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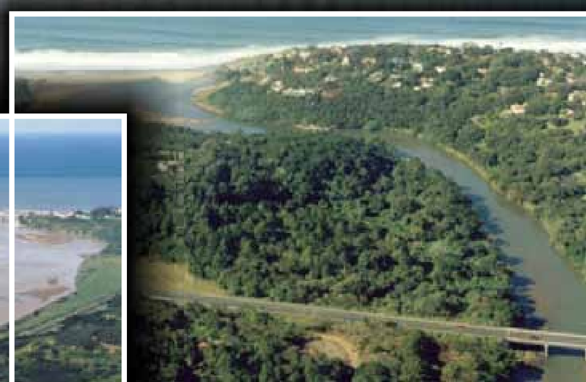
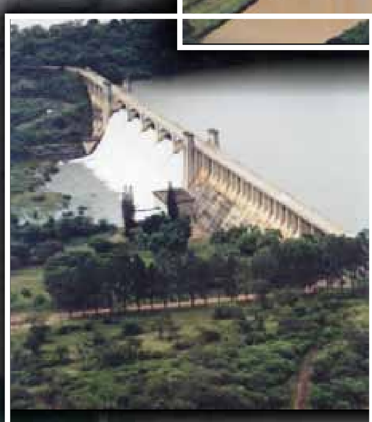
REPUBLIC OF SOUTH AFRICA

DIRECTORATE: NATIONAL WATER RESOURCE PLANNING

Water Reconciliation Strategy Study for the Kwazulu Natal Coastal Metropolitan Areas

First Stage Reconciliation Strategy





JULY 2008

SUBMITTED BY:

DMM

Golder Associates

KV3 KWEZI V3 ENGINEERS

WRP

ZITHOLELE CONSULTING

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WATER RECONCILIATION STRATEGY STUDY FOR THE KWAZULU-NATAL COASTAL METROPOLITAN AREAS

LIST OF REPORTS

Report No:	**Title**
PWMA 11/000/00/0907	Water Quality Review
PWMA 11/000/00/0907	Urban Water Requirements and Return Flows
PWMA 11/000/00/0907	Potential Savings through WC/WDM
PWMA 11/000/00/0907	Infrastructure
PWMA 11/000/00/0907	First Stage Reconciliation Strategy

Above list of reports effective as at July 2008

WATER RECONCILIATION STRATEGY STUDY FOR THE KWAZULU-NATAL COASTAL METROPOLITAN AREAS

FIRST STAGE RECONCILIATION STRATEGY

REFERENCE

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Prepared by:

DMM Development Consultants, Golder Associates Africa, Kwezi V3 Engineers, WRP Consulting Engineers and Zitholele Consulting.

Report No. PWMA 11/000/00/0907

Title: ***First Stage Reconciliation Strategy***

Authors: *PG Van Rooyen*

CE Talanda

HG Marè

Study Name: ***Water Reconciliation Strategy Study for the KwaZulu-Natal Coastal Metropolitan Areas***

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Approved for the Consultants by:

……………………………………………….

PG van Rooyen
Study Leader

DEPARTMENT OF WATER AFFAIRS and FORESTRY

Directorate National Water Resource Planning

Approved for DWAF by:

……………………………………………….

T Nditwani
Deputy Chief Engineer: National Water Resource Planning East
(Study Co-ordinator)

……………………………………………….

NJ van Wyk
Chief Engineer: National Water Resource Planning East
(Project Manager)

……………………………………………….

JA van Rooyen

Director: National Water Resource Planning

EXECUTIVE SUMMARY

Introduction

*The water requirements of the KwaZulu-Natal metropolitan coastal areas in the vicinity of Durban (**Figure 1.1** in the document) are growing rapidly. This is as a result of the current economic growth, improved water supply services, urbanization of the population and associated expansion of residential and other developments being implemented. This trend is expected to continue over the medium term as reflected in planned new urban developments. The area along the coast between the Tongati and the Thukela Rivers, within the iLembe District Municipality (DM,) is experiencing developments of large residential estates and industries which require additional water resources for the North Coast supply area.*

In addition, the development of the Dube Trade Port, which includes the King Shaka Airport and the commercial and residential development that the trade port will attract in the vicinity of La Mercy, will also result in increasing water requirements.

The bulk water system of the KwaZulu-Natal coastal metropolitan area consists of an extensive network of water conveyance and treatment infrastructure (pipelines and aqueducts) transferring water from the main storage reservoirs, Midmar, Albert Falls, Nagle and Inanda Dams in the Mgeni River System and Hazelmere Dam on the Mdloti River to the users. Furthermore, the Mooi-Mgeni Transfer Scheme augments the supply of the upper Mgeni River (Midmar Dam) and in the far north of the study area, KwaDukuza in the iLembe DM, currently receives water from the Mvoti River.

In order to reconcile future water requirements with the available water resources, the Department of Water Affairs and Forestry (DWAF) initiated this reconciliation strategy study as the next step in finding appropriate water supply solutions for the region.

Study Procedure and Methodology

The overarching study approach was to develop reconciliation strategies in two stages. The first stage involved developing and assessing scenarios of possible future reconciliation options. The First Stage Reconciliation Strategy was presented to the Department of Water Affairs and Forestry (DWAF) Management and Stakeholders for comments. Further investigations were identified for assessment during the development of the Second Stage Reconciliation Strategy which is scheduled for completion by March 2009.

An essential part of the strategy development process was the integration of information from various processes and studies in order to arrive at a strategy that account for all major aspects that influence the bulk water supply situation in the study area.

The focus of the assessments for the First Stage Strategy included the following:

- *Develop water requirement and return flow scenarios by focusing on the eThekwini and Msunduzi municipal areas.*
- *Determine the potential for Water Conservation and Demand Management by concentrating on the main urban areas.*
- *Assessment of the irrigation water requirements in the various catchments.*
- *Identify and assess possible infrastructure intervention options including potential large scale water reuse options.*
- *Identified and assessed several reconciliation options based on the water requirement scenarios and the identified augmentation options.*
- *Provide an initial indication of how the implementation of the Ecological Water Requirements (EWR) could influence the projected water balance situation.*

In support of the above described technical work, an integrated stakeholder engagement process was followed.

Water Requirement Scenarios

Irrigation

The irrigation water requirements in the different catchments in the study area were estimated by comparing the data sources form various previous studies to the available information from the Water Allocation registration Management System (WARMS) database. The comparisons were discussed with the water resource managers of the respective regional office in order to establish the most appropriate data. The irrigation requirements for the main catchments as obtained from the six different data sources that were evaluated are summarized in ***Table 4.1*** *in the document.*

Urban Water Requirement Scenarios

The main urban demand centers in the study area are currently supplied from four main river systems, namely the Mgeni, Mdloti, Mvoti and the Thukela River System as illustrated in ***Figure A-3 in Appendix A****. The water requirements for the various demand centers will be presented according to each of the sub-systems.*

Mgeni River System

*Urban water requirement scenarios were developed for the Msunduzi Local Municipality (LM) and eThekwini Metropolitan Municipality (MM) (main water users in the study area) by applying the Water Requirement and Return Flow Model (****DWAF, 2004b****) for the planning period up to 2030. One of the driver variables in the model is population and scenarios were developed from a detailed assessment of the various population databases by Dr. McCarthy as part of the study (****DWAF, 2007d****).*

The Water Requirement and Return Flow Model was configured for 53 Sewage Drainage Areas (SDAs) and calibrated for the year 2006. The calibration involved changing model parameters to match both the water use and return flows observed for each SDA for the year 2006. The Water requirement projections were derived for three scenarios as illustrated in ***Table 1****.*

The total gross water requirement projection for the Mgeni River System was developed by combining the water requirement projections of both the Msunduzi and eThekwini municipal areas with the projections derived by Umgeni Water for the portions of uMgungundlovu DM and Ugu DM that are supplied from the Mgeni River. The water requirement projections for the three scenarios are illustrated in ***Figure 4.8*** *in the document. The Umgeni Water projection for the Mgeni System is also illustrated.*

Table 1: Mgeni River water requirement scenarios

Scenario	***Description***
Scenario A	• *High population projection* • *Improved water supply services* • *Indirect water use increased in identified SDAs according to economic analysis (Hammarsdale, Cato Ridge, Hillcrest, Southern, Umhlanga, Phoenix, Verulam, Tongaat)* • *Indirect water use in remaining SDA's increased by the same ratio as the direct water use requirements*
Scenario B	• *Low population projection* • *Improved water supply services* • *Indirect water use increased in identified SDAs according to economic analysis (Hammarsdale, Cato Ridge, Hillcrest, Southern, Umhlanga, Phoenix, Verulam, Tongaat)* • *Indirect water use in remaining SDA's increased by the same ratio as the direct water use requirements*
Scenario C	• *Medium population projection* • *Improved water supply services* • *Indirect water use increased in identified SDAs according to economic analysis (Hammarsdale, Cato Ridge, Hillcrest, Southern, Umhlanga, Phoenix, Verulam, Tongaat)* • *Indirect water use in remaining SDA's increased by the same ratio as the direct water use requirements*

Mdloti River System

*The majority of the water supplied from the Mdloti River through the Hazelmere Dam is to the northern parts of eThekwini MM and Siza Water (supply Ballito and Dolphin Coast areas). The remainder is supplied to Ndwedwe, Groutville and periodic transfers to KwaDukuza. Existing water requirement projections were adapted from the Water and Sanitation Master Plan for the iLembe District Municipality (**Scenario M-A**) (**DWAF, 2007b**) and from Umgeni Water (**Scenario M-B**). The water requirement projections for the Mdloti System are illustrated in **Figure 4.9** in the document.*

Mvoti River System

*Water is currently supplied from the river abstraction on the Mvoti River to KwaDukuza. Water requirement projections for KwaDukuza and the surrounding towns were obtained from the Water and Sanitation Master Plan for the iLembe District Municipality (**DWAF, 2007b**). The purpose of the* *master plan was to plan bulk supply schemes to all areas in iLembe. The projections were therefore compiled for the total water requirements that would ultimately be required. It was assumed that the total bulk supply scheme would take time to implement and that the current water use of 10.5 million m^3/annum would increase to what was projected by 2012. The water requirement projection is illustrated in* ***Figure 4.10*** in the document.

Lower Thukela River System

*The lower Thukela River System is defined as the river section between Kranskop and the Thukela Mouth in this report. A water requirement projection for the Lower Thukela supply area (**Scenario T-A**) was adopted from the ILembe Master Plan (**DWAF, 2007b**). The projection shown in **Figure 4.11** of the document excludes the existing demands and only includes the projected growth in demands in order to compare the projection to the existing available yield in the Lower Thukela System.*

Potential Savings through Water Conservation and Water Demand Management Measures

*The Msunduzi LM and eThekwini MM where the main focus of the study as they hold the greatest potential for savings. This does not mean that the smaller areas should not undertake WC/WDM, but potential savings in these areas were assumed to be negligible compared with the greater supply area. Three saving scenarios were compiled from the assessment of the potential for water conservation and water demand managements (WC/WDM) in the urban sector. The savings were applied to the water requirements of Scenario A and were labeled **Scenarios A.1**, **A.2** and **A.3** respectively. The description and saving results from the scenarios are as following:*

- ***Scenario A.1**: 5 years water loss programme*
- ***Scenario A.2**: 5 years water loss programme and efficiency.*
- ***Scenario A.3**: 10 years water loss programme*

*A summary of the estimated savings in water requirements of the three above-mentioned scenarios for the Mgeni River System are presented in **Table 2**.*

Table 2: Savings for the indicated planning years: Scenario A.1, A.2and A.3 compared to Scenario A

Scenarios	*Planning Years*					
	2007	***2011***	***2016***	***2021***	***2026***	***2031***
A.1	*5.4 (1.5%)*	*33.8 (8.6%)*	*42.7 (9.9%)*	*44.9 (9.5%)*	*47.2 (9.3%)*	*49.6 (9.1%)*
A.2	*5.4 (1.5%)*	*33.8 (8.6%)*	*61.4 (14.3%)*	*91.9 (19.4%)*	*113.0 (22.2%)*	*121.7 (22.4%)*
A.3	*5.4 (1.5%)*	20.1 *(5.1%)*	39.2 *(9.1%)*	44.9 *(9.5%)*	47.2 *(9.3%)*	49.6 *(9.1%)*

Notes: (1) All volumetric values are given in million m^3/annum.

(2) Values in brackets give the percentage reduction in the total system urban demand from ***Scenario A****.*

Future Intervention Requirements and Augmentation Schemes

Given the water requirement and return flow scenarios and the potential saving scenarios through WC/WDM measures presented in the previous sections, the need for intervention (when further WC/WDM measures and/or the development of an augmentation scheme are required) was determined by assessing the water reconciliation (water balance) situation over the planning period for the Mgeni, Mdloti, Mvoti and Lower Thukela River Systems. This was undertaken by firstly defining the planning scenarios and, secondly, carrying out scheduling analysis to determine the date when further intervention should be required (see description of planning scenarios in a subsequent section).

The following infrastructure intervention options were considered:

- ***Mooi-Mgeni Transfer Scheme Phase 2 (Springrove Dam)****: The scheme consists of the Spring Grove Dam on the Mooi River with a pump station and transfer infrastructure to transfer the water to Midmar Dam on the Mgeni System. The yield of the Spring Grove Dam has been determined as 60 million m^3/annum. The implementation timeframe for the scheme is 4 years.*

- ***Mkomazi-Mgeni Transfer Scheme Phase 1 (Smithfield Dam)****: The scheme consists of an initial dam on the Mkomazi River near Smithfield, with a pump station and transfer tunnel to transfer the water to the Mgeni System. The yield of the Spring Grove Dam has been determined as 147 million m^3/annum. The implementation timeframe for the scheme is 10.5 years.*

- ***Mvoti River development Option (IsiThundu Dam)****: The Mvoti Development Scheme consists of a dam on the Mvoti River near IsiThundu; abstraction works, a pump station, transfer infrastructure. The yield of the IsiThundu Dam has been estimated as 46.3 million m^3/annum. The scheme has an implementation time frame of 10 years.*

- ***Lower Thukela Scheme****: The Lower Thukela Scheme includes the utilisation of the unused yield in the Lower Thukela and consists of abstraction works, pump station and transfer infrastructure. The maximum available yield in the Lower Thukela was estimated as 77 million m^3/annum. The yield included the available yield in the Lower Thukela of 45 million m^3/annum and the unused allocation of Mhlathuze Water of 32 million m^3/annum. The scheme has an implementation plan of 5 years.*

- ***Waste Water Reuse Options****: The option includes the indirect re-use of the treated effluent from the Kwamashu (location allows supply to both the Mgeni supply area and the north coast metropolitan area), Northern and the North Coast waste water treatment plants (Tongaat, Verulam and Phoenix). The implementation timeframe is 5 years.*

Both the infrastructure and the WC/WDM options were evaluated economically by calculating the net present values (NPV) and the comparative Unit Reference Values (URV) at a reconnaissance level of detail.

