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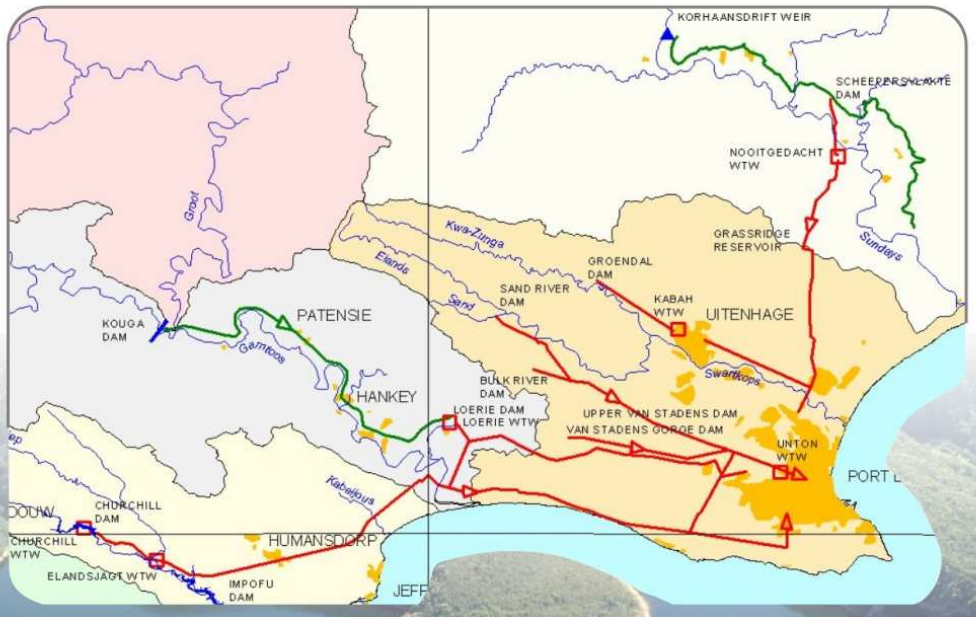
Water Reconciliation Strategy Study for the Algoa Water Supply Area

Algoa Reconciliation Strategy



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April 2011

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Department:
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Directorate: National Water Resource Planning

Aurecon Project No. 402448

Water Reconciliation Strategy Study for the Algoa Water Supply Area

ALGOA RECONCILIATION STRATEGY

April 2011

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Department of Water Affairs
Directorate National Water Resource Planning

Water Reconciliation Strategy Study for the Algoa Water Supply Area

APPROVAL

Title	:	Agoa Reconciliation Strategy
DWA Report no.	:	WMA 15/M00/00/1409/04
Consultants	:	Aurecon South Africa (Pty) Ltd in association with: AfriCoast Engineers SA (Pty) Ltd Palmer Development Group Groundwater Africa MGP Consulting cc Scherman Colloty & Associates
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Water Reconciliation Strategy for the Algoa Water Supply Area

Study Reports

Report Name	DWA Report Number	Aurecon Report number
Impact of Changed Crops on Water Quality in the Great Fish River	WMA 15/M00/00/1409/01	5004
Preliminary Reconciliation Strategy	WMA 15/M00/00/1409/02	5005
Inception	WMA 15/M00/00/1409/03	5006
Algoa Reconciliation Strategy	WMA 15/M00/00/1409/04	5007
Annexure A: Interventions Workshop	WMA 15/M00/00/1409/04	5007A
Annexure B: Public Participation	WMA 15/M00/00/1409/04	5007B

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EXECUTIVE SUMMARY: ALGOA RECONCILIATION STRATEGY

E1 INTRODUCTION

The Algoa Reconciliation Strategy Study was undertaken by the Department of Water Affairs (the DWA), in cooperation with the Nelson Mandela Bay Municipality (NMBM) and other stakeholders in order to secure a sustainable future water supply for NMBM and the other towns served by the Algoa Water Supply System (AWSS). **Figure E1** shows the study area which extends from the Kouga River system in the west to the Sundays River system in the east. The AWSS provides water to the Gamtoos Irrigation Board, the NMBM and to several smaller towns within Kouga Municipality.

A core element of the recommendations presented in this Strategy is Integrated Water Resource Management. This necessitates that choices are made and requires the cooperative contributions of all affected parties. Some of the recommendations that are presented in this Strategy are challenging, but they comprise practical and logical next steps to ensure sustainable and improved future management of the AWSS including the selection of interventions to balance supply and requirements.

New approaches are needed to plan and supply urban water needs, including altered consumer behaviour and appreciation of the scarcity of water, and the development and funding of more diversified portfolios of integrated new and alternate water sources, the return of surface and groundwater systems to sustainable levels of abstraction, and new institutional arrangements. Concerted political will is necessary to invigorate water reform in the AWSS. Sustained attention, resources and continued hands-on leadership and action will be necessary to ensure that this Strategy is successfully implemented and continually updated.

E2 PURPOSE OF THE STRATEGY

The purpose of the Reconciliation Strategy is to determine the current water balance situation and to develop various possible future water balance scenarios up to 2035. It further aims to describe the proposed strategy, and the associated actions, responsibilities and timing of such actions that are urgently needed to reconcile the supplies and requirements, to enable additional interventions to be timeously implemented so as to prevent the risk of a water shortage becoming unacceptable.

E3 THE ALGOA WATER SUPPLY SYSTEM

The AWSS currently comprises two major dams in the west, several smaller dams and a spring situated near to NMBM, and an interbasin transfer scheme from the Orange River via the Fish and Sundays rivers to the east. The combined yield of these sources at an assurance of supply of 98% (corresponding to 1 failure in 50 years or 1 in 50 year assurance) is 147.5 million m^3/a, of which 99 million m^3/a (271 Ml/day) is for urban use by NMBM and other small towns, and 48.5 million m^3/a for irrigation, but excluding agricultural use from the rivers upstream of the dams that form part of the AWSS**. Figure E1** shows the main components of the AWSS, and these and the main water users are described below.

E3.1 Western System

The Western System provides water to NMBM from the Churchill (**Figure E2**) and Impofu (**Figure E3**) dams on the Kromme River, from the Kouga Dam (**Figure E4**) on the Kouga River and from the Loerie Balancing Dam on the Loerie Spruit, a tributary of the Gamtoos River. The bulk supply of water provided to NMBM and the coastal towns from the combined Western System at an assurance of 1 in 50 years amounts to 65 million m^3/a (178 Ml/day). The Gamtoos Irrigation Board has an allocation from Kouga Dam of 59.36 million m^3/a at an assurance of 1 in 10 years, corresponding to 44.4 million m^3/a at 1 in 50 year assurance. There is also relatively small usage by other towns and irrigators as well as a small provision for ecological water requirements (EWR) below Impofu Dam.

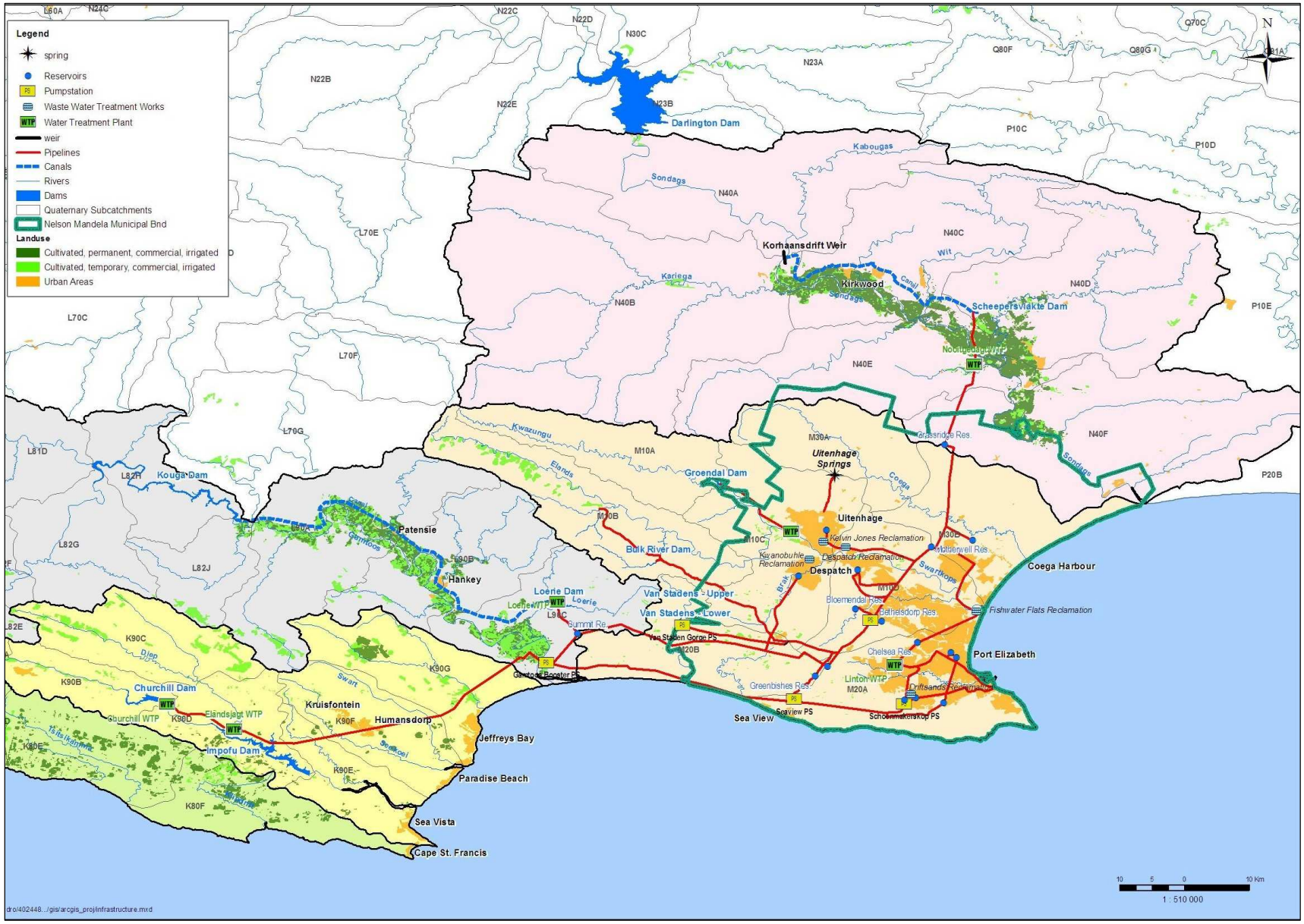

Figure E1 The Algoa Water Supply System (AWSS)

Figure E2 Churchill Dam on the Kromme River

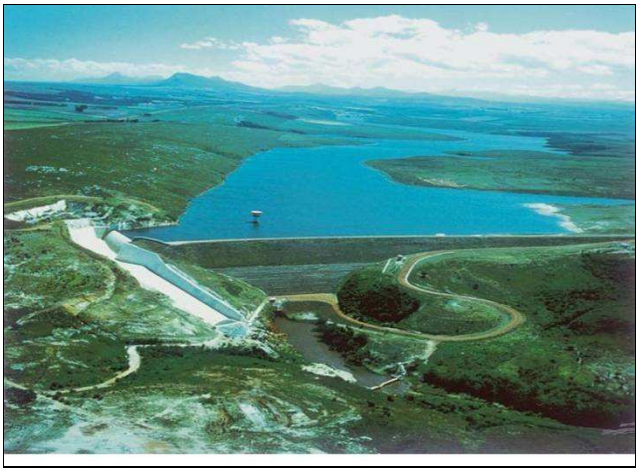

Figure E3 Impofu Dam on the Kromme River

E3.2 Eastern System

The Eastern System receives water transferred from the Gariep Dam on the Orange River via the Orange-Fish Tunnel, the Fish River, the Fish-Sundays Canal, Skoenmakers River, and Darlington Dam. The current quantity of bulk water supplied to NMBM from this system is 26 million m^3/a (71 Ml/day).

The Lower Sundays River Water User Association (LSRWUA) does not receive water from the AWSS but also obtains water from the Gariep Dam on the Orange River via the same transfer scheme. The LSRWUA uses about 99 million m^3/a and their total allocation, including the reserved water to be allocated at some future date for the proposed expansion of the irrigation area to serve resource poor farmers in the Barclay Bridge area is 155 million m^3/a.

E3.3 Central System

The Central System consists of the older dams on the Sand, Bulk, Van Stadens and Kwa Zunga (a tributary of the Swartkops) rivers and the Uitenhage Springs, all of which are owned by the NMBM. Combined, the quantity of water abstracted by NMBM from these sources is about 10 million m^3/a (27 Ml/day) including 4 million m^3/a (11 Ml/day) from Groendal Dam (**Figure E5**). Groendal also supplies 2.4 million m^3/a to irrigators.

Figure E4 Kouga Dam on the Kouga River

Figure E5 Groendal Dam

E.4 WATER USE

E.4.1 Historical water use

The AWSS provides water for domestic use and for use by more than 373 industries in the NMBM and also to several smaller towns within the Kouga Municipality. DWA's Water Use Authorisation and Registration Management System (WARMS) shows that in 2007 the registered water use of NMBM was 87.6 million m^3/a. The water requirements of the NMBM have increased steadily over the past few years, due to in-migration, increased service levels and industrial activity. In 2008 total urban and industrial use from the system was estimated to be 103.0 million m^3/a (282 Ml/day).

Historical urban and industrial water use from the AWSS is shown in **Figure E6**.

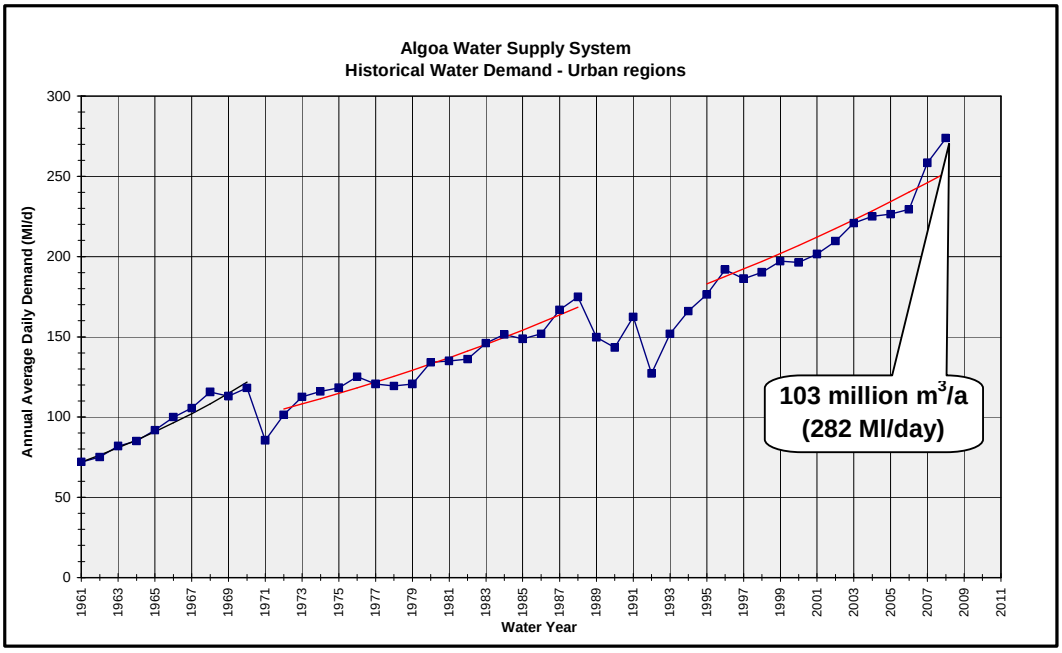

Figure E6 Historical urban and industrial water use from the AWSS

The full allocation to the Gamtoos Irrigation Board is 59.36 million m^3/a from the Kouga Dam but in most years inadequate yield is available from the Kouga Dam to enable the irrigators to make full use of this allocation. It was agreed at the Scenario Workshop held in December 2009 that, for future analyses and planning of the AWSS, it should be assumed that the full allocation of the Gamtoos Irrigation Board would be provided at a 91% (1 in 10 year) assurance of supply. This equates to 44.4 million m^3/a at a 1 in 50 year assurance of supply.

Historical water use by the Gamtoos Irrigation Board from Kouga Dam is shown in **Figure E7**. In 2009 the combined total usage by irrigation from the AWSS (from the Kouga, Impofu and Groendal dams) was estimated to be 48.5 million m^3/a at a 1 in 50 year assurance of supply.

The Lower Sundays River Water User Association (LSRWUA) irrigates with water transferred from the Gariep Dam on the Orange River. The total allocation from the Gariep Dam is 155 million m^3/a, and the current average usage is in the order of 99 million m^3/a. These values have not been included in the AWSS water balances, as the water is transferred from and used in a system that is separate from the AWSS.

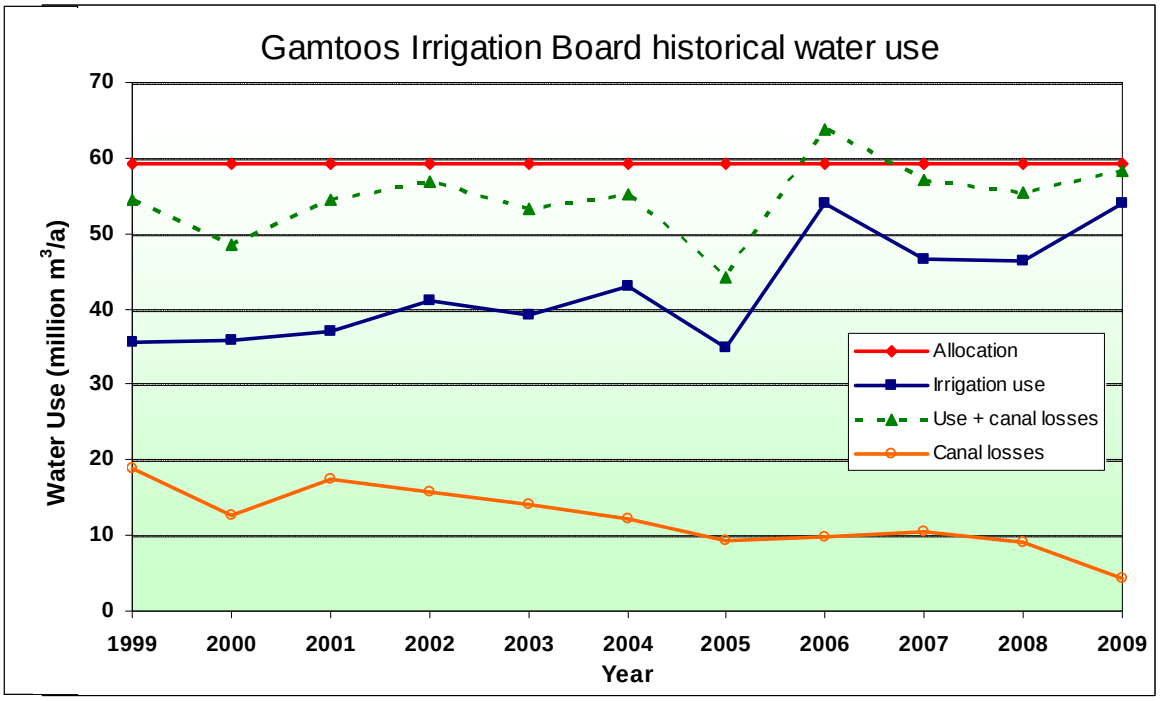

Figure E7 Historical water use by the Gamtoos Irrigation Board

Figure E7 shows how the estimated losses/unaccounted for water from the conveyance canal from Kouga Dam to Loerie Balancing Dam have decreased significantly from previous estimates, due to improved metering and operation, replacement of the siphons and major rehabilitation to the canals. In 2009 the reduced canal losses were 4.3 million m^3/a.

E4.2 Total 2009 water use from the AWSS

The total usage of water from the AWSS in 2009 was 157.8 million m^3/a. This comprises urban use by NMBM and various small towns, agricultural water use, losses from the Kouga/Loerie canal, and ecological water requirements as shown in **Table E1** and **Figure E8**.

The full annual allocation of the Gamtoos Irrigation Board is 59.36 million m^3/a at 91% assurance of supply (1 in 10 year failure), which corresponds to an allocation of 44.4 million m^3/a at 98% assurance of supply (1 in 50 year failure). Similarly, the annual requirement of agricultural use from Impofu Dam of 2 million m^3/a at a 91% assurance of supply is calculated to be 1.7 million m^3/a at 1 in 50 year assurance, and the 1 in 50 year irrigation supply from Groendal Dam is assumed to be 2.4 million m^3/a.

Table E1: Total water use from the AWSS in 2009 at 1 in 50 year assurance of supply

Water Use	million m^3/a	%
Urban	103.0	68.0%
Irrigation	48.5	30.7%
Canal Losses	4.3	2.7%
Ecological Water Requirements	2.0	1.3%
TOTAL	**157.8**	**100.0%**

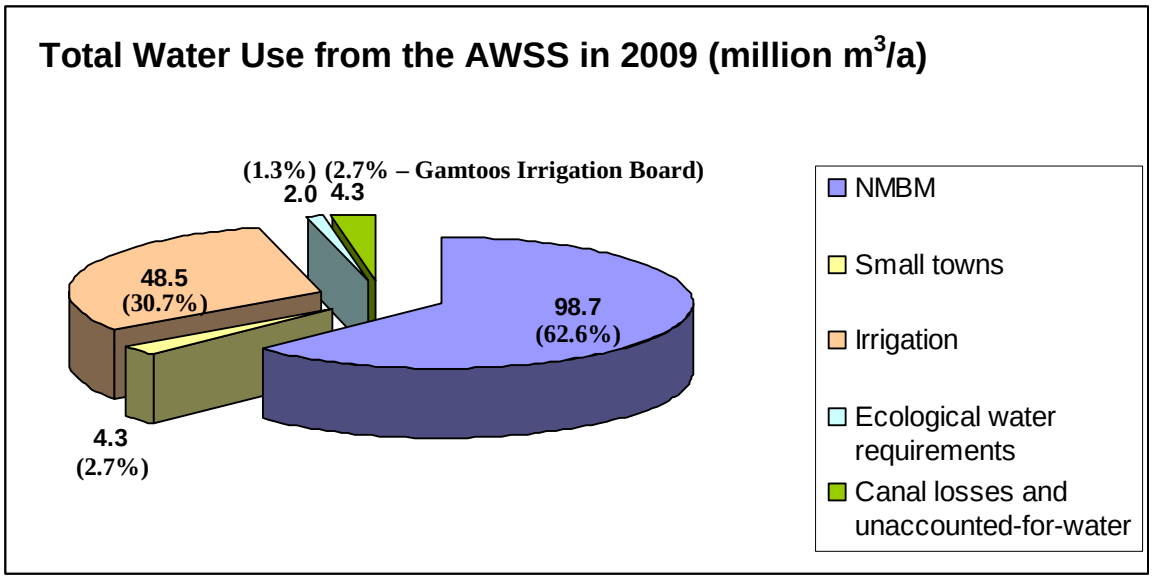

Figure E8 Total water use from the AWSS in 2009

E4.3 Coega IDZ water requirements

Most, if not all, new industrial water requirements are expected to arise within the Coega IDZ, however there is considerable uncertainty about the likely rate of uptake of industrial water. The cancellation of the aluminium smelter power contract with Eskom in 2009 appears to be the ultimate termination of an energy intensive industrial development strategy for the region based on available and cheap electricity. The economic recession created considerable uncertainty for potential industrial investors and this necessitated the revision of the previous Coega Water Master Plan that was prepared in mid-2009.

An updated draft business plan for the supply of industrial (non-potable) water to the Coega IDZ was prepared by Afri-Coast Engineers and SSI in March 2010. This business plan indicates that the industrial (non-potable) water requirements of the Coega IDZ will increase as indicated in **Figure E9**.
The future potable water requirements of the Coega IDZ are accounted for in the scenarios for the future potable water requirements from the AWSS described below.

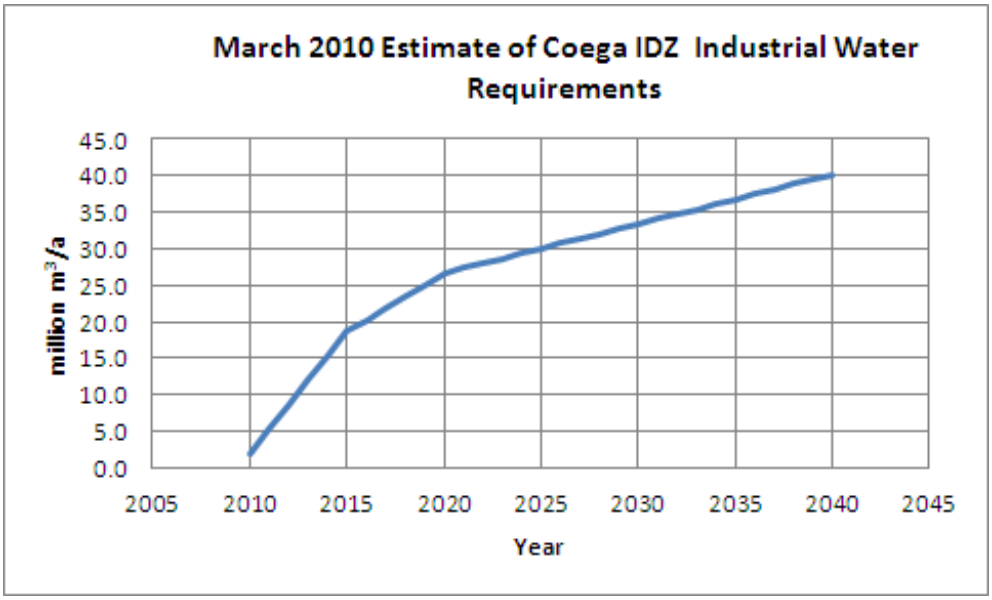

Figure E9 March 2010 estimate of Coega IDZ industrial (non-potable) water requirements

E4.4 Total urban and non-potable water requirement scenarios

The following assumptions were made for the development of future water requirement scenarios from the AWSS:

- The **future requirements for irrigation and the environment** will remain unchanged with no growth in the future.
- The **requirements for potable water use in NMBM** for both domestic and industrial use including potable use within the Coega IDZ will grow in accordance with one of **two scenarios**:
    - **High Growth** will take place on account of high population growth and high economic growth (at a rate of 3.5% per annum from 2009)
    - **Low Growth** will take place on account of low population growth and low economic growth (at a compound rate of 1% per annum from 2009)
- The rates of growth for **potable use in the small towns in Kouga Municipality** served by the AWSS will be the same as for NMBM.
- The **industrial (non-potable) water requirements in the Coega IDZ** will grow as described in **Section E4.3** above.

On the basis of these assumptions **two total water requirement scenarios** were developed:

- **Total High-Growth Water Requirement Scenario** includes the current irrigation usage, the High Growth potable urban domestic and industrial requirements scenario for NMBM and the small towns, and the industrial (non-potable) requirements of the Coega IDZ as shown in **Figure E10**.

- **Total Low-Growth Water Requirement Scenario** including the current irrigation usage, the Low Growth potable urban domestic and industrial requirements scenario for NMBM and the small towns, and the industrial (non-potable) requirements of the Coega IDZ as shown in **Figure E11**.

The base year for these water requirement scenarios is 2009 when the requirements were 157.8 million m^3/a,, as shown in **Table E1**.

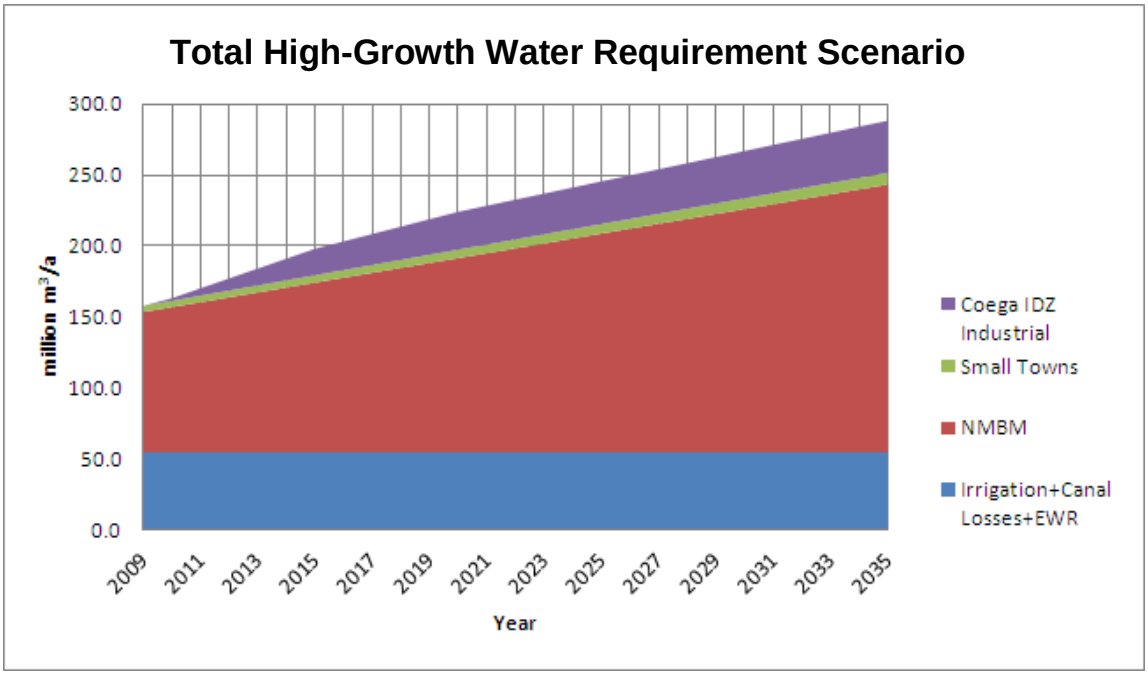

Figure E10 Total High-Growth water requirement scenario for the AWSS

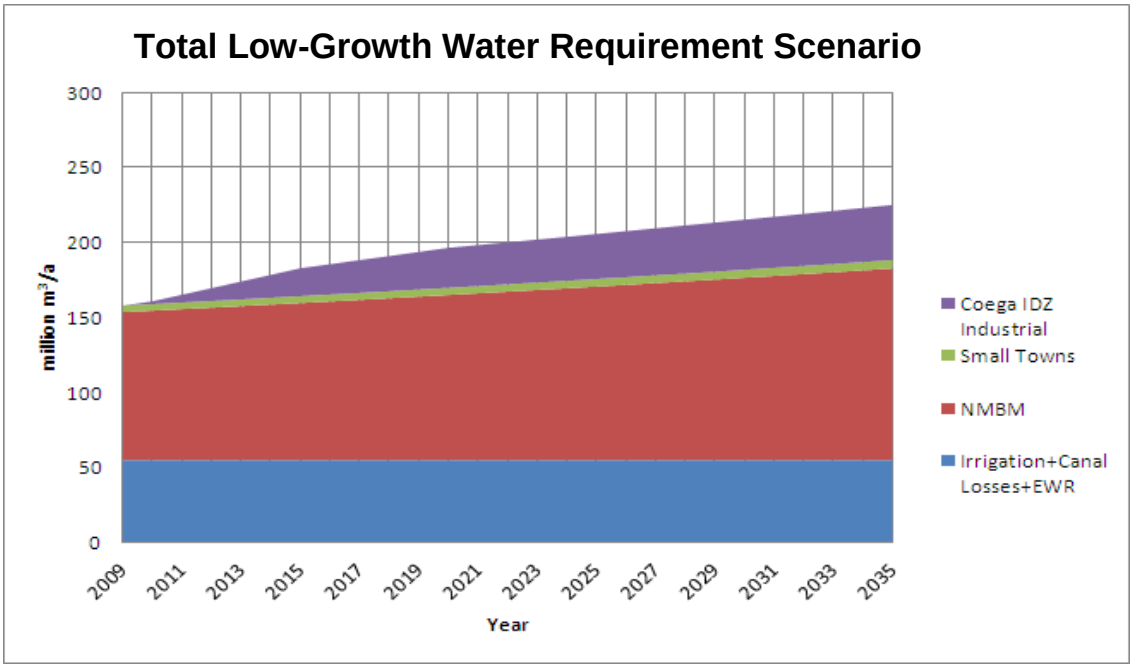

Figure E11 Total Low-Growth water requirement scenario for the AWSS

E5 WATER AVAILABILITY

E5.1 Existing supplies

The 1 in 50 year and 1 in 20 year long-term stochastic yields of the various sources of supply available for urban, industrial and agricultural use are shown in the table below.

