Revised schedules for the eradication of unlawful water use and projections of target savings through Water Conservation and Water Demand Management (WC/WDM) in accordance with ñProject 15%ò
- Updated water balance for the Crocodile West River System and revised transfer requirements to support any shortfall in the Crocodile System from the Vaal River System.

Revised reconciliation scenarios were assessed to evaluate how sufficient water could be made available to supply the water requirements in the system for the planning period up to the year 2050.

2. STUDY APPROACH

2.1. Monitoring of Water Use and Return Flows

The aim with the monitoring task was to compare the actual water use and return flow data with the projections of the 2009 Reconciliation Strategy scenarios to identify any significant differences. The comparison results were used to review and update the Water Requirements and Return Flow Scenarios where appropriate. The focus of the monitoring was on the Rand Water supply area and water use data provided by Rand Water was summarised and compared with the 2009 High Water Requirement Scenario.

In addition, the data was analysed in an attempt to determine the portion of the water supplied to the users located in the Crocodile West River Catchment and those situated in the catchment of the Vaal River (North-South split). The monitor of the North-South split is necessary because it influences the water availability in both the Vaal and Crocodile systems. Water supplied to the urban areas in the North generates treated wastewater which is discharged into the Crocodile West River System while water supplied to areas in the South contributes to the return flows into the Vaal River System. The objective of monitoring the North-South split is to identify if the actual water supplied to these areas is different to what was assumed in the scenario assumptions and if necessary adjust the assumptions for planning purposes.

An analysis of the actual volumes of water discharged from 45 waste water treatment works situated in the Rand Water Supply Area were undertaken. This information was compared with the 2009 Reconciliation Strategy High scenario and the return flow factors as well as the North-South Split of the of the return flows were evaluated.

The results for the monitoring task are presented in **Section 3.1** of this document.

2.2. Revised Water Requirements and Return Flow Scenarios

The High Scenario was updated by making appropriate adjustments in accordance with the findings from the monitoring task and the growth assumptions from the 2009 Reconciliation Strategy (applying the High population growth) were maintained for the updated scenario. The scenarios were also extended by linear extrapolation from 2030 to 2050.

Adjustments were made to the return flow and North ï South split assumptions as discussed in **Section 3** of this report.

Revised water requirement scenarios were also applied for Eskom, Sasol, Midvaal and Sedibeng Water based on the latest information provided by each respective organisation.

For irrigation water use it was assumed that the compliance control measures already implemented will result in no further increases in unlawful irrigation water use. The assumed unlawful eradication scenario applied in this study was that 85% of the unlawful water use will be removed by the year 2013.

Section 3.2 describes the revised water requirement and return flow scenarios.

2.3. Water balance of the Crocodile West River System

The water balance of the Crocodile West River system were revised based on the latest information with the aim to calculate what transfers are required from the Vaal River System to supplement any shortfall in the Crocodile. The balance calculations incorporated the planned transfer to the Lephalale area for the provision of water to the proposed Eskom power stations and the planned Sasol Coal to Liquid Plant.

The water balance calculations made use of revised yield results for the Crocodile West River System which was based on updated hydrology and higher resolution network models. The current assessment took into consideration the assurance of supply and accounted for the risk criteria of the different user sectors receiving water from the Crocodile West River System.

The results of the water balance calculations are presented in **Section 3.3.**

2.4. WRPM scenario simulation analysis

In the Vaal River Reconciliation Strategy Study it was identified that integrated systems analyses should be undertaken for the evaluation of reconciliation options through simulation of scenarios with the Water Resource Planning Model (WRPM).

The most recent WRPM model configuration was applied for these analyses with the required changes to simulate the selected water requirement and return flow scenarios, the components of the proposed LHWP Phase II scheme (Polihali Dam and conveyance infrastructure) as well as the identified mine water effluent management scenarios.

Each scenario was analysed for 1000 stochastic sequences and the risk of drought curtailment results were evaluated to determine the relative differences between the scenarios as well as to obtain the dates when further intervention will be required for each case.

The scenarios are described and the results presented in Section 3.4.

Section 3.5 of this document describes the updated water balances which is a simplified representation of the of the WRPM simulation analysis results.

3. RESULTS

3.1. Monitoring of Water Use and Return Flows

Table 3.1 compares the actual water use with the 2009 Reconciliation Strategy High scenario data for the Rand Water supply area for the year 2009. The last column in the table shows the differences and indicates the total water use for the Rand Water supply area is effectively the same. The actual water use for Tshwane, Johannesburg and Ekurhuleni are lower than the High scenario, however, the actual water use for the ñOtherò users are significantly higher compared to the High scenario projection.

A cursory analysis of the components making up the ñOtherò water users is presented in **Table 3.2** showing the actual annual total water use for the years 2006 to 2009. The last column presents the compounded annual growth rate over the period, which indicate significant changes (in most cases increases) in the water use occurred. The Delmas and Thembisile / Bronkhorstspruit water user components are existing water users that were supplied from other sources in the past and therefore the increases observed does not represent normal growth in water use.

Table 3.1: Comparison of water use for the Rand Water supply area

Water users	Actual 2009	Scenario 2009 (1)	Difference
Tshwane	210.00	244.85	34.86
Johannesburg	502.76	509.37	6.61
Ekurhuleni	320.53	344.27	23.74
Mogale	25.99	25.96	-0.03
Randfontein	9.16	9.87	0.70
Emfuleni	77.61	68.30	-9.31
Other	278.31	215.40	-62.91
Total	**1424.35**	**1418.02**	**-6.34**

Notes: (1) 2009 Reconciliation Strategy High Scenario.
All values are in million m^3/annum.

Based on the data in **Table 3.2** it is recommended that further analysis of these minor water users supplied by Rand Water need to be undertaken to improve the confidence in the estimates of the future water use of these components for planning purposes. In addition, it is proposed that further assessments be carried out to determine what potential for savings can be achieved through the implementation of Water Conservation and Water Demand Management.