Planning Scenarios and Reconciliation Options

Given the water requirement and return flow scenarios as well as the WC/WDM saving options, the following planning scenarios were compiled for analysis of the water balance:

- ***Scenario I****: The option of utilising the Lower Thukela Scheme for supplying and supporting the Mvoti and Mdloti supply areas respectively was investigated. The various interventions for the Mgeni System were also investigated. The water requirement projection* ***Scenario A.1*** *was used for the Mgeni System.*

- ***Scenario II****: The option of developing the Mvoti River for supplying and supporting the Mvoti and Mdloti supply areas respectively was investigated. The purpose of* ***Scenario I*** *and* ***II*** *was to investigate the two alternative options in order to observe their respective constraints and opportunities. The water requirement projection* ***Scenario A.1*** *was used for the Mgeni System.*

- ***Scenario III***: *The purpose of **Scenario III** was to investigate the impacts of the implementation of efficiency measures through WC/WDM. **Scenario III** was similar to Scenario I with **Scenario A.2** used as the water requirement projection.*

- ***Scenario IV***: *The scenario assumed that the treated wastewater from some of the WWTW's supply the estuarine water requirements for the Mdloti and Tongati Rivers. The scenario was conducted for investigative purposes and was not taken further. The water requirement projection **Scenario A.1** was used for the Mgeni System.*

- ***Scenario V***: *The purpose of the scenario was to determine the impact on the water resources if the projected return flow growths of the re-use options and additional identified re-use options are included. The water requirement projection **Scenario A.1** was used for the Mgeni System.*

- ***Scenario VI***: *The purpose of the scenario was to determine the impact on the water resources systems if the re-use options were excluded as interventions in order to illustrate the importance of re-use.*

Scenario I *was regarded as the favourable scenario by the study team and the results for the Mgeni, Mdloti and Mvoti River Systems are illustrated and described in **Figure 1**, **Figure 2** and **Figure 3** respectively.*

Rainwater Harvesting

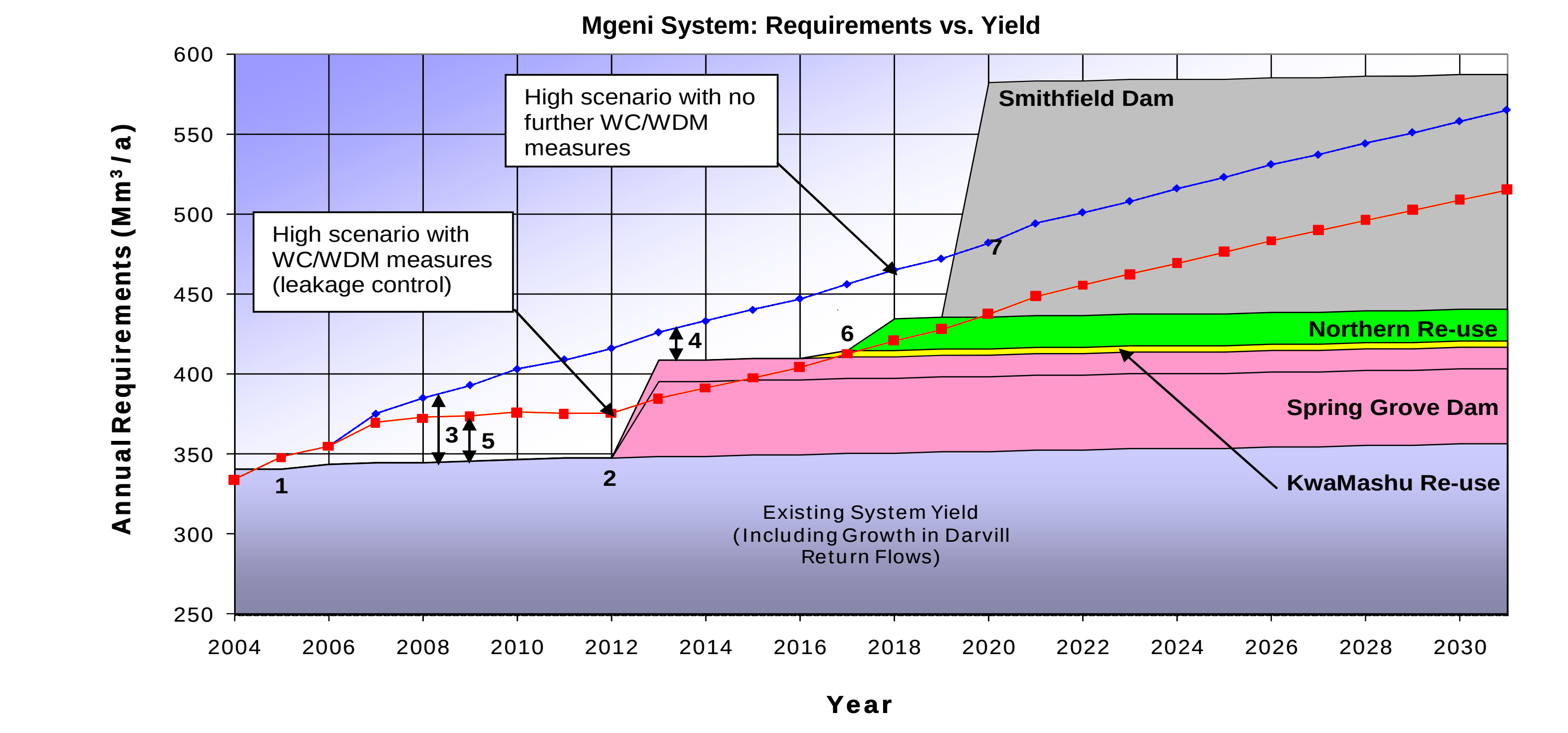
Rainwater harvesting (rainwater collection with for instance roof tanks) is another method of extending the water resource that was investigated by the study. Although it proved to not have a major impact on reduction of municipal water demand when analyzed with conventional methods of yield determination, rainwater harvesting has considerable benefits. It would allow users to limit their dependence on formal water supply, it could assist with subsistence food gardening, in times of severe water restrictions it would provide important relief for basic needs and above all it would stimulate a culture of efficient water use. Rainwater Harvesting should thus be actively encouraged in the study area.

Perspective on Water Quality Management

Water quality data and water quality reports from previous studies were used to develop an understanding of the water quality profiles of the major rivers in the study area. The situation assessment indicated that, with respect to salinity and nutrients (Phosphate and Nitrate), the

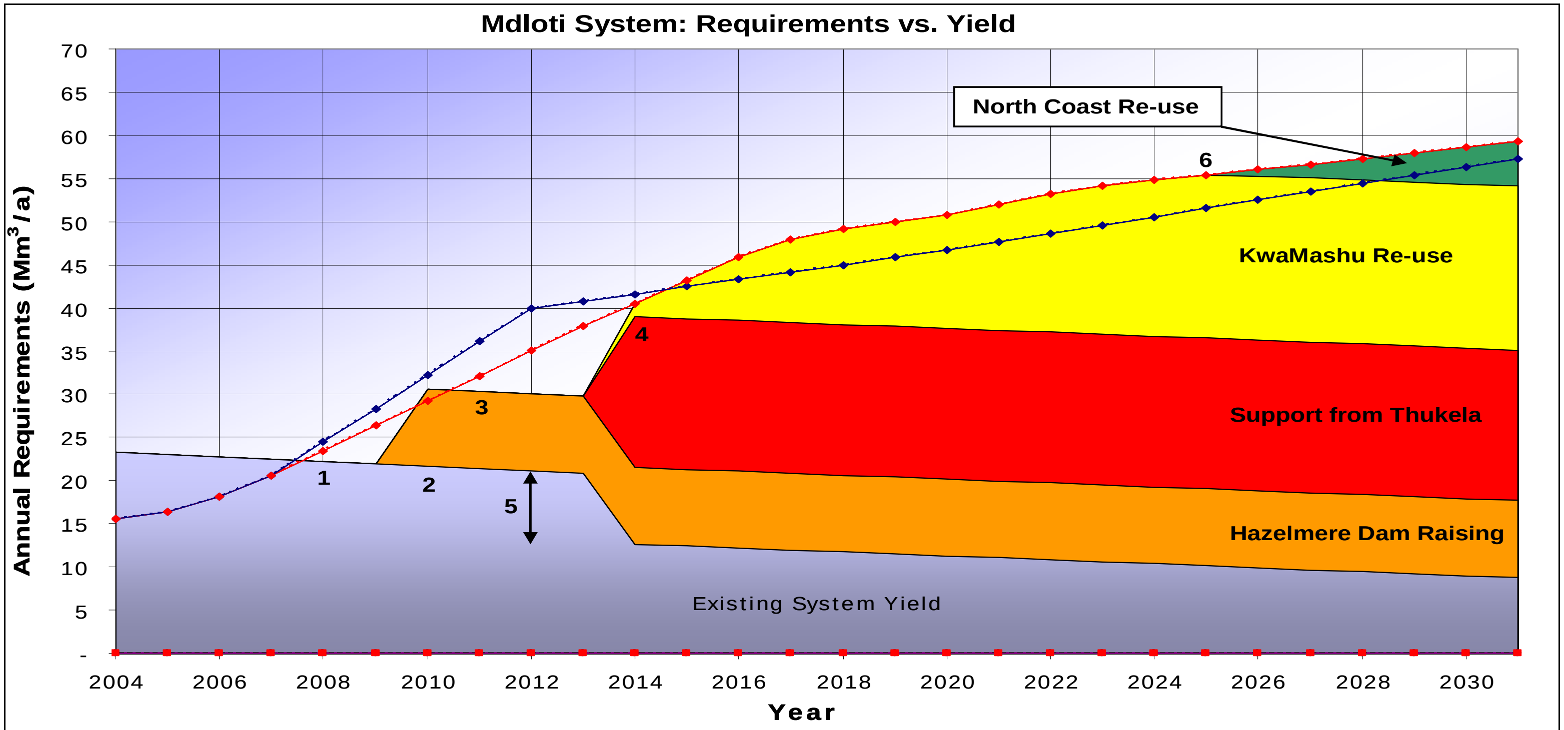
Mkomazi, Mooi, Mdloti and Mvoti River Systems are acceptable. An increasing trend in nutrients and ammonium concentration have however been observed in the Mooi River.

The water quality in the upper Mgeni River (Midmar Dam) is good, however the situation deteriorates further downstream. The water quality deteriorates significantly a distance below Nagle Dam, where the Mgeni River is joined by the Msunduzi tributary. The water quality is very poor with high conductivity, very high faecal contamination indicating sewage pollution, very high nitrate concentrations, high ammonium, high phosphorus and high turbidity occurring mainly due to the confluence with the Msunduzi River.



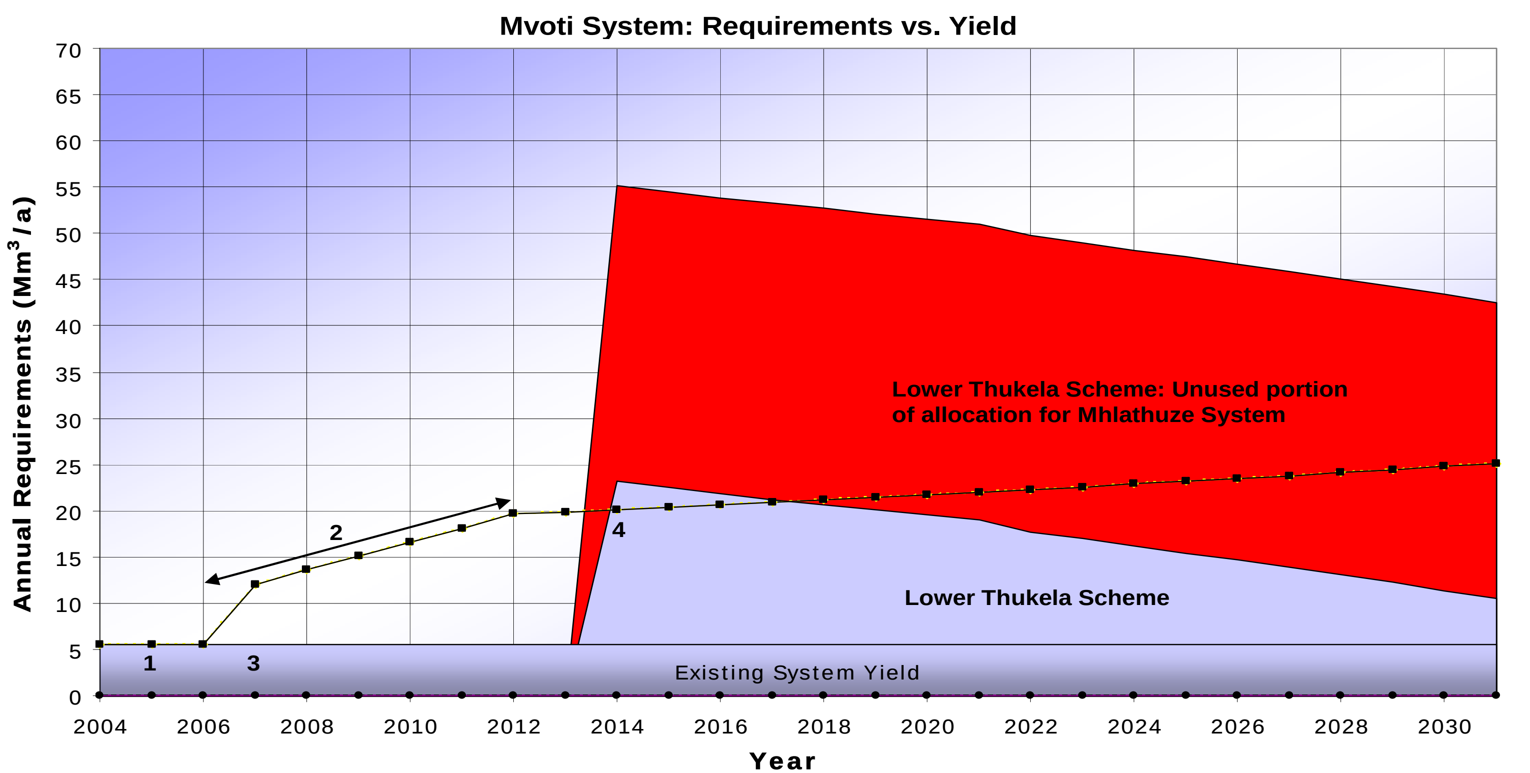
1. Requirements exceed existing system yield in 2005. The situation remains until Spring Grove Dam has been completed. Note: The situation has been masked by good rainfall in recent years, resulting in high storage levels in the reservoirs.
2. The implementation programme for Spring Grove Dam (Phase I and II) is for the scheme to deliver water by 2012.
3. Serious shortages are evident before the implementation of Spring Grove Dam.
4. If no WC/WDM measures are implemented, the yield of Spring Grove Dam will not be sufficient to solve the shortages.
5. With the implementation of WC/WDM measures, the shortages before the implementation of Spring Grove dam are reduced, however not completely resolved. Depending on the rainfall up to 2012, restrictions may be required to manage the shortages.
6. Additional interventions need to be introduced in 2017, where the water requirements exceed the available yield (including Spring Grove Dam). The KwaMashu and Northern re-use options were scheduled to be implemented in 2017 and 2018 respectively. The earliest implementation date for Smithfield Dam is in 2019 and hence the re-use options were selected.
7. Smithfield Dam has been scheduled to be implemented and deliver water by 2020, where the need for further interventions is required.

Figure 1: Mgeni River System water balance diagram



1. Requirements exceed existing system yield in 2008 and the situation remains until the raising of the dam wall has been completed. Depending on the rainfall up to 2010, restrictions may be required to manage the shortages.
   Note: The decrease in existing yield is due to sedimentation.
2. The implementation programme for the raising of Hazelmere Dam has been scheduled to increase the available yield by 2010.
   Note: The Ecological Water Requirements (EWR) have not been included.
3. Additional interventions for augmentation are required shortly after the dam wall has been raised i.e. 2011, where the water requirements exceed the available yield, indicating the need for further interventions.
4. The earliest possible implementation of additional interventions is in 2014. Support from the Lower Thukela (Lower Thukela Scheme) and the KwaMashu re-use option have been scheduled to deliver water by 2014.
5. The reduction in yield in 2014 is due to the implementation of the EWR releases. The EWR releases are scheduled to be implemented when sufficient water is available for meeting the projected water requirements.
6. The North Coast Re-use option (Verulam and Tongaat Central WWTW's) has been scheduled to deliver water by 2025, when additional interventions are again required.

Figure 2: Mdloti River System water balance diagram



1. Supply has been limited by the existing yield of the run-of-river abstraction.
2. The water requirement projection was sourced from the ILembe Master plan, which has planned bulk supply schemes to all the areas in ILembe. Additional towns and villages not currently supplied from the Mvoti River have been included in the water requirement projection. It is assumed that the current water use will increase through improved service delivery until 2012, where after natural growth occurs.
3. Interventions for augmentation are required from 2007 onwards, where the water requirements exceed the existing yield.
4. The earliest implementation of possible interventions is in 2014, where the Lower Thukela Scheme has been scheduled to deliver water by 2014. The implementation date for alternative Mvoti River Development Option is 2019, making the Lower Thukela Scheme more favorable.