Table E1 Long-term stochastic yields of the Algoa Water Supply System

Sources of supply	1 in 50 year yield or existing allocation/use (million m^3/a)	1 in 20 year yield or existing allocation/use (million m^3/a)
NMBM older dams	3.3	4.0
Groendal Dam	6.5	6.5
Uitenhage Springs	2.4	2.4
Churchill/Impofu dams	44.4	51.0
Kouga/Loerie dams	75.5	86.0
Sundays River GWS	25.6	25.6
Re-use	1.7	1.7
Combined Total Yield	**159.4**	**177.2**

Bulk water planning is generally done at a 1 in 50 year assurance of supply, for urban water supply. For the AWSS urban water use is more than 60% of total use, and is expected to increase. Therefore future evaluation and scenario planning has been based on a 1 in 50 year assurance of supply.

E5.2 Climate change

The Annual Report of the Water Research Commission for the period April 2008 to March 2009 entitled *An Evaluation of the Sensitivity of Socio-Economic Activities to Climate Change in Climatically Divergent South African Catchments* states that global climate change models indicate that in the intermediate future (2046 to 2065) the Kromme and Kouga river catchments may experience slightly lower mean annual rainfalls and fewer runoff events of 20 mm or more. Lower mean annual rainfalls will result in

lower soil moisture contents and together with reduced rainfalls in excess of 20 mm per day in reduced runoff.

On the other hand the models also indicate that the catchment of the Orange River is likely to experience slightly higher mean annual precipitations as well as slightly increased frequency of rainfalls in excess of 20 mm, which together would increase runoff from the catchment of the Orange River that serves the AWSS via Darlington Dam on the lower Sundays River.

Although there is considerable uncertainty concerning the possible effects of climate change on runoff into the existing and potential future dams of the AWSS, the formulation of a climate change scenario has been based on the conservative assumption that the runoff from all existing local water schemes serving the AWSS (but not the supply from the Orange River) will reduce linearly by 10% (13 million m^3/a) over the period 2011 to 2023 and that there will be no further reductions in their yields thereafter.

E5.3 Ecological water requirements

The existing ecological water requirements (EWR) for the lower Kromme River of 2 million m^3/a has been taken into account in the AWSS water balance calculations, although no ecological releases are at present being made from the Impofu Dam. There are also currently no EWR releases from the other dams serving the AWSS, however, provision has been made for EWR releases in determining the yields of all possible future schemes.

The influence on the yield of the existing AWSS of making EWR releases from the existing dams could be significant. Potential yield reductions following implementation of the Reserve have been considered in two of the AWSS water balance scenarios evaluated by assuming that the combined yield of the local surface and groundwater sources (but not the supply from the Orange River) will reduce linearly over a 3 year period from 2014 to 2017 by 15%, corresponding to a reduction in yield of 23.6 million m^3/a.

E6 COMPARISON OF FUTURE WATER REQUIREMENTS AND EXISTING AVAILABILITY

Figure E12 shows the current water balance and future Total High-Growth and Total Low-Growth water requirement scenarios as well the Water Availability from all existing sources of supply.

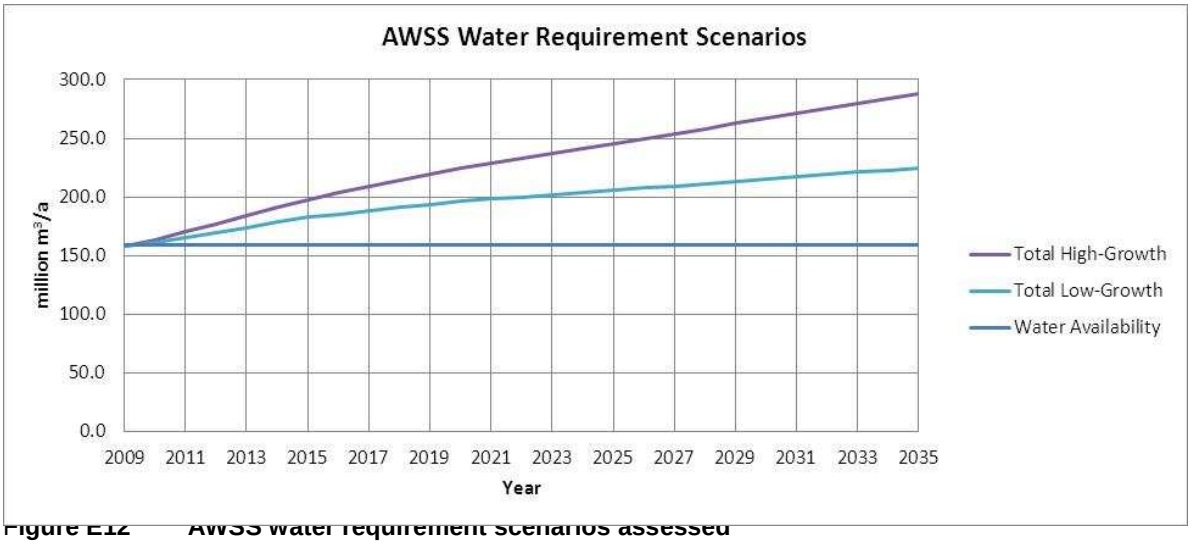

Figure E12 AWSS water requirement scenarios assessed

It is concluded that the system was just in balance in 2009 and that any increase in use would put the system at risk. It is clear that measures to solve this problem must be proceeded with immediately on account of the lead times necessary for implementation.

E7 INTERVENTIONS

E7.1 Selection of interventions

A significant number of potential interventions, which could contribute to meeting the future water requirements of the AWSS, were initially identified from previous and on-going studies, with the inclusion of several newly formulated interventions. The following categories of interventions were identified:

- Water conservation and water demand management (WC/WDM);
- Increased operational efficiency of the current water supply system;
- Trading of water use authorisations;
- Re-use of water;
- Groundwater schemes;
- Inter-basin transfer schemes;
- Desalination of seawater;
- Desalination of brackish river water; and
- Surface water schemes.

Detailed intervention implementation programmes were developed and interventions that could potentially be implemented in the medium-term were then identified.

The selection of interventions was based on:

a. Lowest cost based on Unit Reference Value (URV) which provides an indication of the combined capital and operation costs;
b. Time required for implementation;
c. Adequate yield, and certainty that the yield can be realised;
d. Spreading of risk by becoming less reliant on surface water sources; and
e. Ensuring that there would be an adequate number of interventions available to meet the Total High-Growth Water Requirement Scenario described above.

E7.2 Emergency interventions

The severe and prolonged drought in 2009-2010 led NMBM to impose severe water restrictions and to fast track the implementation of the following emergency interventions, most of which had previously been identified as priorities by the preliminary scenario planning processes:

- Improved operation of the Kouga Loerie System
- Water Conservation and Water Demand Management (WC/WDM)
- Nooitgedagt Low-Level Scheme supplied from the Orange River
- Swartkops desalination of seawater
- Groundwater abstraction close to existing infrastructure, mainly in the vicinity of Bushy Park.

E7.3 Summary of interventions considered

Descriptions of the interventions that were considered for the Strategy following preliminary screening and taking account of those considered or already implemented by NMBM as possible emergency interventions (**shown in bold**) are provided in **Table E2**.

Table E2 Interventions considered for the Reconciliation Strategy

Intervention	Description of intervention
URBAN WATER CONSERVATION AND DEMAND MANAGEMENT:	
WC/WDM upstream/downstream of user meters	Continued roll-out of the active WC/WDM programme within NMBM, controlled by a full-time manager, and implementation of the existing WC/WDM programme and new WC/WDM activities. **This program has been expedited as one of NMBM's Emergency Interventions.**
Rainwater harvesting	Collection of rainwater from roofs, primarily for toilet flushing. The collection of rainwater for supplementing of garden water use is deemed to be an extension of this option. **Rainwater harvesting is being promoted by NMBM.**
TRADING OF WATER USE AUTHORISATIONS:	
Water trading – upper Great Fish River	Purchasing of water use entitlements from farmers using Orange River water in the upper Great Fish River, to be supplied to NMBM via the Nooitgedagt abstraction infrastructure.
Water trading - Baviaanskloof River	Purchasing of water use entitlements from farmers in the Baviaanskloof River valley, to be supplied to NMBM via the existing Kouga/Loerie system.
LAND USE CHANGES:	
Removal of alien invasive plants	Programmes to remove invasive alien plants in the catchments of the Kromme, Kouga and Baviaanskloof rivers which is already being done on a large scale. **This is already being done on a large-scale.**
RE-USE OF WATER:	
Re-use of water treated to industrial standards – Coega WWTW	Re-use of treated water from the future Coega WWTW, to meet requirements for industrial (non-potable) quality water within the Coega IDZ. **This scheme is included in the business plan for the Coega IDZ.**
Re-use of water treated to industrial standards – Fish Water Flats WWTW	Re-use of treated water from the Fish Water Flats WWTW, to meet requirements for industrial quality water within the Coega IDZ. **This scheme has been set by the Eastern Cape Department of Economic Affairs, Environment and Tourism (DEAET) as a condition of water supply to the Coega IDZ and is included in the business plan of the Coega IDZ.**
Re-use of water treated to potable standards	Potable re-use of treated water from the Fish Water Flats (and possibly Uitenhage and Despatch WWTWs) through reverse osmosis treatment, storage in a proposed new dam at Echodale on the Elands River and treated at a new water treatment works. The recently identified alternative scheme to utilise treated effluent via Loerie Dam would be a similar alternative, however the URV may be lower.
DESALINATION:	
Coega Industry Desalination Option	Purchasing of potable water by NMBM from an industry in the Coega IDZ, which utilises reverse-osmosis to produce chlorine and caustic soda and high-quality water as a by-product of the process. This option is also dependent on the construction of a bulk seawater intake system for the Coega IDZ.
Lower Sundays River irrigation return flows	Abstraction of irrigation return flows in the Sundays River downstream of the Sundays River Water User Association, desalination, and blending at Olifantskop reservoirs with treated Orange River water

Intervention	Description of intervention
	supplied from the Nooitgedagt WTW.
Desalination of seawater	Supply via a bulk seawater intake system for multiple potential sea water users within the Coega IDZ area, pumping sea water via pipeline to the proposed RO plant site (to be shared with the planned Coega WWTW). **The recently identified alternative scheme to site a desalination plant on the Swartkops Estuary would be a similar alternative, with a similar URV and is one of NMBM's Emergency Interventions that would also improve the diversification of the sources of supply.**
GROUNDWATER AUGMENTATION SCHEMES:	
Fast-tracked groundwater schemes: - Jeffreys Arch - Van Stadens - Bushy Park - South-Eastern Coega Fault	Fast-tracking the implementation of the Jeffreys Arch, Van Stadens River Mouth, Bushy Park and the South-Eastern Coega Fault new groundwater schemes. Some of these schemes could either supply NMBM or alternatively supply small coastal towns, freeing up water for NMBM. **Groundwater development at Bushy Park is one of NMBM's Emergency Interventions.**
SURFACE WATER AUGMENTATION SCHEMES:	
Maximising yield of the existing Kouga/Loerie Scheme	Lowering of the operational level to which water can be abstracted from Loerie Dam to increase the yield, requiring no additional infrastructure or operating staff, but improved operation and increased periods of pumping at maximum capacity. **This scheme has been implemented.**
ORP/Nooitgedagt Low-Level Scheme	Increased supply from the Orange River to NMBM, supplied from Nooitgedagt Water Treatment Works (WTW) via a new pipeline to the Olifantskop Reservoir. This scheme would also offer significant energy savings on account of the reduced pumping heads needed. **DWA recently issued a licence to NMBM to abstract 58.3 million m^3/a of water from the Orange River with the proviso that the licence could be reduced back to 22 million m^3/a after 20 years, however NMBM have requested that the licence be made permanent on account of the high capital cost of this scheme.** **This scheme is one of NMBM's Emergency Interventions.**
Abstraction of lower Gamtoos River irrigation return flows	Abstraction of irrigation return flows by NMBM downstream of the largest irrigation component of the Gamtoos Irrigation Board (upstream of the tidal river zone) and pumping this water into the Loerie Dam for blending with water from Kouga Dam. **This scheme was considered by NMBM as a potential emergency measure but was eliminated on account of its potential impact on the ecology of the important Gamtoos Estuary.**
Guernakop Dam on the Kouga River	Construction of a new 83 m high rollcrete dam at Guernakop approximately 15 km upstream of the upper end of Kouga Dam on the Kouga River and doubling of the capacities of the Loerie WTW and the pipelines to NMBM.
Raising Kouga Dam on the Kouga River (replacement and raising)	Construction of a mass gravity rollcrete dam immediately downstream of the existing Kouga Dam and doubling of the capacities of the Loerie WTW and the pipelines to NMBM. **DWA are currently investigating this scheme for Dam Safety reasons.**
Tsitsikamma River Diversion to Impofu Dam	Diversion of flows from a diversion weir on the lower Tsitsikamma River, and pumping the water to a high point, from where the water would gravitate via pipeline into a stream which flows into Impofu Dam. The water would be treated at the Elandsjagt WTW and distributed through existing infrastructure.

E7.4 Evaluation of interventions

The selected interventions were evaluated and compared with one another. Information was drawn from various existing reports, as well as from expert knowledge, to compile the summary evaluations of interventions, to be able to compare interventions with one another at a common baseline. Some of the interventions had been evaluated very superficially by previous studies, and a number of new interventions were identified. Evaluation was done at desktop level for such interventions, to provide a reasonable level of information. Whilst the baseline information differs in extent and reliability, it nevertheless represents the latest available information for each option.

E8 WATER BALANCE SCENARIO PLANNING

The primary focus of the water balance scenario planning was to evaluate a range of interventions and the sequences of their implementation to meet the expected shortfalls in the supply up to 2035. A range of water balance scenarios was developed to assist in formulating the strategies for the reconciliation of supply and requirements for the AWSS. Eight water balance reconciliation scenarios are presented in the Report, of which three are presented below, two to meet the Total High-Growth Water Requirement Scenario and one to meet the Total Low-Growth Water Requirement Scenario described in **Section E4.4** above.

E8.1 Water Balance Scenarios to meet *Total High-Growth Water Requirement*

The two water balance scenarios for *the* ***Total High-Growth Water Requirement Scenario*** which are presented below are as follows:

Water Balance Scenario 1 for Total High-Growth Water Requirement:
NMBM's Emergency Interventions with a permanent allocation from the Orange River, as well as Non-Potable Water Re-use Schemes at the Coega and Fishwater Flats WWTW to supply NMBM until 2028

Water Balance Scenario 7 for Total High-Growth Water Requirement:
NMBM's Emergency Interventions with a temporary allocation from the Orange River and in addition Groundwater Abstraction, a New Raised Kouga Dam, Purchase of Irrigation Allocations, the Coega IDZ Desalination Scheme and the Sundays River Desalination Scheme as well as Non-Potable Water Re-use Schemes at the Coega and Fishwater Flats WWTW to supply NMBM until 2034 with the release of EWRs from existing dams and the impacts of Climate Change.

E8.1.1 Water Balance Scenario 1 and Strategy to meet Total High-Growth Water Requirement

Water Balance Scenario 1 is shown in **Figure E13** and illustrates how NMBM's Emergency Interventions together with Water Re-use from the Coega and Fishwater Flats WWTW could meet the combined potable requirements of the AWSS and the non-potable industrial water requirements of the Coega IDZ until 2028. **Figure E13** also shows that NMBM's Emergency Interventions would supply sufficient water to meet both the increase in the potable requirements of NMBM and the other towns as well as the Coega IDZ's industrial (non-potable) water requirements until 2019.

Figure E14 also shows that the industrial non-potable water requirements of the Coega IDZ could be met from the surplus capacity of the potable sources until 2019, after which there would be sufficient effluent from the Coega WWTW that would be treated to supply the industrial water requirements of the Coega IDZ until 2024. The further growth of the industrial requirements of the Coega IDZ would be met from 2025 onwards by effluent treated to industrial standards at the Fish Water Flats WWTW.

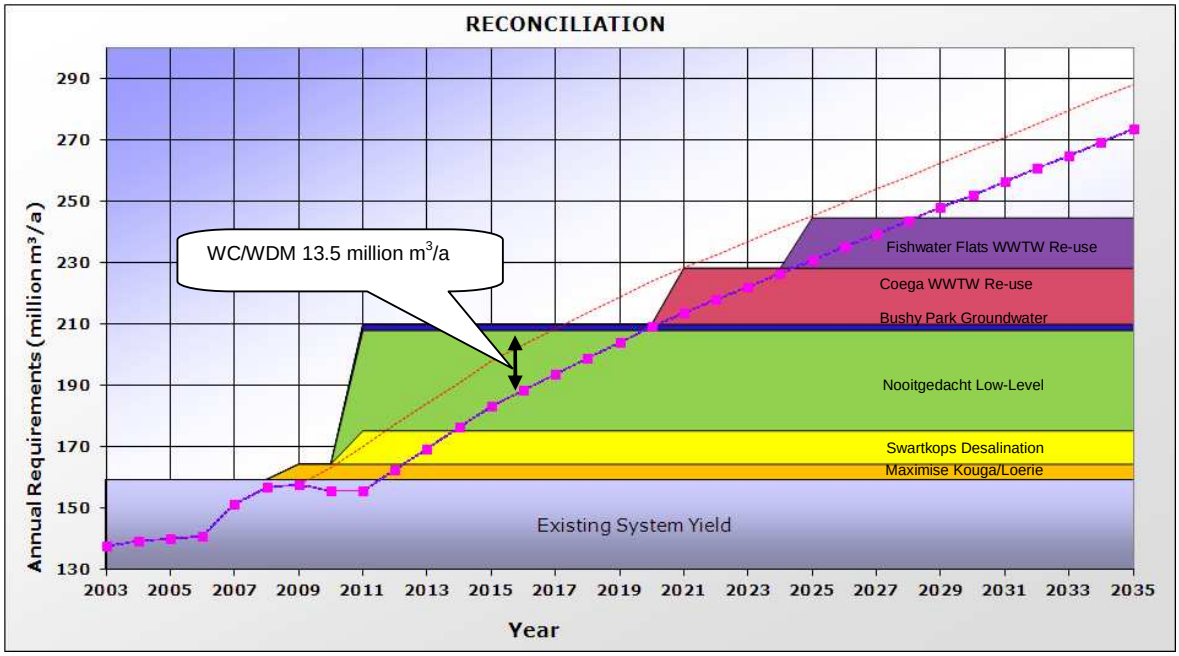

Figure E13 AWSS Combined Potable and Non-Potable Water Balance Scenario 1 for Total High-Growth Water Requirement

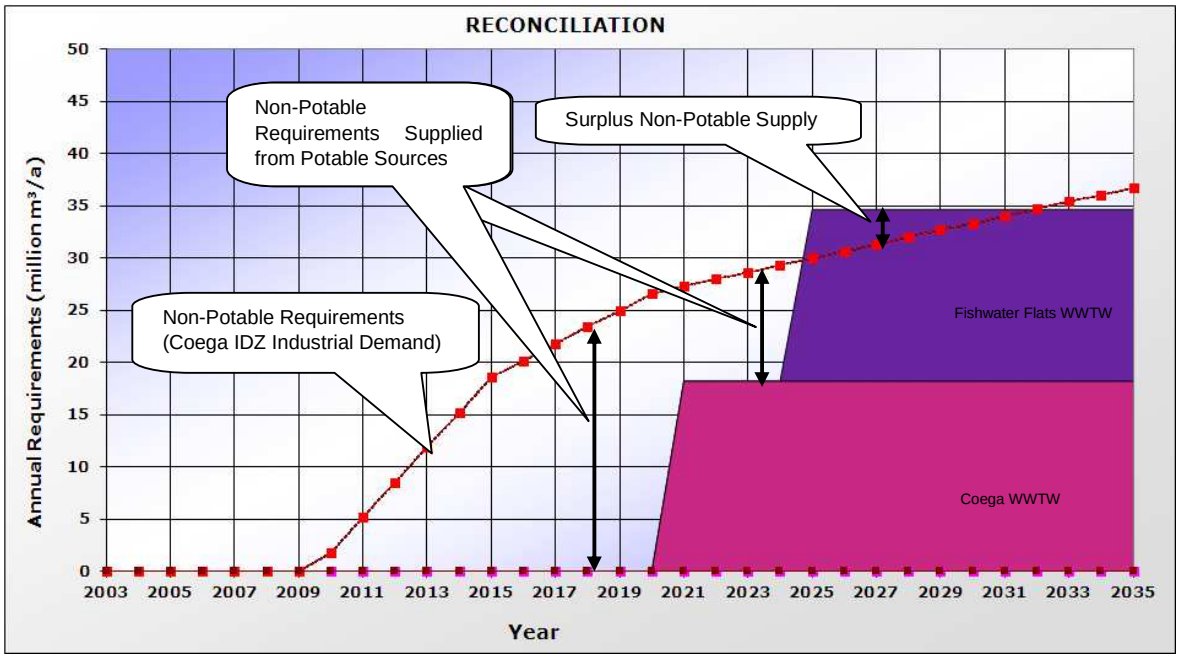

Figure E14 AWSS Water Balance Scenario 1 for Industrial (Non-Potable) Supply to Coega IDZ

The **Strategy for Water Balance Scenario 1** – with responsibilities for implementation as indicated below – would be as follows:

- Maximise the yield of the Kouga Loerie system by improved operation of Loerie Dam - NMBM, the GIB and DWA.
- Accelerate the implementation of the Emergency Measures including:
    - Implementation of a suite of WC/WDM measures to permanently reduce the urban requirements by at least 13.5 million m^3/a – NMBM and local towns
    - Fast tracking the construction of the Nooitgedagt Low Level Scheme - NMBM
    - Fast tracking the implementation of the Swartkops desalination scheme – NMBM

  - Implementation of the Bushy Park groundwater development – NMBM
- Undertake a feasibility study of the use of treated waste water from the Coega IDZ WWTW, the Fish Water Flats WWTW and other WWTW operated by NMBM to optimise the use of treated waste water - NMBM and Coega IDZ
- Design and implement separate potable and industrial (non-potable) water distribution systems in the - Coega IDZ
- Design and implement the sewage reticulation of the Coega WWTW to deliver sufficient effluent to the WWTW to supply 18.3 million m^3/a of effluent treated to industrial standards from 2021 onwards and plan the future tertiary treatment facility at Coega accordingly – NMBM and Coega IDZ
- If the feasibility study confirms that treated waste water from Fish Water Flats WWTW should be treated to industrial standards and delivered to the Coega IDZ then the design and construction of the Fish Water Flats tertiary treatment facility and the pipeline from Fish Water Flats to the Coega IDZ should be implemented to deliver industrial (non-potable) water by 2025 – NMBM and Coega IDZ

E8.1.2 Water Balance Scenario 7 and Strategy for Total High-Growth Water Requirement

Water Balance Scenario 7 shown in **Figure E15** would necessitate the implementation of all identified feasible interventions as the supply would be reduced by the following:

- EWR releases of 23.6 million m^3/a from local dams would be phased in from 2014 to 2017
- Climate change would reduce the yields of local dams by an additional 13 million m^3/a phased in from 2011 to 2023.
- The additional Orange River allocation to NMBM of 36.3 million m^3/a would be phased out over 5 years commencing in 2032, 20 years after the Nooitgedagt Low Level Scheme is commissioned.

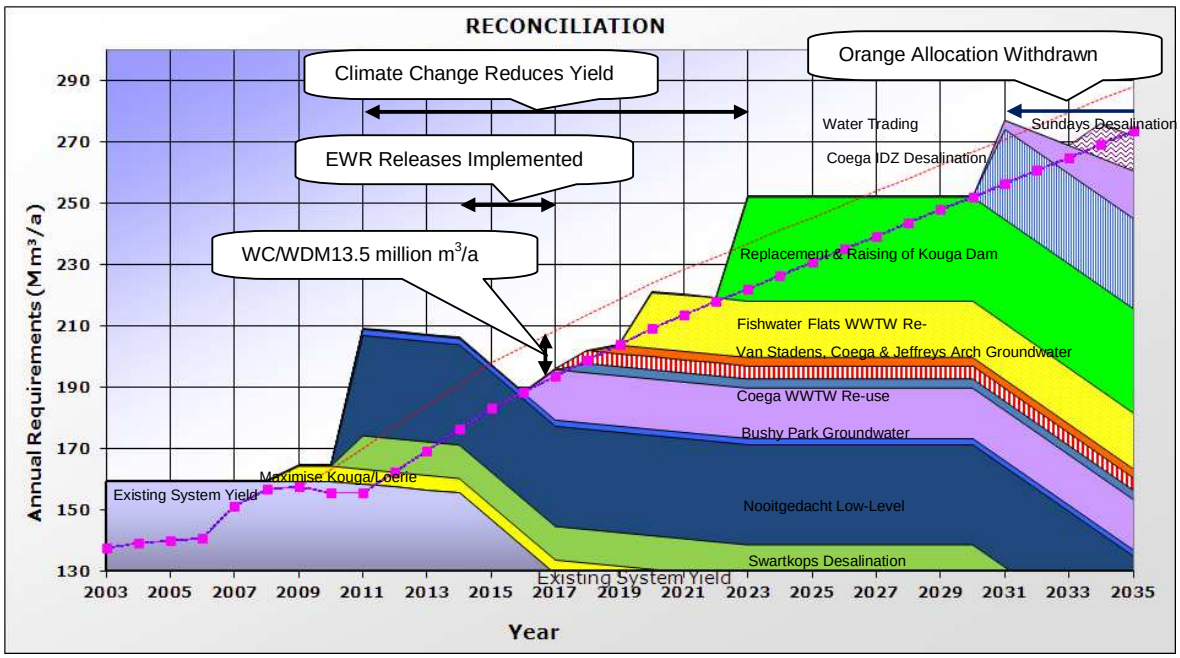

Figure E15 AWSS Combined Potable and Non-Potable Water Balance Scenario 7

The **Strategy for Water Balance Scenario 7** – with responsibilities as indicated below – would be as follows:

- The Strategies for Water Balance Scenario 1 would need to be implemented much earlier than for that Scenario – NMBM and DWA
- A Reserve determination should be undertaken for the EWR releases together with a study to determine the impact of the EWR on the yield so that additional interventions can be timeously

implemented so as to ensure the on-going reconciliation of supplies and requirements. The study should include the determination of new operating rules – DWA and NMBM

- The hydrology of the system should be updated and the possible impacts of climate change should be closely monitored - DWA and NMBM
- The replacement and raising of Kouga Dam (which is currently being planned by DWA for Dam Safety reasons) should be studied at feasibility level – DWA and NMBM
- Feasibility studies of the desalination of seawater and of the Sundays River irrigation return flows should be undertaken with particular consideration of the impacts of phasing out the additional Orange River allocation – NMBM and DWA
- The possible replacement of the Orange River allocation with trading options for the purchase of irrigation water rights should be investigated – NMBM and DWA

E8.2 Water Balance Scenario 8 for Total Low-Growth Water Requirement Scenario

One water balance scenario is presented for *the* ***Total Low-Growth Water Requirement Scenario:***

Water Balance Scenario 8 for Total Low-Growth Water Requirement:
NMBM's Emergency Interventions with a permanent allocation from the Orange River, as well as Non-Potable Water Re-use Schemes at Coega and Fishwater Flats to supply NMBM until well beyond 2035

Water Balance Scenario 8 shown in **Figure E15** should be compared with Water Balance Scenario 1 shown in **Figure E13**. **Figure E15** shows that for the Total Low-Growth Water Requirement Scenario the Emergency Interventions to be implemented by NMBM would meet the combined potable and Coega IDZ industrial water requirements until 2035. Therefore it would only be necessary to implement the water re-use scheme from the Coega WWTW after 2035 and the Fishwater Flats Re-use scheme some years later.

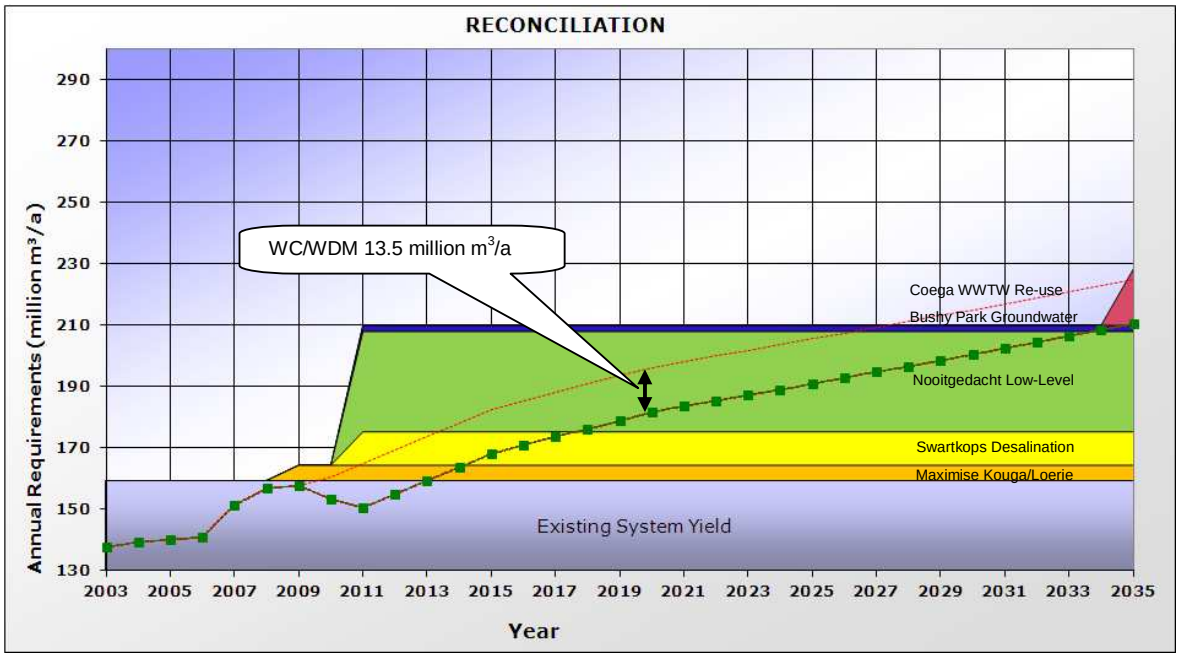

Figure E15 AWSS Combined Potable and Non-Potable Water Balance Scenario 8

The **Strategy for Water Balance Scenario 8** would be the same as that for Water Balance Scenario 1, however the differences between these Strategies (**Figures E13 and E15**) clearly show the need for the following additional strategies:

- The water requirement scenarios should be regularly updated to ensure that interventions are scheduled and implemented at the optimal times.
- The scheduling of new interventions should be regularly updated.

E9 INSTITUTIONAL ARRANGEMENTS

Any strategy is as good as its practical implementation. Alignment of the key role-players and continuous monitoring is required to ensure performance and compliance in meeting the objective of the strategy, to reconcile future water availability with the requirements. The strategy can only be kept alive by a decision-support framework which will enable timely decisions to be made on water resource interventions. A technical support team will need to monitor all the impacts and the effectiveness of WC/WDM measures implemented so as to be able to identify new opportunities. Co-operation by the institutions responsible for the entire water supply chain is essential to achieve the intended objectives. The creation of an environment where partnerships can be formed to tackle specific recommended actions should be encouraged.

It is recommended that an Algoa **Strategy Implementation Steering Committee** be established towards the end of the Reconciliation Strategy Study. The Strategy Implementation Steering Committee has as its main functions and objectives:

a. To ensure that the Strategy recommendations are implemented
b. To ensure that the Strategy remains relevant and is updated when needed,
c. To monitor and co-ordinate the implementation of the relevant actions identified in the Strategy, and
d. To make recommendations on long-term planning activities required to ensure reconciliation of requirements and supply in the AWSS area (e.g. recommending feasibility studies for particular interventions to ensure timely implementation).

An **Administrative and Technical Support Group** (ATSG) will be responsible for general administrative and technical support to the Strategy Implementation Steering Committee.

E10 PUBLIC PROCESS

The primary intention of the public process was to create awareness of the project at a broad-based level throughout the AWSS and potentially affected areas. This process:

- Established a mechanism for receiving comments from stakeholders and the general public, to respond to their queries and contributions and to enable any interested and affected party to contact the study team;
- Created awareness in the printed media, radio and television for the scheduled public meetings;
- Distributed newsletters and other documentation to key stakeholders; and
- Identified potential problems, disputes, or other negative elements emerging from the public process, evaluated these timeously, and recommended how to address these.

Three public meetings were held to inform the public of the study objectives, progress, findings and recommendations and to invite comment and discussion at the different phases of the study. Newsletters to give information on the progress with the study were widely distributed before these meetings. The public participation at the public meetings was regarded as a success in that all participants were generally satisfied with the level of information given by the study team. The existing owners of the AWSS, namely DWA and the NMBM, shared a good working relationship during the formulation of the Strategy and were well represented at the public meetings.