Table 3.2: Analysis of the minor water users supplied by Rand Water

Water user / Municipality	2006	2007	2008	2009	Compounded Annual Growth
Sasolburg	15.92	15.39	15.49	14.27	-3%
Rustenburg	22.48	24.14	27.90	31.47	9%
Govan Mbeki	19.50	19.33	20.39	21.40	2%
Lesedi	4.85	4.55	5.07	4.91	0%
Midvaal	8.20	8.90	9.59	9.29	3%
Merafong	9.13	8.32	8.40	8.79	-1%
Westonaria	5.46	5.88	6.06	6.40	4%
Heilbron	1.81	1.88	1.91	1.92	2%
Kungwini (Pretoria East)	4.08	4.94	5.30	5.14	6%

Delmas	0.83	1.30	1.73	1.50	16%
Royal Bafokeng	2.42	2.56	3.24	3.13	7%
Thembisile/ Bronkhostspruit/ Meyerton	7.99	11.53	13.33	12.29	11%
Mining users	69.89	84.86	79.82	74.40	2%
Individual users	29.75	18.36	18.29	19.25	-10%
Unspecified	42.43	57.80	66.76	64.14	11%
TOTAL	**244.75**	**269.75**	**283.29**	**278.31**	**3%**

Note: The highlighted (shaded) municipalities form part of ñProject 15%.

Analysis of the North-South Split

Figure 3.1 presents the position of the various water user meters in the Rand Water Supply System showing those that are clearly located in the North as blue dots and those in the south as green dots. The meters represented by the red dots are located on the catchment divide and could be supplying water into either of the two areas.

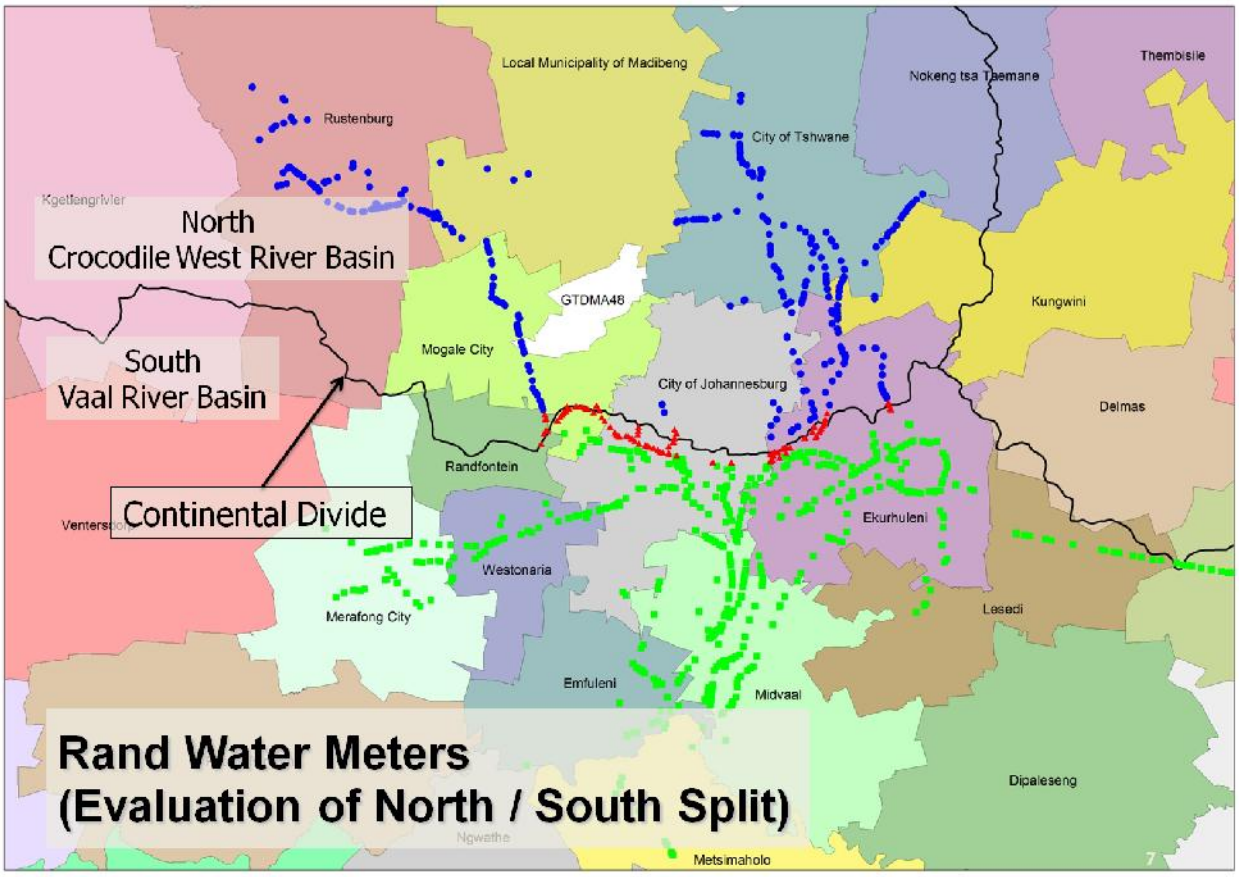


Figure 3.1: Rand Water Meters

Tables 3.3 and 3.4 presents the water supply volumes for the three meter categories for Johannesburg and Ekhurhuleni and indicates that the unassigned (red dot) meters make

up more than 15% of the total water use. It was therefore not possible to make a reliable estimate of the North-South split only based on the geographical positions of the meters. The analysis is therefore inconclusive and further investigations into the supply areas of each of the red dotted meters need to be undertaken before a reliable split in water use between North and South can be determined.