Figure 3: Mvoti River System water balance diagram

Strategic Perspective

The findings of the assessments presented above have resulted in the development of a number of specific water resource management strategies, required for the sustainable management of the *water resources in the KZN study area. These are summarised as follows:*

1. *A System Operation Management Forum should be established to should promote active involvement in the operational management of the Mgeni and Mdloti River Systems among the relevant institutions.*
   Action: DWAF Regional Office
   Timing: August 2008
2. *EThekwini and the other municipalities should implement further WC/WDM measures. A detailed action plan should urgently be developed..*
   Action: Ethekwini MM, Ilembe DM, Msunduzi LM
   Timing: End 2008
3. *Rainwater harvesting should be actively encouraged.*
   Action: All
   Timing: Ongoing
4. *Implement the Mooi-Mgeni Transfer Scheme (Spring Grove Dam and transfer system). DWAF has recently directed the Trans-Caledon Tunnel Authority (TCTA) to implement Phase-2 of the Mooi-Mgeni Transfer Scheme (MMTS-2 - Spring Grove Dam and associated transfer infrastructure).*
   Action: DWAF National Water Resources Infrastructure Branch (NWRIB), TCTA
   Timing: Immediate
5. *The study on the raising of Hazelmere Dam should be completed and implemented.*
   Action: DWAF:OA, DWAF:NWRIB
   Timing: Immediate
6. *The North Coast Pipeline for short term support to KwaDukuza and long term support to the Mdloti System (bi-directional pipeline) should be implemented.*
   Action: Umgeni Water
   Timing: 2009
7. *A feasibility study of the Lower Thukela Scheme and Mvoti River Development Option for supply to the Northern Areas should be commissioned.*
   Action: DWAF:OA
   Timing: Begin study Jan 2009

8. *A feasibility study for water re-use options for supply to the North Coast and Mgeni River System (current and future wastewater sources should be considered) should be commissioned.*
   Action: eThekwini MM
   Timing: Begin study Jan 2009

9. *A feasibility study for confirming the potential savings through the implementation of efficiency measured (WC/WDM) should be commissioned.*
   Action: Ethekwini MM, iLembe DM, Msunduzi LM
   Timing: Begin study in Jan 2009

10. *The Feasibility Study of the Mkomazi River Transfer Scheme should be implemented.*
    Action: DWAF:OA
    Timing: Begin study Jan 2009

11. *The Study Steering Committee should gradually be converted into a Strategy Steering Committee as soon as the Reconciliation Strategy has been finalised.*
    Action: DWAF: National Resources Planning (NWRP), Study Steering Committee (SSC)
    Timing: Immediate

Water Reconciliation Strategy Study for the KwaZulu-Natal Coastal Metropolitan Areas

TABLE OF CONTENTS

Acronyms

DM	District Municipality
DWAF	Department of Water Affairs and Forestry
EWR	Ecological Water Requirement
HFY	Historic Firm Yield
ISP	Internal Strategic Perspectives
KZN	KwaZulu-Natal
LM	Local Municipality
MM	Metropolitan Municipality
MMTS	Mooi-Mgeni Transfer Scheme
NPV	Nett Present Value
NWRIB	National Water Resources Infrastructure Branch
NWRP	National Water Resources Planning
OA	Options Analysis
RDM	Resource Directed Measures
RDP	Reconstruction and Development Programme
SDA	Sewage Drainage Area
SRP	Soluble Reactive Phosphorous
SSC	Study Steering Committee
TCTA	Trans-Caledon Tunnel Authority
URV	Unit Reference Value
UW	Umgeni Water
WC/WDM	Water Conservation and Demand Management
WSA	Water Services Authority
WSP	Water Services Provider
WARMS	Water Allocation Registration Management System
WRYM	Water Resources Yield Model
WWTW	Waste Water Treatment Works

Water Reconciliation Strategy Study for the KwaZulu-Natal Coastal Metropolitan Areas

1 INTRODUCTION

1.1 BACKGROUND

The Department of Water Affairs and Forestry (DWAF) has identified the need for the Reconciliation Study in the report "Internal Strategic Perspective for the Mvoti to Mzimkulu Water Management Area" **(DWAF, 2004a)**. The motivation for the study has arisen from the rapidly growing water requirements of the Kwa-Zulu Natal (KZN) metropolitan area which are a result of the expanding economy, urbanisation of the population in the KZN Province and improved water supply services. Water Conservation and Water Demand Management initiatives by eThekwini District Municipality and other Water Service Authorities (WSAs) were successful in slowing the increasing water requirement trend, however, water balance projections (water requirements versus availability comparisons) indicates potential shortfalls in supply is expected to occur and that there is an imminent need for management intervention.

DWAF and other institutions involved in the management of the water resource and supply systems of the KZN Metropolitan Area have in the past carried out various studies on intervention measures to improve the water supply situation. The knowledge base that has been created by these studies provides a sound and essential platform from which the First Stage Reconciliation Strategy has been developed. In order to harness this information a Literature Review Report **(DWAF, 2007a)** was compiled to summarise the available information in one document and also present a synthesis of the information by highlighting the pertinent aspects of Integrated Water Resource Management that will be assessed and incorporated in the reconciliation strategy.

1.2 MAIN OBJECTIVES OF THE STUDY

The main objective of the study is to compile a Reconciliation Strategy that will identify and describe water resource management interventions that can be grouped and phased to jointly form a solution to reconcile the water requirements with the available water for the period up to the year 2030. The development of the strategy requires reliable information on the water requirements and return flows (wastewater), the available water resources for the current situation as well as likely future scenarios for a planning horizon of twenty to thirty years.

The following main aspects were covered in the study:

- Update the current and future urban and agricultural water requirements and return flows;
- Assess the water resources and existing infrastructure;
- Formulate reconciliation interventions, both structural and administrative/regulatory;
- Document the reconciliation process including decision processes that are required by the strategy; and
- Conduct stakeholder consultation in the development of the strategy.

In order to achieve these objectives the study was undertaken through a series of tasks which culminated into a set of study reports that are listed on the back of the cover page of the report. The information from the task reports was combined to formulate the reconciliation strategy, the main deliverable from the study, which is presented in this report.

1.3 STUDY AREA

The focus study area stretches from the KwaZulu-Natal North Coast to the Mgeni System (including the Mooi-Mgeni Transfer) with a planned transfer of water to the South Coast. The area includes portions of the Mngungundlovu, iLembe and Ugu District Municipalities, the Msunduzi Local Municipality and the eThekwini Metropolitan Municipality's area of jurisdiction, see **Figure A.1** in **Appendix A** for a map of the study area. The study area was divided into two components, namely the total area from where the water is sourced (Source Study Area) and the area to which water is supplied (Primary Study Area).

The bulk water supply system of the KwaZulu-Natal coastal metropolitan area consists of an extensive network of water conveyance and treatment infrastructure (pipelines and aqueducts) transferring water from the main storage reservoirs, Midmar, Albert Falls, Nagle and Inanda Dams in the Mgeni River System and Hazelmere Dam on the Mdloti River to the water users. Furthermore, the Mooi-Mgeni Transfer Scheme augments the supply of the upper Mgeni River (Midmar Dam) and in the far north of the study area Kwadukuza, in the iLembe DM, receives water from the Mvoti River.

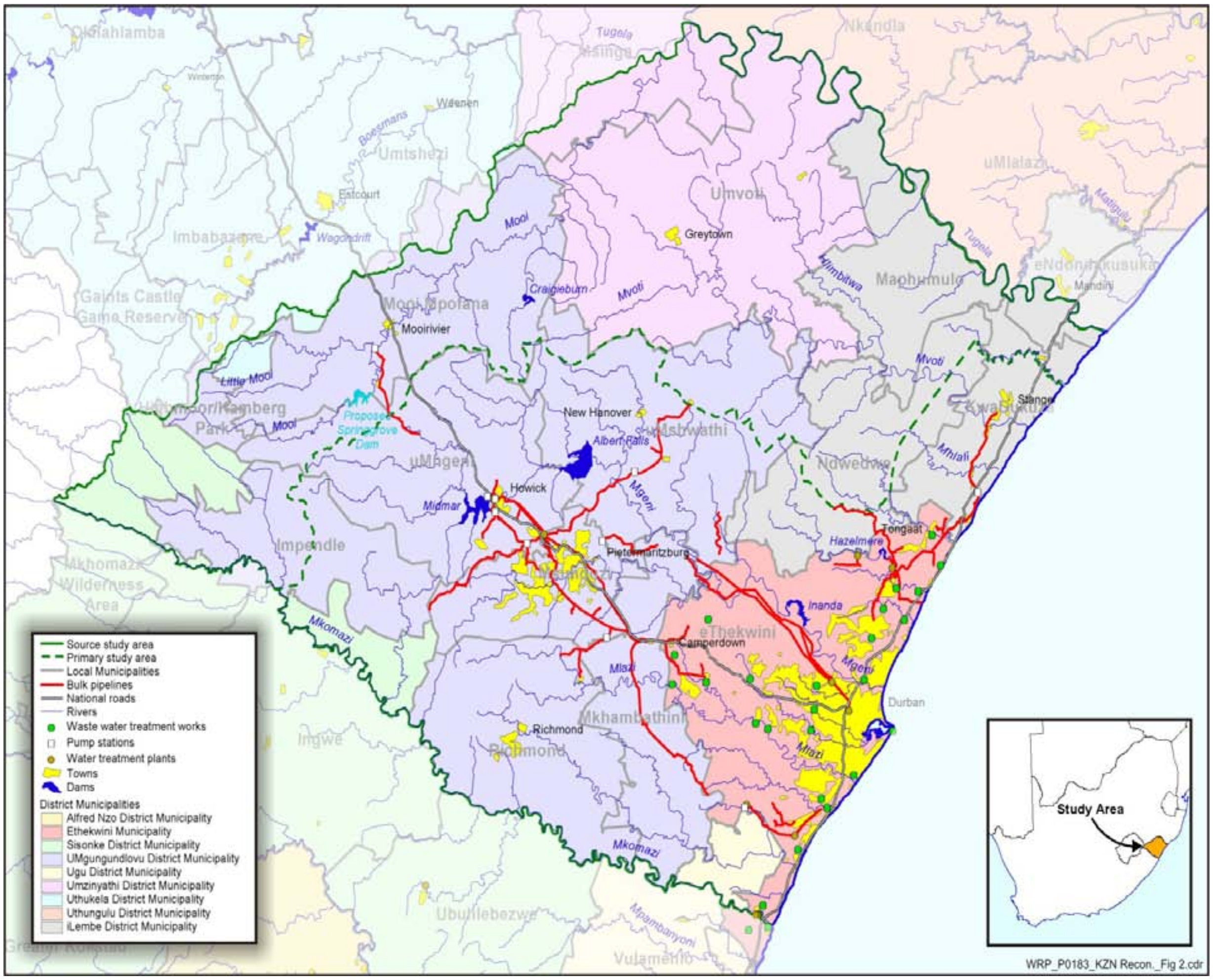


Figure 1.1: Study Area

1.4 PURPOSE AND LAYOUT OF THIS REPORT

This report describes the First Stage Reconciliation Strategy for the KwaZulu-Natal coastal metropolitan areas and serves as a summary document that collates information of other technical reports that were compiled in the study.

The introduction, given in **Section 1**, is followed by descriptions of the study procedure and the reconciliation strategy development methodology in **Section 2** and **Section 3** respectively. **Section 4** describes the water requirement and return flow scenarios on which the water conservation and water demand management scenarios, presented in **Section 5**, were based. The results from the first five chapters are used to determine the requirements for future interventions to reconcile the demand with the available supply, as presented in **Section 7**. A brief perspective on water quality management aspects are provided in **Section 8**. The report concludes with four chapters covering: uncertainties concerning reconciliation, strategic perspective regarding water management, recommendation for investigations during the development of the Second Stage Reconciliation Strategy and finally, the references used in the report are presented in **Section 13**.

2 STUDY PROCEDURE

The study has been structured into three phases as shown in **Figure 2.1**. The **first phase** is the Inception Phase, where the focus was on collecting and assimilating available information and initiating the stakeholder engagement process. The **second phase** involved developing the First Stage Reconciliation Strategy (**first stage strategy**) that focused on identifying local drivers responsible for the present growth in water and by using local economic factors, socio-economic household profiles, socio-political interventions by government and local demographic trends, water requirement scenarios up to 2030 were derived. For the **third phase**; the Second Stage Reconciliation Strategy (**second stage strategy**), the comments received from the first stage strategy will be incorporated and the strategy will be refined in view of identified issues.

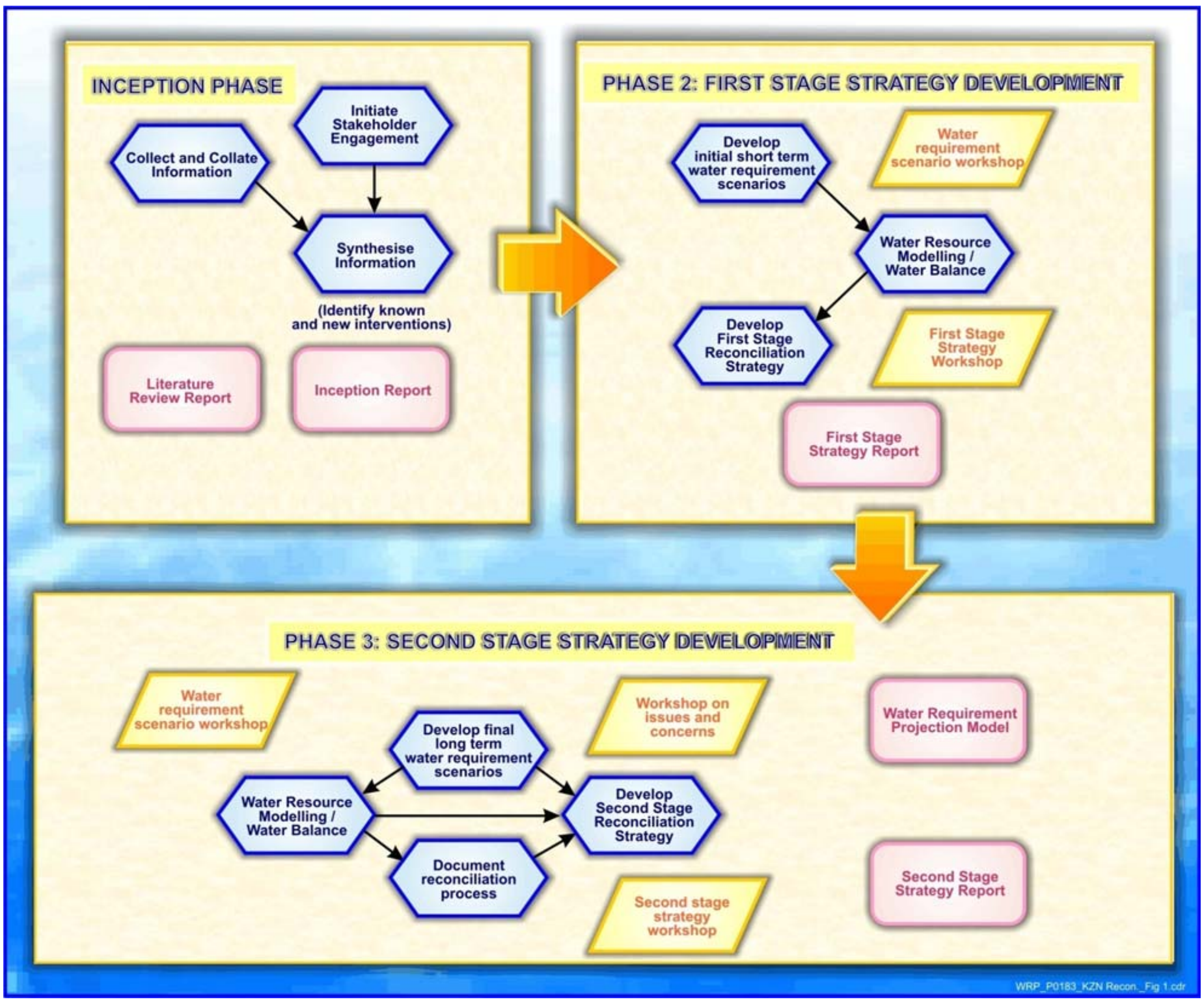


Figure 2.1: Schematic presentation of the Reconciliation Study structure

The focus of the assessments for the First Stage Strategy included the following:

- Developed water requirement and return flow scenarios by focussing the assessments on the eThekwini, Msunduzi and ILembe municipal areas.
- Estimated the irrigation water requirements in the study area by comparing the data sourced from the Water Allocation Registration Management System (WARMS) database to the information obtained from various studies conducted in the study area.
- Determined the potential for Water Conservation and Water Demand Management (WC/WDM) by concentrating on the main urban areas. This involved developing scenarios of potential savings in water use for the planning period leading up to the year 2030.
- Identified and assessed possible infrastructure intervention options including the potential of large scale water re-use options that could have water quality and water supply benefits.
- Identified and assessed several reconciliation options based on the water requirement scenarios and the identified augmentation options.
- Provided an initial indication of how the implementation of the Ecological Water Requirements (EWR) could influence the projected water balance situation.
- The successful development and implementation of such water reconciliation strategies requires the main stakeholders in the study area to be actively involved in both processes. During the first phase of the project, partnerships were established with the main stakeholders, which included the WSA's (Msunduzi Local Municipality, eThekwini Metropolitan Municipality, iLembe District Municipality and Ugu District Municipality), Umgeni Water and Siza Water. The organisations were consulted with regard to information sourcing for the various study tasks and they also contributed towards the transparent process of developing the first stage strategy.
- In support of the above described technical work, an integrated stakeholder engagement process, which consolidated the communication needs, was followed as depicted graphically in **Figure 2.2**.