E11 STRATEGY ACTION PLAN

A Strategy Action Plan was developed that details actions, responsibilities and timelines to meet the objectives and recommendations of the Strategy.

E12 RECOMMENDATIONS

Based on the findings of the study, the following recommendations are put forward to ensure on-going reconciliation of water supply and requirement within the AWSS:

a. **A Strategy Steering Committee**, supported by an Administrative and Technical Support Group, should be formed as soon as possible in order to make recommendations, on an annual basis, on long-term planning activities required to ensure continued reconciliation of water requirements and available supply in the AWSS area. Particularly important are:
   - The monitoring of supplies and requirements including the annual updating of the likely future requirements.
   - Ensuring that studies of interventions are undertaken in sufficient time to enable the responsible authorities to take the necessary actions to timeously implement the identified interventions to meet the growth in the future water requirements.
   - Annually updating the Strategy.
   - The issuing of an annual newsletter to keep the public informed.

b. The **Water Conservation and Water Demand Management** interventions implemented by the NMBM during the drought emergency should be permanently established, including:
   - Annual review of stepped water tariffs to reflect scarcity of water supplies;
   - Maintaining high profile community/schools information and education campaigns;
   - Bulk meter installation and universal metering;
   - Promoting water use efficiency;
   - Ensuring that water-efficiency measures/devices are implemented/installed for all new consumers;
   - Monthly readings of all zone meters and conducting of monthly water balances to identify zones and sub-zones with leakage problems;
   - Network night-flow monitoring, bulk supply and plumbing leak detection and repair programmes as part of an active leakage control system, leak reporting hotline and repair teams;
   - Pressure management;
   - Promotion of rainwater tanks; and
   - Ensuring appropriate monitoring/tracking and reporting of all aspects of WC/WDM.

c. The **local surface water sources** have been most impacted by the recent drought and the following actions and studies are recommended:
   - NMBM, GIB and DWA should continue to optimize the operation of the Kouga/Loerie system to minimize spillage at Loerie Dam.
   - DWA should undertake a Water Availability Assessment Study (WAAS) of the Kouga/Loerie and Churchill/Impofu systems and update the available yields.
   - Thereafter DWA should reinvestigate the Guernakop scheme and the replacement and the raising of Kouga Dam (which may have to be rebuilt for safety reasons and therefore could be raised for significantly lower marginal cost than assumed for this study).

- The potential impacts on the yields of the existing dams that would arise from the implementation of ecological Reserve releases and from Climate Change should also be investigated by DWA.

d. Preliminary investigations of **groundwater** have identified a number of potential wellfields that should be investigated further by NMBM or other local authorities with the assistance of DWA. Other actions identified by the Strategy include the capping of unused artesian boreholes and the monitoring of wellfield abstractions and groundwater levels.

e. An additional allocation of **water from the Orange River** has been approved by DWA to enable NMBM to fast track the Nooitgedagt Low-Level Scheme as an emergency scheme during the drought. However as this additional allocation may be reconsidered by DWA after 20 years, it is recommended that NMBM and DWA investigate options for replacing this allocation including the purchase of irrigation allocations from the Orange River and the desalination of Sundays River irrigation return flows. It is also recommended that DWA and NMBM investigate options for providing additional storage in the vicinity of the Scheepersvlakte Balancing Dam to continue to supply NMBM for periods when the canal is taken out of service for maintenance purposes.

f. A comprehensive study of the **use of treated waste water** should be undertaken by NMBM and DWA. The study should address the following:
   - The use of treated waste water from the Coega and Fishwater Flats WWTW for industrial (non-potable) purposes in the Coega IDZ, including the timing of such re-use schemes as it is likely that the initial industrial water requirements of the Coega IDZ can be met from the initial surplus capacity of the potable supply system after the Nooitgedagt Low-Level and the Swartkops Desalination schemes are commissioned during the drought emergency.
   - The implications of any delays in the implementation of NMBM's Emergency Interventions on the water balance scenarios should be assessed.
   - All options for non-potable water re-use, including supplies to other industrial areas and for irrigation of parks, sports fields etc.
   - Options for direct and indirect potable re-use including the Loerie and Echodale Dam options.
   - The implications of re-use on other schemes such as the impact of reduced effluent available to dilute the brine discharges from the proposed Swartkops Desalination Scheme.

g. The Reconciliation Strategy has indicated that the **desalination of seawater** may be the only source of supply that will be available to meet the growing water requirements of the NMBM in the longer term. NMBM's responsibilities for the options identified by the Reconciliation Strategy should include:
   - The possibe development of the Swartkops Desalination Scheme as a drought emergency measure.
   - Ongoing liaison with the CDC regarding the possible development of a desalination scheme within the Coega IDZ and the likely timing and cost thereof.
   - The monitoring of sea water quality at or close to the potential points of abstraction from the Swartkops Estuary and for the Coega IDZ scheme with the assistance of DWA and the CDC.
   - The feasibility of integrating the potential future desalination schemes into the AWSS.

DEPARTMENT OF WATER AFFAIRS
Directorate National Water Resource Planning

Water Reconciliation Strategy Study for the Algoa Water Supply Area
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ACRONYMS

AADD	Average annual daily demand
AADWF	Annual average daily water flow
AWSS	Algoa Water Supply System
CDC	Coega Development Corporation
DEDEA	Eastern Cape Department of Economic Development and Environmental Affairs
DWA(F)	Department of Water Affairs (and Forestry)
EWR	Ecological Water Requirement
FWF	Fish Water Flats
IDZ	Industrial Development Zone
ISP	Internal Strategic Perspective
LSRWUA	Lower Sundays River Water User Association
NaCl	Sodium Chloride
NMBM	Nelson Mandela Bay Municipality
ORP	Orange River Project
RO	Reverse Osmosis
RPST	Reconciliation Planning Support Tool
WARMS	Water Use Authorisation and Registration Management System
WC/WDM	Water Conservation and Water Demand Management
WTW	Water Treatment Works
WWTW	Wastewater Treatment Works

Water Reconciliation Strategy Study for the Algoa Water Supply Area

1. BACKGROUND

1.1 INTRODUCTION

The Algoa Reconciliation Strategy Study was undertaken by the Department of Water Affairs (the DWA), in cooperation with the Nelson Mandela Bay Municipality (NMBM) and other stakeholders in order to secure a sustainable future water supply for NMBM and the other towns served by the Algoa Water Supply System (AWSS). **Figure 1.1** shows the study area which extends from the Kouga River system in the west to the Sundays River system in the east. The AWSS provides water to the Gamtoos Irrigation Board, the NMBM and to several smaller towns within Kouga Municipality.

A core element of the recommendations presented in this Strategy is Integrated Water Resource Management. This necessitates that choices are made and requires the cooperative contributions of all affected parties. Some of the recommendations that are presented in this Strategy are challenging, but they comprise practical and logical next steps to ensure sustainable and improved future management of the AWSS including the selection of interventions to balance supply and requirements.

New approaches are needed to plan and supply urban water needs, including altered consumer behaviour and appreciation of the scarcity of water, and the development and funding of more diversified portfolios of integrated new and alternate water sources, the return of surface and groundwater systems to sustainable levels of abstraction, and new institutional arrangements. Concerted political will is necessary to invigorate water reform in the AWSS. Sustained attention, resources and continued hands-on leadership and action will be necessary to ensure that this Strategy is successfully implemented and continually updated.

1.2 PURPOSE OF THIS DOCUMENT

The purpose of the Reconciliation Strategy is to determine the current water balance situation and to develop various possible future water balance scenarios up to 2035. It further aims to describe the proposed strategy, and the associated actions, responsibilities and timing of such actions that are urgently needed to reconcile the supplies and requirements, to enable additional interventions to be timeously implemented so as to prevent the risk of a water shortage becoming unacceptable.

The Preliminary Reconciliation Strategy was completed in 2009 and focused on the medium-term (i.e. up to 2020) interventions to meet the immediate and potential medium-term requirements. The Reconciliation Strategy (this document) evaluates a range of interventions and sequences of their implementation that may be necessary to address various future water requirement scenarios up to 2035 and recommends actions for implementation of the Strategy.

While the Strategy was being finalised in early 2010 two significant changes took place which have been incorporated into the Strategy:

- NMBM took the decision to fast track the implementation of a number of emergency measures to ensure continuity of supply in the event that the very severe drought being experienced at the time should persist.
- The potential future industrial water requirements of the Coega Industrial Development Zone (IDZ) were revised.

1.3 OVERVIEW OF THE STUDY AREA

The NMBM is regarded as the economic hub of the Eastern Cape Province, contributing more than 40% of the Gross Geographic Product of the whole Province. For the next ten years, economic growth has the potential to rise above 5% per annum given the establishment of the Coega IDZ and the international deep water harbour at Ngqura, although this has been tempered by the current depressed global economic climate. The proximity of extensive commercial agriculture contributes to growth in the NMBM, providing permanent and seasonal jobs, as well as value-added activities for communities, both within and on the fringe of the NMBM. The opportunities within the NMBM have led to a rapidly increasing population through in-migration and growth in peri-urban settlements, which has exacerbated the backlog in services.

1.4 THE ALGOA RECONCILIATION STRATEGY

1.4.1 The need for a strategy

As a proactive activity to ensure water availability for continued growth and development in the country the Directorate: National Water Resource Planning of the DWA embarked on a number of reconciliation strategy studies of large metropolitan areas. The *Water Reconciliation Strategy Study for the Algoa Water Supply System* covers the area supplied by the AWSS.

1.4.2 Strategy objectives

The purpose of the Strategy is to achieve reconciliation of the water supply available from the AWSS sources shown in **Figure 1.1** with the water requirements up to 2035 of the various water services authorities served by the AWSS, mainly the NMBM, and the industrial and agricultural water users in the area. The Strategy aims for adequate levels of assurance of supply within the constraints of affordability and at appropriate levels of service to users, whilst ensuring protection of current and possible future resources, and efficiency of operation and management of the AWSS, in an integrated and sustainable manner.

The purpose of the Preliminary Reconciliation Strategy that was tabled in May 2009 was to identify and prioritise suitable reconciliation measures to ensure a water balance up to about 2020. However the existing water supplies could barely meet the current (2010) requirements on account of the severity of the drought and therefore NMBM is planning to fast-track the implementation of some of the measures identified by the Strategy.

This Reconciliation Strategy aims to refine certain aspects of the Preliminary Strategy, and to identify and prioritise suitable further reconciliation measures to ensure a water balance up to about 2035.

The Strategy Action Plan consolidates the planning process to ensure implementation of actions.

The objectives of the Preliminary Reconciliation Strategy were to:

- Commence public participation and awareness creation of the imminent water shortages and of the study;
- Establish an initial database of key stakeholders and role-players within the AWSS;
- Devise a set of interventions and water-balance scenarios for further review and consideration by stakeholders and experts;
- Develop toolkits to assist with the future reconciliation of supply and requirements; and
- Devise criteria for the selection and short-listing of interventions that might be suitable for implementation within the twenty five-year timeframe; and

- Prepare recommendations for the preparatory measures to be undertaken before interventions can be implemented to meet the anticipated growth in the water requirements of the AWSS, propose actions regarding further investigations and assign responsibilities,.

1.4.3 Strategic considerations

Reconciliation strategy planning can assist in guiding the management of a water supply system in a co-ordinated, efficient, cost effective and environmentally sound fashion. Community consultation is a key component of the strategic planning process. The strategic planning process involves developing an understanding of the water supply system and its relevant environments; the human, economic, natural and built environments and the interaction between these. This allows the issues, risks, opportunities, trends and limitations to be considered in the development of possible long-term 'potential futures' and ultimately the development of a 'future direction'. Such a 'future direction' cannot be developed in isolation from the community, non-government organisations and the State and municipalities.

In the development of a 'future direction' for the AWSS, some 'big picture' questions had to be considered; specifically the use of Orange River water that is soon expected to be even more in demand in the economic heartland of the country and which will create 'competition' for this limited resource. Innovative and creative thinking is therefore called for, where national best-interest considerations may outweigh regional best-interest considerations, whilst ensuring that regional interests are not harmed.

The overriding principles of sustainability in water supply and management have been followed, for implementing a strategic water balance planning approach and Action Plan that will ensure a sustained water supply for following generations. The issue of climate change further needs to be tackled, to limit the risks that climate change will pose to the AWSS users in future.

1.4.4 Drought-relief measures

The Reconciliation Strategy does not address short-term drought-related issues and actions, but focuses on achieving long-term water balance. It is important to note that during the finalisation of this Strategy Report, which addresses long-term issues, the AWSS experienced a critical drought. Significant decisions are being taken by NMBM to fast-track the implementation of drought-relief measures and interventions, some of which are considered to be costly options. Some actions related to the emergency measures may therefore not be captured in this Strategy. For water balance scenario planning purposes it has been assumed that the implementation of all the emergency schemes would be completed in 2011, however delays have extended this date to 2012 and possibly later if the drought is broken.

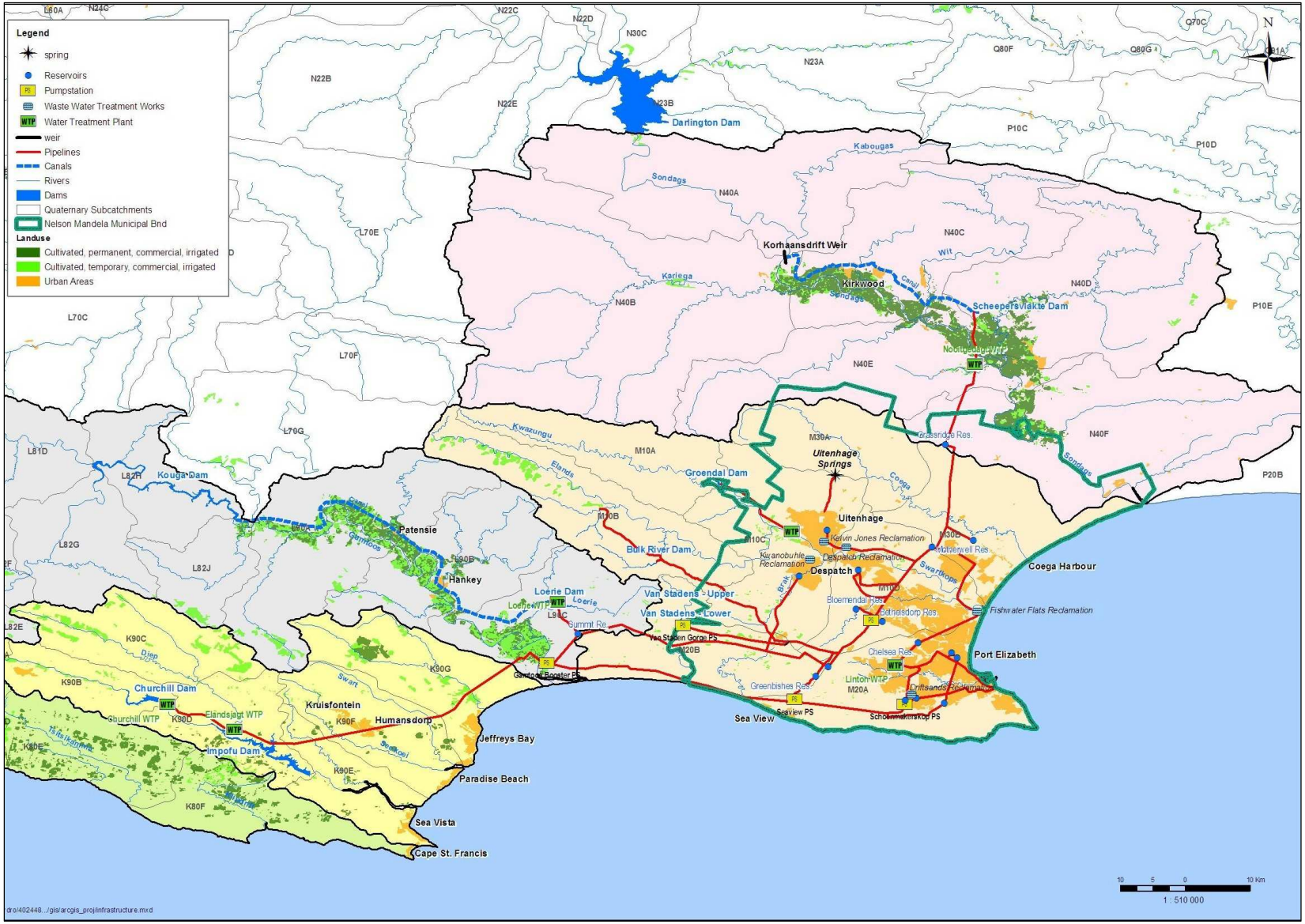

Figure 1.1 The Algoa Water Supply System

1.5 THE ALGOA WATER SUPPLY SYSTEM

The AWSS currently comprises two major dams in the west, several smaller dams and a spring situated near to NMBM, and an interbasin transfer scheme from the Orange River via the Fish and Sundays rivers to the east. The combined yield of these sources at an assurance of supply of 98% (corresponding to 1 failure in 50 years or an 1 in 50 years assurance) is 147.5 million m^3/a, of which 99 million m^3/a (271 Ml/day) is for urban use by NMBM and other small towns, and 48.5 million m^3/a for irrigation, but excluding agricultural use from the rivers upstream of the dams that form part of the AWSS**. Figure 1.1** shows the main components of the AWSS, and these and the main water users are described below.

Western System

The Western System provides water to NMBM from the Churchill (**Figure 1.2**) and Impofu (Figure 1.3) dams on the Kromme River, from the Kouga Dam (**Figure 1.4**) on the Kouga River and from the Loerie Balancing Dam on the Loerie Spruit, a tributary of the Gamtoos River. The bulk supply of water to NMBM and the coastal towns from the combined Western System at an assurance of 1 in 50 years amounts to 65 million m^3/a (178 Ml/day). The Gamtoos Irrigation Board has an allocation from Kouga Dam of 59.36 million m^3/a at an assurance of 1 in 10 years, which is equivalent to an allocation of 44.4 million m^3/a at an assurance of 1 in 50 years. There is also relatively small usage by other towns and irrigators as well as a small provision for ecological water requirements (EWR) below Impofu Dam.

Eastern System

The Eastern System receives water transferred from the Gariep Dam on the Orange River via the Orange-Fish Tunnel, the Fish River, the Fish-Sundays Canal, Skoenmakers River, and Darlington Dam. The current quantity of bulk water supplied to NMBM from this system is 26 million m^3/a (71 Ml/day).

The Lower Sundays River Water User Association (LSRWUA) does not receive water from the AWSS but also obtains water from the Gariep Dam on the Orange River via the same transfer scheme. The LSRWUA uses about 99 million m^3/a and their total allocation, including the reserved water to be allocated at some future date for the proposed expansion of the irrigation area to serve resource poor farmers in the Barclay Bridge area, is 155 million m^3/a.

Figure 1.2 Churchill Dam on the Kromme River

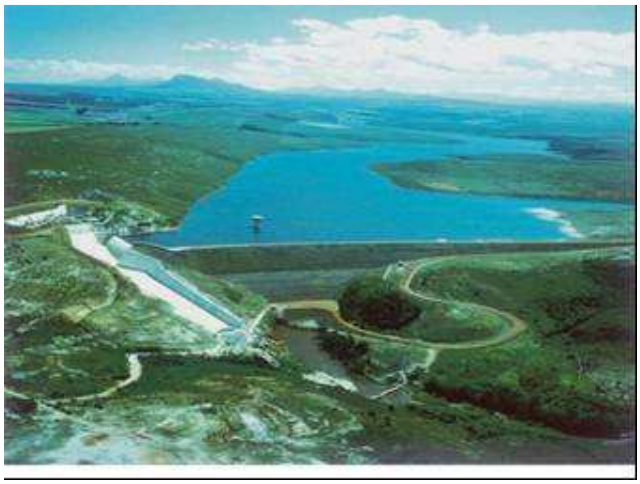

Figure 1.3 Impofu Dam on the Kromme River

Central System

The Central System consists of the older dams on the Sand, Bulk, Van Stadens and Kwa Zunga (a tributary of the Swartkops) rivers and the Uitenhage Springs, all of which are owned by the NMBM. Combined, the quantity of water abstracted by NMBM from these sources is about 10 million m^3/a (27 Ml/day) including 4 million m^3/a (11 Ml/day) from Groendal Dam (**Figure 1.5**). Groendal also supplies 2.4 million m^3/a to irrigators.

Figure 1.4 Kouga Dam on the Kouga River

Figure 1.5 Groendal Dam

1.6 STRUCTURE OF THIS DOCUMENT

This **Strategy** is presented in eleven chapters, with more detailed supporting information on the Interventions and Public Participation contained in Appendices A and B respectively. The contents of these chapters are as follows:

Chapter 1: Background (this Chapter) introduces the reader to the background to and purpose of the Strategy, strategic considerations and the AWSS.

Chapter 2: Water requirements addresses historical and current water use by urban, industrial and agricultural users and the development of future water requirement scenarios.

Chapter 3: Water availability and system operation identifies the long-term yield available from the AWSS, and addresses key yield-related and operational issues that could influence the Strategy.

Chapter 4: Comparison of requirements and availability defines the current water balance of the AWSS, taking assurance of supply of different uses into account.

Chapter 5: Interventions addresses the identification, preliminary screening and evaluation of potential interventions.

Chapter 6: Scenario planning addresses the selection, evaluation and results of a range of water balance scenarios.

Chapter 7: Recommended interventions discusses the background to and salient features of the interventions recommended for implementation or to be studied further.

Chapter 8: Institutional arrangements addresses the establishment of the committees responsible for the implementation of the Strategy and their respective roles.

Chapter 9: Public process explains the public participation process followed for this study.

Chapter 10: Strategy Action Plan provides an Action Plan that details actions, responsibilities and a timeline to meet the objectives and recommendations of this Strategy.

Chapter 11: Recommendations provides summary Strategy recommendations.

The **Annexures** are contained in the following reports:

Annexure A: **Interventions Workshop** held in October 2009 to evaluate interventions including comparative information such as yield, costing, environmental and social impacts and also future water scenarios as envisaged at that time.

Annexure B: **Public Participation**

2. WATER REQUIREMENTS

The total 2009 usage of water from the AWSS was 157.8 million m^3/a. This comprises urban use by NMBM and towns, agricultural water use, losses from the Kouga/Loerie canal, and ecological water requirements as discussed below.

2.1.1 Urban water use

The AWSS provides water for domestic use and for more than 373 industrial users in the NMBM and also for several other smaller towns within the Kouga Municipality.

The opportunities within the NMBM have led to a rapidly increasing population through in-migration and growth in peri-urban settlements. This has exacerbated the backlog in services, which were inherited when the NMBM was created through the amalgamation in 2000 of four separate municipalities. At present the housing backlog is around 88 000 units, most of which fall within the low-income categories. In addition to the housing backlog, it is estimated that the need for new residential erven could be as high as 28 000. Of the current 300 000 households within the NMBM, around 27 000 do not have in-house water supplies, and of the 32 000 which do not have sanitation services, approximately 25 000 are on the bucket system. The NMBM is committed to eradicate and replace the bucket system with reticulated sewage systems. Approximately 45 000 new low-cost houses were built from 1994 to 2008. All new houses built since 1994 are fully serviced, contributing to the high growth in water requirements. It must be noted that the above figures relating to sanitation services are estimates and continuously change with the construction of new houses and the influx of people into the Metropolitan area.

The water use and water allocations of NMBM shown in **Table 2.1** are registered in DWA's Water Use Authorisation and Registration Management System (WARMS) database.

Table 2.1 NMBM registered water use and water allocations

Dam or river	Water use start date or registration date	Registered volume (million m^3/a)	Water allocation (million m^3/a)
Kouga/Loerie dams	1968/01/01	23.000	23.000
Lower Sundays River	1993/01/01 2005/06/01 2007/01/01 (2010)	13.500 17.000 22.000 (58.300)	13.500
Kromme River (Impofu Dam)	1985/01/01	18.000	18.000
Kromme River (Churchill Dam)	1946/01/01	20.075	20.075
Bulk River (Bulk River Dam)	1906/01/01	0.910	0.910
Sand River and Palmiet River (Sand River Dam)	1973/01/01 2005/06/01	1.825 2.555	1.825
Van Stadens River (Upper Dam)	1975/05/01	0.365	0.365
Van Stadens River (Lower Dam)	1975/05/01	0.730	0.730
Total allocation			**78.410**

The registered uses by NMBM have not yet been verified and therefore water use licences have not yet been issued. The increased allocation from the Orange River (36.3 million m^3/a) may be phased out commencing 20 years after the new Nooitgedagt Low Level Scheme is commissioned.

The water requirements of the NMBM have increased steadily over the past few years, due to the in-migration, increased service levels and industrial activity. In 2009 urban water use of NMBM was 98.7 million m^3/a (270 Ml/day), including additional re-use of water by industries located within the NMBM of 1.7 million m^3/a (4.7 Ml/day). The 2008 urban water use of Humansdorp, Jeffrey's Bay, Paradise Beach, St Francis Bay, and Loerie was 3.6 million m^3/a (9.9 Ml/day). Urban use from the Kouga/Loerie sub-System by the small inland towns of Hankey and Patensie is estimated to be 0.7 million m^3/a (1.9 Ml/day). Total urban and industrial use from the system is therefore estimated to be 103.0 million m^3/a (282 Ml/day).

Historical urban and industrial water use from the AWSS is shown in **Figure 2.1**.

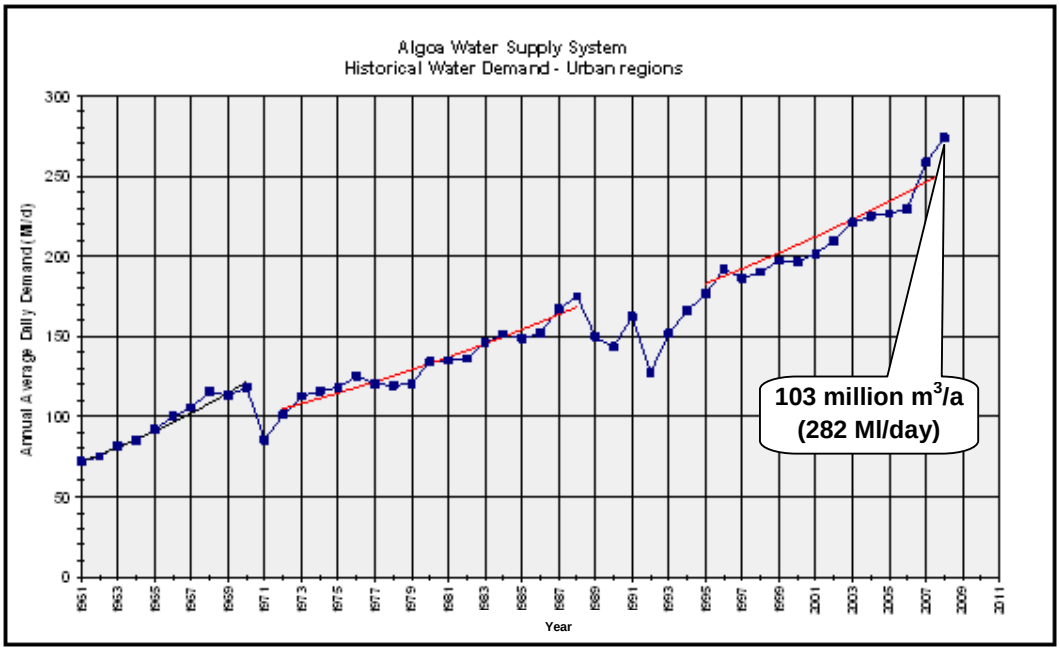

Figure 2.1 Historical urban and industrial water use from the AWSS

2.1.2 Agricultural water use

The full allocation to the Gamtoos Irrigation Board (GIB) is 59.36 million m^3/a (7 420 ha at 8 000 m^3/ha), but in most years inadequate yield has been available from the Kouga Dam to enable the irrigators to be supplied with their full allocation, as is evident from **Figure 2.2**. On the other hand **Figure 2.2** shows that the GIB's use has increased in recent years which can in part be attributed to the expansion of the irrigated areas (mainly citrus). However, some of this apparent increase in water use arises from improved metering as old water meters were replaced with new ones, and the under recording of use by the old water meters led to some of the actual water use being identified as unaccounted-for-water/losses.

Noting the increased actual use in recent years and the typical assurance of supply for irrigation, it was agreed at the Scenarios Workshop for this study, held in December 2009 that as the full allocation of the GIB of 59.36 million m^3/a, from the Kouga Dam is for an assurance of supply of 91% (1 in 10 year assurance), the equivalent supply for an assurance of 98% (1 in 50 year assurance) should be determined as this is the assurance of supply for the urban sector and for the reconciliation strategy. The supply available to the GIB at 98% assurance (1 in 50 year assurance of supply) has been determined to be 44.4 million m^3/a (as described in Section 4).

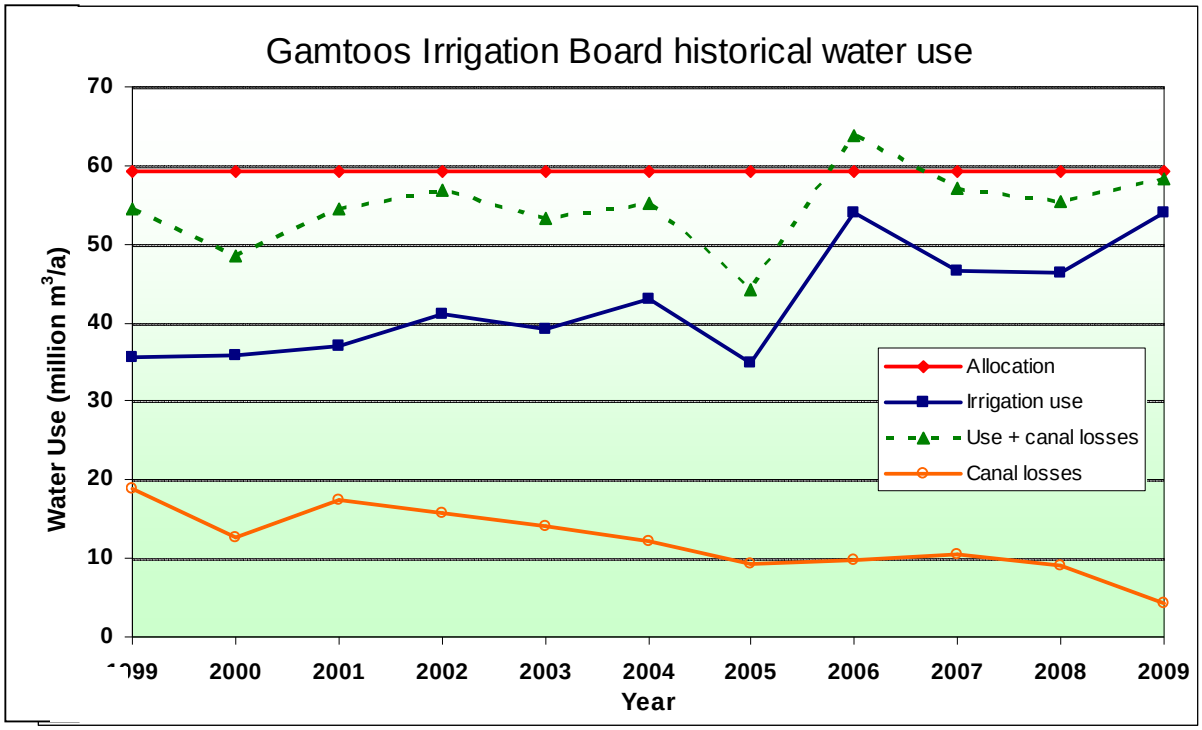

Figure 2.2 Historical water use by the Gamtoos Irrigation Board

The allocated irrigation quota from the Groendal Dam is 2.4 million m^3/a at a 1 in 50 year assurance of supply. This use was not previously included as use from the AWSS, but for completeness, is now taken into account. Usage from the Impofu Dam for irrigation and a bottling plant is about 2 million m^3/a at a 1 in 10 year (91%) assurance of supply and is calculated as 1.7 million m^3/a at a 1 in 50 year (98%) assurance of supply.

The combined total usage by agriculture from the current AWSS is estimated to be 48.5 million m^3/a at a 1 in 50 year assurance of supply. This excludes irrigation usage from the rivers upstream of the dams that form part of the AWSS. Upstream usage is taken into account in the determination of the yields that are available from the dams for downstream usage from the AWSS.

The Lower Sundays River Water User Association (LSRWUA) irrigates with water transferred from the Gariep Dam on the Orange River via the Orange-Fish Tunnel, the Fish River, the Fish-Sundays Canal, Skoenmakers River, and Darlington Dam. The total allocation from the Gariep Dam is 155 million m^3/a and the current average usage is in the order of 99 million m^3/a. These values have not been included in the AWSS water balances, as the water is transferred from and used in a system that is separate from the AWSS.