Table 3.3: Summary of water use for Johannesburg North – South Split

Area	Water use for 2009 (million m^3/annum)	Percentage
North (blue meters)	149.4	29.7%
South (green meters)	257.3	51.2%
Uncertain (red meters)	96.1	19.1%
Total	**502.8**	**-**

Table 3.4: Summary of water use for Ekurhuleni North – South Split

Area	Water use for 2009 (million m^3/annum)	Percentage
North (blue meters)	45.4	14.0%
South (green meters)	226.2	69.5%
Uncertain (red meters)	`53.8	15.5%
Total	**325.4**	**-**

Return Flow Analysis

The results of the return flow comparison between the actual flows and the 2009 Strategy Scenario for Johannesburg and Ekurhuleni are presented in **Table 3.5** and the following observations can be made:

- The total 2009 actual return flows for Johannesburg is 20% higher than the 2009 Strategy Scenario while for Ekurhuleni the return flows are 7% lower**.**
- The year 2009 return flow factor (return flow divided by water use) for Johannesburg (75%) is significantly higher compared to the 2009 Strategy Scenario (61%) while the return flow factor for Ekurhuleni is 57% in both cases.

- The North ï South Split calculation shows for Johannesburg there is 3% more return flows to the South (actual vs. 2009 Scenario) while for Ekurhuleni the shift is 6% more to the North.

A possible reason for the large return flow factor for Johannesburg is storm water (rainwater) intrusion into the sewage networks (this was supported by anecdotal information). Runoff from paved urban areas (storm water) are already taken into consideration in the water balance as a separate component and to avoid double counting it was decided to apply the 2009 Strategy Scenario return flow factor (61% for Johannesburg and 57% for Ekurhuleni) for the development of the revised water requirement and return flow scenarios. The Actual 2009 North ï South split was adopted for the revised scenarios.

Table 3.5: Summary of return flow analysis results

Municipality	Component	2009 Actual		2009 Strategy Scenario	
Johannesburg	Total Return Flows	376.19		313.29	
	Total Return Flows	376.19		313.29	
	North Return Flows	157.71	42%	141.16	45%
	South Return Flows	218.48	58%	172.13	55%
	Actual Water Use	502.76		514.96	
	Return Flow Factor %	75%		61%	
Ekurhuleni					
	Total Return Flows	185.36		198.63	
	North Return Flows	47.55	26%	40.53	20%
	South Return Flows	137.81	74%	158.10	80%
	Actual Water Use	325.43		348.03	
	Return Flow Factor %	57%		57%	

Note: Return flow and water use values are given in million m^3/annum.

3.2. Revised Water Requirement and Return Flow scenarios

Based on the methodology presented in **Section 2.2** and the assumptions regarding the return flows given in **Section 3.1** a revised High Water Requirement and Return Flow Scenario was developed as summarised in **Table 3.6**.

Revised saving scenarios were compiled (see details in separate progress report on the status and outlook for Water Conservation and Water Demand Management) for users in the Rand Water supply area. **Figure 3.2** presents the water requirement graphs of the 2009 High Scenario, revised 2010 High Scenario as well as the projection with the adjusted WC/WDM target saving scenario.

Table 3.6: Summary of 2010 High Water Requirement and Return Flow Scenario

DESCRIPTION	2010	2015	2020	2025	2030	2040	2050
WATER REQUIREMENTS:							
Rand Water	1438	1591	1735	1838	1973	2180	2408
Mittal Steel	12	13	14	16	17	17	17
ESKOM	382	405	420	423	423	423	423
SASOL Sasolburg (Raw water)	24	28	31	34	38	42	46
SASOL Secunda	92	103	109	116	124	129	129
Midvaal Water Company	45	46	46	46	46	46	46
Sedibeng Water (Balkfontein only)	45	51	57	61	66	66	66
Other towns and industries	189	193	193	192	193	193	197
Vaalharts/Lower Vaal irrigation	542	542	542	542	542	542	542
Other irrigation in Vaal	612	612	612	612	612	612	612
Wetland/River losses	326	327	328	330	331	333	338
RETURN FLOWS:							
Southern Gauteng (Rand Water)	-405	-423	-462	-491	-523	-577	-638
Midvaal Water Company	-1	-1	-1	-1	-1	-1	-1
Sedibeng Water	-2	-2	-2	-2	-3	-2	-2
Other towns and industries	-73	-79	-82	-86	-90	-93	-97
Irrigation	-61	-61	-61	-61	-61	-61	-61
Mine dewatering	-109	-126	-126	-126	-126	-126	-126
Increased urban runoff	-103	-107	-113	-121	-129	-150	-178
OVERALL GROSS SYSTEM DEMAND	**3706**	**3911**	**4086**	**4209**	**4365**	**4583**	**4824**
OVERALL NET SYSTEM DEMAND	**2951**	**3114**	**3238**	**3320**	**3432**	**3572**	**3721**

Notes: All values are in million m^3/annum. The values projections from the year 2030 to 2005 were extrapolations.