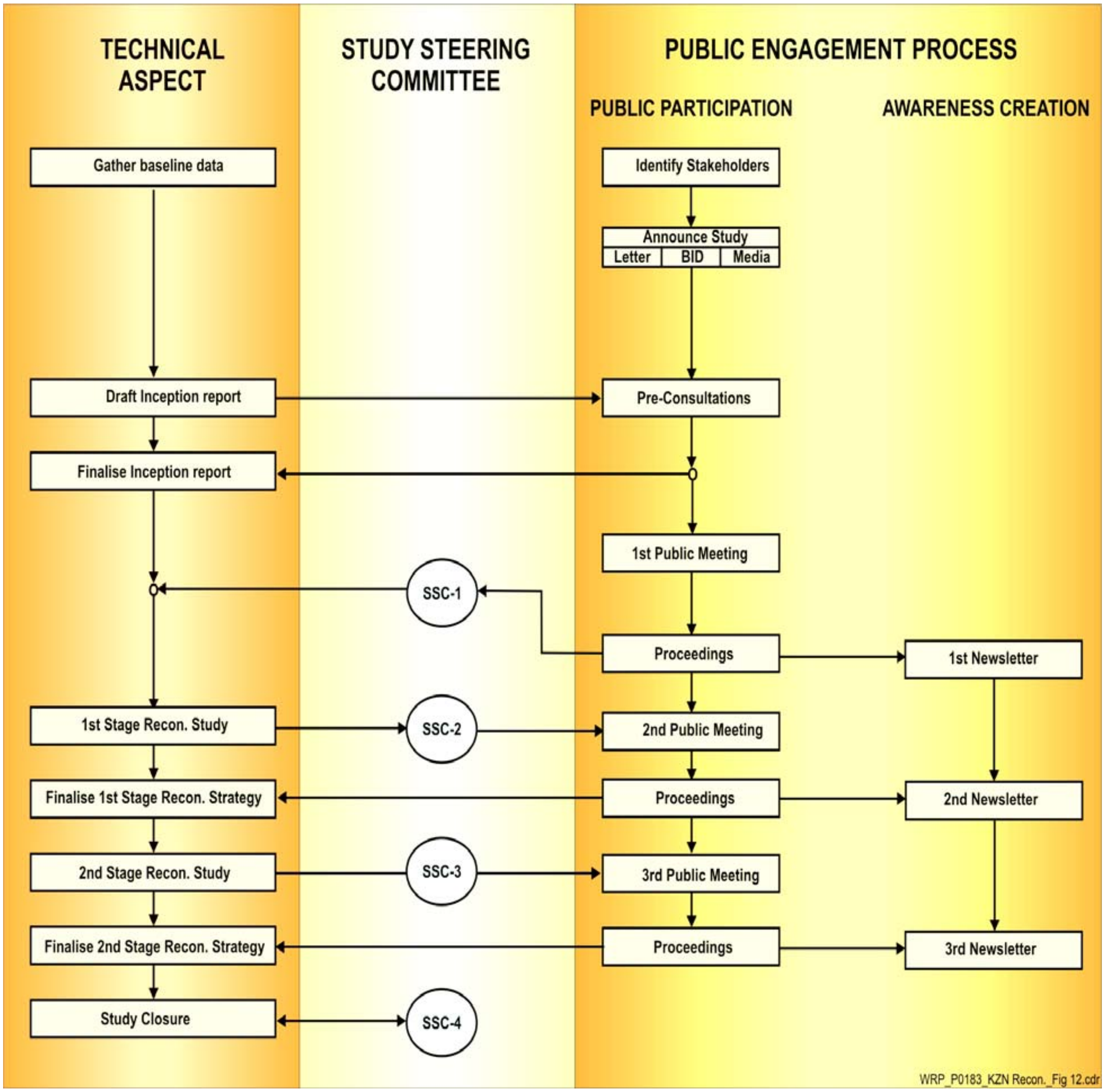


Figure 2.2: Stakeholder engagement process.

3 RECONCILIATION STRATEGY DEVELOPMENT METHODOLOGY

3.1 OVERVIEW

The development of strategies to reconcile the water requirements with the available water in the various river systems in the KwaZulu-Natal Coastal Metropolitan Areas has to be founded on a sound understanding of the projected future water balance up to the year 2030. This long term view is necessary due to the long lead time required to implement a large bulk water augmentation scheme and that the decision to proceed with such schemes has to be taken ten to fifteen years before the first water is delivered.

Understanding the water balance of a system requires information on the water that is available from the water resource systems on the one hand, and what the water requirements are, on the other. DWAF has over the years developed sophisticated analysis techniques and decision support systems to determine the water availability. The approach taken in this study was to use the existing available hydrological databases and simulation models and only make changes to the configurations in accordance with the requirements of each scenario that was analysed. Therefore none of the hydrology databases for the various systems were updated in the study.

Several uncertainties were however identified concerning the current and future water requirements, with the result that the focus of the technical work revolved around determining quantitative scenarios of future water use for all sectors, quantifying the potential for water conservation and water demand management in the urban sector, estimating the irrigation water requirements, identifying potential large bulk water re-use opportunities and obtaining preliminary indications of the reconciliation situation in meeting the Ecological Water Requirements (EWR). A desktop collation and assessment of all readily available “high level environmental information” that was required for the study was carried out for the main river systems in the study area, namely the Mvoti, Tongati, Mdloti, Mgeni; and the Mkomazi river systems.

Once the quantification of the above-mentioned “demand side” components had been completed, scenarios were defined to represent possible future conditions for the different river systems. These scenarios were then analysed according to the available water resources and the years in which intervention measures should be commissioned were established. These interventions could be measured on either side of the water balance, such as more intensive water conservation measures or the development of an infrastructural solution in the form of new water resource augmentation schemes. An economic analysis was conduced for the various intervention options and scenarios by calculating the Unit Reference Values (URV's) for each of the options and scenarios for comparative purposes.

Based on the outcome of the water balances developed for the various river systems and the investigation of the various intervention options, the First Stage Reconciliation Strategy was developed.

The sections below give brief descriptions of the methodology that was followed in the study, grouped according to the main study tasks.

3.2 URBAN WATER REQUIREMENT SCENARIO DEVELOPMENT

Substantial increases in the water use occurred in the urban and industrial sectors in the past years, which can be contributed to the favourable socio-economic conditions that occur in the country and the region. The economic prospects, coupled with rising living standards of the population, as well as other factors such as HIV AIDS are, and will continue having significant influences on the future water requirements to be supplied from the river systems in the study area.

The methodology for determining the urban water requirement scenarios were based on the procedures that were developed as part of the Crocodile River (West) Return Flow Analysis Study **(DWAF, 2004b)**. This method involves defining algorithmic models of each Sewer Drainage Area (SDA), where a SDA encompasses urban areas that are serviced by a sewer collection system that discharges to a particular Waste Water Treatment Works (WWTW). The algorithm uses population as the main driver (independent variable) and through a process of calibration of model parameters define the relationship between population and water requirements as well as return flows.

Given the inherent uncertainties that exist in long-term water requirement estimates, a process of scenario development has been followed to derive likely alternative future water requirement projections (see **Section 4.3**).

3.3 UPDATING OF THE IRRIGATION WATER REQUIREMENTS AND RETURN FLOWS

Water requirements of the irrigation sector have been the subject of various studies in the past. Information from the separate studies conducted on the different river system catchments in the study area were used in recent water resources planning investigations. The water use registration process commissioned by DWAF has generated a further source of information in the form of the Water Allocation Registration Management System (WARMS). At the time the irrigation water requirement task was carried out, no validation studies had been commissioned by DWAF in the different catchments within the study area. As a result the approach followed to estimate the irrigation water use in the different catchments was to compare the data sources from previous studies with the available information in the WARMS database. These comparisons were then discussed with the water resource managers of the respective regional office to decide on the most appropriate data to be use for this study.

3.4 POTENTIAL SAVINGS FROM WATER CONSERVATION AND WATER DEMAND MANAGEMENT

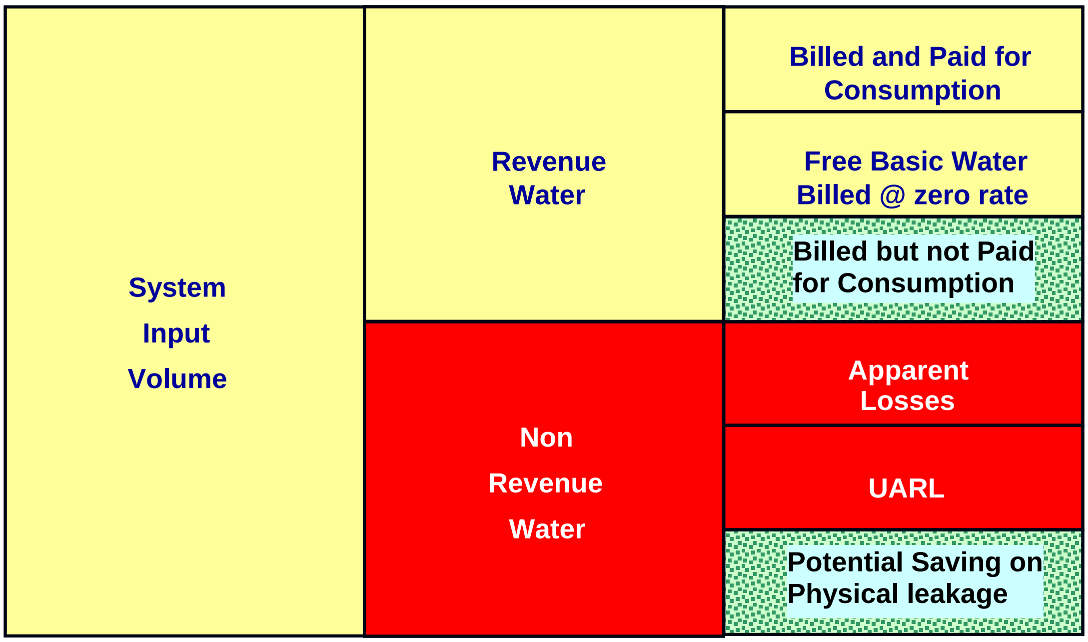
The purpose of the task was to determine the potential water conservation and water demand management (WC/WDM) savings that could be achieved in the main urban centres and key demand centres in the study area. The reader is referred to the First Stage Strategy: Water Conservation and Demand Management Report (**DWAF, 2008a**) of the same study for more detail. The demand centres that were focussed are shown in **Table 3.1** and the total consumption of the demand centres was 349.19 million m^3/a in 2006.

Table 3.1: Major municipal demands considered in the study

Municipality	Water Use in 2006 (million m^3/a)
eThekwini Metropolitan Municipality (Durban)	290.68
Msunduzi Local Municipality (Pietermaritzburg)	50.64
iLembe District Municipality (KwaDukuza)	4.65
Siza Water Company (Ballito and Dolphin Coast in iLembe DM)	3.22
Total	**349.19**

A standard water balance was undertaken for each of the municipalities, which was built up from assessments of water supply zones in their respective supply areas to represent the actual conditions in each zone.

An illustration of the components that make up the water balance is provided in **Figure 3.1** indicating the losses and non-revenue water. From this water balance the potential savings were determined with the focus on the "Billed but not paid for consumption" as well as the "Potential



Notes: UARL – Unavoidable Real Losses

savings on physical leakage" (green hashed blocks) components.

Figure 3.1: Illustration of a standard water balance

Based on detailed assessments made on numerous supply zones in each municipal area, the potential savings coupled with a range of WC/WDM measures were determined. With the knowledge that these measures would require substantial financial and human resources for implementation, a schedule (projection) of future savings were made, resulting in the development of three scenarios (see **Section 5.1** for a description of these scenarios).

3.5 RECONCILIATION FOR A PRELIMINARY RESERVE SCENARIO

Reserve assessments have been undertaken within the study area but are limited to mainly rapid or desktop levels (low confidence estimates). At the time of the study, the DWAF Directorate: Resource Directed Measures (RDM) was planning to commission high confident reserve determination studies for Mvoti, Mkomazi, Mgeni, Mhlali and Mhlatane systems; lower confident reserves for the Mbokkodwini, Toti, Little Toti and Lovu systems and monitoring programmes for the Mhlanga, Tongati and Mhloti systems.

In order to provide an interim perspective on the water balance concerning the Reserve as part of this study, an analysis was carried out where all available Ecological Water Requirement (EWR) information was sourced from the RDM office and incorporated into the Water Resources Yield Model (WRYM). The information was compared to the information in existing WRYM configurations of the various systems. The information was then updated where required and a revised yield analysis was then conducted for the updated systems.

3.6 DETERMINATION OF THE REQUIRED INTERVENTION DATES

The water requirement and return flow scenarios (discussed in **Section 4**) and the potential saving scenarios through WC/WDM measured (discussed in **Section 5**) were used to determine various demand projection scenarios. These were then imposed on the existing yields of the associated river systems and the need for intervention (when further WC/WDM measures and/or the development of an augmentation scheme is required) were determined by assessing the water reconciliation (water balance) situation over the planning period for each of the river systems.

3.7 ECONOMIC EVALUATION OF THE INTERVENTION OPTIONS

The following possible intervention options were identified (see **Section 6** for more detail):

- Mooi-Mgeni transfer scheme, Phase 2
- Mkomazi-Mgeni transfer scheme, Phase 1
- Mvoti-River – IsiThundu Dam
- Desalination plant
- Lower Thukela scheme
- Waste water reuse options

Both the infrastructure and the WC/WDM options were evaluated economically by calculating the net present values (NPV) and the comparative Unit Reference Values (URV) at a reconnaissance level of detail. The URV for each option was calculated for the same base year (September 2007) by escalating the costs obtained from previous studies. The base date for these previous studies varied from 1996 to 2004.

An engineering assessment was conducted for the options that had not been previously investigated and the NPV and URV was then calculated for each of the option. The results of the economic analysis are discussed in **Section 7.4**.

3.8 ENVIRONMENTAL CONSIDERATIONS

A desktop collation and assessment of all readily available “high level environmental information” that was required for the study was conducted for the main river systems in the study area. The type of information obtained included: land cover, sensitive landscape, rivers, natural history sites, red data species, threatened species, biodiversity hot spots etc. This background environmental information was used to assess the proposed water reconciliation strategies. Gaps in the available environmental database and further environmental studies or data collection exercises were identified for the identified strategies.

3.9 STRATEGY DEVELOPMENT

The required intervention dates were established by assessing the water balance situation for the various river systems. The most suitable intervention options were identified by considering both the economic analyses results and the implementation time frames for each of the options. Various planning scenarios that included different development options were analysed in order to identify the opportunities and constraints of the various development options. The First Stage Reconciliation Strategy was developed based on the assessment.