2.1.3 Canal losses

Estimated losses/unaccounted for water from the conveyance canal from Kouga Dam to Loerie Balancing Dam have decreased significantly from previous estimates to 4.3 million m^3/a in 2009, due to improved metering and operation.

2.1.4 Total current use from the AWSS

It is important to note that, for water balance calculations, the annual requirements of the Gamtoos Irrigation Board and of the irrigators from Impofu Dam are based on supplies of 44.4 million m^3/a and 1.7 million m^3/a respectively at 1 in 50 year assurance (as described in **Section 2.1.2** above). Therefore the current total use of water from the AWSS to supply urban and irrigation water usage, canal losses and the ecological water requirements at 1 in 50 year assurance is as follows:

Table 2.2 Current use (2009) from the AWSS (million m^3/a amd %)

Use or allocation	million m^3/a	%
NMBM – urban and industrial use from water sources	97.0	61.5
Re-use of water by industries located within the NMBM	1.7	1.1
Humansdorp, Jeffrey's Bay, Paradise Beach, St Francis Bay and Loerie – urban use	3.6	2.3
Hankey and Patensie – urban use	0.7	0.4
Total Urban Use	**103.0**	**65.3**
Gamtoos Irrigation Board *	44.4	28.1
Groendal irrigators	2.4	1.5
Agricultural use from Impofu Dam	1.7	1.1
Total Irrigation Use	**48.5**	**30.7**
Ecological water requirement (EWR) from Impofu Dam	**2.0**	**1.3**
Gamtoos Irrigation Board canal losses / unaccounted-for-water	**4.3**	**2.7**
TOTAL USE	**157.8**	**100.0**

***** Note that the re-evaluation of the annual requirement of the Gamtoos Irrigation Board described in Chapter 4 has reduced the estimated 1 in 50 year allocation from 46 million m^3/a to 44.4 million m^3/a.

Of the 157.8 million m^3 of water used from the AWSS in 2009, total urban/industrial use was 103.0 million m^3, total irrigation use was 48.5 million m^3/a, ecological water requirements were 2.0 million m^3, and unaccounted-for water/canal losses from the Gamtoos Irrigation Scheme amounted to 4.3 million m^3. Usage by the various water use sectors in 2009 is shown in **Figure 2.3**.

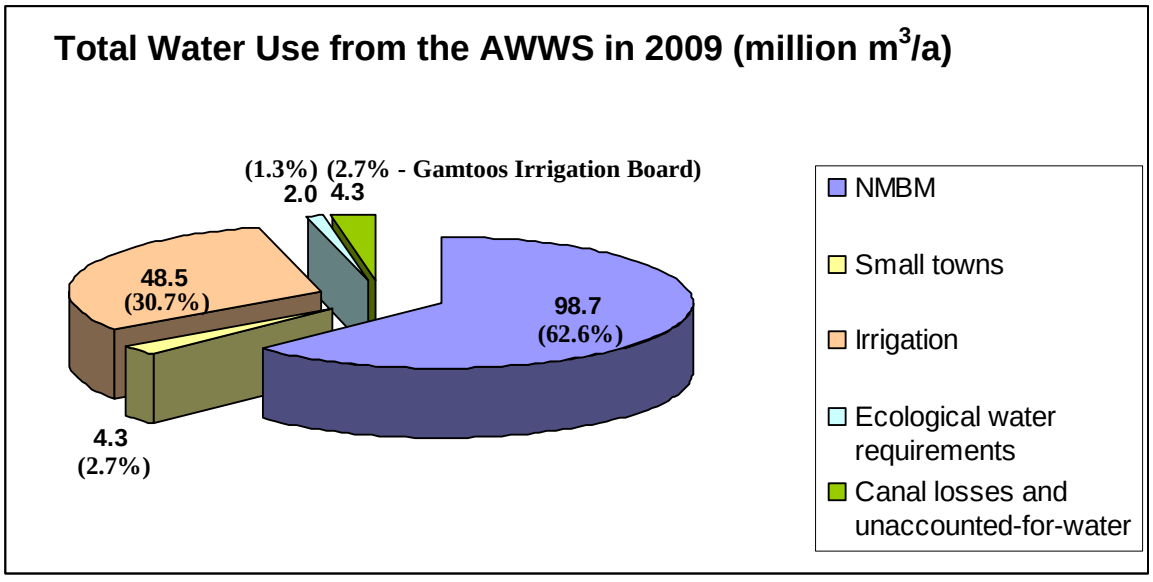

Figure 2.3 Total water use from the AWSS in 2009

2.2 FUTURE WATER REQUIREMENTS SCENARIOS

2.2.1 Understanding past growth in urban and industrial water use

Although population and economic activity records are too coarse to do a detailed econometric analysis of the contributing factors to the water use over the period, the following observations are made, based on the available data and on the various investigations of the work undertaken in the study area in the recent past.

Urban and industrial water use in the region has grown, on average, at 3.9%/a over the period 1971 to 2009. The key drivers of this growth have been population growth and economic development. This growth has not been consistent over this period, and has fluctuated quite significantly. The water growth has included periods of negative growth as a result of water restrictions in times of drought, and periods of more rapid growth in the periods following these restrictions.

Water use, when expressed on a per capita basis, has ranged between 150 and 200 litres per person per day. There are uncertainties, however, associated with the urban population numbers. Census data shows a significant decline in population growth in more recent years, from 3.2% per annum in the 1970s to less than 1% per annum after the 1996 Census.

From a management perspective, the determination of the urban and industrial water requirements depends on the metering, billing, credit control and cash collection practices.

2.2.2 Key factors affecting future urban and industrial water use

Within an urban context, the most important base drivers of water demand are two-fold:

- Population growth
- Economic activity

These two factors are interlinked to some extent, as high levels of growth in economic activity will increase the levels of immigration into the area, whereas depressed economic activity may result in migration away from the area to other centers with higher economic activity and growth.

The following factors are likely to impact significantly on future water use:

- **Population growth**, which in turn will be affected by fertility levels, life expectancy, and migration patterns. There appears to be a fairly strong consensus that fertility levels are declining and that life expectancy will decline significantly as a result of HIV/Aids. This results in base population growth forecasts being low, at 0.5%/a. The key uncertainty has to do with migration patterns. Immigration from rural areas to the NMBM area is expected to be strong. However, there also appears to be out-migration from this area to urban areas in the Western Cape and Gauteng. These patterns are driven largely by economic forces.

- **Economic growth**. The region enjoyed strong economic growth in the 1970s and more recently after 2000. This recent growth was partly the result of the strong country–wide economic growth experienced in the past seven years. However, major contributors to growth in this region are government services and related investment associated with the Coega Industrial Development Zone (IDZ) and its associated infrastructure requirements. The success, or otherwise, of the Coega IDZ will have a significant influence on the future economic growth of this area.

- **Price**. Although urban water price elasticities are not anticipated to be very high (typically less than -0.3 and more often substantially less than this), if future supply options are significantly more expensive than the current supplies, then water requirements will be affected.

- **Water management**. The effectiveness of water management in terms of water meter coverage, the extent and accuracy of meter reading and billing, and the effectiveness of credit control policies will also affect calculated water requirements.

Other factors which will affect water requirements include:

- Water use efficiency and technology change; and
- Climate change.

It is useful to have some understanding of the dynamics affecting each of these, and on the basis of this understanding, to develop a set of scenarios of future water requirements.

With regard to economic activity, the pace at which the Coega IDZ grows, and the nature of the economic activities within the Coega IDZ will have a very significant effect on future water requirements.

2.2.3 Understanding the drivers

Key drivers for population growth are the nature of **migration** patterns (which is linked to the relative performance of the regional, local and competing economic centers – particularly Gauteng and the Western Cape), and the trajectory of **HIV/Aids** (linked to the efficacy of the ARV roll-out and other factors).

The performance of the **local economy** is tied, in many ways, to the performance of both the national and international economies, as illustrated during the recent global financial and economic turmoil and downturn. Most importantly, future economic growth is likely to be strongly linked to the performance of the Coega IDZ. As yet, there is no significant confirmed anchor industrial client, though the establishment of the PetroSA petroleum refinery is looking likely at this stage. Unfortunately, the era of abundant and cheap electricity is over, and the Coega industrial strategy will not be able to depend on energy intensive industries (such as aluminium smelting) establishing there.

The cost (and hence **price**) of water will also increase significantly in future when the switch to water re-use and desalinated water occurs. This will also have implications for water use efficiency and technology choices.

2.2.4 Coega IDZ industrial use

Most, if not all, new industrial water requirements are expected to arise within the Coega IDZ, however there is a great deal of uncertainty as to the likely rate of uptake of industrial water. The cancellation of the aluminium smelter power contract with Eskom in 2009 appears to be the ultimate termination of any energy intensive industrial development strategy for the region based on available and cheap electricity.

Business Day, 16 October 2009.
Global aluminium giant Rio Tinto Alcan and South Africa's power utility Eskom confirmed on Thursday that plans for the proposed $2.7-billion Coega smelter project, which was destined for South Africa's Eastern Cape Province, had been terminated, owing to Eskom's capacity constraints. In a joint statement, Rio Tinto, Eskom and the South African government revealed that the 'Electricity Supply Agreement', signed in November 2006, had been terminated.

Although the aluminium smelter will not be a user, there appears to be considerable uncertainty concerning the projections of the future water requirements of the Coega IDZ

as illustrated by the two most recent projections interrogated by the study as outlined below:

- In mid-2009 the Coega Water Master Plan was interrogated and revised industrial water requirement projections were developed. This projection assumed that the major industrial investment within the Coega IDZ would be the PetroSA oil refinery which would come on line in 2015. The projections showed that the future requirements for industrial (non-potable) water and for potable water would be as indicated in **Figure 2.4**. What was striking about these projections was the low requirement for industrial quality water relative to the requirement for potable quality water.
- An updated draft business plan for the supply of industrial (non-potable) water to the Coega IDZ was prepared by Afri-Coast Engineers and SSI in March 2010. This business plan indicates that the industrial (non-potable) water requirements of the Coega IDZ will increase as indicated in **Figure 2.5**. These estimated industrial (non-potable) requirements are larger than previously estimated and in the year 2015 their make-up is expected to be as indicated in **Table 2.3**.

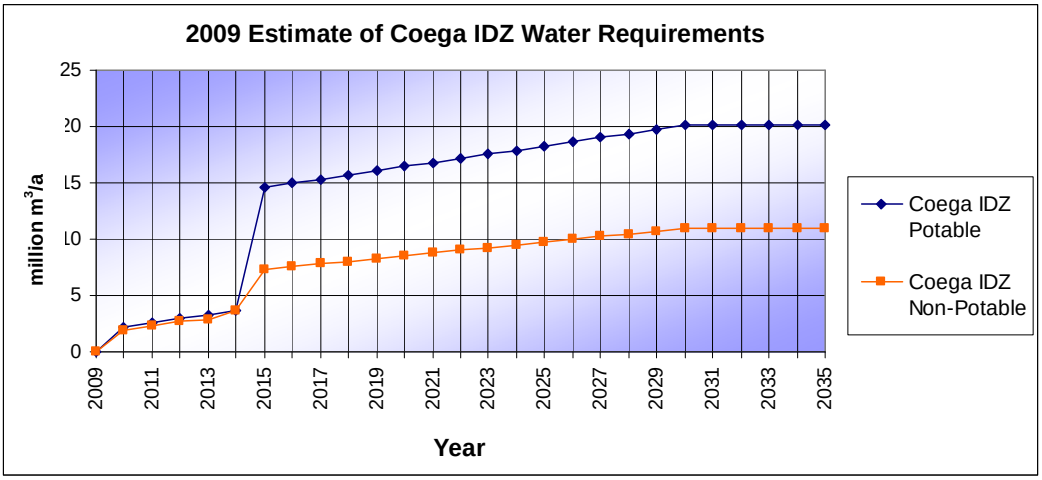

Figure 2.4 2009 Estimate of Coega IDZ Potable and Non-potable Water Requirements

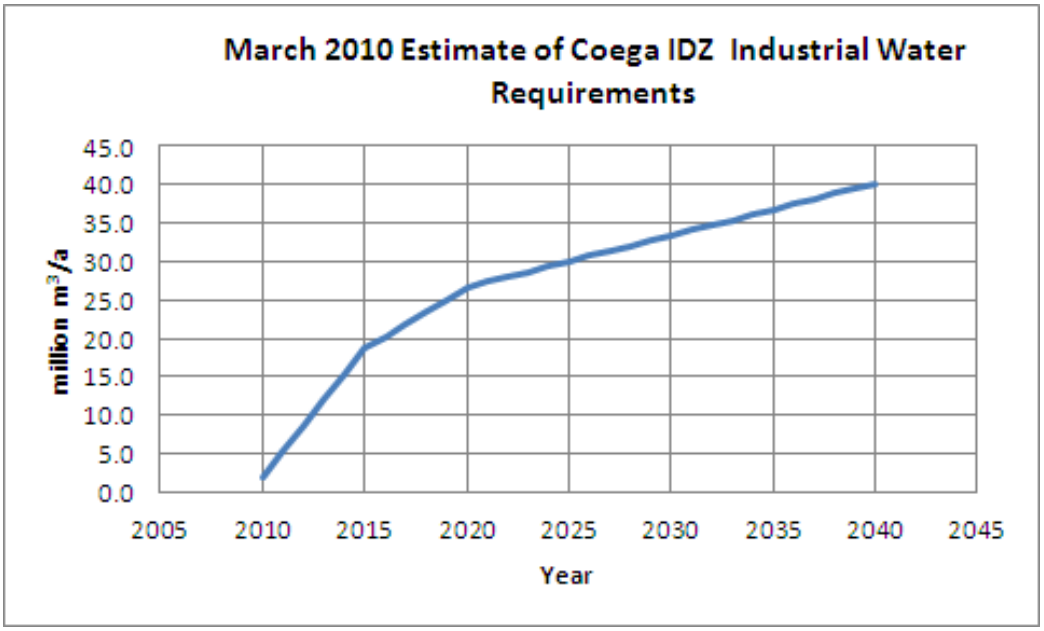

Figure 2.5 March 2010 Estimate of Coega IDZ Industrial (non-potable) Water Requirements

Table 2.3 March 2010 estimated make-up of future industrial (non-potable) water requirements of the Coega IDZ in 2015 (million m^3/a)

Industry	million m^3/a
Ferro manganese smelter	6.6
PetroSA	7.3
Chlorine derivatives	0.9
Titanium dioxide pigment paint	2.1
Coal and ore smelting plant	0.4
Other industries	1.4
Total use	**18.7**

The March 2010 projections indicate that the Coega IDZ's requirements for industrial quality water will be considerably greater than indicated in the 2009 Coega Water Master Plan projections. However the industrial (non-potable) water requirements of the Coega IDZ could be met from sources which supply potable water as well as from sources that provide industrial (non-potable) quality water (whereas the potable water requirements cannot be provided by non-potable water without further treatment and preferably barrier storage as discussed in **Section E2** of **Annexure A**).

2.2.5 Future water requirement scenarios

Key Assumptions

The following assumptions were made for the development of the future water requirement scenarios from the AWSS:

- The **future requirements for irrigation and the environment** will remain unchanged with no growth in the future.
- The **requirements for potable water use in NMBM** for both domestic and industrial use including potable use within the Coega IDZ will grow in accordance with one of **two scenarios**:
    - **High Growth** will take place on account of high population growth and high economic growth (at a rate of 3.5% per annum from 2009)
    - **Low Growth** will take place on account of low population growth and low economic growth (at a compound rate of 1% per annum from 2009)
- The rates of growth for **potable use in the small towns in Kouga Municipality** served by the AWSS will be the same as for NMBM.
- The **industrial (non-potable) water requirements in the Coega IDZ** will grow as described in **Section 2.2.4** above.

Total High-Growth and Low-Growth Water Requirement Scenarios

For the assumpt ions above **two total water requirement scenarios** were developed:

- **Total High-Growth Water Requirement Scenario** includes the current irrigation usage, the High Growth potable urban domestic and industrial requirements scenario for NMBM and the small towns, and the industrial (non-potable) requirements of the Coega IDZ as shown in **Figure 2.6**.

- **Total Low-Growth Water Requirement Scenario** including the current irrigation usage, the Low Growth potable urban domestic and industrial requirements scenario for NMBM and the small towns, and the industrial (non-potable) requirements of the Coega IDZ as shown in **Figure 2.7**.

The base year for these water requirement scenarios is the 2009 calendar year when the requirements were 157.8 million m^3/a, as shown in **Table 2.2** above.

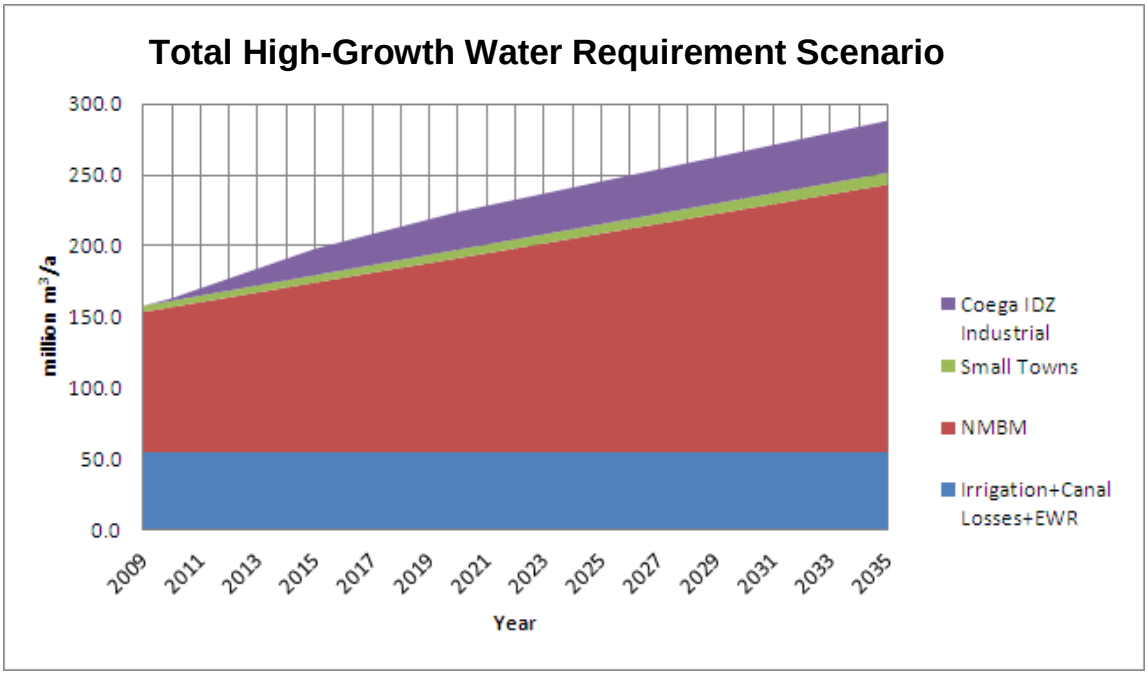

Figure 2.6 Total High-Growth Water Requirement Scenario for the AWSS

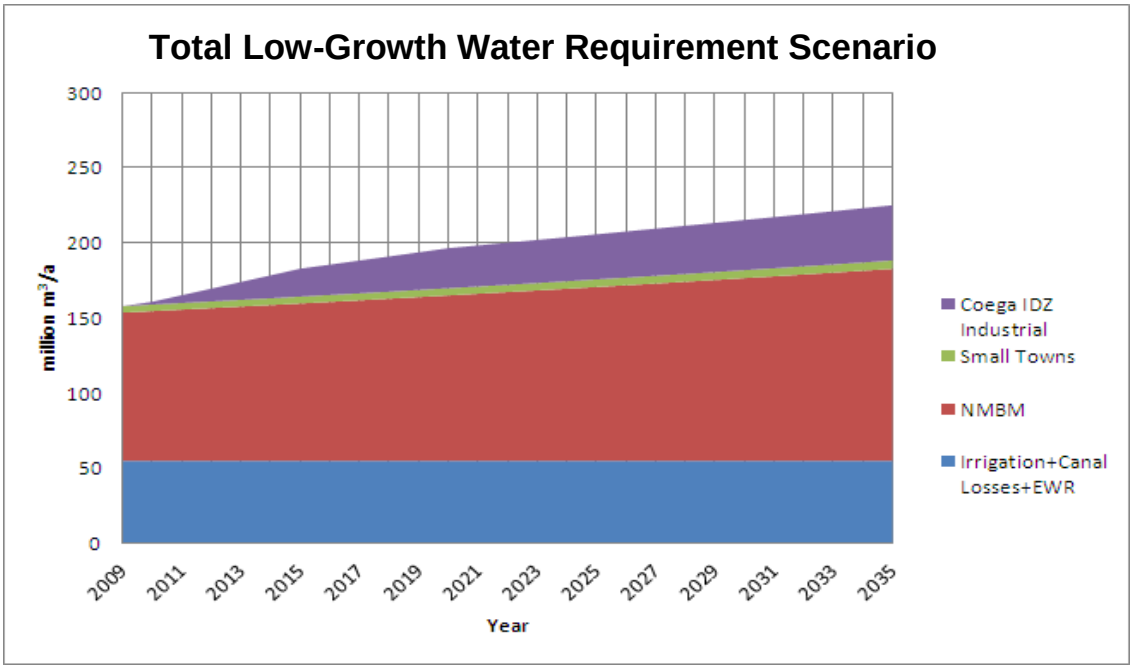

Figure 2.7 Total Low-Growth Water Requirement Scenario for the AWSS

Important qualification

It is important to note that the scenarios presented above were developed during a global economic crisis. The global recession and a slow recovery from this recession are likely to have significant implications for water requirement growth projections for the AWSS. There is also a possibility that the

projected requirements for the Coega IDZ may not materialise, or may materialise much more slowly than presented in these scenarios.

The implications of the recession for the strategy to meet future water requirements are as follows:

- The economic uncertainty increases uncertainty concerning the growth in water requirements.
- Water use must be continuously and carefully monitored;
- Future scenarios/projections need to be revised frequently, based on updated information;
- Planning to increase water availability needs to be as flexible as possible; and
- Interventions that are more flexible in terms of timing should be favoured, all other considerations being equal.

3. WATER AVAILABILITY AND SYSTEM OPERATION

3.1 YIELD OF THE ALGOA WATER SUPPLY SYSTEM

The 1 in 50 year and 1 in 20 year long-term stochastic yields of the various sources of supply available for urban, industrial and agricultural use are shown in **Table 3.1**. These yields are mainly based on the Algoa Water Resources Stochastic Analysis Study (DWAF, 1996), but also on the Algoa Pre-feasibility Study (DWA, 2002) and the latest available yield estimates for the Uitenhage Springs. These historical flow records have also been utilised for the Algoa Operational Analysis Study of the Kouga/Loerie and Churchill/Impofu sub-systems. No information on updated yield determinations has to date become available from the Algoa Water Resources Bridging Study (DWAF, 2007 to date).

Table 3.1 Long-term stochastic yields of the AWSS

Sources of supply	1 in 50 year yield or existing allocation/use (million m^3/a)	1 in 20 year yield or existing allocation/use (million m^3/a)	*Utilizable dead storage (million m^3)*
NMBM older dams	3.3	4.0	*0*
Groendal Dam	6.5	6.5	*0*
Uitenhage Springs	2.4	2.4	*0*
Churchill/Impofu Dams	44.4	51.0	*9[1]*
Kouga/Loerie Dams	75.5	86.0	*0*
Sundays River GWS	25.6	25.6	*0*
Re-use	1.7	1.7	
Combined Total Yield	**159.4**	**177.2**	

Note 1.The total dead storage is 18 million m^3 of which 9 million m^3/a can be accessed. However as the rate of abstraction from Impofu dead storage is limited to 50 Ml/day (18 million m^3/a) this limited utilisable dead storage has virtually no effect on the 1 in 50 year and 1 in 20 year yields of the AWSS.

Bulk water planning is generally based on a 1 in 50 year assurance of supply, for urban water supply. For the AWSS, urban water use comprises more than 60% of the total use, and is expected to increase. Therefore evaluation and future planning has been based on a 1 in 50 year assurance of supply. Should irrigation water use in the AWSS be supplied at e.g. a 1 in 20 year or even lower assurance of supply, an increased yield would be available for use, but at a higher risk.

The allocated quota for irrigation of 2.4 million m^3/a from the Groendal Dam, which according to a Water Court ruling took priority over the urban water allocation from Groendal Dam (but may have been cancelled) has been included in the yield of and requirements from Groendal Dam.

3.2 CLIMATE CHANGE

The Annual Report for the period April 2008 to March 2009 of the Water Research Commission Project entitled *An Evaluation of the Sensitivity of Socio-Economic Activities to Climate Change in Climatically Divergent South African Catchments* utilised the results of an earlier WRC project entitled *Evaluation of Potential Changes of Hydrologically Relevant Statistics of Rainfall in Southern Africa under Conditions of Climate Change.*

The Annual Report states that global climate model outputs from the fourth Intergovernmental Panel on Climate Change (IPCC) report downscaled to the South African regional level show an increasing trend in mean annual rainfalls over the central and eastern regions of South Africa for the intermediate future (2046-2065), with further increases in the more distant future, as shown in **Figure 3.1**. On the other hand

the consensus of the regional climate model results is that a decrease in mean annual rainfall will be experienced over the Western Cape Province of South Africa.

If rainfall in excess of 20 mm per day or more is considered an event which will produce runoff, then for the projected intermediate future climate (2046 – 2065) the Global Climate Models (GSMs) indicate that events of this magnitude are likely to increase in occurrence over the eastern parts of South Africa as shown in **Figure 3.2** but fewer such events are expected in the Western Cape. Furthermore, the distant future trends are more pronounced than those of the intermediate future and therefore give reason for further concern.

With reference to **Figure 3.1** and **Figure 3.2**, it seems that in the medium term the catchments of the Kromme and Kouga rivers may experience slightly lower mean annual rainfalls and fewer runoff events of 20 mm or more. Lower mean annual rainfalls will result in lower soil moisture contents and together with reduced rainfalls in excess of 20 mm per day in reduced runoff.

On the other hand the models also indicate that the catchment of the Orange River is likely to experience slightly higher mean annual precipitations as well as slightly increased frequency of rainfalls in excess of 20 mm, which together would increase runoff from the catchment of the Orange River that serves the AWSS via the Orange-Fish Tunnel and the Darlington Dam on the lower Sundays River.

Although there is considerable uncertainty concerning the possible effects of climate change on runoff into the existing and potential future dams of the AWSS, the formulation of climate change scenarios (refer to Chapter 5) has been based on the conservative assumption that the runoff from all existing local water schemes serving the AWSS will reduce linearly from 2011 to 2023 by 10% (13 million m^3/a) and that there will be no further reductions in yields thereafter.

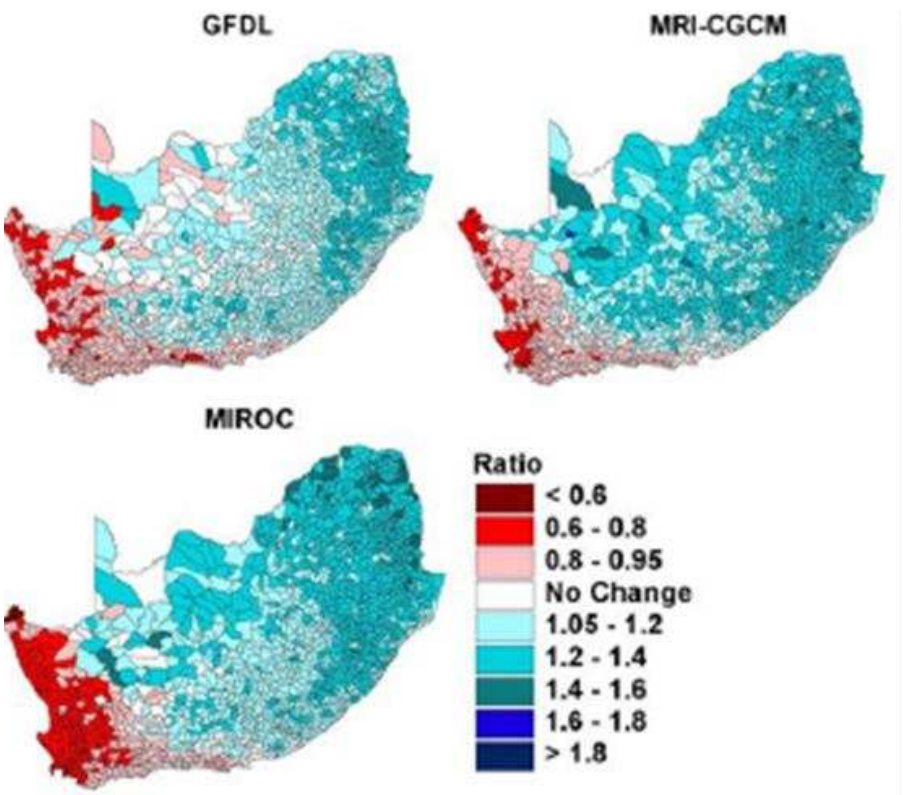

Figure 3.1 GSM Predictions of Changes in Mean Annual Rainfall

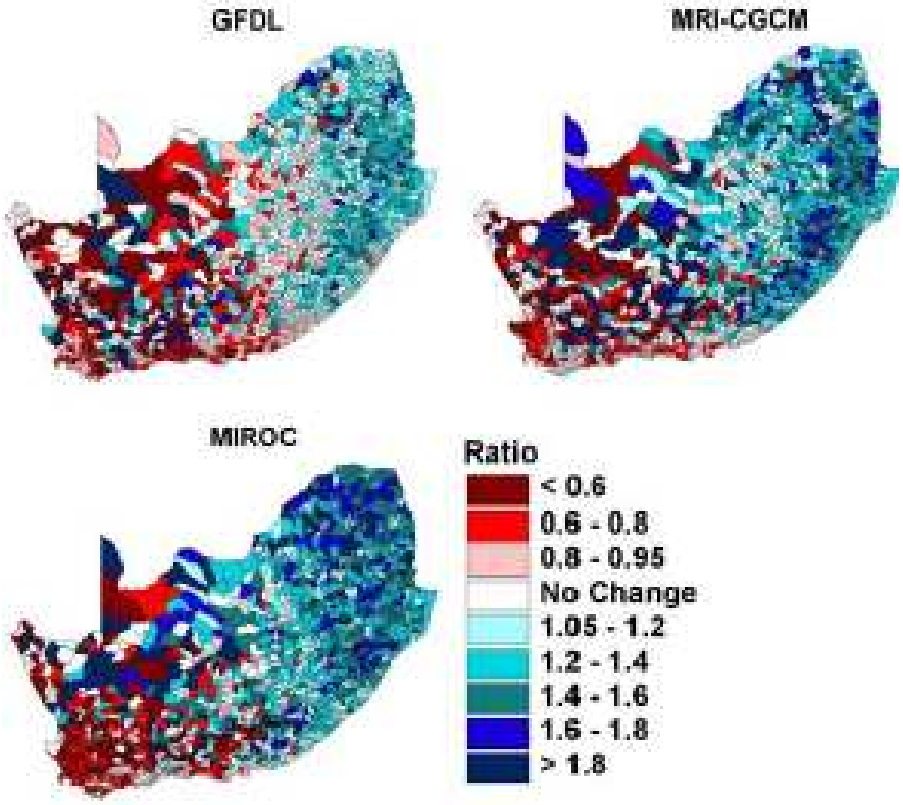

Figure 3.2 GSM Predictions of Changes in Numbers of Days with Rainfalls > 20 mm

3.3 ECOLOGICAL WATER REQUIREMENTS (EWR)

3.3.1 EWR releases from existing AWSS dams

The existing ecological water requirement (EWR) for the lower Kromme River of 2 million m^3/a has been taken into account in the AWSS water balance calculations, although no ecological releases are at present being made from the Impofu Dam. The Preliminary Kromme Estuary EWR of 5 million m^3/a, as determined in the 2005 Kromme/Seekoei Comprehensive Reserve Determination Study, has not yet been implemented.

Apart from the Kromme River, where an inadequate EWR release (2 million m^3/a instead of 5 million m^3/a) is currently taken into account, no EWR releases have been implemented for the other AWSS rivers, i.e. the Kouga and Van Stadens rivers and tributaries of the Swartkops River.

The influence on the system yield of making EWR releases for the Reserve could be significant, and therefore the process of Reserve determination at adequate levels of detail and the implementation thereof need to be carefully approached. The potential yield reductions following implementation of the Reserve have been considered in two of the AWSS water balance scenarios evaluated by assuming that the combined yield of the local surface and groundwater sources (but not the supply from the Orange River) will reduce linearly over a 3 year period from 2015 to 2017 by 15%, corresponding to a reduction in yield of 23.6 million m^3/a.