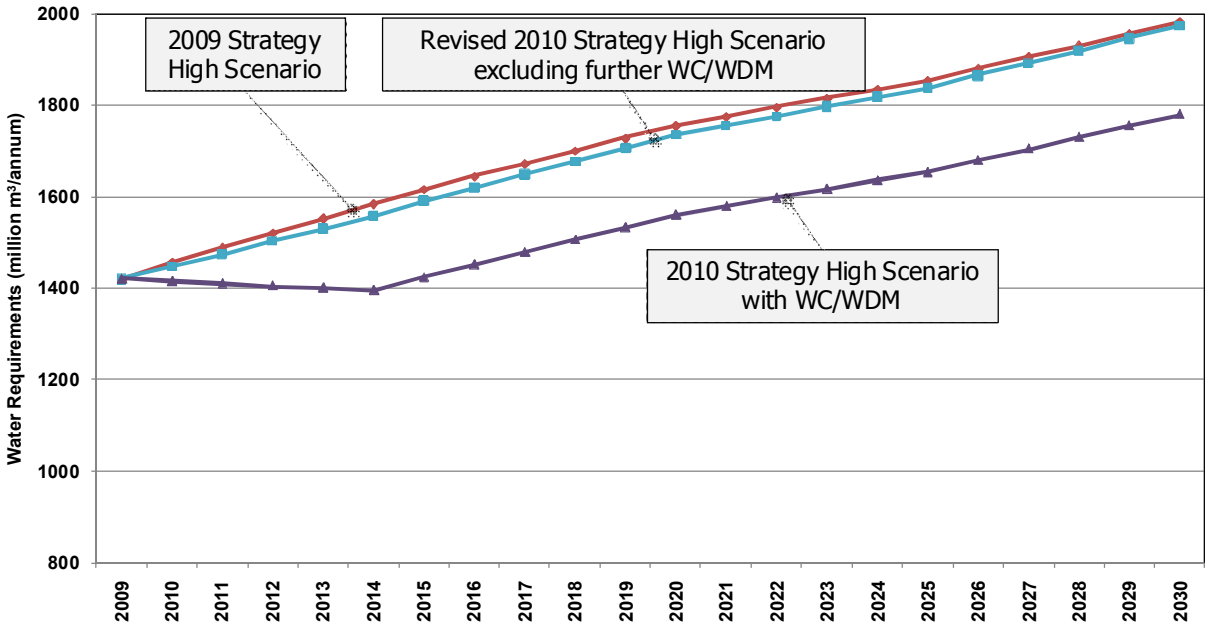


Figure 3.2: Water requirement scenarios for the Rand Water Supply Area

3.3. Water balance of the Crocodile West River System

The results of the Crocodile West River System water balance and the raw water transfers needed from the Vaal River system are presented in **Figure 3.3**. The graph indicates that the maximum transfer required from the Vaal River System for the selected scenarios is expected to be 13 million m^3/annum in the year 2020. In the subsequent years the increasing return flows exceeds the water required for the planned projects in the Lephalale Area and with the result that excess water will be available in the Crocodile West River System over the long term.

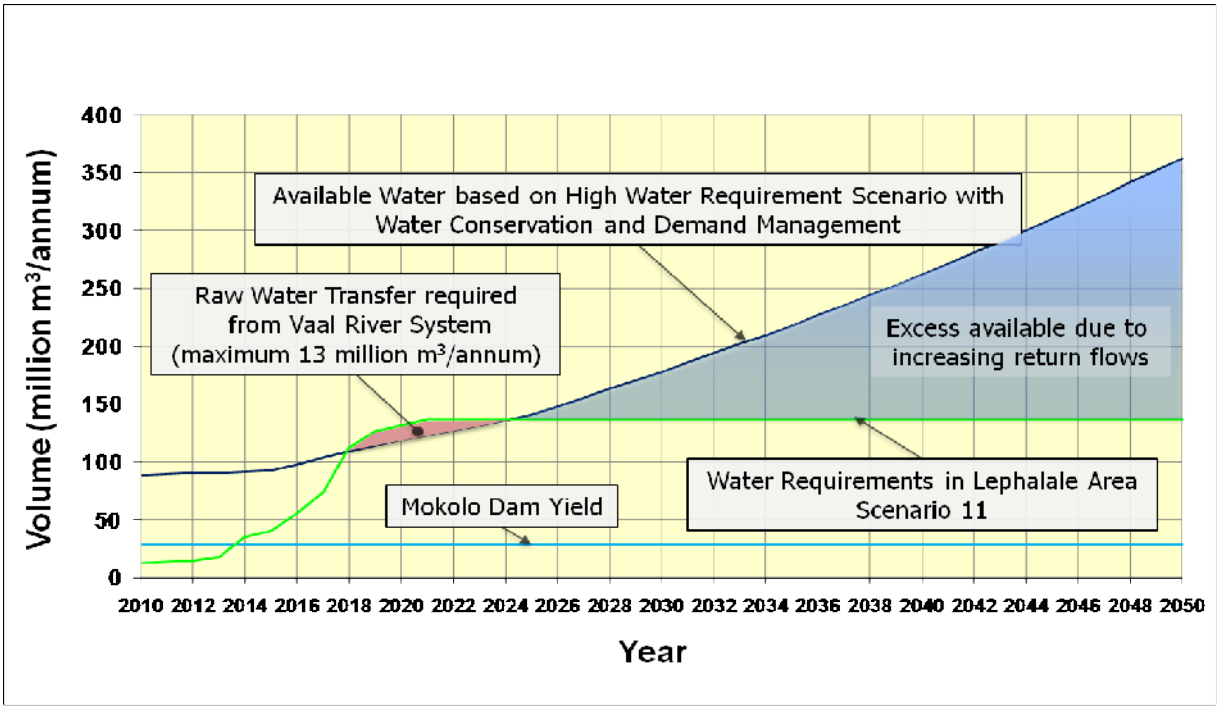


Figure 3.3 Water balance of the Crocodile West River System

3.4. Risk analysis - Water Resource Planning Model simulations

The Water Resource Planning Model of the Integrated Vaal River System was applied to determine the risk of drought curtailments for each year of the planning period through simulation analysis. Four scenarios were analysed as summarised in **Table 3.7**

Table 3.7: Description of scenarios analysed with the Water Resource Planning model

No.	Water Requirements and Return Flows	Mine water Management	Unlawful Water Use	LHWP Phase 2
1	High without further WC/WDM	Neutralisation and discharge into Vaal	Not reduced	Delivery 2020
2	High with target WC/WDM	Neutralisation and discharge into Vaal	Removed by 2013	Delivery 2020
3	High with target WC/WDM	Desalination for urban use	Removed by 2013	Not implemented
4	High with target WC/WDM	Desalination for urban use	Removed by 2013	Delivery 2020

The graphical results of the four scenarios are presented in the subsequent figures.