4 WATER REQUIREMENT AND RETURN FLOW SCENARIOS

4.1 INTRODUCTION

This section describes the water requirements and return flow scenarios that were developed in the study and are presented according to the following headings:

- Irrigation water requirements (**Section 4.2**)
- Urban water requirements and return flows (**Section 4.3**)

4.2 IRRIGATION WATER REQUIREMENTS

4.2.1 Overview

The irrigation water requirements within the study area were obtained from six different sources as listed in this section. Most of the sources did not cover the full study area but only certain parts. The WARMS database was the only source that covered the study area in full. The sources or studies used to obtain the relevant information included the following:

1. WARMS (2006/07-adjusted) Data extracted from the Water Allocation Registration Management System. Since WARMS is a “live” database system that is updated continuously, it should be noted that the database used for this study was dated August 2007.
2. Mgeni River System Analysis Study by BKS (1989 development level)
3. Mooi-Mgeni Transfer Phase 2 Feasibility using WARMS data (2005 development level)
4. Mvoti River Dam Feasibility Study by Ninham Shand (1995 development level)
5. Hazelmere Dam Raising by Knight Piésold Consulting (2000 development level)
6. Mkomazi-Mgeni Transfer Scheme Pre-feasibility by Ninham Shand (1995 development level)

The results from these studies were compared and discussed with the DWAF regional office to decide on the most realistic irrigation development data (see **Section 3.3**). The recommended volumes were then compared to the data used in the WRYM configurations of the various river systems.

4.2.2 Summary of irrigation water use

For the purpose of presenting the results of the irrigation developments, the study area was divided into nine main catchments and 21 sub-catchments. These sub-catchments are presented in **Figure A-2** in **Appendix A**.

Table 4.1 summarises the irrigation water requirements for the five main catchments as obtained from the different data sources that were evaluated. The recommended irrigation requirements are mainly based on the latest results from the WARMS database.

For the Mooi River catchment the latest WARMS data indicated a total irrigation requirement of 62.3 million m^3/a, this however excluded the development in the former KwaZulu near Muden, with an irrigation requirement of approximately 6.4 million m^3/a. With the Muden development included the total irrigation requirement for the Mooi River catchment increased to 68.7 million m^3/a, which compares well with the total from the BKS study.

The far higher demand is indicated in the Mooi-Mgeni Transfer Phase 2 Feasibility Study (**DWAF, 2007c**), which made use of the 2005 WARMS data. The reason for the substantial difference between the 2005 and 2006/07 WARMS data is due to the way the data was utilised. For the purpose of this study the focus for the WARMS data was on the demands included in the database. Due to the effects of double cropping, the areas registered are sometimes difficult to interpret and as a result the emphasis was placed on the irrigation volumes and not the irrigation areas. In the Mooi-Mgeni Transfer Phase 2 Feasibility Study, the irrigation areas from the 2005 WARMS database were used in combination with a water use of 6 310m^3/ha/a, which was obtained from the Goba Moahloli Keeve Steyn Study. This resulted in the high demand of 96.5 million m^3/a, which is 27.8 million m^3/a larger than the water use from the WARMS data (see **Table 4.2**). The irrigation areas from the 2005 and 2007 WARMS data base are in fact very similar.

The Springrove Dam site is located in the upper reaches of the Mooi River catchment and the difference in irrigation requirements upstream of Springrove Dam for the two studies is reduced to 3.5 million m^3/a, which is significantly lower than the difference for the entire Mooi-Catchment. As a result the yield analysis results for Springrove Dam from the Mooi-Mgeni Transfer Phase 2 Feasibility Study were accepted. The conservative yield estimate was accepted as a water use validation study has not been conducted in the catchment.

Some growth in irrigation did occur in the Mkomazi catchment, but not to the extent indicated by the Mkomazi – Mgeni Transfer Scheme Pre-feasibility study. The DWAF regional office confirmed that the WARMS irrigation requirement of 27.8 million m^3/a is the most accurate for the catchment.

The irrigation demands obtained from the different studies for the Mgeni catchment are very similar. The yield analysis results from the Mkomazi-Mgeni Scheme Pre-feasibility Study were used for the study (irrigation requirement of 49.7 million m^3/a). The yield results (Smithfield Dam) from the higher irrigation water requirements were accepted due to both the low reliability of the supply to irrigation and also to obtain a conservative yield estimate, as no validation study of the water use has been completed in the catchment.

Table 4.1: Irrigation water requirements

Catchment Description	Irrigation Water Requirement (million m^3/annum)						
	Recommended	WARMS (2006)	BKS (1989)	WARMS (2005)	Mvoti Dam Feasibility (1995)	Hazelmere Dam Raising (2000)	Mkomazi-Mgeni Transfer Scheme Pre-feasibility (1995)
Mkomazi	27.8	27.8	18.1	-	-	-	49.7
Mooi	68.7	68.7	67.3	96.5	-	-	-
Mgeni	55.9	55.9	60.2	52.1	-	-	-
Mdloti	6.2	6.2	14.8	-	-	12.6	-
Mvoti	25.6	25.6	-	-	29.4	-	-
Total	**184.2**	**184.2**					

Table 4.2: Irrigation area and requirements recommended to be used in this study

Catchment description	Recommended Irrigation demands at 2006 development level		
	Area (ha)	Requirement	
		million m^3/a	m^3/ha/a
Mkomazi	5 549	27.8	5 011
Mooi	14 124	68.7	4 866
Mgeni	12 712	55.9	4 398
Mdloti	1 256	6.2	4 850
Mvoti	6 522	25.6	3 920
Total	**40 163**	**184.2**	**23 045**

The lower WARMS volume for the Mdloti catchment was recommended for use in this study. Farmers below Hazelmere Dam started to de-schedule irrigation after they were billed for the water use. This resulted in the significant decrease in the irrigation water requirement. The rainfall in this area is high enough to produce dry-land sugar cane and the farmers are therefore not prepared to pay for the irrigation water. The recommended irrigation requirements of 6.2 million m^3/a were included in the yield estimate of Hazelmere Dam in the Mdloti System.

The initial WARMS irrigation requirement for the Mvoti River catchment was 21.0 million m^3/a. This volume was slightly increased by the DWAF Regional office to 25.6 million m^3/a as all the irrigation in quaternary U40J at the river mouth had not been registered. The total irrigation requirement from the WARMS however does compare fairly well with that obtained from the Mvoti River Dam Feasibility Study (**DWAF, 1996a**). The yield results from the Mvoti River Dam Feasibility Study Extension (**DWAF, 2000**) were used for the study. Irrigation water requirements of 56.9 million m^3/a were used for the yield analysis. The yield results with the larger irrigation requirements were accepted in order to obtain a conservative yield estimate as a validation study on the water use in the catchment has not been conducted.

The irrigation demand for the five main catchments in the study area accumulates to a total of 184 million m^3/a (230 million m^3/a for the total study area) with a total irrigation area of approximately 40 000 ha (49 800ha for the total study area). An assumption was made that the irrigation water requirements will remain constant over the planning period of the study.

4.3 URBAN WATER REQUIREMENTS AND RETURN FLOWS

4.3.1 Overview

The urban sector represents the largest portion of the systems water use and substantial increases in the water use occurred historically as a result of the increasing urban population and expanding economic activities in the study area.

As was done in the National Water Resource Strategy, the water usage in the study area was split into two components; these being direct water use, the main driver being population, and indirect water use, the main driver being the economy.

A number of population databases have been developed for KwaZulu-Natal by various organisations using the 2001 Census as a base. A detailed assessment of the population databases and the compilation of scenarios for future population projections was conducted by Dr. McCarthy as part of the study (**DWAF, 2007d**). The population growth from the 2006 base year was established for three scenarios from which the direct water usage requirement projection was developed. Additionally the economic drivers affecting the indirect water consumption were investigated by an economist, in order to establish the indirect water requirement projection.

The results from the demographic study are discussed in the section below with the main focus on the population in the eThekwini Metropolitan Municipality and the Msunduzi Local Municipality.

The main demand centres in the study area are currently supplied from four main river systems, namely the Mgeni, Mdloti, Mvoti and the Thukela river system as illustrated in **Figure A-3** in **Appendix A**. The water requirements for the various demand centres will be presented according to each of the sub-systems.

4.3.2 Population scenarios

The key variables affecting the population projections are the possible impact of AIDS, land use and urbanisation trends and the future political and economic prospects. Based on these three population projection scenarios were developed, namely a low, middle and high road projection.

The population growth within the various suburbs in the eThekwini municipal area and also in surrounding towns function differently due to various factors such as the N3 Pietermaritzburg to Durban growth corridor, new international airport on North Coast, property developments etc. As a result the coastal metropolitan areas were divided into four sub-regions according to the population growth characteristics (see **Figure 4.1**). The four sub-regions with their respective suburbs are:

1. **Inner:** Umhlanga, Durban North, KwaMashu, Pinetown, Bellair, Rossburgh, Chatsworth and Mobeni.
2. **South:** South of Mobeni including Umlazi, Amanzimtoti, Illovo, Mgababa and Umkomaas.
3. **North:** Umdloti and northwards including Pheonix, Inanda, Verulam, Tongaat and KwaDukuza.
4. **West:** West of Kloof: Including Hillcrest, Mphumalnga, Fredville, Cato Ridge, Camperdown/ Mkhambathini, Msuduzi/Pietermaritzburg and Mgeni municipality.

The population projections established for the four sub-areas for the three scenarios are shown in **Table 4.3**. Because of inevitable error levels involved in demographic projections over a thirty year period, the population figures in the table have been rounded to only one decimal point behind the million. From the table it can be seen that the projections for the study area as a whole is at a minimum of 600 000 increase in population, and at maximum of 1,5 million increase over thirty years. Almost half of this growth (in any scenario) is projected for the north alone, and over two thirds for the west and the north combined. The sensitivity of areas to different scenarios varies. For example in central Durban there is little sensitivity, the difference between highest and lowest scenarios over 30 years being only some 0,1 million people; but in contrast in the north there is greater sensitivity, the difference here being 0,9 million people. The reader is referred to the Demographic Projections report of the same study for further details (**DWAF, 2007d**).

Whilst the projected population growth has significant implications for water resources planning, probably more important will be the changing household/homes structure of the population. Over the past decade the major theme of change in this regard has been the extension of services to formerly un-served informal settlements, and/or the movement of households out of un-serviced shacks into low cost formal, serviced homes. It is projected that this theme will continue for at least two decades more. As a result, the actual water consumption seems destined to increase more rapidly than population.

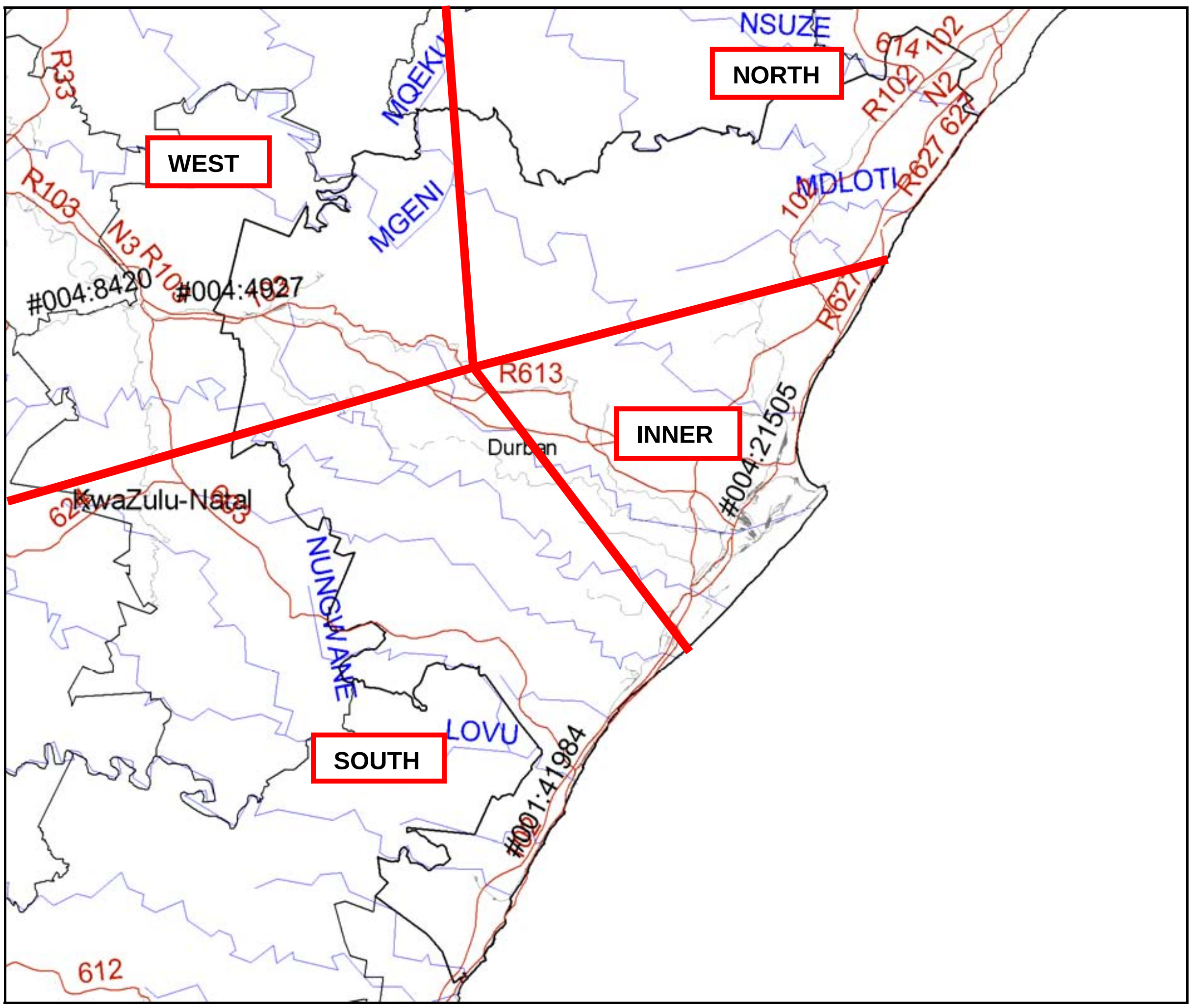


Figure 4.1: Map of sub-areal components

Table 4.3: Projected population growth

Year	Scenario	Population (million)				
		Inner	South	North	West	TOTAL
2001		1.0	1,3	1,3	1,3	5.0
2005	Low	1.0	1,3	1,3	1,3	
	Medium	1.0	1.3	1,4	1,4	
	High	1.0	1,3	1,4	1,4	
2010	Low	1.0	1,3	1,4	1,4	
	Medium	1.0	1,4	1,5	1,4	
	High	1.0	1,4	1,5	1,6	
2015	Low	1.0	1,3	1,5	1,4	
	Medium	1	1,4	1,5	1,5	
	High	1,1	1,4	1,6	1,6	
2020	Low	1.0	1,4	1,5	1,5	
	Medium	1.0	1,4	1,6	1,5	
	High	1,1	1,5	1,7	1,6	
2025	Low	1.0	1,4	1,6	1,5	
	Medium	1,1	1,4	1,7	1,6	
	High	1,1	1,5	1,8	1,7	
2030	Low	1.0	1,4	1,6	1,5	5,6
	Medium	1,1	1,5	1,8	1,7	6,0
	High	1.1	1,5	1,9	1,8	6,5

4.3.3 Mgeni River System supply area

4.3.3.1 Methodology

The Mgeni River system supplies water from Midmar, Albert Falls, Nagle and Inanda dams to the Msunduzi Local Municipality (LM) and the eThekwini Metropolitan Municipality (MM). Water is also supplied to a portion of the uMgungundlovu District Municipality (DM), large rural areas surrounding Pietermaritzburg and will also soon supply a portion of Ugu DM, along the South Coast. The largest portion of the current urban water requirements are eThekwini MM (80%) and Msunduzi LM (14%).

The water requirements and return flows for the eThekwini and Msunduzi Municipal areas were determined with the Water Requirement and Return Flow database model, which was developed for DWAF as part of the Crocodile (West) River Return Flow Assessment Study (**DWAF, 2004b**). The model uses Sewage Drainage Areas (SDAs) as modelling component where a sewer pipe network system collects the wastewater for treatment at the waste water treatment works before it is discharged. There were fifty three SDAs identified in the two municipal areas, as illustrated graphically in **Figure 4.2**. The various SDAs in each of the municipal areas are listed in **Table 4.4**. Some of the SDAs identified are not linked to waste water treatment works and have been indicated as such. The demands of these SDA's amount to 9% and 25% of the total demand for eThekwini MM and Msunduzi LM respectively (12% of the combined demand).