There is a need to develop a strategy for the implementation of the Reserve for existing dams of the AWSS. This should be implemented in a phased manner, as it could lead to a significant reduction in the yield of the AWSS.

3.3.2 Reserve releases for new interventions

In the planning of all new potential interventions, inclusive of dam raising options, the implementation of the Reserve has been considered in the calculations of yields of the various interventions.

The *Desalination of lower Sundays River return flows* intervention would intercept mostly irrigation return flows and reduce flows to the estuary. The Sundays River estuary as shown in **Figure 3.3** is considered important and by limiting the abstraction to within an acceptable range, such abstraction could possibly improve the condition of the estuary. Much more accurate flow and water quality measurements are however needed to determine the Reserve requirement and required flow regime of the lower Sundays River at an acceptable level of confidence.

Figure 3.3 Estuary of the Sundays River

Ecological scientists have indicated that the abstraction of water from the lower Gamtoos River would be detrimental to the Gamtoos estuary, and flow measurements, water quality information and ecological studies would be needed to confirm whether this scheme could be implemented.

3.4 OPERATION OF THE AWSS

The AWSS system also comprises extensive bulk conveyance infrastructure components which are owned and operated by the DWA, the Gamtoos Irrigation Board, and the NMBM. Irrigation requirements from the AWSS peak in the summer months from October to January, which is also the main rainy season. Domestic requirements of NMBM also peak over the summer season, with the added effect of around 300 000 visitors to the many holiday resorts close by, most of whom arrive during this peak period.

The municipal supply is optimised for cost of operation, however, the available storage capacity of the smaller dams is not fully utilised due to capacity limitations of pipelines and treatment works. There is

also some capacity (which is currently not fully utilised) to re-use more water from the six largest wastewater treatment works (WWTW).

As indicated in **Appendix B of Annexure A**, an additional 1 in 50 year system yield of 26 million m^3/a (71.2 Ml/day) relative to the current system yields, and a 1 in 20 year system yield of 17 million m^3/a (46.5 Ml/day) could be accommodated by the existing pipeline infrastructure if this is upgraded by boosting, so as to meet the peak week demand factor of 1.3. The capacities of all existing water treatment works, pumps, and pipelines were considered for this assessment.

Unaccounted-for water losses are around 20%, reaching up to 40% in some municipal areas, which represent significant potential for water savings from the existing water supply system. The emergency measures introduced by NMBM in 2010 have targeted water losses and excess usage, and have successfully reduced requirements.

The operation and management of the AWSS has already been modified to reduce water wastage, particularly through the improved operation of Loerie Dam as proposed in the Preliminary Strategy and therefore has been incorporated into the various intervention scenarios presented in **Section 6.**

The inter-basin water transfer from the Gariep Dam on the Orange River contributes about 560 million m^3/a to the Fish and Sundays rivers, mainly for irrigation and to dilute the salinity levels in these rivers, when there is surplus water in the Orange River system. Current water supply for irrigation from the Orange River to the LSRWUA is about 99 million m^3/a and as an emergency measure NMBM is currently abstracting about 33 million m^3/a.

The main storage dam for the LSRWUA is Darlington Dam, as shown in **Figure 3.4.** There is a need to prioritise the rehabilitation of Darlington Dam.

Figure 3.4 Darlington Dam on the lower Sundays River

Some operational issues in the AWSS that require attention are the following:

- There is a need to improve the flexibility within the AWSS system and particularly the transfer of Orange River water to the western side of NMBM.

- The combined operation of the Kouga-Loerie system between the Gamtoos Irrigation Board and NMBM must be adhered to, specifically the pattern of abstraction by NMBM at the Loerie treatment works. Operational risks can result if agreed system operational rules are not strictly adhered to.

- Various incidents of raw sewage spillages into specifically the upper Kouga River system have been a concern and it is necessary that DWA's regional office staff liaise with responsible municipalities to stop this from happening.

- Dam safety concerns about the Darlington Dam need to be addressed. At present the dam can only be operated at a maximum capacity of 45%, due to the inoperability of the mechanical works. If this is rectified, it will enhance the transfer security of the system.

DWA, NMBM and the GIB reassess the operation of the AWSS annually and if necessary implement restriction measures to ensure that the dams are not excessively drawn down.

It should be noted that although until very recently the historical water requirements were less than the 1 in 50 year availability of 159.6 million m^3/a shown in **Table 3.1** above, on a number of occasions it was necessary to impose restrictions on the urban users as well as the irrigators. These situations may have arisen on account of the higher losses from the Gamtoos Canals in the past, or because the inflows into Kouga Dam have been impacted by upstream allocations to a greater extent than indicated by the most recent hydrological assessment undertaken in 1996. Further studies are necessary to resolve these uncertainties and it is recommended that the hydrology of the catchment area be updated by a Water Availability Assessment Study (WAAS).

4. COMPARISON OF REQUIREMENTS AND AVAILABILITY

For the determination of the current water balance of the AWSS, it is recommended that urban water requirements, EWR, and losses/unaccounted-for water (UAW) from the Gamtoos Canal be assessed at a 1 in 50 year assurance of supply, whilst water for irrigated agriculture is assessed at a 91% (100% supplied for 70% of the time and 70% supplied for 30% of the time) assurance of supply. The exception would be the 2.4 million m^3/a supplied to the irrigators below Groendal Dam, which has been assumed to receive preference above the urban water supply from Groendal Dam in terms of a Water Court Order, although this must be confirmed, and has therefore been assessed at a 1 in 50 year assurance of supply.

The assurance of supply at which irrigators and NMBM receive water from Kouga Dam needs to be considered further, on account of uncertainties concerning the extensive irrigation usage in the Langkloof upstream of the Kouga Dam. It is generally accepted that the Kouga/Loerie sub-system is over-allocated, that the confidence in the water balance of this sub-system is low, and that the water balance of this sub-system must be revisited. The estimation of the maximum 1 in 50 year yield available for irrigation, for use by the Gamtoos Irrigation Board from the Kouga/Loerie Sub-system, has been determined from the 1 in 50 year yield of the sub-system (based on the 1996 hydrological assessment) minus the 1 in 50 year urban water use allocation from the sub-system (NMBM and some small towns) and the main and branch canals UAW/distribution losses; i.e.

$$75.5 – (23.0+0.7+4.3) = 47.5 \text{ million } m^3/a.$$

Using the relationship between the 1 in 10 year and 1 in 50 year yields for the Kouga/Loerie Sub-system determined for the Algoa Stochastic Analysis (101/75.5 = 1.34) , this translates to a maximum 1 in 10 year availability of 63.5 million m^3/a at a 1 in 10 year assurance of supply for irrigation. The full allocation of the GIB of 59.36 million m^3/a at an assurance of 1 in 10 years is therefore just less than the theoretical maximum potential irrigation water that can be supplied from this sub-system. The corresponding 1 in 50 year allocation for irrigation is 44.4 million m^3/a (59.36/1.34). This seems to indicate that the system is theoretically not over-allocated, but there is significant doubt whether such “surplus” water is actually available for increased use.

Use by the various water use sectors of the AWSS, according to assurance of supply, is as shown in **Table 4.1**.

Table 4.1 Current requirements from the AWSS according to assurance of supply

Water use	Requirement (million m^3/a)		
	At 1 in 50 year	At 1 in 10 year	Equivalent 1 in 50 year
Urban and industrial use	103.0		103.0
Gamtoos Irrigation Board[1]		59.36[1]	44.4[2]
Groendal irrigators	2.4		2.4
Agricultural use from Impofu Dam		2.0	1.7[3]
Ecological water requirement (EWR) from Impofu Dam	2.0		2.0
Gamtoos Irrigation Board canal losses / unaccounted-for-water	4.3		4.3
Total use			**157.8**

1. Note that the annual requirement of the Gamtoos Irrigation Board has changed from the 42 million m^3/a previously used in water balance calculations to their full allocation of 59.36 million m^3/a at a 91% assurance of supply, following a significant increase in use and a corresponding decrease in unaccounted-for-water/losses, after improved metering, operation and extensive refurbishments.

2. The equivalent 1 in 50 year agricultural water use for the Gamtoos Irrigation Board was calculated using the relationship between the 1 in 50 year and 1 in 10 year stochastic yields for the Kouga/Loerie Sub-system.
3. The equivalent 1 in 50 year agricultural water use from Impofu Dam was calculated using the relationship between the 1 in 50 year and 1 in 10 year yields for the Churchill/Impofu Dams.

If the 2008/09 equivalent 1 in 50 year water use of 157.8 million m^3/a is compared with the 1 in 50 year system yield of 159.4 million m^3/a, then the 2009 surplus was 1.6 million m^3/a. The recent prolonged drought has indicated that this assessment of the surplus is optimistic and in 2009-2010 there was a significant deficit necessitating severe restrictions over a prolonged period which led to NMBM fast tracking a number of interventions as described in **Section 5.4**.

The Reconciliation Planning Support Tool (RPST), described in **Section 5.2**, was customised for the AWSS. The RPST was populated with the water requirement scenarios described in **Section 2.2.4**, with the 1 in 50 year yield of the AWSS, and with information on the range of interventions evaluated, to be able to establish the estimated shortfall. **Figure 4.1** shows the current water balance and future Total High-Growth and Total Low-Growth water requirement scenarios as well the Water Availability from all existing sources of supply. The Coega IDZ industrial (non-potable) water requirement projections that are incorporated into these Scenarios are shown in **Figure 4.1**.

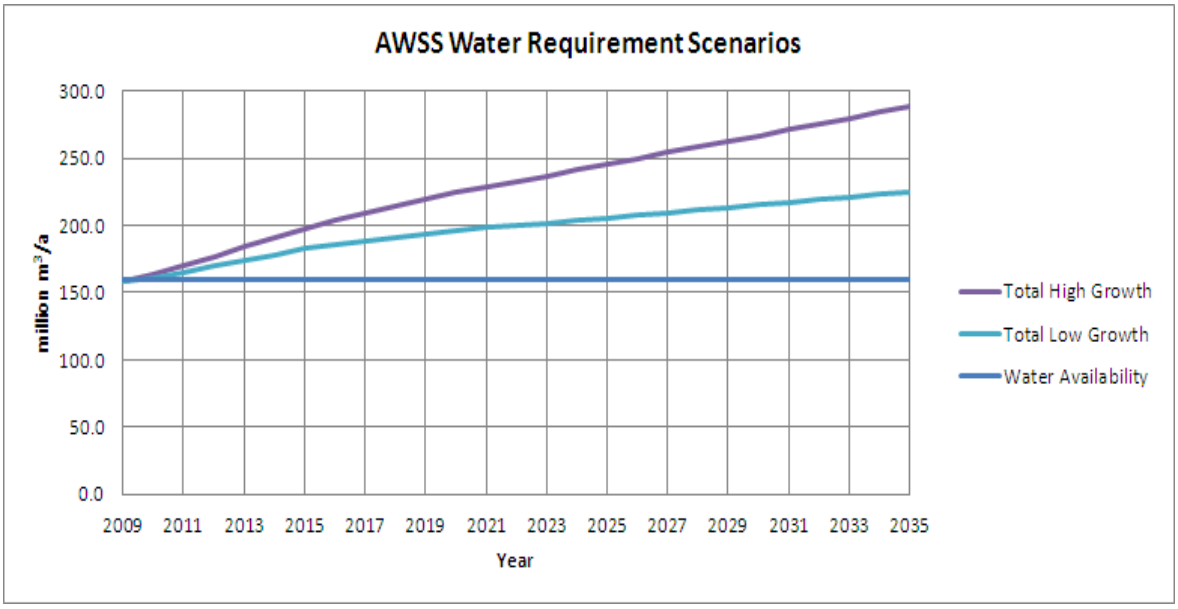

Figure 4.1 AWSS water requirements scenarios assessed

The potential influences of making ecological water requirement releases from the existing AWSS dams and of climate change (two scenarios) were considered in the water balance scenario analyses. It was shown that these would significantly lower the quantity of water available for use from the existing AWSS. On the other hand, the preliminary estimates of the ecological Reserves have been accounted for in considering all the potential future infrastructure developments.

It has been assumed that the system was just in balance in 2009 and that any increase in use would put the system at risk. The higher the growth in water requirements, the higher the risk would be, especially if large users in the Coega IDZ are established within the next five years. It is clear that measures to solve this problem must be proceeded with immediately on account of the lead times necessary for implementation and that the planned Emergency Measures are necessary.

5. INTERVENTIONS

Following the determination of the water balance, the Strategy followed a step-wise process which was developed to identify the most favourable interventions or groups of interventions to meet possible future water requirement scenarios, when these exceed the available supplies. The steps in the reconciliation strategy process are listed below:

Step 1: Identification of interventions;
Step 2: Preliminary screening of interventions;
Step 3: Public review of selected interventions;
Step 4: Scenario planning process;
Step 5: Review of selected scenarios by water institutions, authorities, and key stakeholders;
Step 6: Obtaining public feedback on scenarios; and
Step 7: Implementing interventions and initiating studies of interventions.

By initially following a Preliminary Strategy development process, some interventions and studies were identified for fast-tracking. The drought emergency that developed during the course of the study forced NMBM to implement various emergency measures and to select schemes to be fast tracked.

5.1 IDENTIFICATION OF INTERVENTIONS

More than sixty potential interventions, which could contribute to meeting the future water requirements of the AWSS, were initially identified (Step 1) from previous and on-going studies, including several newly formulated interventions, as shown in **Annexure A**.

The following categories of interventions were identified:

- Water conservation and water demand management (WC/WDM);
- Increased operational efficiency of the current water supply system;
- Trading of water use authorisations;
- Re-use of water;
- Groundwater schemes;
- Inter-basin transfer schemes;
- Desalination of seawater;
- Desalination of brackish river water; and
- Surface water schemes.

5.2 PRELIMINARY SCREENING OF INTERVENTIONS

Each intervention was then evaluated (Step 2) based on:

a. Lowest cost based on Unit Reference Value (URV) which provides an indication of the combined capital and operation costs;
b. Time required for implementation;
c. Adequate intervention yield, and certainty that the yield can be realised;
d. Spreading of risk by becoming less reliant on surface water sources; and
e. Ensuring that there are an adequate number of interventions to supply water up to 2035 (and beyond).

Interventions that could potentially be implemented within the planning periods were identified.

The selected interventions were then compared with one another. Some interventions were discarded

following discussion of such interventions at various study meetings and workshops, when it became apparent that they were flawed or could not really be termed interventions.

The interventions that were considered for the Strategy following preliminary screening are summarised in **Table 5.1**, in which those interventions that were selected **as Emergency Measures by NMBM are shown in bold**:

Table 5.1 Interventions considered for the Strategy

Intervention	Description of intervention
URBAN WATER CONSERVATION AND DEMAND MANAGEMENT:	
WC/WDM upstream/downstream of user meters	Continued roll-out of the active WC/WDM programme within NMBM, controlled by a full-time manager, and implementation of the existing WC/WDM programme and new WC/WDM activities. **This program has been expedited as one of NMBM's Emergency Interventions.**
Rainwater harvesting	Collection of rainwater from roofs, primarily for toilet flushing. The collection of rainwater for supplementing of garden water use is deemed to be an extension of this option. **Rainwater harvesting is being promoted by NMBM.**
TRADING OF WATER USE AUTHORISATIONS:	
Water trading – upper Great Fish River	Purchasing of water use entitlements from farmers using Orange River water in the upper Great Fish River, to be supplied to NMBM via the Nooitgedagt abstraction infrastructure.
Water trading - Baviaanskloof River	Purchasing of water use entitlements from farmers in the Baviaanskloof River valley, to be supplied to NMBM via the existing Kouga/Loerie system.
LAND USE CHANGES:	
Removal of alien invasive plants	Programmes to remove invasive alien plants in the catchments of the Kromme, Kouga and Baviaanskloof rivers. **This is already being done on a large scale.**
RE-USE OF WATER:	
Re-use of water treated to industrial standards – Coega WWTW	Re-use of treated water from the future Coega WWTW, to meet requirements for industrial (non-potable) quality water within the Coega IDZ. **This scheme is included in the business plan for the Coega IDZ.**
Re-use of water treated to industrial standards – Fish Water Flats WWTW	Re-use of treated water from the Fish Water Flats WWTW, to meet requirements for industrial quality water within the Coega IDZ. **This scheme has been set by the Eastern Cape Department of Economic Affairs, Environment and Tourism (DEAET) as a condition of water supply to the Coega IDZ and is included in the business plan of the Coega IDZ.**
Re-use of water treated to potable standards	Potable re-use of treated water from the Fish Water Flats (and possibly Uitenhage and Despatch WWTWs) through reverse osmosis treatment, storage in a proposed new dam at Echodale on the Elands River and treated at a new water treatment works. The recently identified alternative scheme to utilise treated effluent via Loerie Dam would be a similar alternative, however the URV may be lower.
DESALINATION:	
Coega Industry Desalination Option	Purchasing of potable water by NMBM from an industry in the Coega IDZ, which utilises reverse-osmosis to produce chlorine and caustic soda and high-quality water as a by-product of the process. This option is also dependent on the construction of a bulk seawater intake system for the Coega IDZ.
Lower Sundays River irrigation return flows	Abstraction of irrigation return flows in the Sundays River downstream of the Sundays River Water User Association, desalination, and

Intervention	Description of intervention
	blending at Olifantskop reservoirs with treated Orange River water supplied from the Nooitgedagt WTW.
Desalination of seawater	Supply via a bulk seawater intake system for multiple potential sea water users within the Coega IDZ area, pumping sea water via pipeline to the proposed RO plant site (to be shared with the planned Coega WWTW). **The recently identified alternative scheme to site a desalination plant on the Swartkops Estuary would be a similar alternative, with a similar URV and is one of NMBM's Emergency Interventions that would also improve the diversification of the sources of supply.**
GROUNDWATER AUGMENTATION SCHEMES:	
Fast-tracked groundwater schemes: - Jeffreys Arch - Van Stadens - Bushy Park - South-Eastern Coega Fault	Fast-tracking the implementation of the Jeffreys Arch, Van Stadens River Mouth, Bushy Park and the South-Eastern Coega Fault new groundwater schemes. Some of these schemes could either supply NMBM or alternatively supply small coastal towns, freeing up water for NMBM. **Groundwater development at Bushy Park is one of NMBM's Emergency Interventions.**
SURFACE WATER AUGMENTATION SCHEMES:	
Maximising yield of the existing Kouga/Loerie Scheme	Lowering of the operational level to which water can be abstracted from Loerie Dam to increase the yield, requiring no additional infrastructure or operating staff, but improved operation and increased periods of pumping at maximum capacity. **This scheme has been implemented.**
ORP/Nooitgedagt Low-Level Scheme	Increased supply from the Orange River to NMBM, supplied from Nooitgedagt Water Treatment Works (WTW) via a new pipeline to the Olifantskop Reservoir. This scheme would also offer significant energy savings on account of the reduced pumping heads needed. **DWA recently issued a licence to NMBM to abstract 58.3 million m^3/a of water from the Orange River with the proviso that the licence could be reduced back to 22 million m^3/a after 20 years, however NMBM have requested that the licence be made permanent on account of the high capital cost of this scheme.** **This scheme is one of NMBM's Emergency Interventions.**
Abstraction of lower Gamtoos River irrigation return flows	Abstraction of irrigation return flows by NMBM downstream of the largest irrigation component of the Gamtoos Irrigation Board (upstream of the tidal river zone) and pumping this water into the Loerie Dam for blending with water from Kouga Dam. **This scheme was considered by NMBM as a potential emergency measure but was eliminated on account of its potential impact on the ecology of the important Gamtoos Estuary.**
Guernakop Dam on the Kouga River	Construction of a new 83 m high rollcrete dam at Guernakop approximately 15 km upstream of the upper end of Kouga Dam on the Kouga River and doubling of the capacities of the Loerie WTW and the pipelines to NMBM.
Raising Kouga Dam on the Kouga River (replacement and raising)	Construction of a mass gravity rollcrete dam immediately downstream of the existing Kouga Dam and doubling of the capacities of the Loerie WTW and the pipelines to NMBM. **DWA are currently investigating this scheme for Dam Safety reasons.**
Tsitsikamma River Diversion to Impofu Dam	Diversion of flows from a diversion weir on the lower Tsitsikamma River, and pumping the water to a high point, from where the water would gravitate via pipeline into a stream which flows into Impofu Dam. The water would be treated at the Elandsjagt WTW and distributed through existing infrastructure.

5.3 EVALUATION OF INTERVENTIONS

In order to compile the summary evaluations of interventions so as to be able to compare interventions with one another at a common baseline, information was drawn from various existing reports, as well as from expert knowledge. It was found that previously some of the interventions had been evaluated very superficially, or not at all. Evaluation was done at desktop level for such interventions, to provide a reasonable level of information. Whilst the baseline information differs in extent and reliability, it nevertheless represents the latest available information for each option.

Where possible, **capital costs** were based on costs available from previous studies. These costs were escalated to be representative of the base year costs (June 2009). In some cases, costs had to be estimated from basics, as some interventions had not been costed previously. An evaluation period of 25 years was selected for the determination of unit reference values (URVs) of all water augmentation schemes. Discount rates of 0%, 3%, 6% and 8% were used in the calculation of URVs, to cater for funding by both NMBM and the DWA. Multiplication factors were applied to allow for additional costs.

Annual **operating costs** were also determined. In the case of Reverse Osmosis (RO) schemes, the operating costs were reduced by the cost of conventional treatment so that such schemes could be compared with the others on a common basis.

Detailed **implementation programmes** were developed for the evaluated interventions. The programmes take account of the duration (in years, or parts of years) of separate implementation phases (e.g. pre-feasibility study and EIA approval process) for each intervention, i.e. the time required to implement each intervention. The time to implement an intervention is determined by the various processes and procedures that must be undertaken. Based on the existing level of information for each intervention, different levels of studies or processes are required such as reconnaissance, pre-feasibility and feasibility studies, and construction or implementation. The processes for the various interventions depend on the amount of information gathered by previous studies, as well as the likely duration to complete further studies, and to obtain the necessary approvals for implementation. The typical times required for the various processes necessary for the implementation of the various interventions in normal circumstances are indicated in **Table 5.2**.

Table 5.2 Typical times to implement interventions

Scheme	Time to Implement and Develop Yield (years)
B1: WC/WDM Doubled Savings	**2**
E1: Industrial Effluent to Coega - ex FWF 45 Ml/d	**6**
E2: Potable Effluent	**8**
E3: Industrial Effluent to Coega - ex Coega 45 Ml/d	**6**
F1a: Coega IDZ Desalination (includes 5 year lag)	**9**
F2: Lower Sundays River Return Flows	**7**
F3: Seawater Desalination	**7**
G1: Maximise Kouga/Loerie Scheme Yield	**1**
G2: Nooitgedagt Low Level Scheme (EIA, design and licence completed)	**4**
G6: Kouga Dam replacement and Raising	**11**
H1F: Groundwater Jeffreys Arch	**7**
H2F: Groundwater Van Stadens	**7**
H3F: Groundwater Bushy Park	**7**
H4F: Groundwater S-E Coega fault	**7**

Yields of interventions were mainly drawn from existing reports, or determined from available hydrological information.

The evaluations of the range of interventions are documented in **Annexure A**.

5.4 EMERGENCY INTERVENTIONS

The severe and prolonged drought in 2009-2010 led NMBM to impose severe restrictions and to fast track the implementation of the following Emergency Interventions (also shown in **Table 5.1)** most of which had previously been identified as priorities by the preliminary scenario planning processes described in **Section 6.3.1** below:

- **Improved Operation of the Kouga Loerie System**
  The improved operation of the Kouga Loerie system identified by the study commenced in 2009 and is expected to improve the yield by about 5 million m^3/a.

- **Water Conservation and Water Demand Management (WC/WDM)**
  NMBM intensified its WC/WDM programme as follows:
  - The stepped tariffs were adjusted to provide significant tariff increases for increased usage.
  - Leak detection and repair programmes on the bulk mains and the reticulation zones were fast tracked and bulk meters were installed.
  - The programme of plumbing repairs in low income homes was intensified and the plumbing at a number of schools was also repaired.
  - The Call Centre was upgraded and users with high monthly water meter readings were contacted.
  - The publicity campaign was intensified.

  This intensification of the WC/WDM program is expected to result in overall savings of approximately 15 million m^3/a.

- **ORP Nooitgedagt Low-Level Scheme**
  NMBM had anticipated that this would be their next major scheme and had nearly completed the design, and the ROD and licence had been issued. The design was slightly modified and the tender process will be fast tracked to enable water delivery in December 2011. This scheme will increase the supply from the Orange River by about 32.7 million m^3/a to a total of 58.3 million m^3/a.

- **Swartkops Desalination**
  NMBM decided to proceed with a seawater desalination plant to be sited at the old Swartkops Power Station and to discharge brine via the existing sea outfall of the Fishwater Flats Waste Water Treatment Works. Water will be delivered to reservoirs served by the Churchill pipeline so as to augment the supply to the western areas of Port Elizabeth which are served by the dams that have been severely impacted by the drought. The brine will be blended with effluent from the Fishwater Flats WWTW and discharged via the existing sea outfall. The location of the desalination plant in an industrial area and the minimal impact of abstraction and of the brine discharges, as determined by specialist studies, has enabled the EIA process to be fast tracked. With fast tracking of the design and tender processes, water delivery is scheduled to commence by the end of 2011 provided that funding is approved. This scheme will provide an additional yield of about 11 million m3/a (30 Megalitres/day).

- **Groundwater**
  The groundwater scheme at Bushy Park which was identified by the Reconciliation Study will be developed by fast tracking of the EIA, design and tender process to deliver water in 2011.

The Scenarios described in **Chapter 6** take account of the early implementation of these schemes.

6. WATER BALANCE SCENARIO PLANNING

6.1 THE SCENARIO PLANNING PROCESS

The objective of the Water Balance Scenario Planning Process is to identify, evaluate and assess alternative groupings and phasing of interventions to determine the most appropriate combination of interventions that should be implemented to reconcile water supply and requirements in the AWSS. The combination of interventions selected to meet the selected water requirement scenario, is termed a scenario.

The scenario planning process considers a range of possible scenarios to reconcile water supply and requirements. The objective is not to select one 'favourable scenario' but rather to identify which interventions should be studied to allow consideration of a range of possible scenarios. This will allow the DWA, the NMBM, and other stakeholders the maximum amount of flexibility in making informed decisions on which interventions to implement. The outcome of the process is a list of interventions that should be studied by specific dates, so as to meet implementation requirements of a range of reconciliation scenarios. This evaluation involves the use of the Reconciliation Planning Support Tool (RPST) to evaluate the identified reconciliation scenarios.

6.2 THE RECONCILIATION PLANNING SUPPORT TOOL (RPST)

The selection of interventions, either to be studied further or to be implemented, to reconcile water availability of the AWSS with the requirements, is a complex task, with many diverse issues and criteria to consider. The need for a customised planning tool, to provide support for this task to water managers, was identified. A graphical support tool, called the RPST was therefore developed during that Reconciliation Strategy Study to aid the process of scenario planning of interventions. This Tool has been customised for the AWSS and used for developing the different water balance scenarios.

6.3 SCENARIO PLANNING

6.3.1 Preliminary scenario planning

A preliminary scenario planning evaluation was undertaken to identify the most favourable interventions or groups of interventions that could be implemented to meet the potential supply shortfalls for selected water requirement scenarios, in order to prevent the imminent risk of shortages in water supply. This was initially done for the medium term, i.e. for at least up to 2020, for the *Preliminary* Reconciliation Strategy, to ensure early recommendations on actions and studies to be undertaken. A Preliminary Options Workshop was held in November 2008 to specifically address the potential interventions and actions to achieve a water balance in the medium-term.

The following interventions were identified for early implementation:

- Continuous implementation of WC/WDM over a 5-year period, to achieve the currently identified potential savings;
- Maximise the Kouga/Loerie Scheme yield through improved operational measures;
- Implement the Nooitgedagt Low-Level Scheme.

6.3.2 Selected water balance scenarios

The longer-term scenario planning evaluation, i.e. for at least up to 2035, to inform the Reconciliation Strategy, was done once all potential interventions had been adequately evaluated. An Options Workshop was held in October 2009 to specifically address the potential interventions and actions to achieve a water balance in the long-term for the various requirement scenarios. Strategy recommendations were discussed and agreed at the workshop.

These Strategy recommendations were reviewed at the Steering Committee meeting held in March 2010 and various amendments and additions to the scenarios and to the recommendations were requested, evaluated and incorporated into the draft strategy document. Some of these scenarios were presented at the Final Public Meeting held in April 2010, including a reconciliation scenario incorporating the emergency measures planned for fast tracked implementation by NMBM.

Arising from the input provided to the new National Water Resources Strategy in May and June 2010 and from the additional information on the Projected Industrial Water Requirements of the Coega IDZ which became available in mid-July 2010, DWA requested that the Reconciliation Strategy scenarios should be revised as follows as described in **Section 2.2**:

- The industrial requirements of the Coega IDZ should be based on the draft March 2010 business plan for the supply of industrial water to the Coega IDZ, which was prepared by Afri-Coast Engineers and SSI.
- The projected potable and industrial water requirement scenarios should be combined throughout the 25-year reconciliation period up to 2035 (and not only for the period up to 2017, until when it was previously assumed that the industrial requirements of the Coega IDZ would be provided from surplus potable water supplies).
- All scenarios should take account of NMBM's Emergency Potable Water Supply Interventions to be fast tracked and comprising double the originally planned water conservation and water demand management savings, the Swartkops Desalination Plant, the Nooitgedagt Low-Level Scheme and the Bushy Park wellfield development.

The following represent the final selection of water balance scenarios that have been evaluated:

Water Balance Scenarios for the *Total High-Growth Water Requirement Scenario* shown in Figure 2.6:

Water Balance Scenario 1 for Total High-Growth Water Requirement:

NMBM's Emergency Interventions with a permanent allocation from the Orange River, as well as Non-Potable Water Re-use Schemes at the Coega and Fishwater Flats WWTW to supply NMBM until 2028

Water Balance Scenario 2 for Total High-Growth Water Requirement:

NMBM's Emergency Interventions with a permanent allocation from the Orange River, and in addition Groundwater Abstraction and Coega IDZ Desalination Schemes as well as Non-Potable Water Re-use Schemes at the Coega and Fishwater Flats WWTW to supply NMBM beyond 2035

Water Balance Scenario 3 for Total High-Growth Water Requirement:

NMBM's Emergency Interventions with a temporary allocation from the Orange River and in addition Groundwater abstraction, Coega IDZ Desalination, the Purchase of Irrigation Allocations and the Sundays River Desalination Scheme as well as Non-Potable Water Re-use Schemes at the Coega and Fishwater Flats WWTW to supply NMBM beyond 2035

Water Balance Scenario 4 for Total High-Growth Water Requirement:

NMBM's Emergency Interventions with a temporary allocation from the Orange River and in addition Groundwater Abstraction, a New Raised Kouga Dam, the Purchase of Irrigation Allocations and the Sundays River Desalination Scheme as well as Non-Potable Water Re-use Schemes at the Coega and Fishwater Flats WWTW to supply NMBM beyond 2035

Water Balance Scenario 5 for Total High-Growth Water Requirement:

NMBM's Emergency Interventions with a temporary allocation from the Orange River and in addition Groundwater Abstraction, a New Raised Kouga Dam, the Purchase of Irrigation Allocations and the Sundays River Desalination Scheme as well as Non-Potable Water Re-use Schemes at the Coega and Fishwater Flats WWTW to supply NMBM until 2034 with the impacts of Climate Change

Water Balance Scenario 6 for Total High-Growth Water Requirement:

NMBM's Emergency Interventions with a temporary allocation from the Orange River and in addition Groundwater Abstraction, a New Raised Kouga Dam, the Purchase of Irrigation Allocations and the Sundays River Desalination Scheme as well as Non-Potable Water Re-use Schemes at the Coega and Fishwater Flats WWTW to supply NMBM until 2035 with the release of EWRs from existing dams

Water Balance Scenario 7 for Total High-Growth Water Requirement:

NMBM's Emergency Interventions with Temporary Orange River Allocation and in addition Groundwater Abstraction, a New Raised Kouga Dam, the Purchase of Irrigation Allocations, the Coega IDZ Desalination Scheme and the Sundays River Desalination Scheme as well as Non-Potable Water Re-use Schemes at Coega and Fishwater Flats WWTW to supply NMBM until 2034, with the release of EWRs from existing dams and the impacts of Climate Change.

Water Balance Scenarios for the *Total Low-Growth Water Requirement Scenario* shown in Figure 2.7:

Water Balance Scenario 8 for Total Low-Growth Water Requirement:

NMBM's Emergency Interventions with a permanent allocation from the Orange River, as well as Non-Potable Water re-use Schemes at the Coega and Fishwater Flats WWTW to supply NMBM until well beyond 2035.