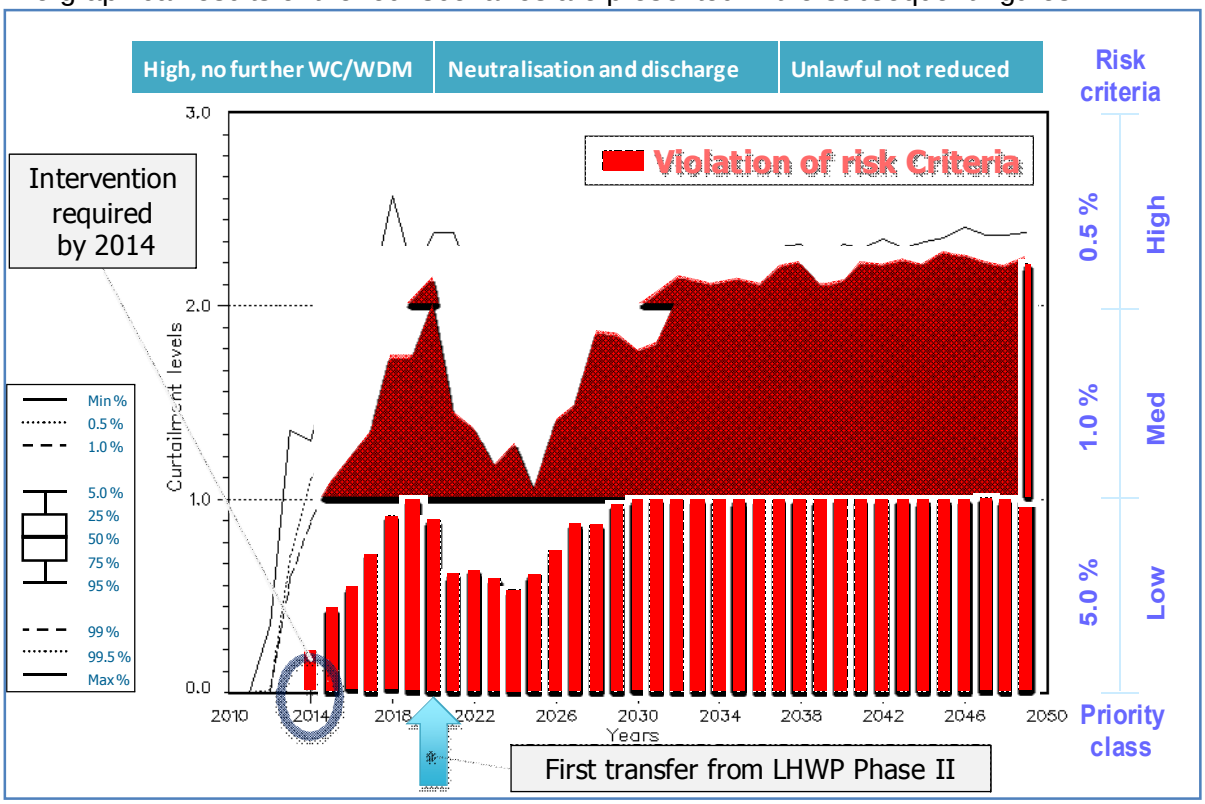


Figure 3.4: Scenario 1: Risk of drought curtailments

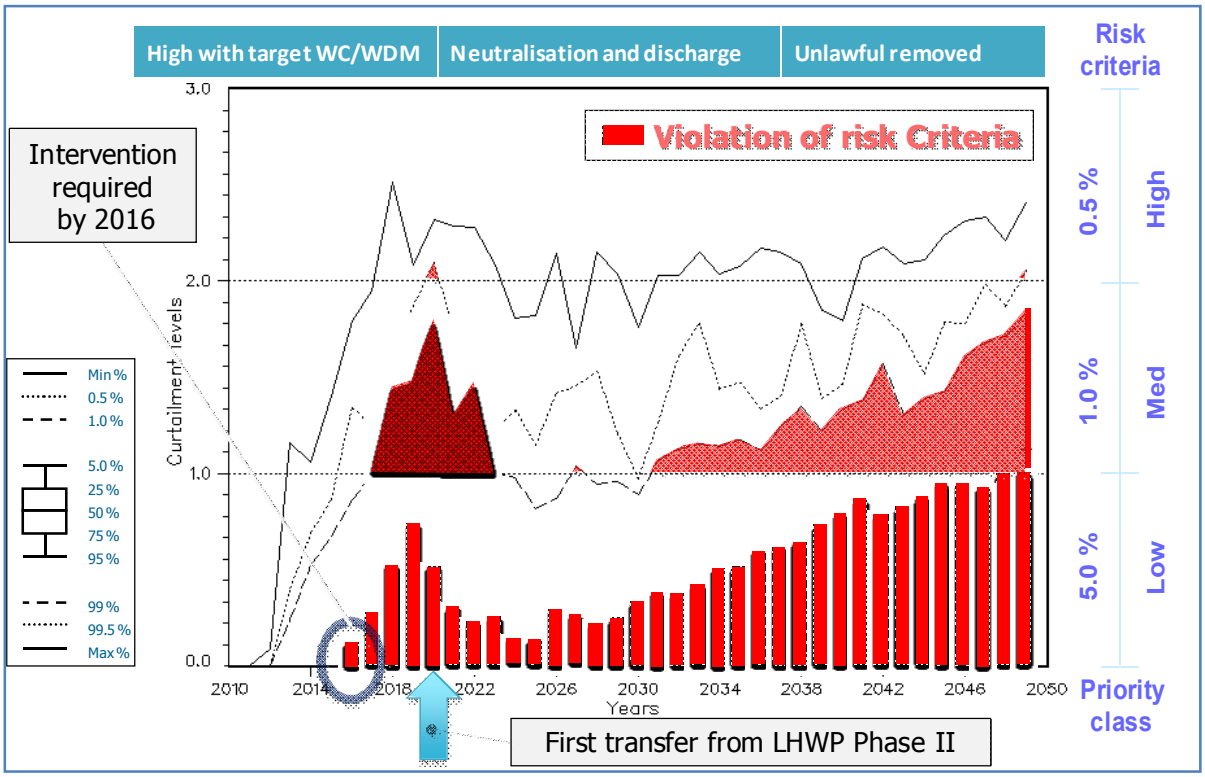


Figure 3.5: Scenario 2: Risk of drought curtailments

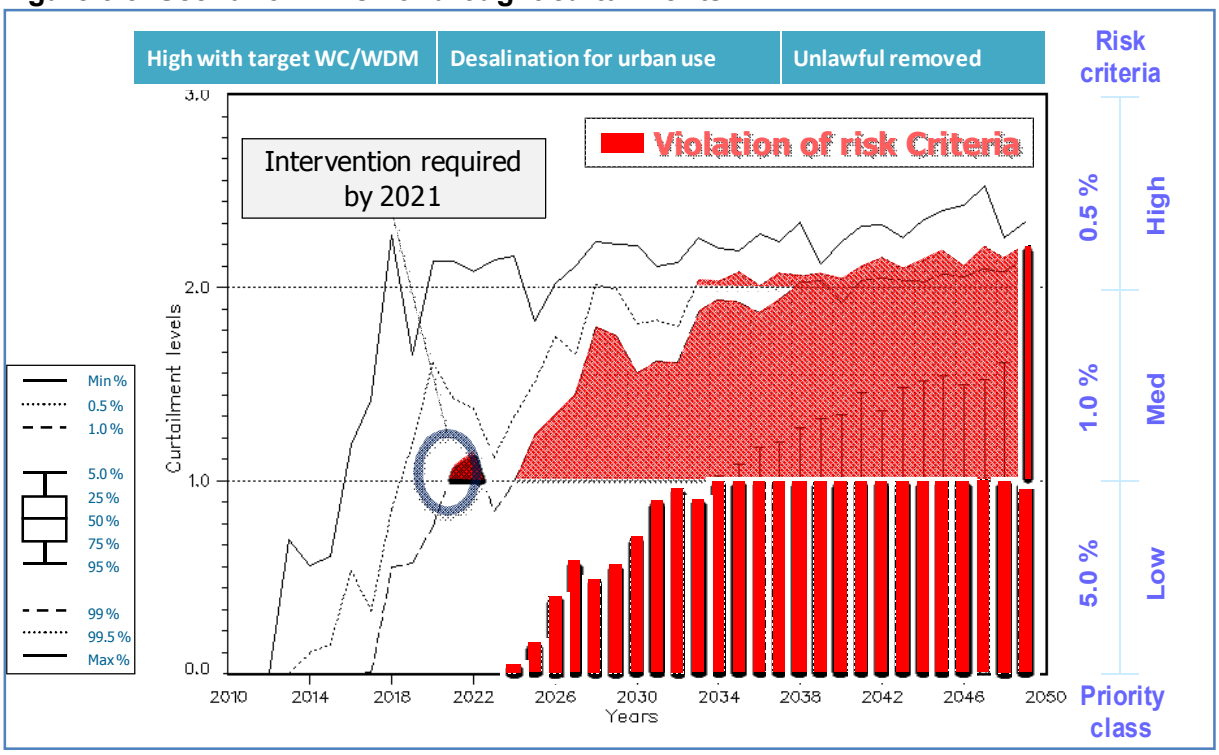


Figure 3.6: Scenario 3: Risk of drought curtailments

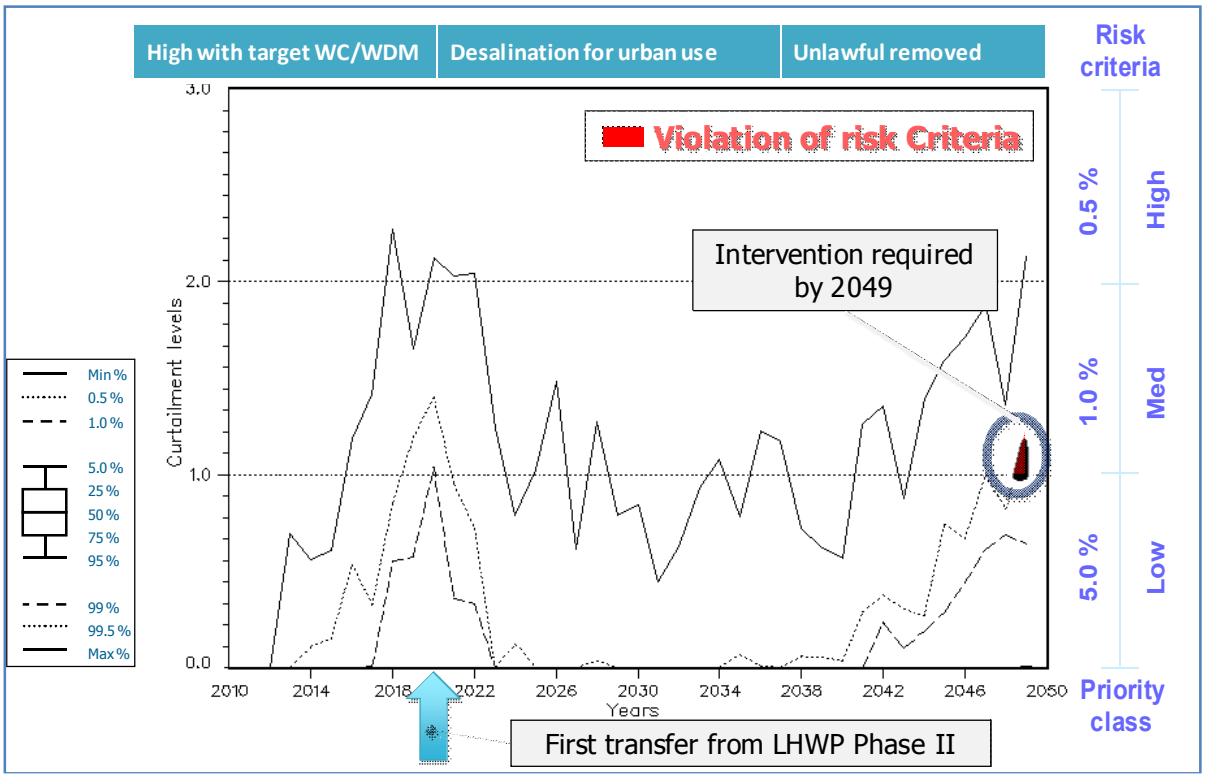


Figure 3.7: Scenario 4: Risk of drought curtailments

The projected risk of drought curtailments for each scenario is presented in **Figures 3.4 to 3.7** respectively. The figures show the three tier priority classification definition and the associated Risk Criteria which defines the maximum risk of curtailments that can be tolerated in any year in each of the Priority Classes.

The years in which violations of the Risk Criteria occurs are highlight in red shared areas and for each scenario the date when further intervention is required has been illustrated.

In summary the graphs show the following:

- The implementation of the target Water Conservation and Water Demand Management savings and the reduction of unlawful use postpone the violations of the Risk Criteria by two years ï comparison of **Figure 3.4** with **Figure 3.5**.
- The results for **Scenario 3** (**Figure 3.6**) shows that with the demand side interventions of **Scenario 2** and by implementing desalination of the mine water for urban water supply, maintains the risks of drought curtailments at acceptable levels until Polihali Dam can deliver water in the year 2020.
- By implementing all the interventions (as represented by **Scenario 4** ï **Figure 3.7**) it is shown that the risk of drought curtailments are at acceptable levels until the year 2049.

3.5. Simplified interpretation of results

The results from the simulation analyses (presented in **Section 3.4)** were used to compile water balances for selected scenarios to illustrate the projected supply situation in the Vaal River System under different situations.

Figure 3.8 presents the projected water balance for the scenario where the unlawful water use is reduced, savings through implementation of WC/WDM measures is implemented and the mine water is neutralised and discharged into the Vaal River System.

Figure 3.8 shows that the high storage state of the system in May 2010 results in temporary short term excess yield in the system. The implication of neutralising and discharging the mine water into the Vaal River system is that large quantities of dilution water has to be released from Vaal Dam to maintain the Total Dissolved Solids in the Vaal Barrage at 600 mg/l. This results in a reduction in the yield available in the upper Vaal River system creating an imbalance with large volumes of unused water in Bloemhof Dam from where it is spilled and wasted from the system. Even if Phase II of the Lesotho Highlands water Project is implemented it is not sufficient to prevent deficits in the systems. (Also see the simulation results for **Scenario 3** ï **Figure 3.6**)