Table 4.4: List of Sewage Drainage Areas according to Municipal Areas

Municipality	Sewage Drainage Areas	Number of SDAs
eThekwini	Southern Works, Umhlathuzana, Central, Kingsburgh, Amanzimtoti, Isipingo, Northern, New Germany, KwaMashu, Umbilo, Mpumalanga, Kwadengezi, Dassenhoek, Hillcrest, Hammersdale, Phoenix, Umhlanga, Umdloti, Verulam, Tongaat Southern, Tongaat Central, Tongaat Central Below, Gennazano, Fredville, Cato Ridge and 19 SDA's without waste water treatment works	44
Msunduzi	Darville and 8 SDA's without waste water treatment works	9
TOTAL NUMBER OF SEWAGE DRAINAGE AREAS		**53**

The methodology that was followed to derive the water requirements and return flow projections for the two municipal areas involved the following steps:

- Populate the data for each SDA in the database model with the population scenario data for the years 2006 and five yearly intervals up to 2031.
- Incorporate land use data, other than housing land use into the database for the SDAs, where it was available.
- Assign water supply meter data of the year 2006 to the SDAs, using GIS area intersection analysis.
- Collate the discharge volume data of the year 2006 from the Waste Water Treatment Works and assign the appropriate data to each SDA.
- Establish the relationships with population and land use by calibrating the model parameters to match the recorded water requirements and return flows for the year 2006.
- Generate the projected water requirements at five year intervals from 2006 for the planning period up to 2031, using the parameters as calibrated for the 2006 year. The population was grown according to the growth rates of the three scenarios discussed in **Section 4.3.2**.
- The above steps were carried out for all 53 SDAs and the results were incorporated into a spreadsheet database.

The reader is referred to the Water Requirements Report of the same study for more detail on the above methodology (**DWAF, 2008b**).

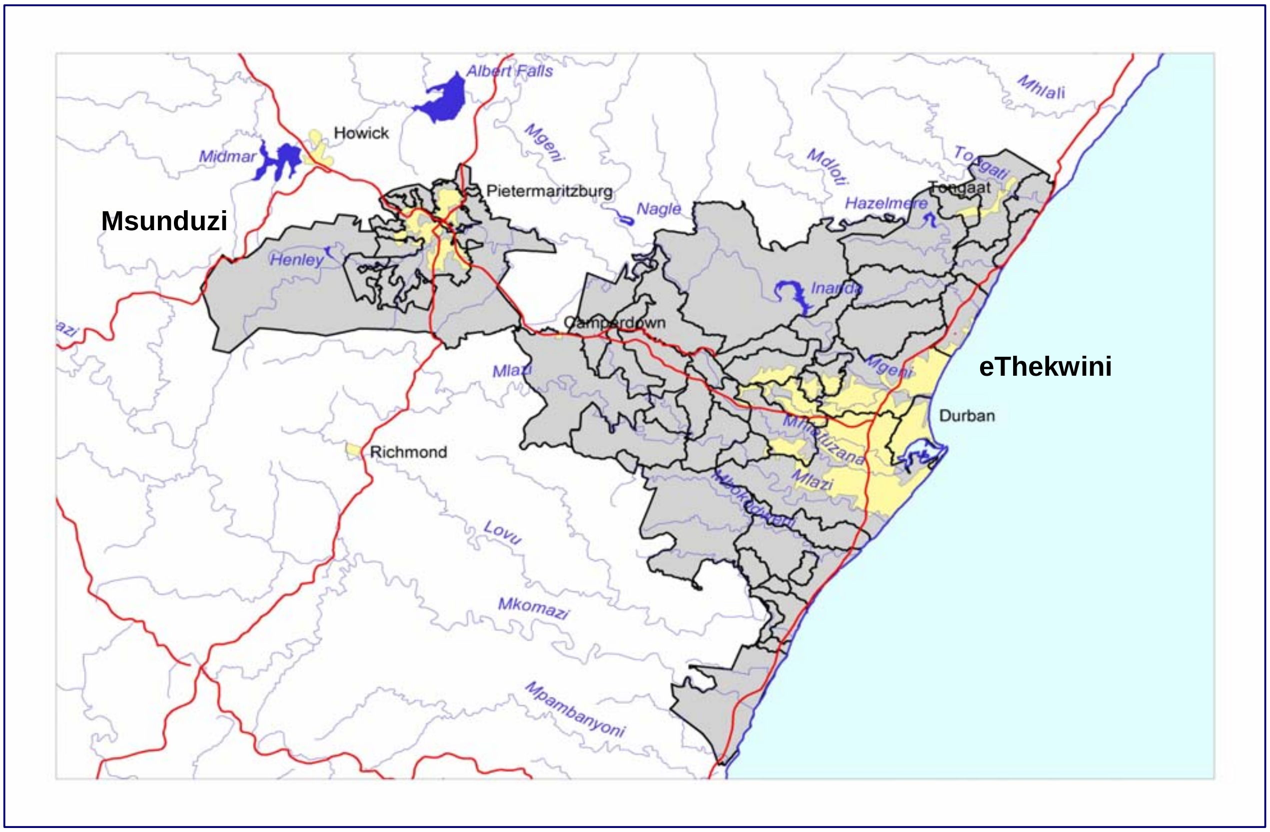


Figure 4.2: Location of the Sewage Drainage Areas within the eThekwini and Msunduzi Municipal areas.

4.3.3.2 Water requirement and return flow results

The population growth data (described in **Section 4.3.2**) was applied to the 2006 population data for each SDA in the water requirement generation database model for the high, low and middle road scenarios. It has been established that the biggest driver of water demand increases has been from upgraded service levels to the low income housing sector. This was accounted for in the model, according to the Reconstruction and Development Programme (RDP) housing implementation programmes that have been scheduled in the eThekwini and Msunduzi municipal areas. Based on discussions with the municipalities, the implementation of 12 000 RDP houses per annum by eThekwini MM (***Moodliar, 2008***) and 1 000 RDP houses per annum by Msunduzi LM (**Subramanian, 2007** and **Enoch, 2007**) were accounted for in the water requirement projection.

The indirect water use in the different SDAs was generally increased by the same ratio as the direct water requirements. The economic analysis however identified certain areas where substantial industrial/commercial growth will take place in certain years, which was additionally accounted for. The demand and return flow projections were generated for the planning period up to the year 2031, according to the steps listed in the previous section. The various demand and return flow scenarios that were generated are shown in **Table 4.5**.

Table 4.5: Water requirement projection scenarios

Scenario	Description
Scenario A	• High population projection • Improved water supply services • Indirect water use increased in identified SDAs according to economic analysis (Hammarsdale, Cato Ridge, Hillcrest, Southern, Umhlanga, Phoenix, Verulam, Tongaat) • Indirect water use in remaining SDA's increased by the same ratio as the direct water use requirements
Scenario B	• Low population projection • Improved water supply services • Indirect water use increased in identified SDAs according to economic analysis (Hammarsdale, Cato Ridge, Hillcrest, Southern, Umhlanga, Phoenix, Verulam, Tongaat) • Indirect water use in remaining SDA's increased by the same ratio as the direct water use requirements
Scenario C	• Medium population projection • Improved water supply services • Indirect water use increased in identified SDAs according to economic analysis (Hammarsdale, Cato Ridge, Hillcrest, Southern, Umhlanga, Phoenix, Verulam, Tongaat) • Indirect water use in remaining SDA's increased by the same ratio as the direct water use requirements

Scenario A was regarded as the base scenario to be used for planning purposes. A summary of the water requirement projections for the eThekwini and Msunduzi municipal areas for the three scenarios are shown in **Figure 4.3** and **Figure 4.4** respectively. The annual average growth rate in water requirements for the eThekwini and Msunduzi municipal areas between 2006 and 2031 are 1.66% and 2.19% respectively for **Scenario A**. The direct water consumption component consists of between 60% - 65% of the total consumption in the eThekwini and Msunduzi areas.

The total return flow projections for the eThekwini and Msunduzi municipal areas are presented in **Figure 4.5** and **Figure 4.6** respectively. An increase from 180 million m^3/annum to 230 million m^3/annum in eThekwini; and 28 million m^3/annum to 40 million m^3/annum in Msunduzi is illustrated for **Scenario A** (planning period 2006 – 2031).