6.3.3 Water Balance Scenario 1 for Total High-Growth Water Requirement

NMBM's Emergency Interventions with a permanent allocation from the Orange River, as well as Non-Potable Water Re-use Schemes at the Coega and Fishwater Flats WWTW to supply NMBM until 2028

Water Balance Scenario 1 would only supply the water requirements of NMBM until 2028. Water Balance Scenarios 2, 3 and 4 address interventions that could be implemented to meet the water requirements thereafter until 2035.

Figure 6.1 has been used to select the most opportune timing for the commissioning of interventions to supply the growth of the potable water requirements of the NMBM and of the non-potable industrial requirements of the Coega IDZ. The use of **Figure 6.1** is explained in some detail below as the same approach is used for selecting the timing of both potable and non-potable interventions for the other scenarios:

- **Figure 6.1** shows that NMBM is planning to implement the following Emergency Interventions to supply potable water:
  - The yield of the Kouga/Loerie system (solid orange bar on graph) has been maximised since 2009 by improved operation of Loerie Dam by DWA, the GIB and NMBM.
  - It was assumed that the Swartkops Desalination Plant (solid yellow bar on graph), the Nooitgedagt Low-Level Scheme (solid green bar on graph), assuming that this volume will be supplied by a permanent allocation from the Orange River, and the Bushy Park Wellfield development (solid blue bar on graph) would all be commissioned by NMBM in 2011.
- The Top Line Graph in **Figure 6.1** represents the "High-Growth" requirement scenario: "3.5% Linear Growth of Potable Requirements" together with the "Coega IDZ Industrial (Non-Potable) Water Requirements".
- The Second Line Graph in **Figure 6.1**:
  - Represents the combined potable and industrial requirements after deducting the Water Conservation and Water Demand Management (WC/WDM) Emergency Interventions which provide double the savings NMBM originally expected , and
  - Shows that the interventions (described above) would be able to meet the combined potable and industrial water requirements until 2020.
- The Third Line Graph in **Figure 6.1**:
  - Represents the combined potable and industrial water requirements after deducting the savings provided by the Water Conservation and Water Demand Management (WC/WDM) Emergency Interventions and the non-potable industrial water supply of the Coega WWTW Industrial Water Re-use scheme that would be commissioned in 2021, and
  - Shows that the interventions (described above) would be able to meet the combined potable and industrial water requirements until 2024.
- The Fourth Line Graph in **Figure 6.1**:
  - Represents the combined potable and industrial requirements after deducting the savings provided by the Water Conservation and Water Demand Management (WC/WDM) Emergency Interventions and the non-potable industrial water supplies of the Coega and Fishwater Flats WWTW Water Re-use schemes would be commissioned in 2021 and 2025 respectively, and
  - Shows that the interventions (described above) would be able to meet the combined potable and industrial water requirements until 2028.
  - It also shows that an additional scheme would be required in 2029.

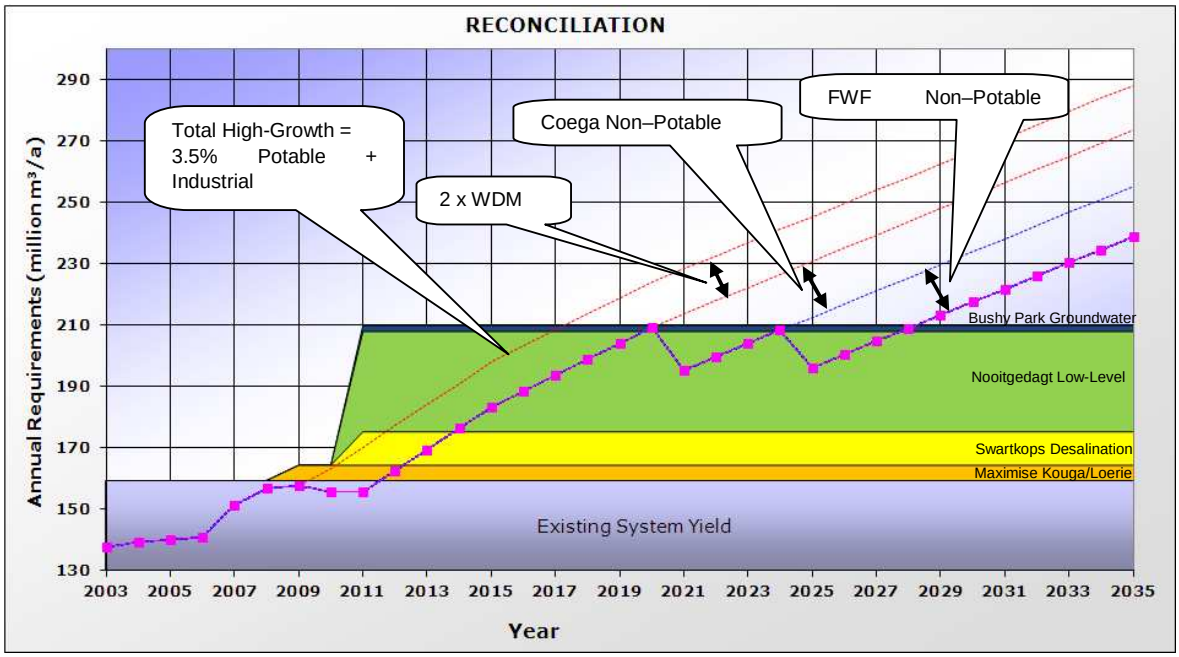

Figure 6.1 Water Balance Scenario 1 for Total High-Growth Water Requirement

The sequence of implementation of the interventions for Water Balance Scenario 1 shown in **Figure 6.1** is described in **Table 2.1**.

Table 6.1 Sequence of Intervention Implementation for Water Balance Scenario 1

Year	Description of Intervention
2009	Maximise the yield of the Kouga/Loerie Scheme through improved operational measures – this has already been implemented on account of its low URV.
2010-2012	Implement as emergency measures double the WC/WDM measures identified by NMBM's strategy – selected for their low URV and opportunity for immediate implementation.
2011	Implement NMBM's emergency schemes comprising the fast-tracked Nooitgedagt Low-Level Scheme, assuming that this will be supplied by a permanent allocation from the Orange River, the Swartkops seawater desalination scheme and the Bushy Park groundwater abstraction scheme – selected because these schemes could be fast tracked and offer diversity of supply.
2021	Implement the Coega WWTW industrial water re-use scheme to supply some of the non-potable water requirements of the Coega IDZ industries. Until then the Coega IDZ's industrial requirements would be supplied from the excess potable water supply capacity that would be available.
2025	Implement the Fishwater Flats WWTW industrial water re-use scheme to supply most of the balance of the Coega IDZ's non-potable industrial water requirements.

Figure 6.1 is needed to determine the timing for the commissioning of the additional potable and non-potable water supply interventions for Scenario 1. **Figure 6.2** shows which interventions would supply the non-potable industrial water requirements of the Coega IDZ, and **Figure 6.3** shows the combined potable and non-potable water requirements and the interventions (both potable and non-potable) for Scenario 1 that would need to be commissioned to meet all water requirements until 2030.

Interventions that could be implemented to meet the High-Growth Water Requirements after 2028 are described in Water Balance Scenarios 2 to 7.

Figure 6.2 provides more information on how the non-potable industrial water requirements of the Coega IDZ (**Figure 2.5**) would be met:

- **Figure 6.2** shows that because surplus potable supply capacity would be available, this surplus capacity would be used to meet the non-potable industrial water requirements of the Coega IDZ from 2010 until 2021 when the Coega WWTW Water Re-use scheme would be commissioned. **Figure 6.2** also shows that from 2021 until 2024 the industrial requirements of the Coega IDZ would be supplied with both treated effluent from the Coega WWTW and with surplus surface water.
- It is also evident from **Figure 6.2** that after the Fishwater Flats Non-Potable Water Re-use scheme is commissioned in 2025 there would be surplus non-potable water supply available until the industrial water requirements exceed the non-potable water supplies from the Coega and Fishwater Flats WWTWs in about 2032.
- On the other hand as discussed above, **Figure 6.1** shows that additional surface water supplies would be required from 2029 onwards as the surplus industrial non-potable supplies shown in **Figure 6.2** could not be used for potable supply.

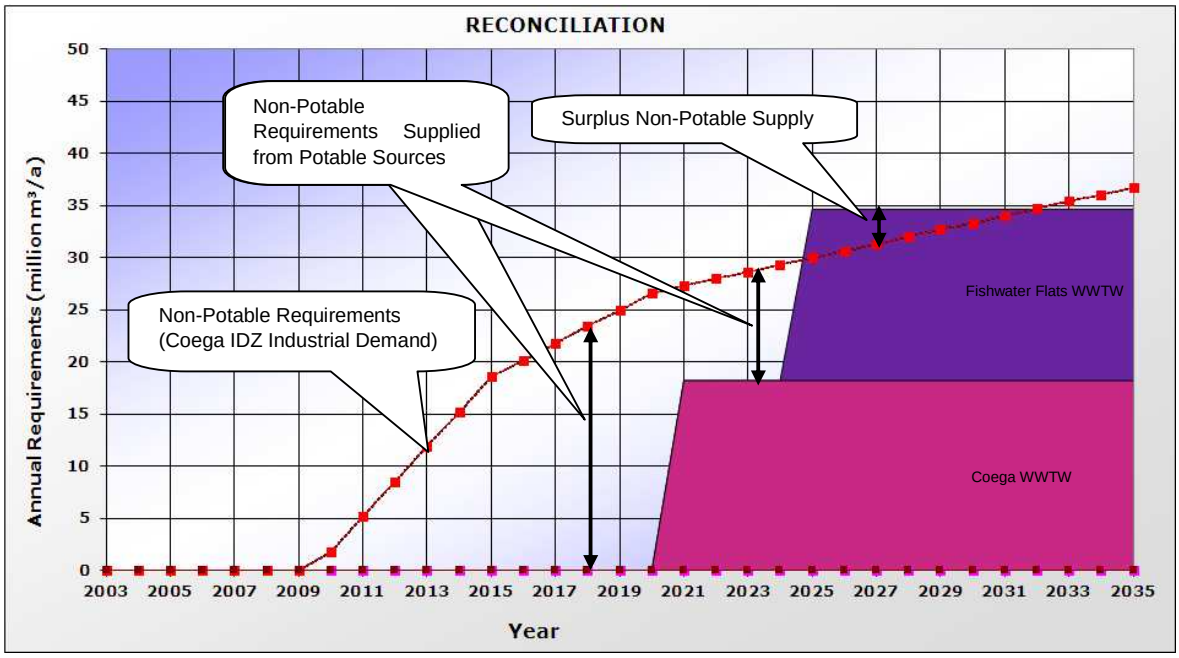

Figure 6.2 AWSS Non-Potable Water Balance Scenario 1

Figure 6.3 shows the combined potable and non-potable water balance for Water Balance Scenario 1, however in this figure the Coega and Fishwater Flats Re-use schemes are indicated as supply schemes, whereas **Figure 6.1** shows how these schemes would reduce the potable water requirements.

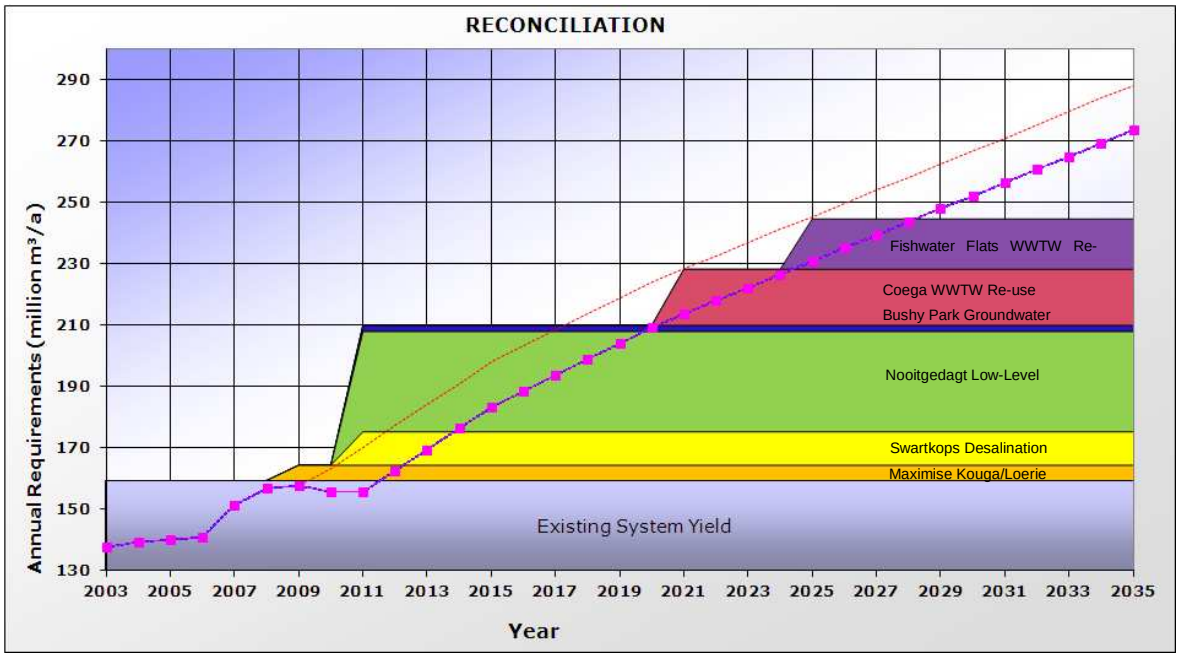

Figure 6.3 AWSS Combined Potable and Non-Potable Water Balance Scenario 1

Scenarios 2 to 8 below were all developed in accordance with the representation shown in **Figure 6.1**, however Scenarios 7 and 8 are also shown in accordance with the representation in **Figure 6.3.**

6.3.4 Water Balance Scenario 2 for Total High-Growth Water Requirement

NMBM's Emergency Interventions with a permanent allocation from the Orange River, and in addition Groundwater Abstraction and Coega IDZ Desalination Schemes as well as Non-Potable Water Re-use Schemes at the Coega and Fishwater Flats WWTW to supply NMBM beyond 2035

Water Balance Scenario 2 shown in
Figure 6.4 is identical to Water Balance Scenario 1 shown in **Figure 6.1** except that after 2028 additional interventions would be provided to meet the requirements up to 2035.

The non-potable utilization of water for Water Balance 2 would be identical to that shown in **Figure 6.2** except that from 2033 onwards the non-potable water requirements would exceed the non-potable supplies available from the Coega and Fishwater Flats WWTW, and therefore these additional requirements would be supplied from the potable water sources.

Up to 2025, the sequence of scheme for Water Balance Scenario 2 shown in
Figure 6.4 and described in **Table 6.2** is identical to that for Water Balance Scenario 1 shown in **Figure 6.1** and described in **Table 6.1** above.

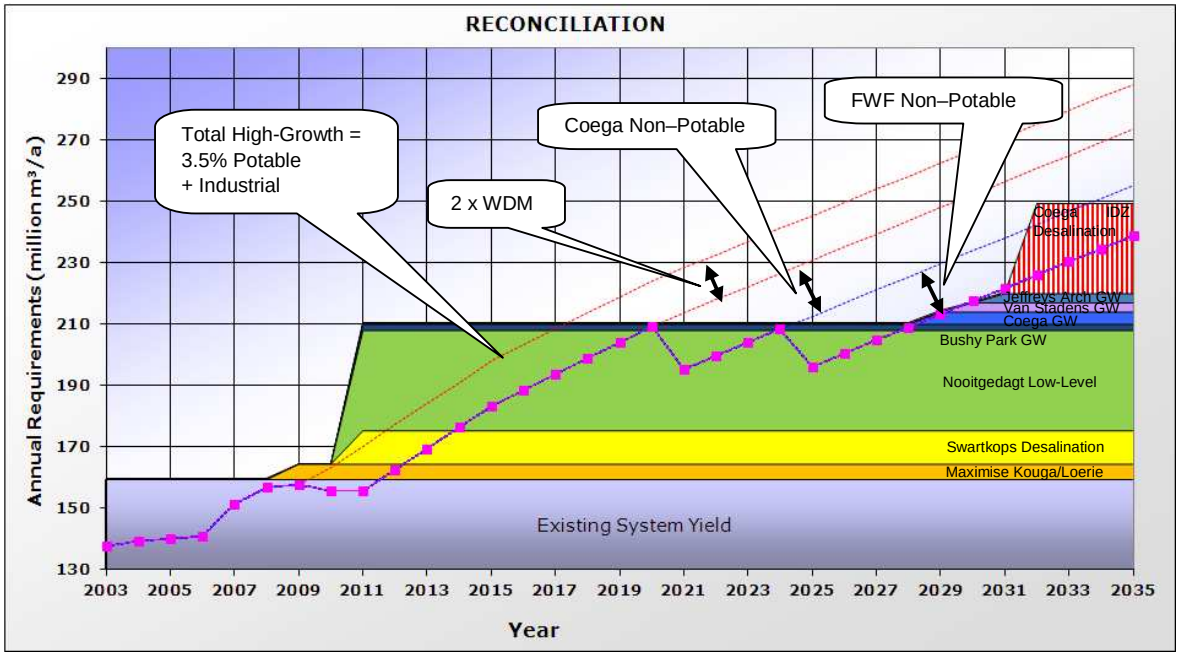

Figure 6.4 AWSS Potable and Non-Potable Water Balance Scenario 2

Table 6.2 Sequence of Intervention Implementation for Water Balance Scenario 2

Year	Description of Intervention
2009	Maximise the yield of the Kouga/Loerie Scheme through improved operational measures – this has already been implemented on account of its low URV.
2010-2012	Implement as emergency measures double the WC/WDM measures identified by NMBM's strategy – selected for their low URV and opportunity for immediate implementation.
2011	Implement NMBM's emergency schemes comprising the fast-tracked Nooitgedagt Low-Level Scheme, assuming that this will be supplied by a permanent allocation from the Orange River, the Swartkops seawater desalination scheme and the Bushy Park groundwater abstraction scheme – selected because these schemes could be fast tracked and offer diversity of supply.
2021	Implement the Coega WWTW industrial water re-use scheme to supply some of the non-potable water requirements of the Coega IDZ industries. Until then the Coega IDZ's industrial water requirements would be supplied from the excess potable water supply capacity that would be available.
2025	Implement the Fishwater Flats WWTW industrial water re-use scheme to supply most of the balance of the Coega IDZ's non-potable industrial water.
2029-2031	**Implement the Van Stadens, Coega and Jeffreys Arch groundwater schemes on account of their low URVs.**
2032	**Implement the Coega IDZ Desalination Scheme to supply the balance of and NMBM's potable water requirements until beyond 2035.**

Note: Changes from Scenario 1 shown in bold.

6.3.5 Water Balance Scenario 3 for Total High-Growth Water Requirement

NMBM's Emergency Interventions with a temporary allocation from the Orange River and in addition Groundwater abstraction, Coega IDZ Desalination, the Purchase of Irrigation Allocations and the Sundays River Desalination Scheme as well as Non-Potable Water Re-use Schemes at the Coega and Fishwater Flats WWTW to supply NMBM beyond 2035

Water Balance Scenario 3 shown in **Figure 6.5** is identical to Water Balance Scenario 2 shown in **Figure 6.4** until 2031. Thereafter Water Balance Scenario 3 shows that if phasing out of the ORP allocation over 5 years would commence in 2031 this would necessitate the provision of a number of additional interventions to meet the requirements up to 2035.

As for Water Balance Scenario 2, the non-potable utilization of water for Water Balance 3 would be identical to that shown in **Figure 6.2** except that from 2033 onwards the non-potable water requirements would exceed the non-potable water supplies available from the Coega and Fishwater Flats WWTW and these additional requirements would be supplied from potable sources.

Up to 2029-2031 the full sequence of scheme implementation for Scenario 3 shown in **Figure 6.5** and described in **Table 6.2** is identical to that for Water Balance Scenario 2 as described in **Table 6.2** .

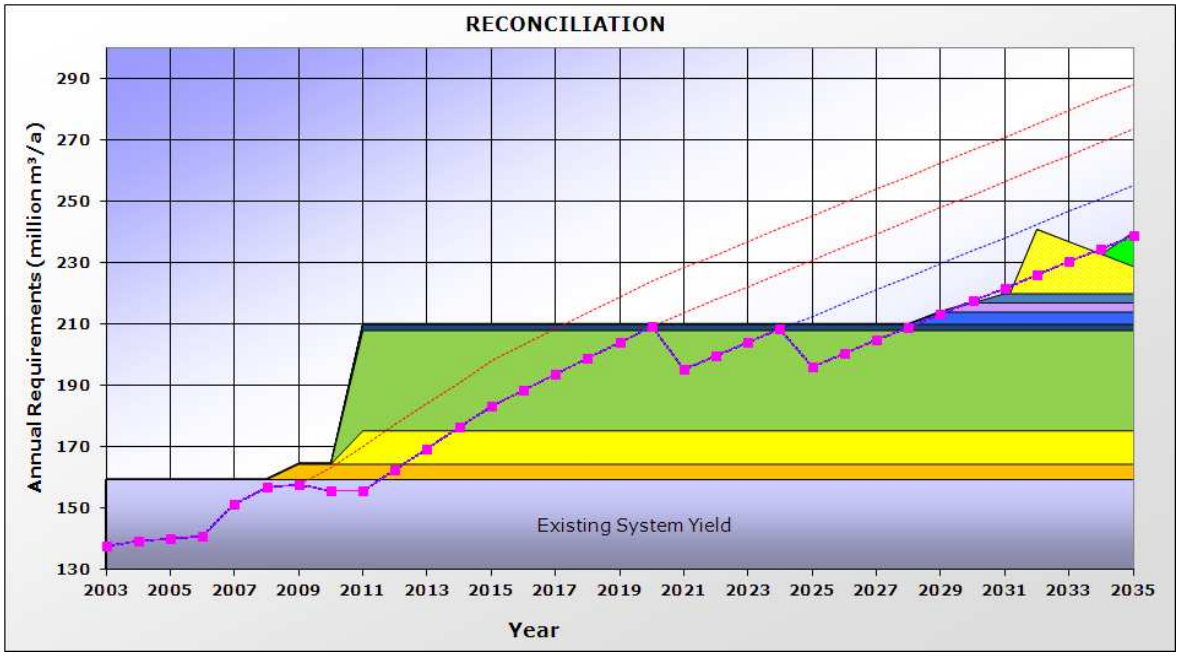

Figure 6.5 AWSS Potable and Non-Potable Water Balance Scenario 3

Table 6.3 Sequence of Intervention Implementation for Water Balance Scenario 3

Year	Description of Intervention
2009	Maximise the yield of the Kouga/Loerie Scheme through improved operational measures – this has already been implemented on account of its low URV.
2010-2012	Implement as emergency measures double the WC/WDM measures identified by NMBM's strategy – selected for their low URV and opportunity for immediate implementation.
2011	Implement NMBM's emergency schemes comprising the fast-tracked Nooitgedagt Low-Level Scheme, assuming that this will be supplied by a temporary allocation from the Orange River, the Swartkops seawater desalination scheme and the Bushy Park groundwater abstraction scheme – selected because these schemes could be fast tracked and offer diversity of supply.
2021	Implement the Coega WWTW industrial water re-use scheme to supply some of the non-potable water requirements of the Coega IDZ industries. Until then the Coega IDZ's industrial requirements would be supplied from the excess potable water supply capacity that would be available.
2025	Implement the Fishwater Flats WWTW industrial water re-use scheme to supply most of the balance of the Coega IDZ's non-potable industrial requirements.
2029-2031	Implement the Van Stadens, Coega and Jeffreys Arch groundwater abstraction schemes on account of their low URVs.
2031	**Phasing out of the ORP allocation over 5 years would commence, and simultaneously phasing in of replacement transfers from the trading of irrigation allocations on the Fish River equal to approximately half the lost allocation would occur, also over 5 years.**
2032	**Implement the Coega IDZ Desalination Scheme.**
2035	**Implement the Sundays River return flows desalination scheme when sufficient transfer capacity would become available in the Nooitgedagt Low-Level Scheme (after withdrawal of the ORP allocation and the partial replacement of this loss of supply with additional supplies from Water Trading).**

Note: Changes from Scenario 2 shown in bold.

6.3.6 Water Balance Scenario 4 for Total High-Growth Water Requirement

NMBM's Emergency Interventions with a temporary allocation from the Orange River and in addition Groundwater Abstraction, a New Raised Kouga Dam, the Purchase of Irrigation Allocations and the Sundays River Desalination Scheme as well as Non-Potable Water Re-use Schemes at the Coega and Fishwater Flats WWTW to supply NMBM beyond 2035

Water Balance Scenario 4 shown in **Figure 6.6** is identical to Water Balance Scenario 3 shown in **Figure 6.5** until 2031. Thereafter Scenario 4 shows alternative interventions to those selected for Scenario 3 that could meet the water requirements if the ORP water allocation is phased out over 5 years from 2031.

As for Water Balance Scenario 2, the non-potable utilization of water for Water Balance Scenario 4 would be identical to that for Scenario 3 shown in **Figure 6.2** as described in **Section 6.3.5.**

Up to 2021, the full sequence of scheme implementation for Water Balance Scenario 4 shown in **Figure 6.6** and described in **Table 6.4** is identical to that shown in **Table 6.3** for Water Balance Scenario 3, but is different thereafter.

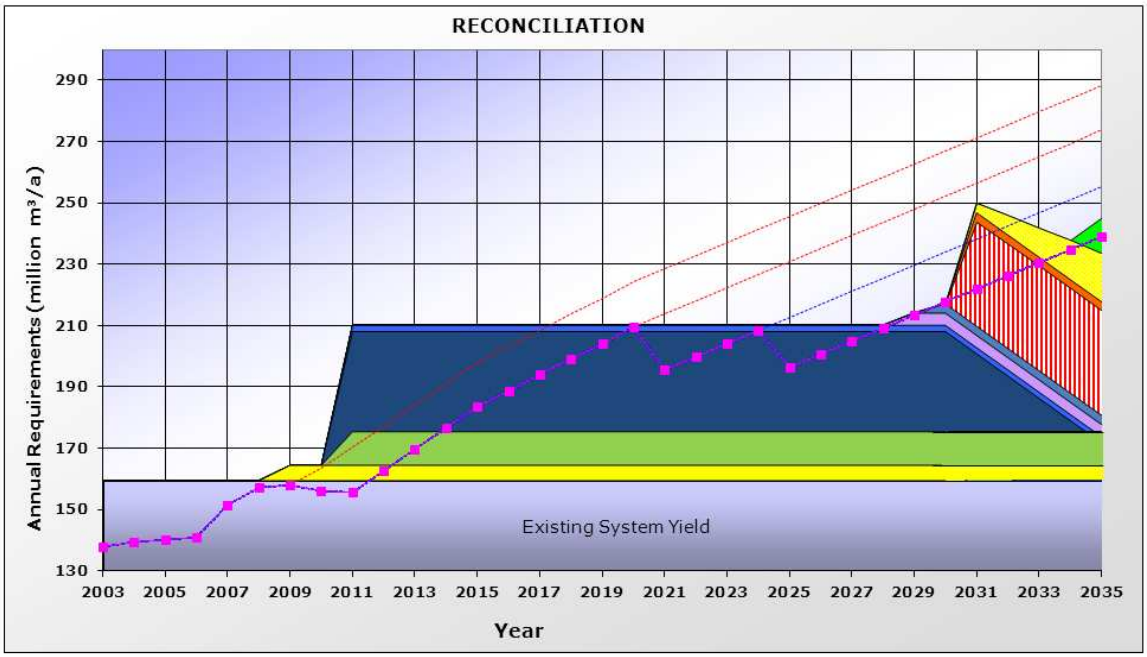

Figure 6.6 AWSS Potable and Non-Potable Water Balance Scenario 4

Table 6.4 Sequence of Intervention Implementation for Water Balance Scenario 4

Year	Description of Intervention
2009	Maximise the yield of the Kouga/Loerie Scheme through improved operational measures – this has already been implemented on account of its low URV.
2010-2012	Implement as emergency measures double the WC/WDM measures identified by NMBM's strategy – selected for their low URV and opportunity for immediate implementation.
2011	Implement NMBM's emergency schemes comprising the fast-tracked Nooitgedagt Low-Level Scheme, assuming that this will be supplied by a temporary allocation from the Orange River, the Swartkops seawater desalination scheme and the Bushy Park groundwater abstraction scheme – selected because these schemes could be fast tracked and offer diversity of supply.
2021	Implement the Coega WWTW industrial water re-use scheme to supply some of the non-potable water requirements of the Coega IDZ industries. Until then the Coega IDZ's industrial requirements would be supplied from the excess potable water supply capacity that would be available.
2024	Implement the Fishwater Flats WWTW industrial water re-use scheme to supply most of the balance of the Coega IDZ's non-potable industrial water requirements.
2029-2031	Implement the Van Stadens, Coega and Jeffreys Arch groundwater abstraction schemes on account of their low URVs.
2031	Phasing out of the ORP allocation over 5 years would commence, and simultaneously phasing in of replacement transfers from the trading of irrigation allocations on the Fish River equal to approximately half the lost allocation would occur, also over 5 years.
2031	**Implement the Raising (Replacement) of Kouga Dam.**
2035	**Implement the Sundays River desalination scheme when sufficient transfer capacity should become available in the Nooitgedagt Low-Level Scheme (after the phasing out of the ORP allocation and the partial replacement of this loss of supply with additional supplies from Water Trading).**

Note: Changes from Scenario 3 shown in bold.

6.3.7 Water Balance Scenario 5 for Total High-Growth Water Requirement

NMBM's Emergency Interventions with a temporary allocation from the Orange River and in addition Groundwater Abstraction, a New Raised Kouga Dam, the Purchase of Irrigation Allocations and the Sundays River Desalination Scheme as well as Non-Potable Water Re-use Schemes at the Coega and Fishwater Flats WWTW to supply NMBM until 2034 with the impacts of Climate Change

Water Balance Scenario 5 in **Figure 6.7** shows a 10% or 13 million m^3/a reduction in the combined yield of the existing local supplies due to potential impacts of Climate Change, phased in from 2011 to 2023. This would necessitate the earlier implementation of additional schemes from 2019 onwards as shown in **Figure 6.7** compared with Scenario 4 shown in **Figure 6.6**.

The non-potable utilization of water for Water Balance Scenario 5 would be similar to that for Scenarios 2, 3 and 4 shown in **Figure 6.2** and as described in **Section 6.3.5,** except that the Fishwater Flats industrial water re-use scheme would be commissioned a year earlier to deliver water in 2023 instead of 2024.

Climate change would also necessitate that the Van Stadens, Coega and Jeffreys Arch groundwater abstraction schemes and the Raising of Kouga Dam take place 3 years earlier than for Scenario 4, the Sundays River return flow desalination scheme 1 year earlier, and in 2035 an additional scheme would be required.

The full sequence of scheme implementation for Water Balance Scenario 5 is shown in **Figure 6.7** and is described in **Table 6.5**.