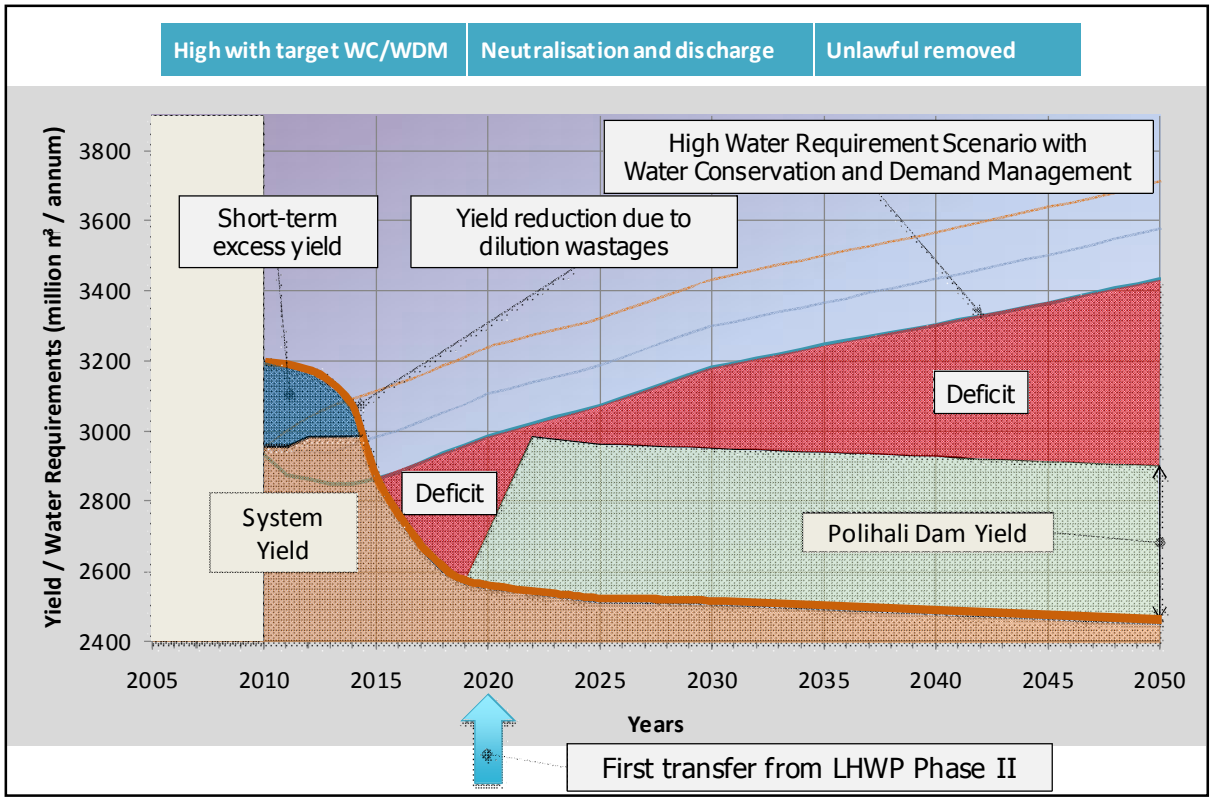


Figure 3.8: Water balance for the indicated scenario and reconciliation option

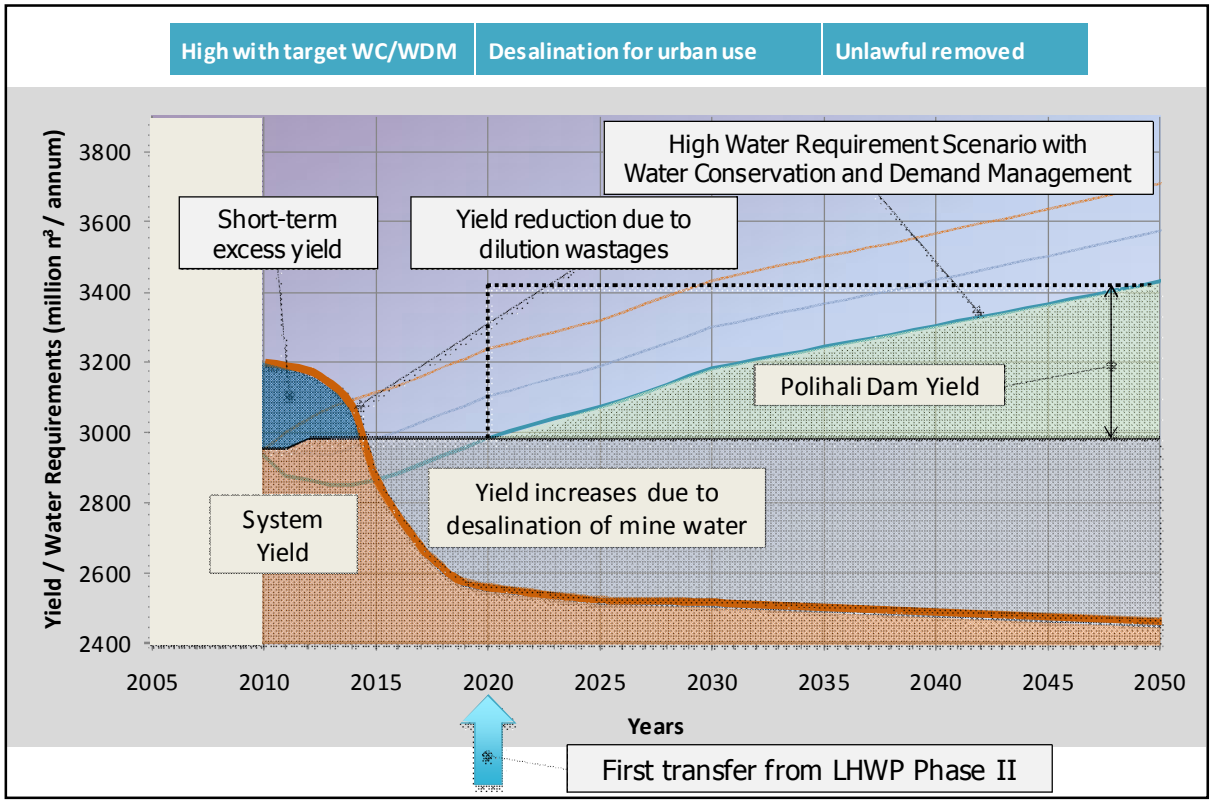


Figure 3.9: Water balance for the indicated scenario and reconciliation option

Figure 3.9 presents the scenario where the mine water is desalinated and the treated water is supplied for urban use by the year 2014. The effect thereof is that much less water is required for dilution (compared to the previous scenario) and no wastage occurs with limited spills from Bloemhof Dam over the long term. By also implementing Polihali Dam (LHWP Phase II) it can be seen that there is sufficient water to supply the water requirement until the year 2049. (This is also illustrated in ï **Figure 3.7** ï **Scenario 4** of the simulation analysis.)

4. CONCLUSIONS

The results of the scenario analyses show that all the interventions identified in the 2009 Reconciliation Strategy is required to make sufficient water available to all users in the Integrated Vaal River System until the year 2049.

The implementation of the interventions, other uncertainties and specific recommendations relating to the management of the Vaal River, Crocodile West River and Olifants River system will be presented and discussed at the Strategy Steering Committee Meeting.

Table notes:

i

CGS:	Council for Geo Science
CME:	Compliance Monitoring and Enforcement
D:	Director
IO:	Directorate Institutional Oversight
IMC:	Inter-Ministerial Committee
IWRP:	Chief-Directorate Integrated Water Resource Planning
NWRP:	Directorate National Water Resource Planning
OA:	Directorate Options Analysis
RPW:	Directorate Resource Protection and Waste
RQS	Directorate Resource Quality Services
ToE:	Team of Experts appointed to advise the IMC through the Directors-General of Water Affairs and Mineral Resources
SO:	Sub-Directorate System Operation
WQP:	Sub-Directorate Water Quality Planning
WRIB	Water Resource Infrastructure Branch
IWRMS:	Directorate Integrated Water Resource Management & Support
WRPS:	Directorate Water Resource Planning Systems
WSR:	Directorate Water Services Regulation

ii

	Action is completed
	Action is ongoing or busy
	Action has not been initiated