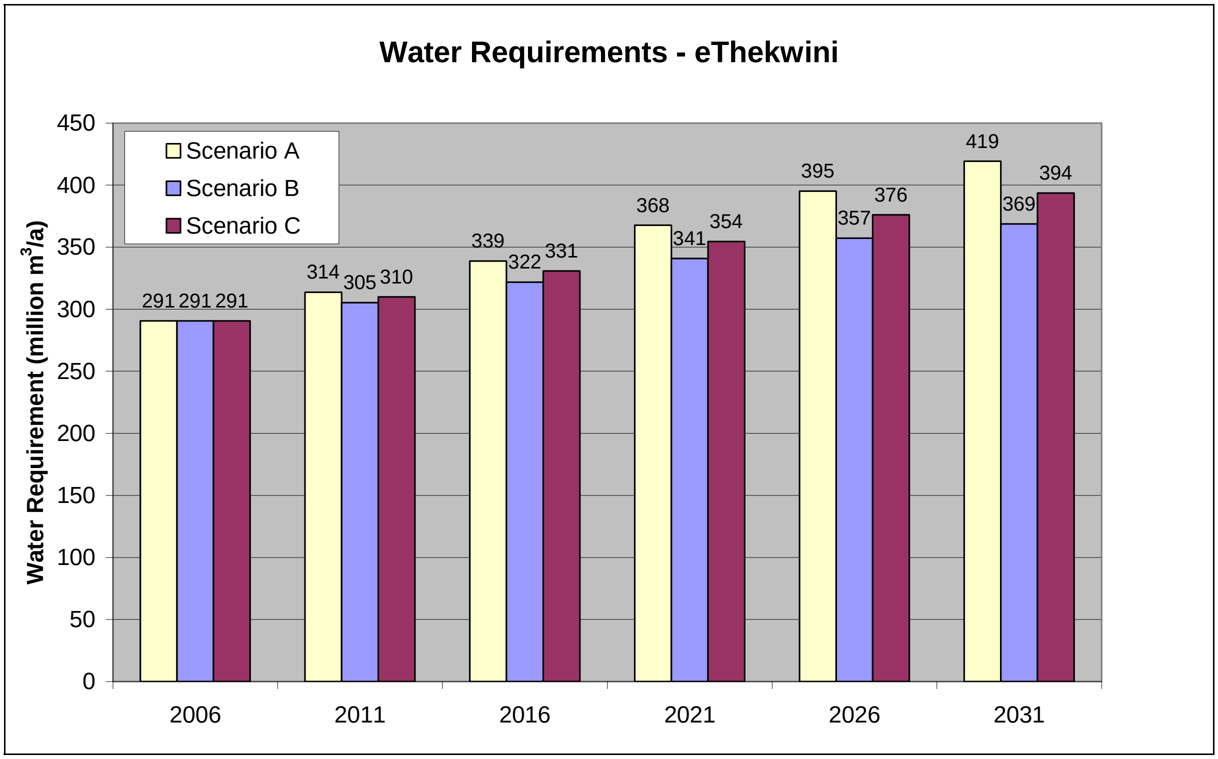


Figure 4.3: Water requirement projections in the eThekwini Municipal Area

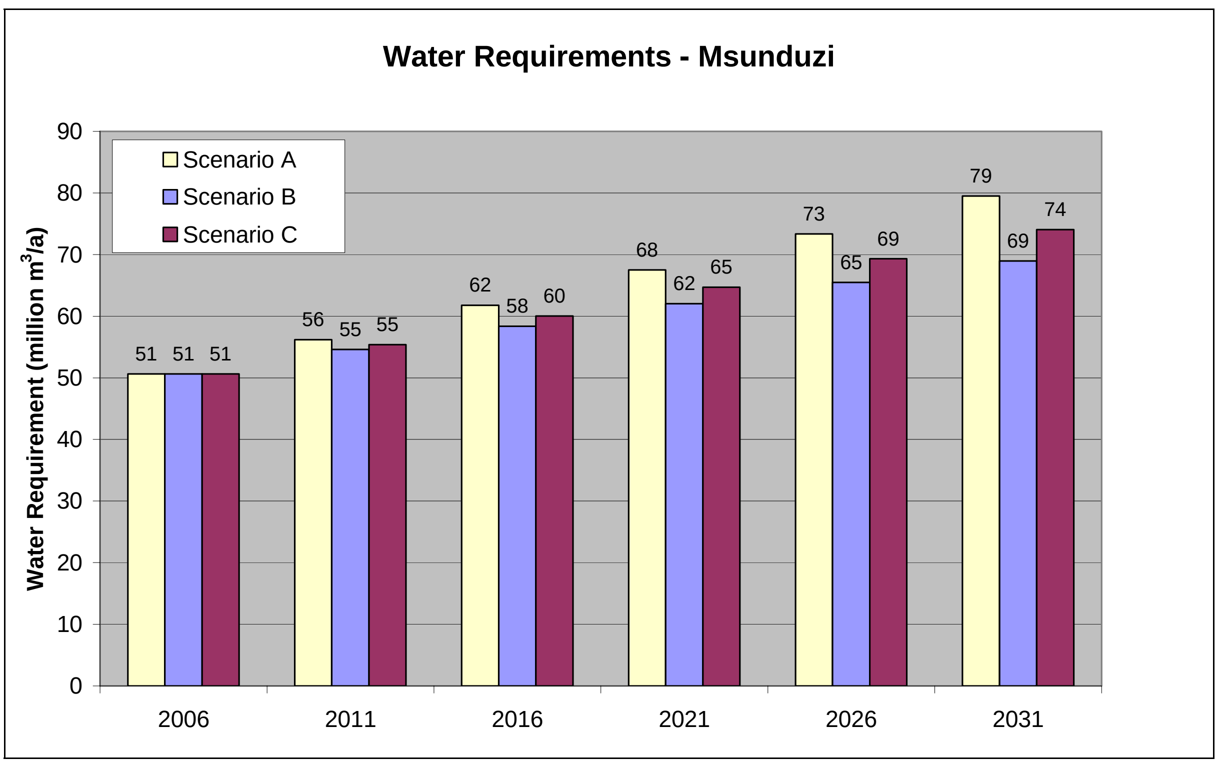


Figure 4.4: Water requirement projections in the Msunduzi Municipal Area

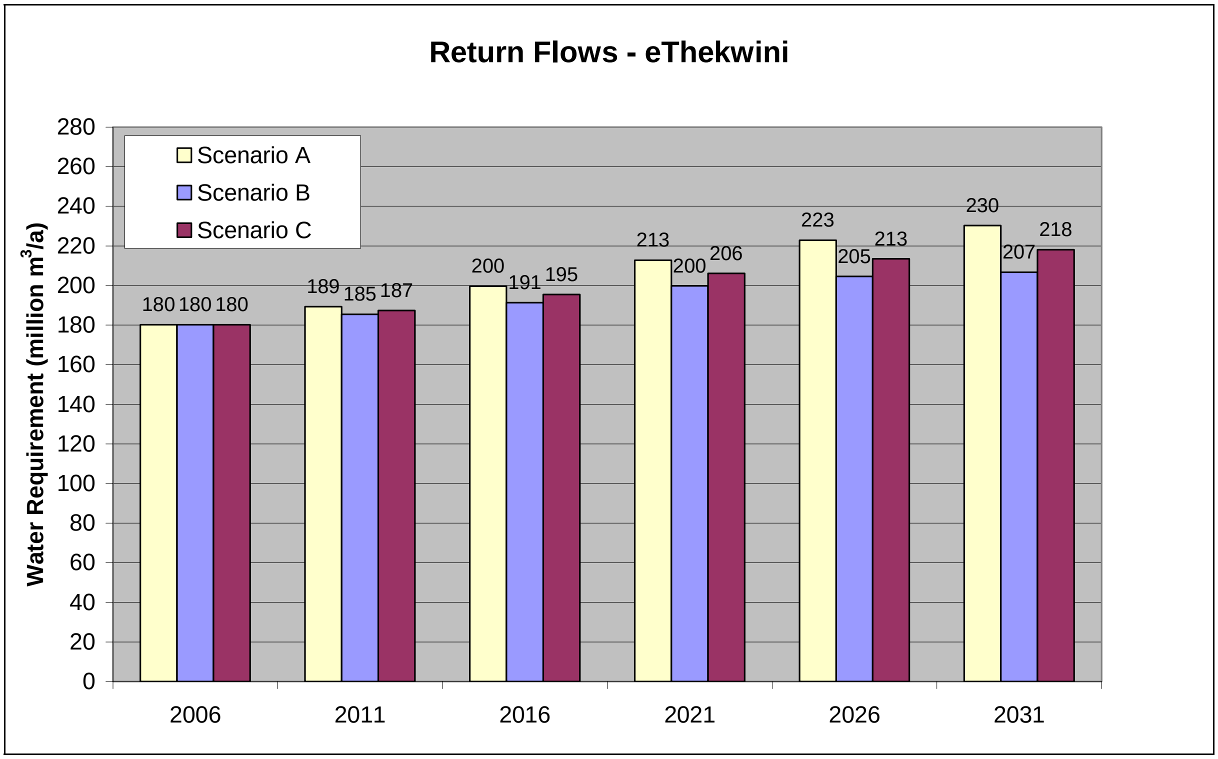


Figure 4.5: Return flow projections for the eThekwini municipal area

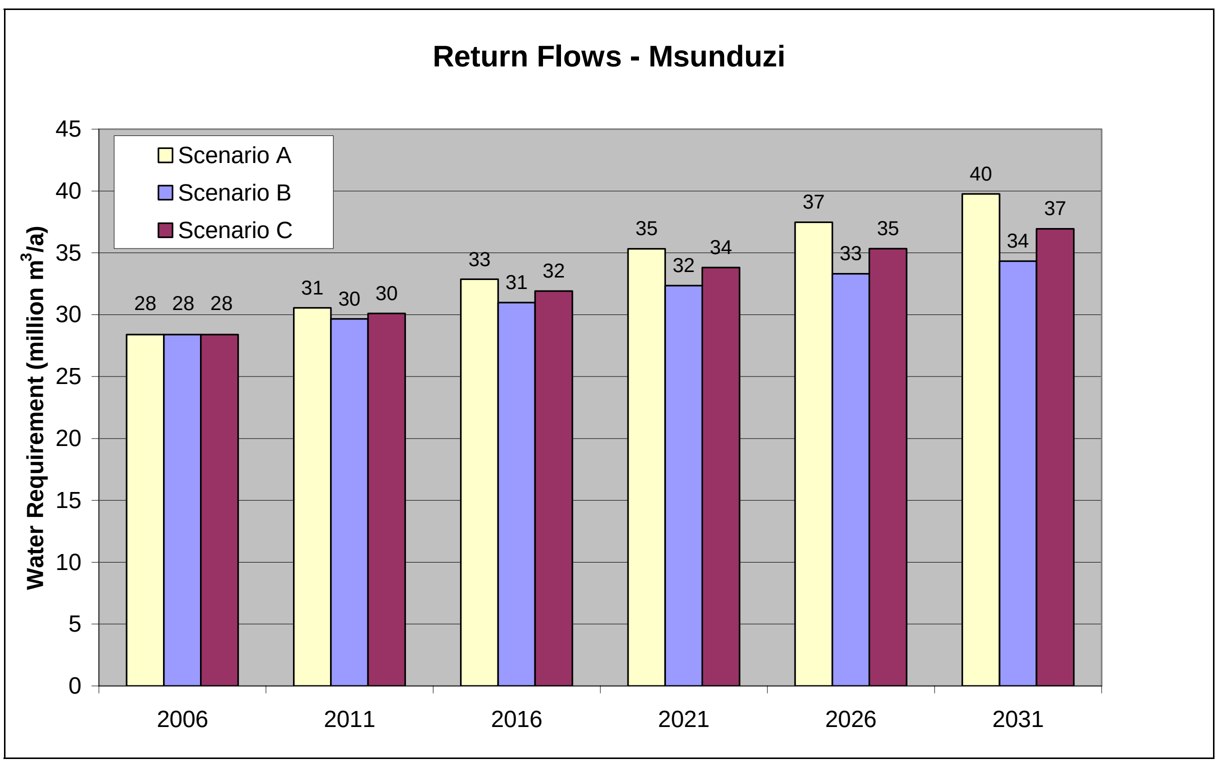


Figure 4.6: Return flow projections for the Msunduzi municipal area

The total gross water requirement projection for the Mgeni River System was developed by combining the water requirement projections of both the Msunduzi and eThekwini municipal areas with the projections derived by Umgeni Water for the portions of uMgungundlovu DM and Ugu DM that are supplied from the Mgeni River. The percentage of the total urban water requirement projection for 2011 (**Scenario A**) supplied to the three main demand centres is illustrated in **Figure 4.7**.

A portion of certain SDA demands in the northern part of eThekwini are also supplied from the Mdloti and Tongaat River System, which were removed from the demand imposed on the Mgeni System. The results for the three water requirement scenarios are illustrated graphically in **Figure 4.8**. The 2008 Umgeni Water requirement projection is also illustrated and is very similar to the **Scenario A** projection up to 2013, after which it drops off and is positioned between **Scenario C** and A for the remainder of the planning period.

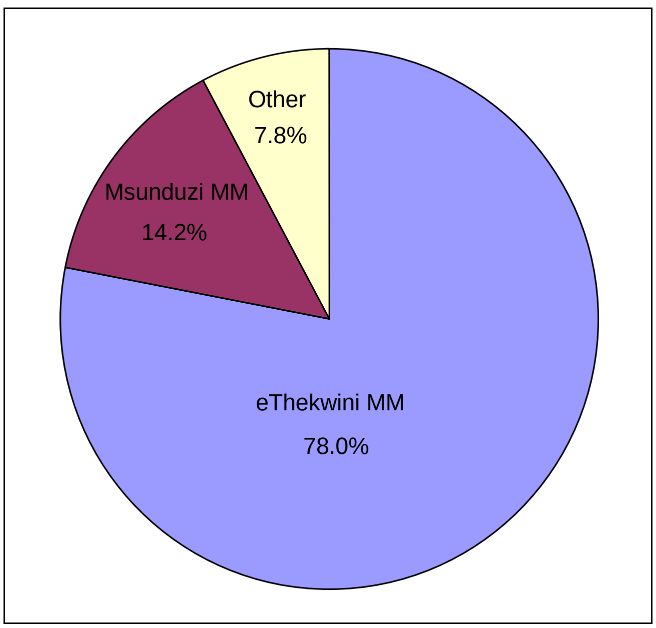


Figure 4.7: Mgeni River System Water requirements

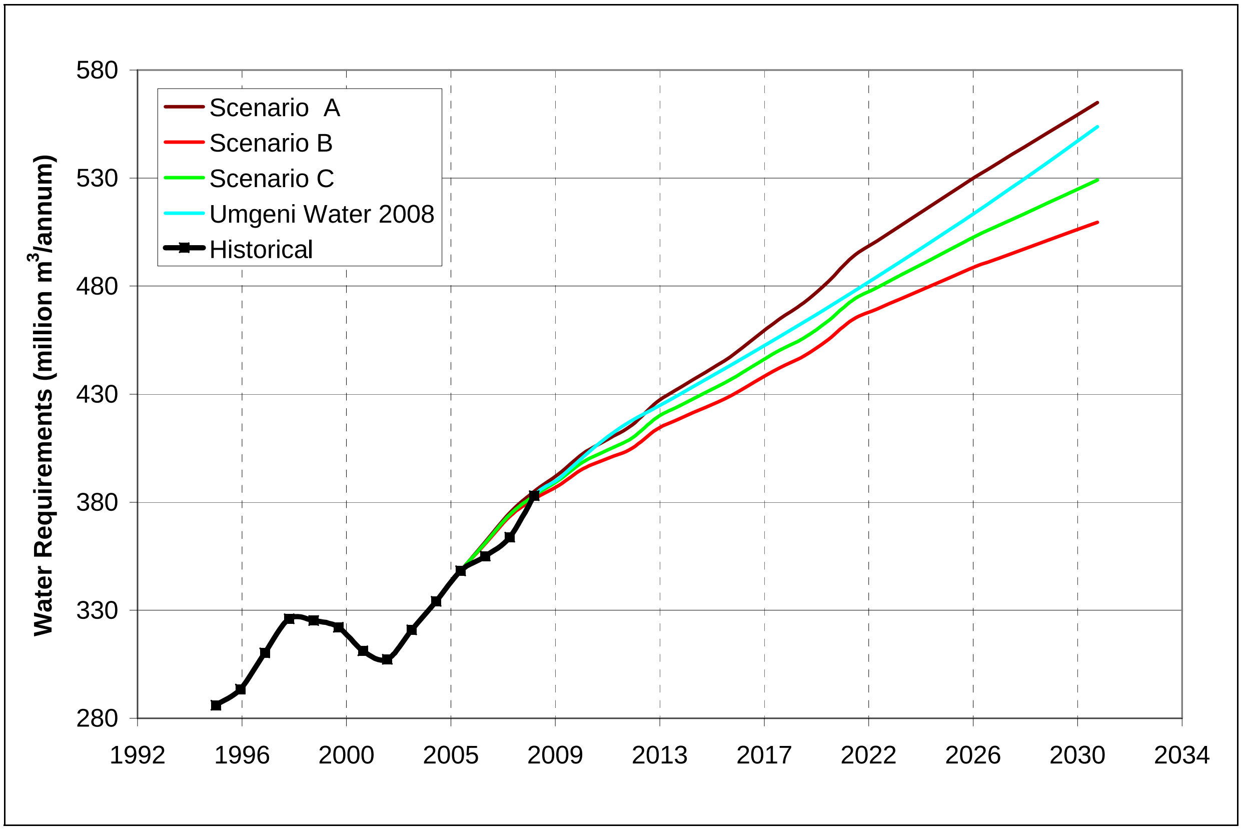


Figure 4.8: Summary of the Mgeni River System urban water requirement scenarios

4.3.4 Mdloti River System water requirement scenarios

The flow in the Mvoti River is regulated by the Hazelmere Dam, which is the source of water supply to the surrounding urban areas and also irrigation (see **Figure A-3** in **Appendix A**). Umgeni Water is the WSA responsible for the operation of the dam as well as the treatment and bulk distribution of the water for urban supply. The areas supplied are northern eThekwini, Siza Water (WSA), surrounding rural areas (Ndwedwe and Groutville) and limited supply to Kwadukuza. In 2006 the total use of the system was 12.0 million m^3/annum, of which 52.2% was supplied to northern eThekwini, 27.0% to Siza Water, 18.5% to Ndwedwe and Groutville and 2.3% to Kwadukuza. Umgeni Water and ILembe DM had compiled recent up to date water requirement scenarios which were adapted for the study.

The Water and Sanitation Master Plan for the iLembe District Municipality (**DWAF, 2007b**) had been completed at the time of the study and contained water requirement projections for the demand centres supplied from the Mdloti System. The projection however excluded the component supplied to the northern parts of eThekwini. The projection for this area was developed using the water requirements and return flow model (**Section 4.3.3**) and the two projections were combined to develop a total water requirement projection (**Scenario M-A**).

The Umgeni Water 2007 projection consists of a combination of projections for the northern parts of eThekwini, Siza Water and additional areas in the ILembe DM supplied from the Mdloti System. The Siza Water and iLembe DM components could further be disaggregated into projections for “approved”, “approval pending” and “conceptual” projects. It was indicted by both Umgeni and Siza Water that several of the approved projects take longer to be developed than expected and that the Umgeni Water Projection is optimistic. The actual consumption in 2007 was also lower than the volume projected by Umgeni Water. Based on these facts, the “approval pending” and “conceptual” categories were removed in order to derive a more realistic water requirement projection (**Scenario M-B**).

A summarised description of the two water requirement projection scenarios are shown **Table 4.6** and are illustrated graphically in **Figure 4.9**.

Table 4.6: Mdloti River System water requirement scenarios

Scenario	Description
Scenario M-A	• iLembe Master Plan projection with the eThekwini component supplied from the Mdloti System included (**Scenario A – Section 4.3.3.2**)
Scenario M-B	• Umgeni Water 2007 projection excluding pending and conceptual developments

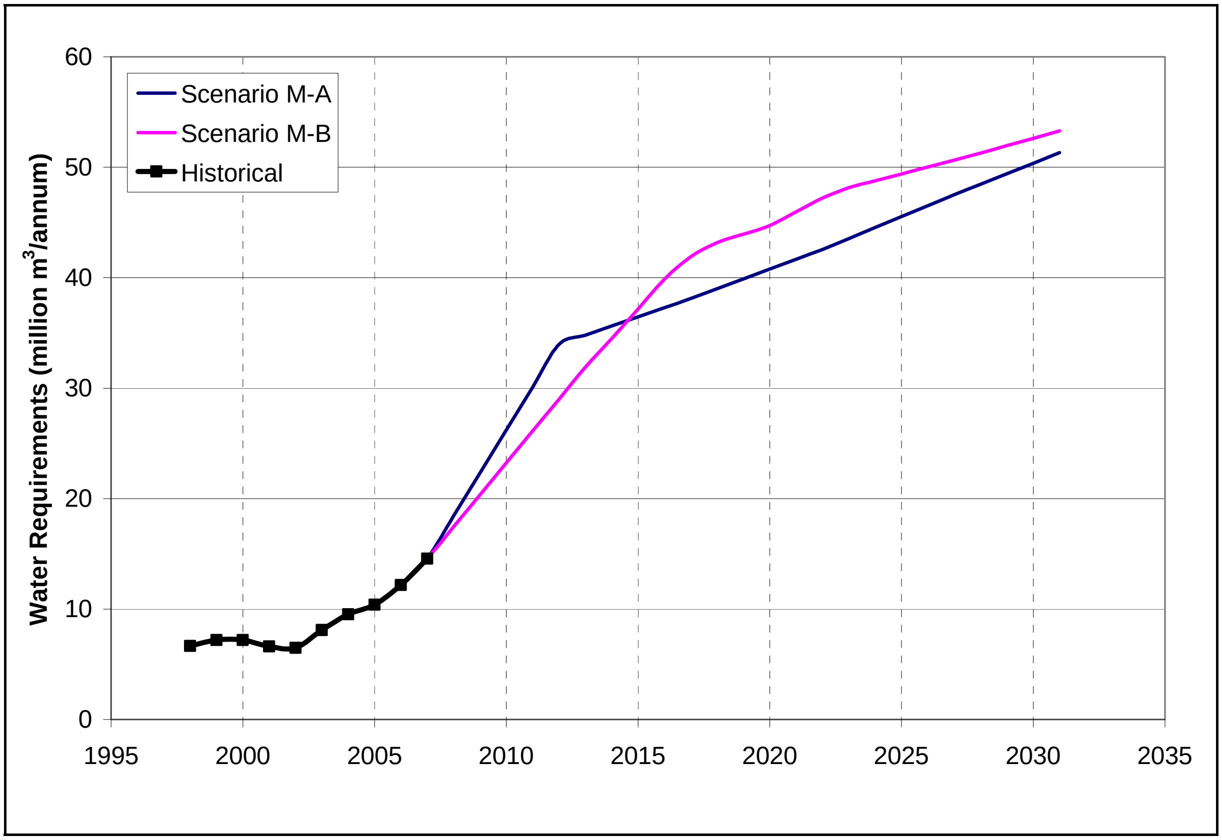


Figure 4.9: Summary of the Mdloti River System water requirement scenarios

4.3.5 Mvoti River System water requirement scenarios

Water is currently supplied from the river abstraction on the Mvoti River System to KwaDukuza via the Mvoti Works. The treatment works have a capacity of 12 Ml/day (4.38 million m^3/annum) which I fully utilised. Additionally, there are two industrial water users also abstracting water directly from the river. These include (**DWAF, 1996b**):

- Sappi fine paper mill (3.6 million m^3/annum)
- Gledhow sugar mill (2.5 million m^3/annum)

According to the Mvoti Dam Feasibility Study: Water Demands report (**DWAF, 1996b**) Glendale sugar mill, distillery and village located upstream of KwaDukuza consumed a total volume of 0.3 million m^3/annum from the Mvoti system. The sugar mill was closed in the late 1990's, while the distillery is still functioning. The water requirement of the distillery is minimal and was regarded as negligible.

Water requirement projections for KwaDukuza and the surrounding towns were sourced from the Water and Sanitation Master Plan for the iLembe District Municipality (**DWAF, 2007b**). These were combined with the industrial demand requirements to produce total water requirement projection for the Mvoti System (**Scenario K-A**) as illustrated in **Figure 4.10**.