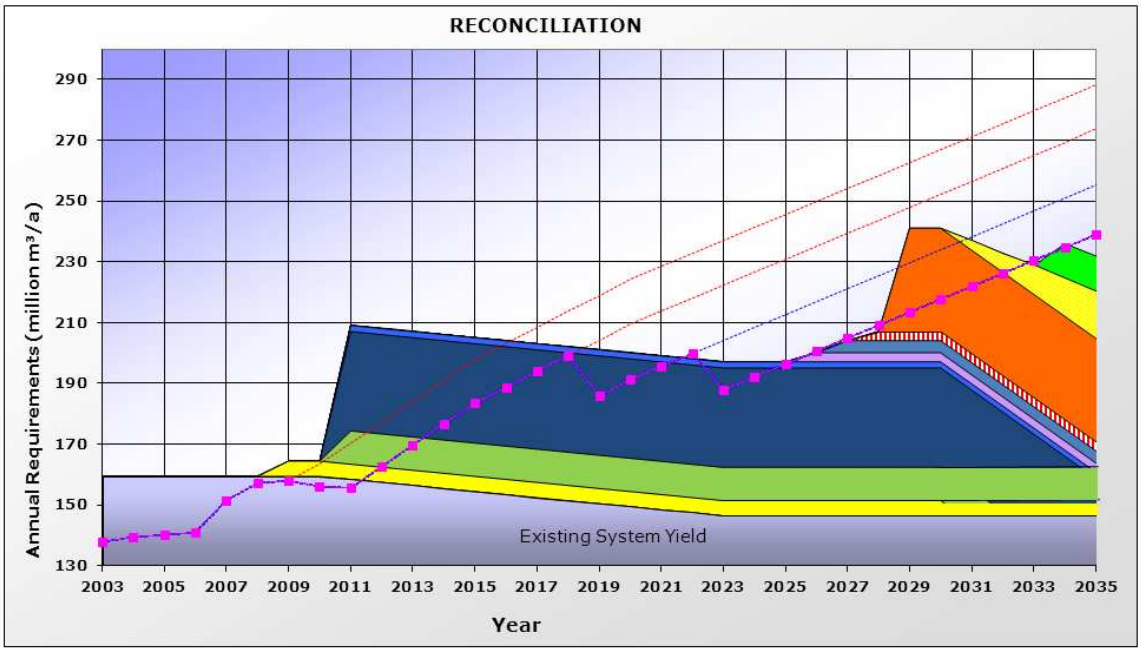

Figure 6.7 AWSS Potable and Non-Potable Water Balance Scenario 5

Table 6.5 Sequence of Intervention Implementation for Water Balance Scenario 5

Year	Description of Intervention
2009	Maximise the yield of the Kouga/Loerie Scheme through improved operational measures – this has already been implemented on account of its low URV.
2010-2012	Implement as emergency measures double the WC/WDM measures identified by NMBM's strategy – selected for their low URV and opportunity for immediate implementation.
2011	Implement NMBM's emergency schemes comprising the fast-tracked Nooitgedagt Low-Level Scheme, assuming that this will be supplied by a temporary allocation from the Orange River, the Swartkops seawater desalination scheme and the Bushy Park groundwater abstraction scheme – selected because these schemes could be fast tracked and offer diversity of supply.
2011-2023	**Climate Change reduces yield of existing local schemes (but not the yield from the Orange River) by 10% between 2011 and 2023.**
2019	Implement the Coega WWTW industrial water re-use scheme to supply some of the non-potable water requirements of the Coega IDZ industries **(3 years earlier than for Scenario 4)**. Until then the Coega IDZ's industrial water requirements would be supplied from the excess potable water supply capacity that would be available.
2023	Implement the Fishwater Flats WWTW industrial water re-use scheme to supply most of the balance of the Coega IDZ's non-potable industrial water requirements **(1 year earlier than for Scenario 4)**.
2026-2028	Implement the Van Stadens, Coega and Jeffreys Arch groundwater abstraction schemes on account of their low URVs **(3 years earlier than for Scenario 4)**.
2029	Implement the Raising (Replacement) of Kouga Dam **(3 years earlier than for Scenario 4)**.
2031	Phasing out of the ORP allocation over 5 years would commence, and simultaneously phasing in of replacement transfers from the trading of irrigation allocations on the Fish River equal to approximately half the lost allocation would occur, also over 5 years.
2034	Implement the Sundays River irrigation return flows desalination scheme when sufficient transfer capacity should become available in the Nooitgedagt Low-Level Scheme (after phasing out of the ORP water allocation and the partial replacement of this loss of supply with additional supplies from Water Trading) **(1 year earlier than for Scenario 4)**.
2035	**An additional scheme would be required to meet the growing requirements in 2035 and beyond.**

Note: Changes from Scenario 4 shown in bold.

6.3.8 Water Balance Scenario 6 for Total High-Growth Water Requirement

NMBM's Emergency Interventions with a temporary allocation from the Orange River and in addition Groundwater Abstraction, a New Raised Kouga Dam, the Purchase of Irrigation Allocations and the Sundays River Desalination Scheme as well as Non-Potable Water Re-use Schemes at the Coega and Fishwater Flats WWTW to supply NMBM until 2035 with the release of EWRs from existing dams

Water Balance Scenario 6 in **Figure 6.8** shows a 15% or 25 million m^3/a reduction in the yield available from all existing sources of supply, including the Orange River allocation. It has been assumed that the implementation of the Reserves for these schemes will be phased in over 3 years commencing in 2015. This would necessitate the earlier implementation of additional schemes from 2017 onwards as shown in **Figure 6.8** compared with Scenario 4 shown in **Figure 6.6**.

The non-potable utilization of water for Water Balance Scenario 6 would be similar to that for Scenarios 2, 3 and 4 shown in
Figure 6.4 and as described in **Section 6.3.5,** except that the Fishwater Flats industrial water re-use scheme would need to be commissioned in 2017 before the Coega industrial water re-use scheme which would be commissioned in 2020. It is assumed that this reversed order of implementation would be necessary because there would not be sufficient sewerage inflow to the Coega works by 2017 to provide the full treated industrial waste water supply of the scheme.

The 15% reduction in the yields of all existing schemes including the supply from the Orange River for Scenario 6 would bring forward the need for additional interventions by about 4 years and would also require some revision of the proposed sequence of implementation of the industrial water re-use schemes at Coega and Fishwater Flats WWTWs as proposed for the previous scenarios.

The full sequence of intervention implementation for Water Balance Scenario 6 is shown in **Figure 6.8** and is described in **Table 6.6**.

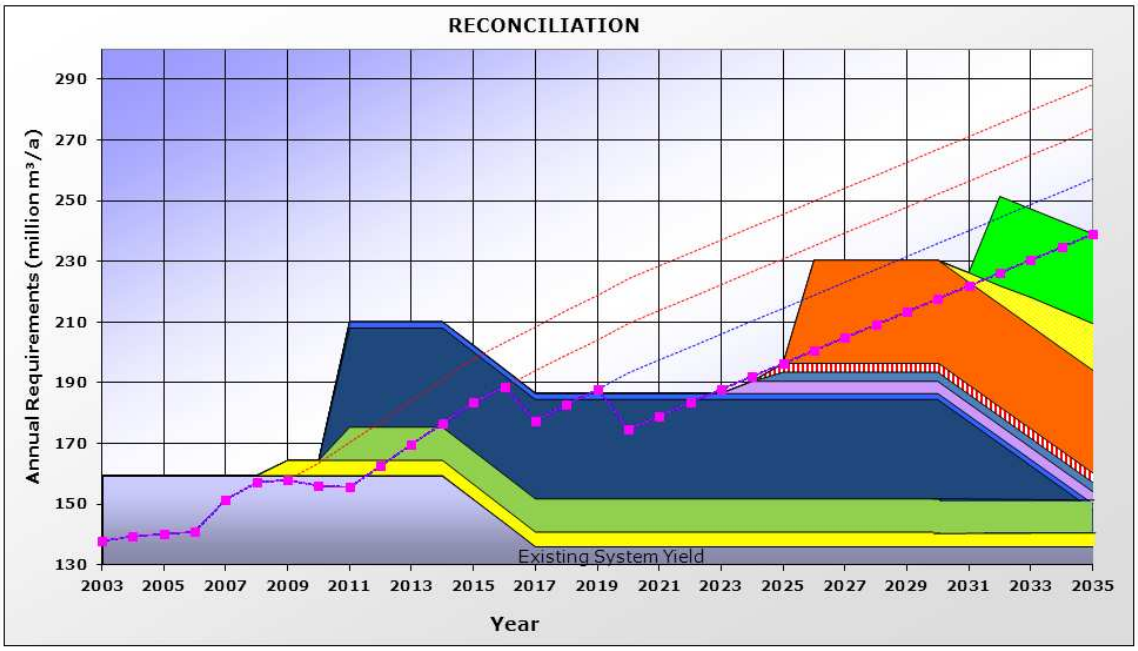

Figure 6.8 AWSS Potable and Non-Potable Water Balance Scenario 6

Table 6.6 Sequence of Intervention Implementation for Water Balance Scenario 6

Year	Description of Intervention
2009	Maximise the yield of the Kouga/Loerie Scheme through improved operational measures – this has already been implemented on account of its low URV.
2010-2012	Implement as emergency measures double the WC/WDM measures identified by NMBM's strategy – selected for their low URV and opportunity for immediate implementation.
2011	Implement NMBM's emergency schemes comprising the fast-tracked Nooitgedagt Low-Level Scheme, assuming that this will be supplied by a permanent allocation from the Orange River, the Swartkops seawater desalination scheme and the Bushy Park groundwater abstraction scheme – selected because these schemes could be fast tracked and offer diversity of supply.
2014-2017	**Implementation of the Reserve for all existing schemes (including the Orange River) reduces the available yield by 15%.**
2017	**Implement the Fishwater Flats WWTW industrial water re-use scheme to supply some of the non-potable water requirements of the Coega IDZ industries. Until then the Coega IDZ's industrial water requirements would be supplied from the excess potable water supply capacity that would be available (whereas for Scenarios 1 to 4 the Coega WWTW industrial supply scheme would be implemented first and FWF 4 years later in 2021).**
2020	**Implement the Coega WWTW industrial water re-use scheme (whereas for Scenarios 1 to 4 the Fishwater Flats WWTW re-use scheme would be implemented first and the Coega WWTW scheme 4 years later in 2025).**
2024-2025	Implement the Van Stadens, Coega and Jeffreys Arch groundwater schemes on account of their low URVs **(about 5 to 6 years earlier than for Scenario 4).**
2026	Implement the Raising of Kouga Dam **(5 years earlier than for Scenario 4).**
2031	Phasing out of the ORP allocation over 5 years would commence, and simultaneously phasing in of replacement transfers from the trading of irrigation allocations on the Fish River equal to approximately half the lost allocation would occur, also over 5 years.
2032	**Implement the Coega IDZ desalination scheme as sufficient capacity would not be available in the Nooitgedagt Low-Level Scheme to implement the Sundays River desalination scheme which would also provide a lower yield.**

Note: Changes from Scenario 4 shown in bold.

6.3.9 Water Balance Scenario 7 for Total High-Growth Water Requirement

NMBM's Emergency Interventions with Temporary Orange River Allocation and in addition Groundwater Abstraction, a New Raised Kouga Dam, the Purchase of Irrigation Allocations, the Coega IDZ Desalination Scheme and the Sundays River Desalination Scheme as well as Non-Potable Water Re-use Schemes at the Coega and Fishwater Flats WWTW to supply NMBM until 2034 with the release of EWRs from existing dams and the impacts of Climate Change.

Water Balance Scenario 7 in **Figure 6.9** shows a 15% or 25 million m^3/a reduction in the yield available from all existing sources of supply including the Orange River due to the implementation of the ecological Reserve on existing schemes. It has been assumed that the ecological Reserves for these schemes will be implemented over 3 years commencing in 2015. It has been assumed that Climate Change would reduce the yields of existing local sources by 10%. This would necessitate the earlier implementation of additional schemes from 2017 onwards as shown in **Figure 6.9** compared with Scenario 6 shown in **Figure 6.8.**

The non-potable utilization of water for Water Balance Scenario 7 would be similar to that for Scenarios 2, 3 and 4 shown in
Figure 6.4 and as described in **Section 6.3.5,** except that the Fishwater Flats industrial water re-use scheme would need to be commissioned in 2017 before the Coega industrial water re-use scheme which would be commissioned in 2020. It is assumed that this reversed order of implementation would be necessary because there would not be sufficient sewerage inflow to the Coega works by 2017 to provide the full treated industrial waste water supply of the scheme.

The potential effect of climate change together with the implementation of the ecological Reserve, compared with the effect of implementing the ecological Reserve only, would necessitate the earlier implementation of the Van Stadens, Coega and Jeffreys Arch groundwater abstraction schemes, the Raising of Kouga Dam and the Coega IDZ desalination scheme. The Sundays River desalination scheme and an additional augmentation scheme would also be required.

The sequence of intervention implementation for Water Balance Scenario 7 is shown in **Figure 6.9** and described in **Table 6.7**.

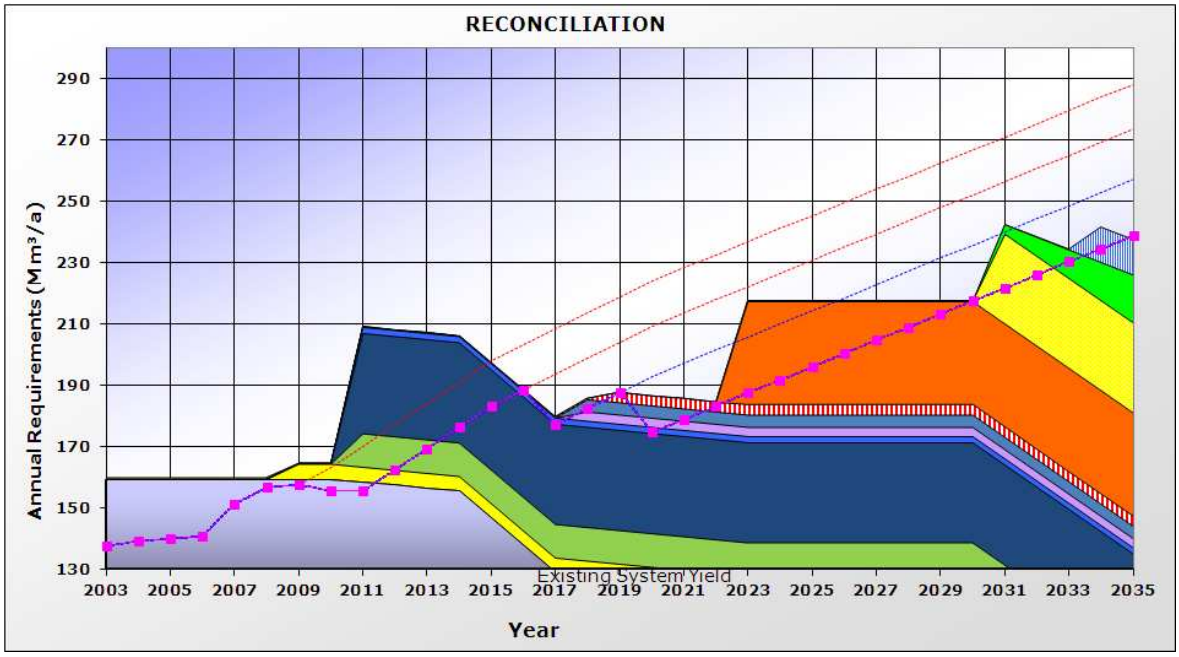

Figure 6.9 AWSS Potable and Non-Potable Water Balance Scenario 7

Table 6.7 Sequence of Intervention Implementation for Water Balance Scenario 7

Year	Description of Intervention
2009	Maximise the yield of the Kouga/Loerie Scheme through improved operational measures – this has already been implemented on account of its low URV.
2010-2012	Implement as emergency measures double the WC/WDM measures identified by NMBM's strategy – selected for their low URV and opportunity for immediate implementation.
2011	Implement NMBM's emergency schemes comprising the fast-tracked Nooitgedagt Low-Level Scheme, assuming that this will be supplied by a permanent allocation from the Orange River, the Swartkops seawater desalination scheme and the Bushy Park groundwater abstraction scheme – selected because these schemes could be fast tracked and offer diversity of supply.
2014-2017	Implementation of the Reserve for all existing schemes (including the Orange River) reduces the available yield by 15%.
2011-2023	**Climate Change reduces yield of existing local schemes (but not the yield from the Orange River) by 10% between 2011 and 2023.**
2017	Implement the Fishwater Flats WWTW industrial water re-use scheme to supply some of the non-potable water requirements of the Coega IDZ industries. Until then the Coega IDZ's industrial water requirements would be supplied from the excess potable water supply capacity that would be available (as for Scenario 6, the Reserve implemented without climate change impact).
2018-2019	**Implement the Van Stadens, Coega and Jeffreys Arch groundwater schemes on account of their low URVs (6 years earlier than for Scenario 6).**
2020	Implement the Coega WWTW industrial water re-use scheme (as for Scenario 6, the Reserve implemented without climate change impact).
2023	Implement the Raising (Replacement) of Kouga Dam **(3 years earlier than for Scenario 6**).
2031	Phasing out of the ORP allocation over 5 years would commence, and simultaneously phasing in of replacement transfers from the trading of irrigation allocations on the Fish River equal to approximately half the lost allocation would occur, also over 5 years.
2031	Implement the Coega IDZ desalination scheme as sufficient capacity would not be available in the Nooitgedagt Low-Level Scheme to implement the Sundays River desalination scheme which would also provide a lower yield **(1 year earlier than for Scenario 6)**.
2034	**Implement the Sundays River irrigation return flow desalination scheme.**

Note: Changes from Scenario 6 shown in bold.

The representation of Scenario 7 shown in **Figure 6.9** should be compared with that shown in **Figure 6.1** for Scenario 1, whereas that shown in **Figure 6.10** should be compared with that in **Figure 6.3**.

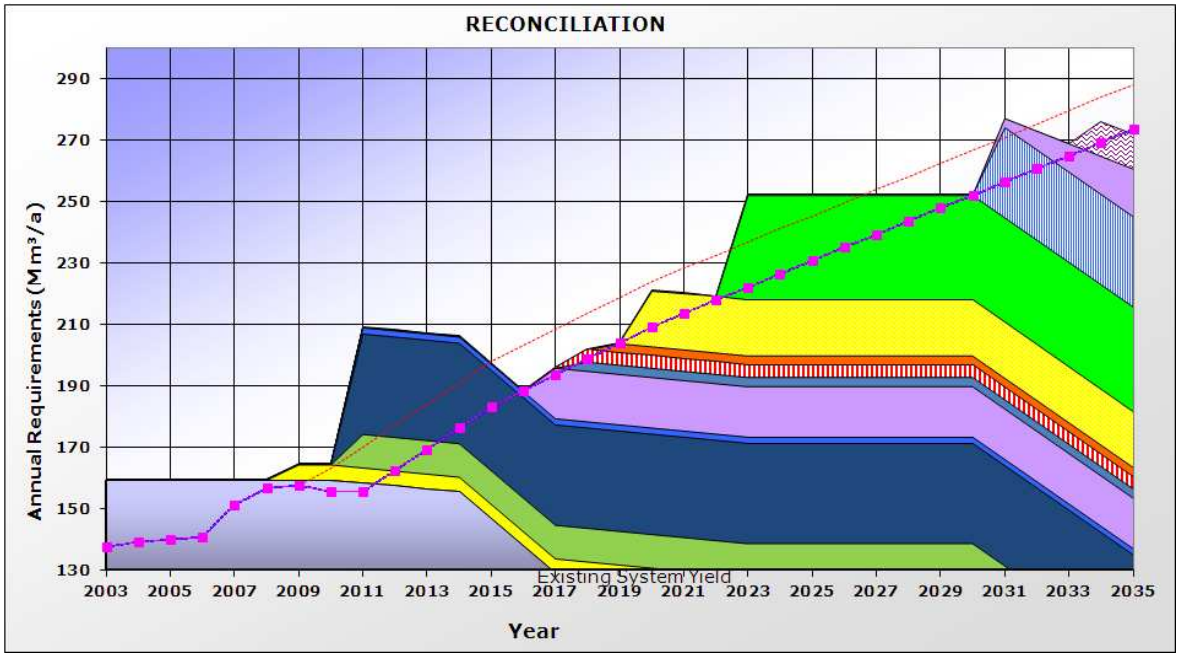

Figure 6.10 AWSS Potable and Non-Potable Water Balance Scenario 7 (to be compared with the Scenario representation shown in Figure 6.3)

6.3.10 Water Balance Scenario 8 for Total Low-Growth Water Requirement

NMBM's Emergency Interventions with a permanent allocation from the Orange River, as well as Non-Potable Water re-use Schemes at the Coega and Fishwater Flats WWTW to supply NMBM until well beyond 2035

Water Balance Scenario 8 shown in **Figure 6.11** and described in **Table 6.8** should be compared with Water Balance Scenario 1 shown in **Figure 6.1** and described in **Table 6.1**. **Figure 6.11** shows that for the Total Low-Growth Water Requirement Scenario the Emergency Interventions to be implemented by NMBM would meet the combined potable and Coega IDZ industrial water requirements until well beyond 2035. Therefore it would only be necessary to implement the re-use scheme from the Coega WWTW after 2035 and the Fishwater Flats Re-use scheme some years later.

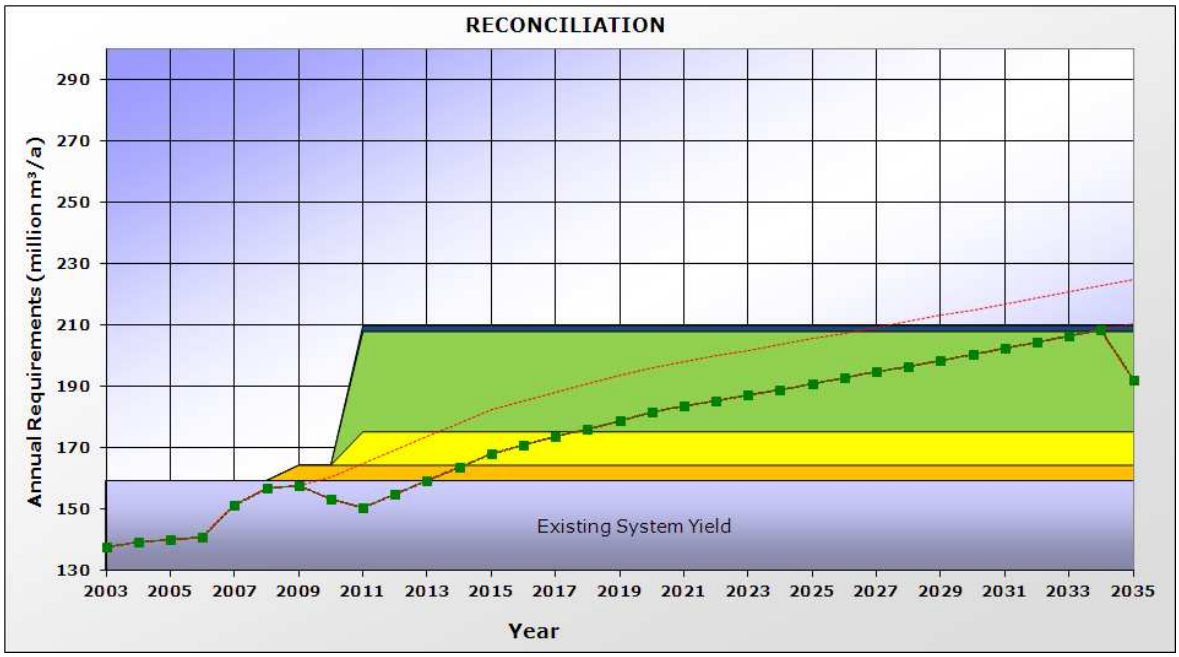

Figure 6.11 AWSS Potable and Non-Potable Water Balance Scenario 8 (to be compared with the scenario representation shown in Figure 6.1)

Table 6.8 Sequence of Intervention Implementation for Water Balance Scenario 8

Year	Description of Intervention
2009	Maximise the yield of the Kouga/Loerie Scheme through improved operational measures – this has already been implemented on account of its low URV.
2010-2012	Implement as emergency measures double the WC/WDM measures identified by NMBM's strategy – selected for their low URV and opportunity for immediate implementation.
2011	Implement NMBM's emergency schemes comprising the fast-tracked Nooitgedagt Low-Level Scheme, assuming that this will be supplied by a permanent allocation from the Orange River, the Swartkops seawater desalination scheme and the Bushy Park groundwater abstraction scheme – selected because these schemes could be fast tracked and offer diversity of supply.
2035	Implement the Coega WWTW industrial water re-use scheme to supply some of the non-potable water requirements of the Coega IDZ industries. Until then the Coega IDZ's industrial requirements would be supplied from the excess potable water supply capacity that would be available.
>> 2035	Implement the Fishwater Flats WWTW industrial water re-use scheme to supply most of the balance of the Coega IDZ's non-potable industrial water requirements.

Note: Changes from Scenario 1 shown in bold.

The representation of Scenario 8 shown in **Figure 6.11** should be compared with that shown in **Figure 6.1** for Scenario 1, whereas **Figure 6.12** should be compared with that in **Figure 6.3**.

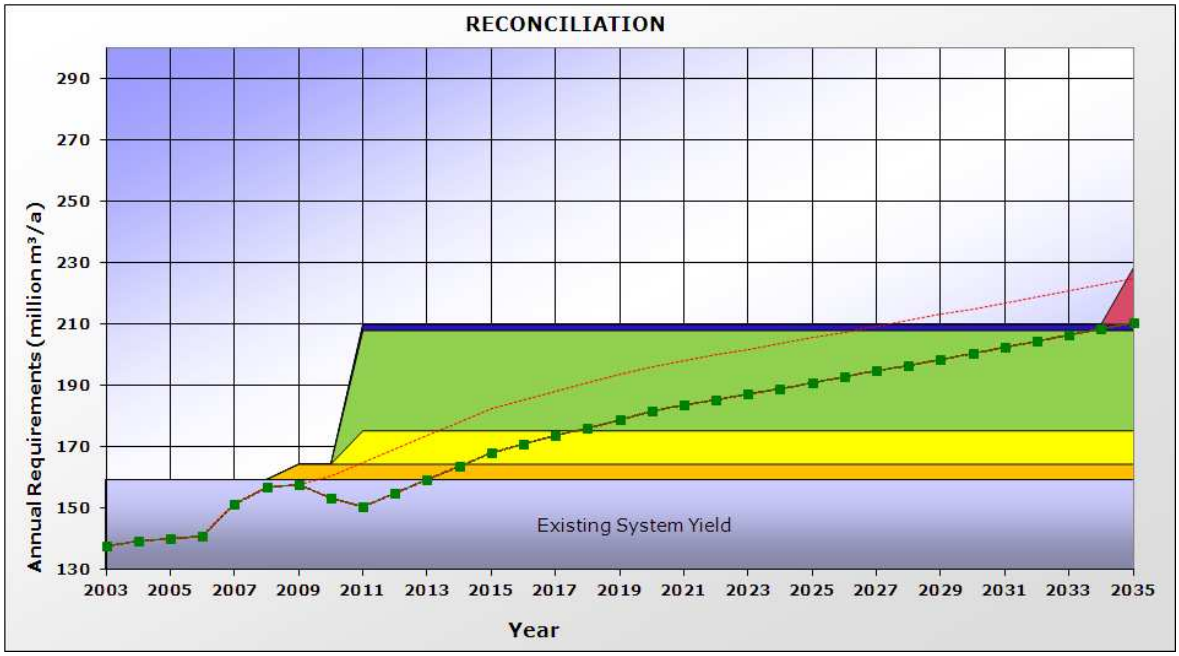

Figure 6.12 AWSS Potable and Non-Potable Water Balance Scenario 8 (to be compared with the scenario representation shown in Figure 6.3)

6.4 EVALUATION OF SCENARIO FINDINGS

Preliminary scenarios were prepared in 2009 and a new set of scenarios was prepared early in 2010 based on information assembled prior to NMBM's planned implementation of emergency measures. As the early implementation of NMBM's emergency measures would have significant implications for the selection of scenarios, it was deemed necessary to prepare a new set of scenarios taking the emergency measures into account. The emergency measures include the interventions identified by this Reconciliation Strategy Study as mentioned below.

Evaluation of the eight Scenarios which have been developed taking NMBM's emergency measures into account and their resultant water balances, leads to the following conclusions:

- An adequate range of potential interventions is available to meet the growing water requirements of the AWSS up to 2035. However surface and groundwater resources are limited and increasing reliance will need to be placed on water re-use and seawater desalination as identified by the Study, the latter being one of the emergency measures to be implemented, and water re-use being a requirement for the establishment of the Coega IDZ as discussed below.

- WC/WDM implementation is essential and therefore its implementation in the emergency has been afforded the highest priority by NMBM. The drought and the declaration of an emergency have enabled NMBM to intensify their leak detection and repair and plumbing repair programs. Increased sliding-scale tariffs have been introduced, usage patterns are being closely monitored and excessive use is brought to the attention of high users.

- Maximising the yield of the existing Kouga/Loerie Scheme yield through improved operational measures is a very cost-effective and rapidly implementable measure. This scheme was identified by the Preliminary Strategy and has already been successfully implemented by DWA, NMBM and the GIB.

- Three significant interventions for potable water use that could be rapidly implemented were identified by the Strategy as potential emergency measures for the following reasons:
  - The design of the Nooitgedagt Low-Level Scheme was advanced, the EIA was virtually complete and application had been made for a water use licence for additional Orange River water.
  - Fast-tracking of groundwater abstraction schemes close to existing infrastructure was feasible.
  - The Swartkops desalination scheme was fast tracked by selecting a site closer to town than that identified by the Strategy Study, where the environmental impacts would be very limited and where the additional supply could be easily integrated into the existing supply system in a similar way to that suggested by the Strategy Study. This supply has the advantage that it is not affected by drought and it would also augment the supply to the western area thus reducing requirements from the dams which have been severely drawn down during the drought.

- Orange River water will continue to be a major source of supply for the AWSS, albeit through additional allocation, water trading or the desalination of irrigation return flows in the Sundays River as also discussed below.

- The DEDEA has set the re-use of water as a prerequisite for water supply to the Coega IDZ. The timing of the development of a water re-use scheme would however be influenced by the

uncertainty that still prevails regarding the likely industrial developments in the Coega IDZ, and the timing thereof.

- Surplus potable supplies are expected to be available to meet the industrial non-potable water requirements of the Coega IDZ up to about 2018.

- Re-use of water from the Coega WWTW for non-potable supply to the Coega IDZ should be phased in when the surplus capacities of the emergency measures implemented is no longer available or as soon as an adequate quantity of effluent is available, as may be necessary. The volume of treated waste water available for use from the Coega WWTW will depend on the volume of sewage diverted from Motherwell and will increase over time as more industries are established within the Coega IDZ.

- Water re-use for non-potable supply to the Coega IDZ will also be required from Fishwater Flats WWTW. This source of non-potable supply should preferably be phased in later on account of the length of the pipeline required but earlier implementation may be necessary if the growth in the availability of treated effluent for industrial use from the Coega WWTW is slower than anticipated.

- Re-use of water for potable supply should be considered in the longer term but availability will depend on the utilization of treated effluent for non-potable industrial use. The cost will be relatively high on account of the need to store water in an impoundment as a safety buffer.

- The desalination of irrigation return flows in the Lower Sundays River is dependent on the availability of spare capacity in the Nooitgedagt Low-Level Scheme which in turn will depend on whether the Orange River allocation to NMBM is permanent or temporary and, if temporary, whether this can be replaced with purchased irrigation allocations.

- The investigations currently being undertaken to fast track groundwater abstraction as an emergency measure will provide increased confidence in this potentially important source of supply although the yields are relatively low compared with other sources.

- Additional desalination of seawater remains a longer term option for the NMBM and other Water Service Authorities in the AWSS area. This option, although currently expensive, can be implemented relatively rapidly as for the Emergency Scheme and is comparable in cost to that of a new dam at Guernakop on the Kouga River or the raising of Kouga Dam.

- The raising of Kouga Dam by constructing a new dam wall immediately downstream of the existing dam would have a lower environmental impact than a new dam at Guernakop and would be easier to operate. The cost of this scheme would be similar to that of a desalination scheme and should be considered as an option in the longer term. This scheme would also make use of the spare treatment and pipeline capacity at Loerie WTW.

- The future implementation of the ecological Reserve on the existing dams of the AWSS and the potential impacts of climate change require that additional reconciliation interventions are studied in order to offset any potential decrease in the yield of the existing system.

- Abstraction of water from the lower Gamtoos River to Loerie WTW does not appear to be a viable intervention on account of the impact that the abstraction of the limited flows in the lower Gamtoos River would have on the ecological functioning of the Gamtoos estuary, which is considered by environmental scientists to be a very important estuary.

- The Tsitsikamma River diversion and larger surface water diversion schemes on rivers to the east of the Tsitsikamma River do not appear to be viable alternatives for augmentation of the AWSS, due to the large distance to the AWSS and the limited yield available. The available yield should rather be used locally.

- NMBM's existing emergency infrastructure would enable 9 million m^3 of the dead storage in Impofu Dam to be utilised at a delivery rate of 18 million m^3/a and therefore this supply would only be utilised as an extreme emergency measure to supply basic human needs. The total of the dead storages in the other reservoirs is less than 1 million m^3.

7. RECOMMENDED INTERVENTIONS

The periods required for the implementation of new water supplies, the potential available yields, and the extent of the additional infrastructure that would be required make it impractical to implement only a single solution. A suite of interventions is therefore recommended to ensure that the growing water requirements of the AWSS can be met in the long term.

On recommendation of the Preliminary Reconciliation Strategy the following intervention was implemented in 2009:

- **Maximise the yield of the existing Kouga/Loerie scheme** by changing the operation of the relevant bulk infrastructure.

The Reconciliation Strategy recommends the urgent implementation of the following Emergency Interventions:

- **Urban WC/WDM,** comprising a range of measures;
- **Nooitgedagt Low-Level Scheme**, using the Orange River water temporarily allocated to NMBM;
- **The development of groundwater sources** and particularly those close to and easily integrated into the existing infrastructure, and
- **Desalination at the Swartkops estuary** should it become necessary to rapidly implement this scheme as an emergency source of supply that would not be affected by drought.

The Reconciliation Strategy recommends that further studies dealing with both demand-side water management measures and supply-side water resource developments, be undertaken and **as a priority**:

- **Re-use of water from the Fishwater Flats and the Coega Wastewater Treatment Plants to supply the Coega IDZ.**

The Reconciliation Strategy Action Plan also recommends that studies of the following interventions or combinations thereof should be initiated or that policies with regard to these should be developed:

- Rainwater harvesting
- Removal of invasive alien plants
- Re-use of water to non-potable and to potable standards
- Water trading to replace the allocation of Orange River water that may be phased out
- Desalination of lower Sundays River irrigation return flows
- Seawater desalination: the Coega IDZ desalination supply option
- Desalination of seawater by NMBM
- Groundwater well-field development
- Guernakop Dam on the Kouga River and
- Kouga Dam on the Kouga River – replacement and raising.

Detailed descriptions of all the interventions are provided in **Annexure A** and the Action Plan for implementation or further study are described in subsequent sections including those that form part of NMBM's suite of Emergency Interventions, and are currently being addressed, but had not yet been addressed in the 2009 Preliminary Reconciliation Strategy.

8. INSTITUTIONAL ARRANGEMENTS

8.1 INTRODUCTION

Any strategy is as good as its practical implementation. Alignment of the key role-players and continuous monitoring are required to ensure performance and compliance in meeting the objective of the strategy, to reconcile future water supply and requirements. The strategy could only be kept alive by a decision-support framework which would enable timely decisions to be made on water resource interventions. A technical support team would need to monitor water requirements, and the implementation programs for all measures, as well as their effectiveness. This team would also make recommendations on measures to be investigated or implemented as well as the programs for implementation.

The planning scenarios in the strategy rely on certain assumptions and generalisations. In reality, there are often deviations from the adopted planning scenarios. These deviations are often temporary in nature, (i.e. due to weather patterns or major sporting events) and thereafter water use and availability would again follow the long-term predicted trajectories. A deviation can also be a longer-term change such as a change in water-user behaviour, adaptation to climate change, the introduction of cheaper new technologies, new knowledge or increased confidence in certain types of technologies.

In order to maintain the strategy, keep it relevant and adapt it in response to changing external factors, regular revision and adequate financing will be necessary. A number of institutions are involved in the planning and operation of the system. These institutions should take part in the strategy revisiting process, should be consulted and should take the responsibility to steer the strategy implementation in the right direction. The establishment of appropriate implementation committees would facilitate this.

The co-operation of all the institutions responsible for the entire water supply chain is essential to achieve the intended objectives. The creation of an environment where partnerships can be formed to tackle specific recommended actions should be encouraged.

8.2 STRATEGY STEERING COMMITTEE (SSC)

It is recommended that an Algoa Strategy Steering Committee is established towards the end of the Reconciliation Strategy Study. Organisations to be represented on the Strategy Steering Committee would need to be identified and would be invited to nominate representatives on the Strategy Steering Committee.

The Strategy Steering Committee would have as its main functions and objectives:

a. To ensure that the strategy remains relevant and is regularly updated,
b. To monitor and co-ordinate the implementation of the relevant actions identified in the strategy, and
c. To make recommendations on long-term planning activities required to ensure reconciliation of requirements and supply in the AWSS area (e.g. recommending a feasibility study for a particular intervention to ensure its timely implementation).

Meetings should be held on a six-monthly basis.

8.3 ADMINISTRATIVE AND TECHNICAL SUPPORT GROUP (ATSG)

Representation on the Administrative and Technical Support Group (ATSG) should be confirmed at the first SSC Meeting. The ATSG will be responsible for general administrative and technical support and will arrange Strategy Steering Committee meetings. They would be responsible for updating the planning scenario. These updates should include all new information relating to revised yields, water requirements

and the benefits of WC/WDM interventions implemented by NMBM. They would further assist with the drafting of press releases and newsletters and any technical tasks required by the SSC.

8.4 SUGGESTED FUNCTIONS OF THE STRATEGY STEERING COMMITTEE AND ATSG

Suggested functions of the Strategy Steering Committee and ATSG are listed in **Table 8.1** and **Table 8.2** respectively:

Table 8.1 Suggested functions of the Strategy Steering Committee

Strategy Steering Committee activities
a. Obtain agreement on implications of altering the assurances of supply to different sectors
b. Monitor how closely the relevant WC/WDM targets and objectives are met
c. Monitor the extent of water re-use against targets
d. Be informed or request updates on changes in system yield
e. Provide updates on the strategy as required
f. Draft and distribute briefing notes on proposed interventions to MEC's offices
g. Liaise with departments involved in developing provincial strategies and provide agreed input
h. Provide annual updates to all local authorities on the strategy
i. Brief relevant municipalities on imminent decisions
j. Inform politicians of press releases prior to release
k. Provide and update information for NMBM and DWA websites
l. Liaise with the relevant NMBM Committees as appropriate
m. Make recommendations on activities required to ensure long-term reconciliation of requirements and supply
n. Review and revise the Reconciliation Strategy and ensure monitoring and co-ordination of implementation.

Table 8.2 Suggested functions of the ATSG

Administrative and Technical Support Group activities
1) Obtain agreement on implications of altering assurance of supply to different sectors
2) Communicate climate change research priorities to WRC and other research institutions
3) Understand how water allocated to the agricultural sector is used and how the corresponding assurances of supply are implemented
4) Review and update requirement scenarios based on findings of further studies (including climate change)
5) Update water requirement scenarios
6) Develop a more sophisticated water use and requirements tool if adequate levels of detailed data become available
7) Define and update monitoring indicators and thresholds of acceptable change to prompt review of projections
8) Compare recently recorded requirements with scenarios to guide the choice of scenarios for planning
9) Decide on comparison scenario/s to be used for planning of future interventions: low, chosen and high
10) Investigate the flexibility of the system in terms of changes in usage patterns and the ability to restrict water use
11) Interpret and clarify the way the system is operated in terms of assurance of supply for long-term planning
12) Ensure that the way in which the requirements and availability are compared is user friendly and easy to understand
13) Participate in the development of relevant Catchment Management Strategies
14) Participate in classification processes that may impact on the AWSS
15) Promote and provide input into the prioritisation of invasive alien plants clearing programmes
16) Participate in the planning for phasing in of the ecological Reserves for existing infrastructure
17) Compile appropriate press releases
18) Ensure that relevant contact details are provided on all information that is disseminated
19) Set up and keep updated a list of media contacts
20) Ensure the utilisation of an efficient system to distribute information
21) Set up a system for efficient distribution of common information
22) Brief relevant municipalities on imminent decisions
23) Provide annual updates to all local authorities on the strategy

Administrative and Technical Support Group activities
24) Liaise with departments involved in developing provincial strategies and provide agreed strategy steering committee input
25) Draft and distribute briefing notes on proposed interventions to MEC's offices
26) Nominate representative to sit on the steering committee of the classification studies
27) Provide updates of the strategy as required
28) Provide and update information for NMBM and DWA websites
29) Advise on the development of monitoring and information regulations under the NWA
30) Support the information management actions identified to support the reconciliation strategy for the AWSS
31) Facilitate the identification and gathering of data and information from other government agencies and sectors which influence the AWSS.

It is proposed that the institutions/agencies to be represented on the Strategy Steering Committee are as shown in **Table 8.3**.

Table 8.3 Proposed institutions/agencies to be represented on the Strategy Steering Committee

Eastern Cape Provincial Government: • Department of Agriculture: 1 representative • Department of Local Government and Traditional Affairs: 1 representative • Nature Conservation: 1 representative • Department of Economic Development and Environmental Affairs: 2 representatives ➢ Planning branch ➢ Environmental branch • Department of Eastern Cape Housing: 1 representative
Local Authorities: • NMBM: 3 representatives ➢ Bulk water, ➢ Wastewater, and ➢ Water demand management • Cacadu District Municipality: 1 representative • Kouga Local Municipality: 1 representative
Department of Water Affairs: • Eastern Cape Regional Office: 3 representatives ➢ Institutional support, ➢ Regulatory support, and ➢ Water sector support • Integrated Water Resource Planning: 4 representatives ➢ National Water Resource Planning, ➢ Options Analysis, ➢ Water Resource Planning Systems, and ➢ Water Use Efficiency • Water Resource Infrastructure Branch: 1 representative
Catchment Management Agencies • Fish to Tsitsikamma CMA : 1 representative
Water User Associations / Irrigation Boards • Gamtoos Irrigation Board: 1 representative • Lower Sundays WUA: 1 representative
Business

- Port Elizabeth Regional Chamber of Commerce and Industry (PERCCI)

The institutions/agencies that are proposed to be represented on the ATSG are as follows:

Table 8.4 Proposed institutions/agencies to be represented on the ATSG

Eastern Cape Provincial Government:

- Department of Agriculture: 1 representative

Local Authorities:

- NMBM: 3 representatives
  - Bulk water,
  - Wastewater, and
  - Water demand management

Department of Water Affairs:

- Eastern Cape Regional Office: 3 representatives
  - Institutional support,
  - Regulatory support, and
  - Water sector support
- Integrated Water Resource Planning: 4 representatives
  - National Water Resource Planning,
  - Options Analysis, and
  - Water Resource Planning Systems
  - Water Use Efficiency
- Water Resource Infrastructure Branch: 1 representatives

Water User Associations / Irrigation Boards

- Gamtoos Irrigation Board: 1 representative

9. PUBLIC PROCESS

The primary intention of the public process followed throughout the Study was to create awareness of the project at a broad-based level throughout the AWSS and potentially affected areas. Specific aims of the public process were as follows:

- Establish a database of stakeholders with potential interest in the Strategy, and regularly update the database;
- Establish a mechanism for receiving comments, respond to these and enable any interested and affected party to contact the project team;
- Create awareness in the printed media, radio and television for the scheduled public meetings;
- Distribute newsletters and other documentation to key stakeholders; and
- Identify potential problems, disputes, or other negative elements emerging from the public process and escalate these timeously to decision makers, with recommendations on how to address these.

The public participation process continued throughout the study. The study team compiled a public database for the study from existing databases, and from input from DWA, NMBM staff and key stakeholders. Distribution of the newsletters and the response sheets resulted in inputs and amendments to the database.

The first public meeting was held on 26 August 2008 in Port Elizabeth, to present the objectives and scope of work of the study to stakeholders, and to invite comments. Advertisements were placed in newspapers to ensure raised public awareness about the public meeting. The study's Newsletter 1 was issued to stakeholders by post and e-mail before the public meeting (the Public Participation Report is included in **Annexure B**).

Following approval of the Preliminary Strategy by the Study Steering Committee, the study's Newsletter 2 was issued to stakeholders by post and e-mail. A second public meeting was held on 18 March 2009 in Port Elizabeth to present the Preliminary Strategy, and to provide an opportunity for the public to comment, and to provide feedback. Advertisements were placed in the Herald newspaper and announcements were made on the Algoa FM and Umhlobo Wenene radio stations to ensure raised public awareness about the public meeting.

A third public meeting was held on 29 April 2010 and Newsletter 3, containing the study recommendations, was issued to stakeholders by post.

The study team conducted several separate briefing sessions, with *inter-alia* the Portfolio Councillor for Water Infrastructure and the Executive Director for Infrastructure and Engineering, in preparation for the public meetings.

The public participation at the public meetings was regarded as a success in that all participants were generally satisfied with the level of information given by the study team. The public participants demonstrated a high level of understanding, which is reflected in the topical nature of the questions posed. This is generally regarded as a good indication of the degree of comprehension by participants in any public participation process. A further indication of successful communication and awareness creation was the open and transparent responses provided to all questions posed to the panel. This created a sense of trust between the participants in the study team, as there was no attempt made to mislead or misdirect questions. The existing owners of the AWSS, namely DWA and the NMBM also showed a good working relationship during the formulation of the Strategy.

10. STRATEGY ACTION PLAN

The Strategy Action Plan identifies the actions to be taken, the responsible authorities and the timing.

10.1 IMPLEMENTATION OF THE RECONCILIATION STRATEGY

a. **Action:** An AWSS Strategy Steering Committee should be formed in order to make recommendations, on an annual basis, on long term planning activities required to ensure reconciliation of requirement and available supply in the AWSS area.
Responsibility: DWA:NWRP and NMBM
Timing: Upon approval of the Strategy

b. **Action:** The AWSS Strategy Steering Committee must ensure that the following monitoring is undertaken in order to be able to ensure the reconciliation of supply and requirement over the longer term:
i. The success of the WC/WDM interventions implemented. This is of particular importance as the volume and implementation date of anticipated water-saving interventions have a significant impact on future supply intervention study start and scheme implementation dates.
ii. Actual water use (agricultural and urban)
iii. Population growth and economic growth rate figures in order to be able to develop a better understanding of future water requirements
iv. Hydrological and geo-hydrological monitoring
v. Water quality monitoring
vi. Reconciliation of requirement and available supply in the AWSS area.
Responsibility: AWSS Strategy Steering Committee
Timing: Upon approval of the Strategy

c. **Action:** An Administrative and Technical Support Group should be established to give support to the Strategy Steering, and implement the decisions of the Strategy Steering Committee.
Responsibility: DWA:NWRP and NMBM
Timing: Upon approval of the Strategy

d. **Action:** The Scenario Planning process should be updated on a regular basis to cater for:
i. Revised future water requirement projections.
ii. Updated information on the implementation of the ecological Reserve and the potential for climate change impacts.
iii. Updated information from recently completed studies (reconnaissance level, pre-feasibility level and feasibility level) for WC/WDM and supply-side interventions to feed into the scenario planning process.
iv. Any other changes to the input data.
v. Revision of the NMBM WC/WDM strategy.
Responsibility: Administrative and Technical Support Group
Timing: Upon approval of the Strategy

e. **Action:** The public process for the Reconciliation Strategy Study was completed with the final public meeting held on 20 March 2010 and the issue of Newsletter 3 in April 2010. The Strategy Steering Committee should continue the public

process after the study is completed and should distribute at least one newsletter or news release per year to stakeholders.

Responsibility: DWA and NMBM

Timing: 2011 and annually thereafter

10.2 URBAN WATER CONSERVATION AND WATER DEMAND MANAGEMENT

a. **Action**: NMBM to implement its WC/WDM Action Plan. This is currently being implemented as part of the Emergency Interventions with the assistance of professional service providers. Ensure that all actions are continued when the drought is over.

Responsibility: NMBM

Timing: WC/WDM Programme: On-going

b. **Action:** Identify WC/WDM interventions that will limit UAW of the AWSS to less than 15% of total water use. The savings that can be achieved through the various actions of NMBM's WC/WDM Strategy should be quantified. Prioritise the interventions in the WC/WDM Action Plan to obtain the maximum benefit and provide appropriate annual budgets to effectively execute interventions.

Responsibility: NMBM

Timing: 2010 and annually thereafter

c. **Action**: Assessment of institutional aspects relating to WC/WDM should be completed, as well as the evaluation of water use data.

Responsibility: NMBM

Timing: Upon approval of the Strategy
Evaluation of water use data: Over the next three years

d. **Action**: Appoint appropriate staff/professional service providers to expedite implementation of NMBM's existing WC/WDM Action Plan. The State should dedicate additional resources to assist NMBM, their existing consultants and their contractors to expedite those components of the WC/WDM Action Plan that will provide the most significant savings in as short a time frame as possible, under the Emergency Drought Action Plan and thereafter.

Responsibility: NMBM and DWA

Timing: 2010 and ongoing

e. **Action**: Arrange for aerial infrared surveys of bulk supply pipelines to identify leaks and repair identified leaks.

Responsibility: NMBM

Timing: Biannually

f. **Action:** Complete the bulk meter installation program and utilise meter data to identify excessive night flows in distribution reticulation, trace and repair leaks.

Responsibility: NMBM

Timing: 2010 and on-going

g. **Action:** Actively pursue the implementation of WC/WDM initiatives in other local authorities served by NMBM and the Algoa Water Supply System: Kouga Municipality (Jeffreys Bay, Cape St Francis, Humansdorp, Hankey and Patensie).

Responsibility: DWA:ECRO: Water Use Efficiency

Timing: On-going during the Emergency and thereafter

h. **Action**: Address the significant water wastage in schools (wastage and inadequate water and sanitation facilities) as the Implementing Agent of the Department of Education, to identify and rehabilitate leaks. This should include the team members to be employed and the budget required, and should be submitted to the DWA Eastern Cape Regional Office, to together agree on the best way to solve the problems.

i. Obtain the sample survey and plans locating the schools;
ii. Review the sample survey and determine the nature of problems and record of use for all affected schools;
iii. Place an implementation team on sites to document details for each school to enable preparation of works document for affected schools;
iv. Discuss accelerated procurement procedures for contractors; and
v. Procure contractors and monitor repairs plus include flow limiters.

Responsibility: NMBM
Timing: On-going

i. **Action:** Address the Private Homes Program and communal standpipes which target high-use private users and would also have the aim of enhancing public awareness and would include:

i. Identify problematic use from NMBM records;
ii. Arrange forward meetings for affected households via Ward Councillors;
iii. At these meetings establish reasons for wastage;
iv. Report findings for each ward for directive; and
v. Act on directives given.

Responsibility: NMBM
Timing: On-going

j. **Action**: Address the leakage repair of plumbing at government buildings. This would enhance public awareness and set an example by government.
Responsibility: NMBM
Timing: On-going

k. **Action**: Address the leakage repair in low-income housing.
Responsibility: NMBM
Timing: On-going

l. **Action:** Develop a rainwater harvesting policy and promote the use of rainwater tanks, especially for new developments, to stimulate change in people's water-use habits.
Responsibility: NMBM assisted by DWA:ECRO: Water Use Efficiency
Timing: On-going

m. **Action**: Prepare a draft policy in support of WC/WDM bylaws, which should *inter-alia* address penalties for excessive water use, promotion of rain water tanks for especially new houses and buildings and the use of private boreholes etc.
Responsibility: NMBM
Timing: Completed

n. **Action**: Review the existing tariff structure, especially the tariff for excessive usage and action measures for such excessive use within defined limits of acceptable use.
Responsibility: NMBM
Timing: Completed for 2010 and to be reviewed annually thereafter

o. **Action**: Intensify the public awareness program: target schools awareness, informative billing, pamphlets and brochures on savings (indigenous gardens etc.), local press and radio.
Responsibility: NMBM
Timing: On-going

p. **Action**: Implement a Hot Line for the reporting of leaks and subsequent repair and monitor and improve the reaction time of dedicated repair teams.
Responsibility: NMBM
Timing: On-going

q. **Action**: Compile and implement a strategic plan for the development of dual systems for the NMBM beach front, golf courses, schools, the university and new developments.
Responsibility: NMBM
Timing: Upon approval of the Strategy

r. **Action**: Evaluate the feasibility of the drafting of a new bylaw that requires the submission of water-wise garden plans for all new developments, with the objective of reducing domestic garden watering requirements.
Responsibility: NMBM
Timing: Upon approval of the Strategy

s. **Action**: It is essential that the DWA support the NMBM with the implementation of their WC/WDM Plan.
Responsibility: DWA:ECRO Water Use Efficiency
Timing: Immediate and on-going

10.3 LOCAL SURFACE WATER SCHEME

10.3.1 Increased system operational efficiency: Loerie Dam

a. **Action**: Maximise the yield available from Kouga and Loerie dams by minimising canal losses through improved operation and by reducing the operating level in Loerie to 40% of full supply capacity.
Responsibility: GIB (Gamtoos Canal operation), DWA, and NMBM
Timing: 2010 and on-going

b. **Action:** Once the procedures to maximise abstraction from Loerie Dam have been confirmed, the NMBM must apply for a formal water use licence from the DWA, for the additional water to be abstracted.
Responsibility: NMBM, DWA and GIB
Timing: 2011

10.3.2 Water Allocation Assessment Study

a. **Action:** Reassess the hydrology and yields of the Kouga/Loerie and Churchill/Impofu systems through a water availability assessment study (WAAS), including irrigation and urban supplies for their respective assurances.
Responsibility: DWA
Timing: 2011 – following approval of the strategy

b. **Action**: Utilise reassessed hydrology of the Kouga/Loerie and Impofu/Churchill systems to determine whether earlier implementation of additional interventions is required.
Responsibility: DWA:System Operation and DWA:NWRP
Timing: 2014

10.3.3 New surface water schemes on the Kouga River

Action: Initiate a pre-feasibility study which considers both the building of Guernakop Dam and the raising of Kouga Dam on the Kouga River.
Responsibility: DWA, D: NWRP
Timing: Once reliable updated hydrology of the Kouga River from the WAAS study is available.

10.3.4 Implementing the Reserve for existing AWSS dams

Action: Develop a strategy for the implementation of the ecological Reserve for existing dams of the AWSS, because if the Reserve is implemented, there will be a significant reduction in available yield from dams, impacting on all users, and additional interventions will need to be developed to meet the Reserve requirements.
Responsibility: DWA:NWRP and RDM
Timing: 2011 - 2012

10.3.5 Climate change

Action: Initiate an impact assessment study to more accurately determine the expected regional impact of climate change on the AWSS water balance and update the relevant water balance scenarios and recommendations accordingly.
Responsibility: DWA:Climate Change
Timing: 2011 - 2012

10.3.6 Removal of invasive alien plants

Action: Actively support the clearing of invasive alien vegetation in the catchments upstream of existing and potential future dams, because:

i. If alien vegetation is not removed the impact on water availability increases with time;
ii. It is much more costly to remove mature trees so it is important to contain alien vegetation and not allow it to spread further.

Responsibility: NMBM, DWA:NWRP and DWA:Working-for-Water
Timing: On-going

10.4 GROUNDWATER DEVELOPMENT

10.4.1 Wellfield Development

Action: Initiate a study at pre-feasibility level, to evaluate at least the following groundwater augmentation options:

i. Jeffreys Arch Hydrogeological Domain
ii. Van Staden's River Mouth Arch
iii. Bushy Park
iv. Uitenhage Aquifer
v. South-Eastern Coega Fault

Responsibility: NMBM
Timing: 2010 for emergency scheme and 2012

10.4.2 Wellfield Monitoring

Action: Cap unused artesian boreholes and establish a network of boreholes to monitor groundwater levels in the various aquifers and monitor abstractions.
Responsibility: NMBM and DWA:ECRO
Timing: 2011

10.5 ORANGE RIVER WATER

10.5.1 Nooitgedagt Low-Level Scheme

a. **Action:** The NMBM have expedited the implementation of the Nooitgedagt Low-Level Scheme by accelerating design and construction and by providing budget for early implementation.
Responsibility: NMBM
Timing: On-going

b. **Action:** NMBM have objected to the terms of the temporary licence issued by DWA for additional abstractions from the Orange River on account of the potential impact that the withdrawal of the licence after 20 years would have on the infrastructure provided for this allocation. The terms of the licence should be reconsidered taking into account that the infrastructure has a design life of 50 to 100 years and therefore it is essential that the lost allocation from the Orange can be replaced in the same vicinity at reasonable cost. The following should be confirmed as soon as possible:

i. Whether the temporary allocation can be made permanent.
ii. Whether measures should be taken to increase the storage capacity of the Scheepersvlakte Balancing Dam in order to bridge periods when the canal is taken out of service for maintenance purposes.
iii. What irrigation allocations could be purchased and the cost and reliability thereof.
iv. Whether re-use of irrigation return flows from the Lower Sundays River would be cost effective and environmentally acceptable.

Responsibility: DWA and NMBM
Timing: As soon as possible

c. **Action:** Evaluate the potential phasing of the use of Orange River water by NMBM, considering the Nooitgedagt Low-Level Scheme and phasing out of the

additional allocation, water trading opportunities and the Lower Sundays River desalination scheme. Such a study could potentially evaluate any synergies with the potential Coega IDZ desalination option. *Inter alia* consider:

i. The option of running the ORP/Nooitgedagt Low-Level Scheme in parallel with the Straits Chemicals supply option and water re-use option (to industrial standards), excluding investigation of the seawater intake;
ii. If the Nooitgedagt Low-Level Scheme is to be treated as a temporary scheme, then consider the possibility that the scheme can act as a peaking scheme in the long-term. This would allow a degree of flexibility, especially if planning on implementing the desalination options for Straits Chemicals and/or the lower Sundays River return flows.
iii. The possibility of conjunctive use of desalinated Sundays River water and the regulation of good quality Orange River water. A combined scheme may lead to increased yields in the long-term.
iv. Straits Chemicals in the Coega IDZ or alternatively the nearby salt works may be interested in using the brine if the chemical composition of the brine would be acceptable.

Responsibility: NMBM and DWA:NWRP and System Operation
Timing: Upon approval of the Strategy

10.5.2 Trading of Orange River Irrigation Allocations

a. **Action:** Undertake a study to identify opportunities and prices for trading of Orange River irrigation allocations (in the Fish River) to replace the temporary Orange River allocation to NMBM, taking the phasing out of the temporary allocation into account.
Responsibility: NMBM assisted by the DWA:ECRO
Timing: Upon approval of the Strategy - 2011

b. **Action**: Utilise the gauge established by DWA to monitor quantity and quality of the Sundays River WUA return flows for some years and thereafter undertake a feasibility study of the option to desalinate the return flows and deliver them to NMBM via the Nooitgedagt Scheme Low-Level (also taking the impact on the estuary into account).
Responsibility: DWA (Eastern Cape - monitoring) / NMBM (study)
Timing: 2015

10.6 RE-USE OF WATER

a. **Action**: Establish gauges to monitor flows and quality of WWTW flows for later possible re-use schemes.
Responsibility: DWA (Eastern Cape – gauging) / NMBM (pre-feasibility study)
Timing: 2011

b. **Action:** Develop integrated re-use policies for areas of jurisdiction and also initiate a pre-feasibility study to determine the full future potential for effluent re-use. There should be close collaboration and integration between the WSAs in this regard where appropriate. This should address the potential at the Fishwater Flats WWTW, other smaller NMBM treatment works and the future Coega

WWTW. This would include the conceptual design of various effluent re-use interventions, and a comprehensive EIA.

Responsibility: NMBM and other WSAs in the AWSS

Timing: Upon approval of the Strategy

c. **Action**: Undertake a feasibility study or studies for re-use of treated effluent from the Fishwater Flats and Coega WWTWs for industrial use at the Coega IDZ and also at other industrial areas.

Responsibility: NMBM

Timing: On-going

d. **Action:** Undertake a pre-feasibility study for the re-use of effluent from Fish Water Flats WWTW for potable use (possibly via Echodale Dam or Loerie Dam), so that a better comparative evaluation can be made in the future.

Responsibility: NMBM

Timing: This study should be undertaken together with the Coega IDZ re-use study.

10.7 DESALINATION OF SEAWATER

a. **Action:** No action can be taken immediately regarding the Coega IDZ desalination scheme, as this option is dependent on the construction of the seawater intake for a potential power station and various industries at the Coega IDZ. The date on which Straits Chemicals will begin operations or not needs to be regularly updated. NMBM should liaise with the CDC and with Straits Chemicals to determine the time frame of planning and constructing the seawater intake and the desalination plant respectively.

Responsibility: NMBM

Timing: On-going

b. **Action:** NMBM should liaise with the CDC and with Straits Chemicals to recommend the implementation of a seawater quality monitoring programme.

Responsibility: NMBM

Timing: Upon approval of the Strategy

c. **Action:** Take account of the findings of the study to investigate the contractual arrangements of a potential future contract between Straits Chemicals.

Responsibility: NMBM

Timing: On-going

d. **Action:** Whether the Swartkops Desalination project is constructed as an emergency measure or not NMBM should continue to monitor water quality at the abstraction site on the Swartkops estuary for the proposed desalination plant. This monitoring should be continued for some years together with water quality analyses of grab samples to provide a sound database for planning the pre-treatment requirements for the proposed desalination plant. It may be necessary to extend the monitoring to other potential locations for abstraction.

Responsibility: NMBM and DWA:ECRO

Timing: On-going

e. **Action:** A prefeasibility study of future desalination options should be undertaken to determine whether or when seawater desalination infrastructure might best be integrated into the further development of interventions to supply NMBM.
Responsibility: NMBM
Timing: 2012

11. RECOMMENDATIONS

Based on the findings of the study, the following recommendations are put forward to ensure on-going reconciliation of water supply and requirement within the AWSS:

a. A **Strategy Steering Committee**, supported by an Administrative and Technical Support Group, should be formed as soon as possible in order to make recommendations, on an annual basis, on long-term planning activities required to ensure continued reconciliation of water requirements and available supply in the AWSS area. Particularly important are:
   - The monitoring of supplies and requirements including the annual updating of the likely future requirements.
   - Ensuring that studies of interventions are undertaken in sufficient time to enable the responsible authorities to take the necessary actions to timeously implement the identified interventions to meet the growth in the future water requirements.
   - Annually updating the Strategy.
   - The issuing of an annual newsletter to keep the public informed.

b. The **Water Conservation and Water Demand Management** interventions implemented by the NMBM during the drought emergency should be permanently established, including:
   - Annual review of stepped water tariffs to reflect scarcity of water supplies;
   - Maintaining high profile community/schools information and education campaigns;
   - Bulk meter installation and universal metering;
   - Promoting water use efficiency;
   - Ensuring that water-efficiency measures/devices are implemented/installed for all new consumers;
   - Monthly readings of all zone meters and conducting of monthly water balances to identify zones and sub-zones with leakage problems;
   - Network night flow monitoring, bulk supply and plumbing leak detection and repair programmes as part of an active leakage control system, leak reporting hotline and repair teams;
   - Pressure management;
   - Promotion of rainwater tanks; and
   - Ensuring appropriate monitoring/tracking and reporting of all aspects of WC/WDM.

c. The **local surface water sources** have been most impacted by the recent drought and the following actions and studies are recommended:
   - NMBM, GIB and DWA should continue to optimize the operation of the Kouga/Loerie system to minimize spillage at Loerie Dam.
   - DWA should undertake a Water Availability Assessment Study (WAAS) of the Kouga/Loerie and Churchill/Impofu systems and update the available yields.
   - Thereafter DWA should reinvestigate the Guernakop scheme and the raising of Kouga Dam (which may have to be rebuilt for safety reasons and therefore could be raised for sigtnificantly lower marginal cost than assumed for this study).
   - The potential impacts on yields that would arise from the implementation of the ecological Reserve requirements at all existing schemes and from Climate Change should also be investigated by DWA.

d. Preliminary investigations of groundwater have identified a number of potential wellfields that should be investigated further by NMBM or other local authorities with the assistance of DWA. Other actions identified by the Strategy include the capping of unused artesian boreholes and the monitoring of wellfield abstractions and groundwater levels.

e. An additional allocation of water from the Orange River has been approved by DWA to enable NMBM to fast track the Nooitgedagt Low-Level Scheme as an emergency scheme during the drought. However as this additional allocation may be reconsidered by DWA after 20 years, it is recommended that NMBM and DWA investigate options for replacing this allocation including the purchase of irrigation allocations from the Orange River and the desalination of Sundays River irrigation return flows. It is also recommended that DWA and NMBM investigate whether it is necessary to provide additional storage in the Scheepersvlakte Balancing Dam so as to be able to supply NMBM during periods when the canal is taken out of service for maintenance purposes.

f. A comprehensive study of the **re-use of water** should be undertaken by NMBM and DWA. The study should address the following:
    - The re-use of treated waste water from the Coega and Fishwater Flats for industrial (non-potable) purposes in the Coega IDZ, including the timing of such re-use schemes as it is likely that the initial industrial water requirements of the Coega IDZ can be met from the initial surplus capacity of the potable supply system after the Nooitgedagt Low-Level scheme is commissioned and if the Swartkops Desalination schemes is also commissioned during the drought emergency.
    - The implications of any delays in the implementation of NMBM's Emergency Interventions on the water balance scenarios should be assessed.
    - All options for non-potable water re-use, including supplies to other industrial areas and for irrigation of parks, sports fields etc.
    - Options for direct and indirect potable re-use including the Loerie and Echodale Dam options.
    - The implications of re-use on other schemes such as the impact of reduced effluent available to dilute the brine discharges from the proposed Swartkops Desalination Scheme.

g. The Reconciliation Strategy has indicated that the **desalination of seawater** may be the only source of supply that will be available to meet the growing water requirements of the NMBM in the longer term. NMBM's responsibilities for the options identified by the Reconciliation Strategy should include:
    - The possibe development of the Swartkops Desalination Scheme as a drought emergency measure.
    - Ongoing liaison with the CDC regarding the possible development of a desalination scheme within the Coega IDZ and the likely timing and cost thereof.
    - The monitoring of sea water quality at or close to the potential points of abstraction from the Swartkops Estuary and for the Coega IDZ scheme with the assistance of DWA and the CDC.
    - The feasibility of integrating the potential future desalination schemes into the AWSS.

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