The purpose of the ILembe Master Plan was to plan bulk supply schemes to all areas in the ILembe DM area. Water requirement projections were therefore compiled based on the total water requirements that would ultimately be required in the area. It was assumed that the bulk supply scheme will take time to implement. The assumption made was that the total current water use of 10.5 million m^3/annum will increase to what was projected in the ILembe Master Plan by 2012, after which the growth from the ILembe Master Plan was assumed.

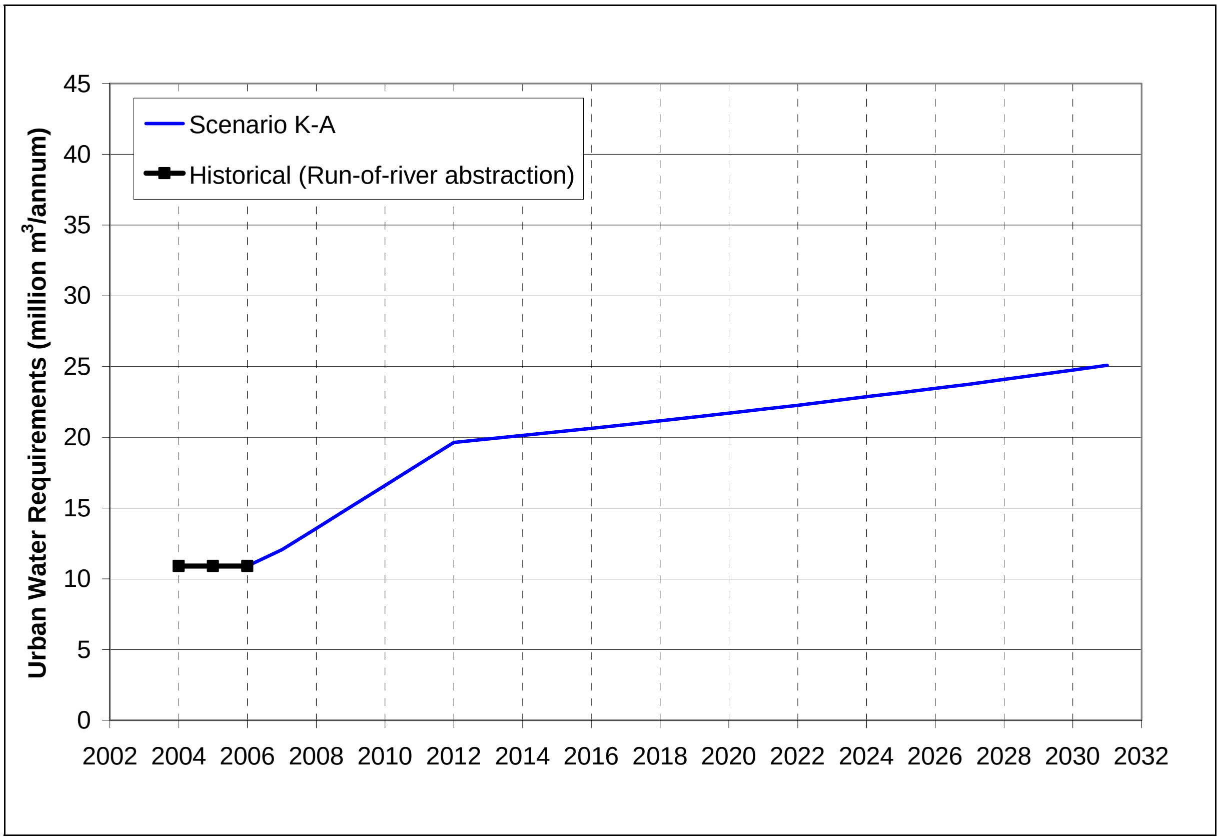


Figure 4.10: Mvoti River System water requirement projection

4.3.6 Lower Thukela River System water requirement scenarios

The lower Thukela River System is defined as the river section between Kranskop and the Thukela Mouth in this report. The three largest abstractions in this part of the river are (see **Figure A-3** in **Appendix A**):

- The Middeldrift abstraction, from where water can be conveyed to the Ngcebo settlement south of the Thukela and also north over the watershed into the Mhlathuze River catchment and thereby serve the needs of greater Richards Bay.
- The Sundumbili abstraction upstream of Mandeni and serves as source for a water treatment works that serves Sundumbili and surrounds.
- The SAPPI abstraction that provides water for the Thukela paper mill of SAPPI, as well as potable water to the town of Mandeni.
- A water requirement projection for the Lower Thukela supply area (**Scenario T-A**) was adopted from the ILembe Master Plan (**DWAF, 2007b**) and included the Ngcebo Scheme supplied from the proposed Middeldrift abstraction and the towns north of the Thukela River supplied from the Sundumbili abstraction (see **Figure A-3** in **Appendix A**). The water requirement projection excludes the existing demands and only includes the projected growth in demands in order to compare the projection to the existing available yield in the Lower Thukela System discussed in **Section 7.1**. The water requirement projection is illustrated in **Figure 4.11**.

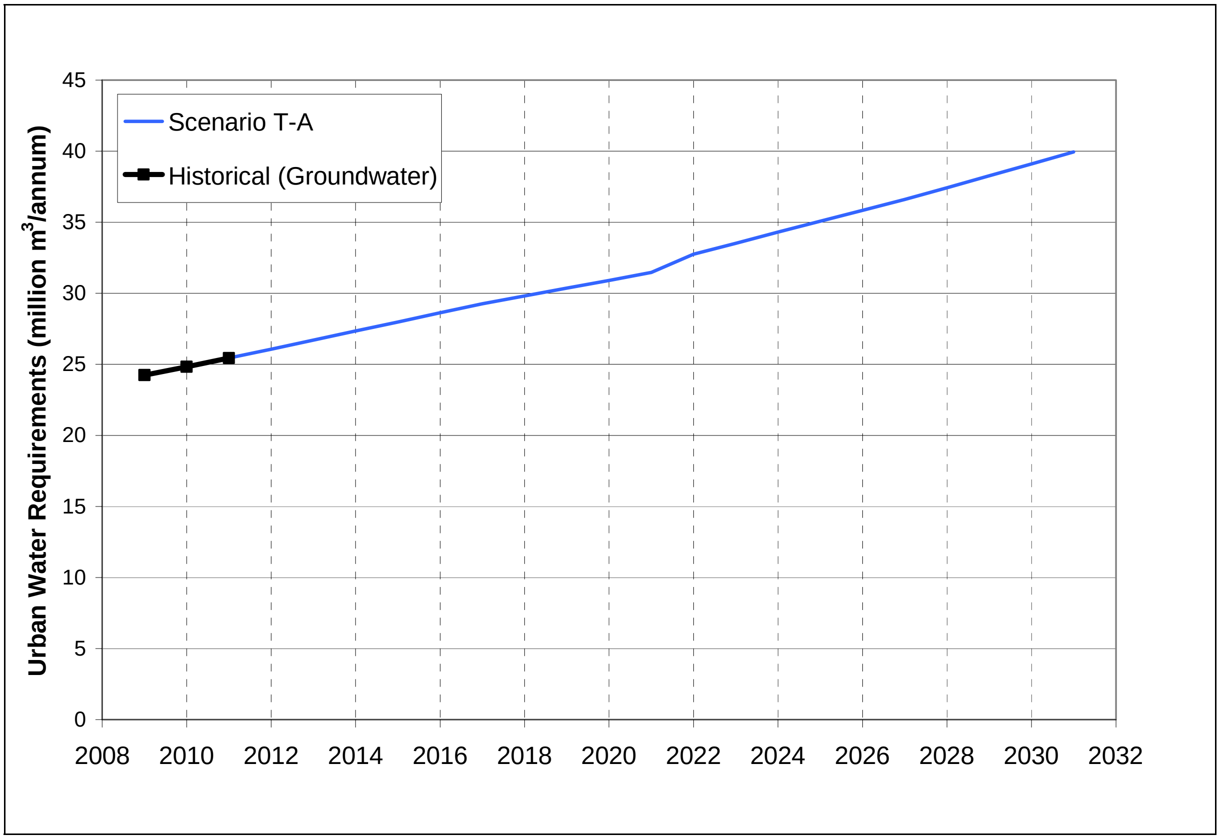


Figure 4.11: Lower Thukela River System water requirement projection

5 WATER CONSERVATION AND WATER DEMAND MANAGEMENT SCENARIOS

The study team focused on the large city centres and key demand centres as they hold the greatest potential for savings. This does not mean that the smaller areas should not undertake WC/WDM, but potential savings in these areas were assumed to be negligible compared with the greater supply area. The following municipalities were focussed on:

- eThekwini Metropolitan Municipality (Durban);
- Msunduzi Municipality (Pietermaritzburg); and
- Ilembe District Municipality which focused on Siza Water Company and KwaDukuza (Stanger)

eThekwini MM has an advanced WC/WDM programme and should be commended for their efforts. It has however been established through the study (in consultation with eThekwini MM) that there is scope for further WC/WDM initiatives in eThekwini. Msunduzi on the other hand has major water loss problems with a very high average consumption. This municipality should embark on a major WC/WDM programme in order to reduce their losses and reduce their consumption.

The water balance for the Siza Water supply area (iLembe DM) showed that there is limited scope for reducing real losses in the area. The objective in this area should be to enforce efficiency measures to reduce customer demand. This could be achieved through tariff increases and consumer awareness. It was established that the water losses in Stanger were not excessive but are to a large extent controlled by the capacity of the Stanger WTW. It is expected that should the capacity increase, the losses will increase and it is proposed that the municipality should also embark on amore extensive WC/WDM programme.

eThekwini and Msunduzi municipalities account for approximately 91% of Umgeni Water's total supply and are the main focus of this report.

5.1 OVERVIEW

Three saving scenarios were developed from the assessment of the potential for water conservation and water demand management (WC/WDM) in the urban sector of the eThekwini and Msunduzi Municipalities. The savings were applied to the water requirement of **Scenario A** (see **Section 4.3.3.2**) and were labelled **Scenarios A.1**, **A.2** and **A.3** respectively. The description and saving results from the scenarios are presented in the following section.

5.2 SCENARIO DESCRIPTIONS

5.2.1 **Scenario A.1**: 5 Years water loss programme

- Water losses can be controlled within the next 5 years (2005 to 2010) and maintained afterwards.
- Very limited water use efficiency is introduced.

This scenario assumes that certain actions can be implemented over a period of 5 years after which the capital costs will decrease and only maintenance costs will remain. This scenario addresses only reduction in wastage with very limited introduction of water use efficiency.

5.2.2 **Scenario A.2**: 5 Years water loss programme and efficiency

- Water losses can be controlled within the next 5 years (2005 to 2010) and maintained afterwards (same as for **Scenario A.1**).
- Water use efficiency is implemented by targeting the billed consumption. It was assumed that a 1% per annum efficiency can be gained from 2015 increasing to approximately 25% in the year 2025.

This scenario is the most optimistic with regard to the savings that can be achieved and involves both savings from the Non-Revenue Water as well as savings from the Revenue Water, which are assumed to take place over 5 years and 10 years respectively.

The savings from the non-revenue water concentrate on issues such as leakage detection and repair in areas where consumers have high levels of payment and any losses after the customer meter are basically considered to be part of the customer demand – normally these losses are relatively small since the customer will identify any household leakage and repair the leaks quickly. In the case of areas where the level of payment is very low or is based on a “lump-sum” tariff, the losses tend to be greatest inside the properties after the consumer meter. In many cases, no accounts are sent to the consumers or the accounts are so high that they are generally ignored and payment will never be received by the Municipality. In such areas, the general monthly water demand per property (assuming that there is full 24-hour supply) is usually between 35 m^3/month and 55 m^3/month. If the water use can be controlled in some manner through proper metering with billing and cost recovery (often using pre-paid meters etc), the water demand tends to drop to approximately 10 m^3/month. In many cases, the revenue generated from the water sales is insufficient to justify the expense of metering and billing, however, the real saving to the municipality can be in the order of 40 m^3/month, which is often sufficient to justify major investment.

In the medium and high-income areas, the main WC/WDM measures that can be used to reduce wastage (reduction in customer demand is not considered at this stage) concentrated on the reduction in losses from physical leakage before the customer meter. In these areas, most of the water supplied to consumers is both metered and paid for by the consumer and therefore wastage inside the properties tends to be relatively small and is not the serious problem that exists in many of the low income areas. Although the physical leakage is considered to be the main problem in the middle and high income areas, the levels of leakage tend to be relatively small compared to the levels experienced in the low income areas and therefore the potential savings that can be achieved are also small.

This is scenario is potentially problematic for the water utilities since their capital costs and much of their operational costs are fixed while the income is dependant on the water sales. To reduce the overall demand can cause problems to the financial viability of a water utility.

In **Scenario A.2**, it was also assumed that some savings could be achieved through more efficient water practices inside the properties. This typically involves the use of water efficient appliances (washing machines, toilet cisterns etc) as well as low flow shower heads and water efficient gardens where irrigation is either not required or significantly reduced. .

5.2.3 **Scenario A.3**: 10 Years water loss programme

- Water losses can be controlled within the next 10 years (2005 to 2010) and maintained afterwards.
- No water use efficiency is introduced.

Scenario A.3 is basically the same as **Scenario A.1** and only addresses the reduction in wastage. This scenario, however, assumes that certain actions can only be implemented over a period of 10 years, which is considered to be more easily achievable than **Scenario A.1**, based on practical experience gained by the project team from numerous WC/WDM projects.

5.2.4 Potential savings and net system water requirements

Table 5.1, **Table 5.2** and **Table 5.3** present the savings that can be achieved for each of the scenarios described above (savings are shown in **Row b** of each tables). It was assumed that the WC/WDM measures will also impact on the return flows. The return flows from the Msunduzi

Municipality contribute to the resources utilised by eThekwini and hence the reduction needed to be accounted for as reflected in **Row c**. The overall impact on the net system water requirement is determined in **Row d**, and **Row e** provides the total system net water requirement. The gross system water requirement (including treatment works losses of 4%) is reflected in **Row f**. The results of the three scenarios are illustrated graphically in **Figure 5.1**.

Table 5.1: Savings and system net water requirements for Scenario A.1

Row	Component Description	Planning Years					
		2007	2011	2016	2021	2026	2031
a	Nett System Demand	360.7	393.3	430.0	474.5	510.1	543.2
b	Reduction in Water Requirements	5.4	33.8	42.7	44.9	47.2	49.6
c	Reduction in Msunduzi LM Return Flows	0.2	4.6	5.9	6.2	6.5	6.9
d	Net Reduction	5.2	29.2	36.8	38.7	40.7	42.7
e	System Nett Demand	355.5	364.1	393.2	435.8	469.4	500.5
f	System Gross Demand	369.7	378.6	408.9	453.3	488.2	520.5

Notes: (1) All volumetric values are given in million m^3/annum. Table 5.2: Savings and system net water requirements for Scenario A.2

Row	Component Description	Planning Years					
		2007	2011	2016	2021	2026	2031
a	Nett System Demand	360.7	393.3	430.0	474.5	510.1	543.2
b	Reduction in Water Requirements	5.4	33.8	61.4	91.9	113.0	121.7
c	Reduction in Msunduzi LM Return Flows	0.2	4.6	6.9	8.8	10.1	10.8
d	Net Reduction	5.2	29.2	54.5	83.1	102.9	110.9
e	System Nett Demand	355.5	364.1	375.5	391.4	407.2	432.4
f	System Gross Demand	369.7	378.6	390.6	407.1	423.5	449.7

Notes: (1) All volumetric values are given in million m^3/annum.

Table 5.3: Savings and system net water requirements for Scenario A.3

Row	Component Description	Planning Years					
		2007	2011	2016	2021	2026	2031
a	Nett System Demand	360.7	393.3	430.0	474.5	510.1	543.2
b	Reduction in Water Requirements	5.4	20.1	39.2	44.9	47.2	49.6
c	Reduction in Msunduzi LM Return Flows	0.2	2.4	5.4	6.2	6.5	6.9
d	Net Reduction	5.2	17.7	33.8	38.7	40.7	42.7
e	System Nett Demand	355.5	375.7	396.1	435.8	469.4	500.5
f	System Gross Demand	369.7	390.7	412.0	453.3	488.2	520.5

Notes: (1) All volumetric values are given in million m^3/annum.

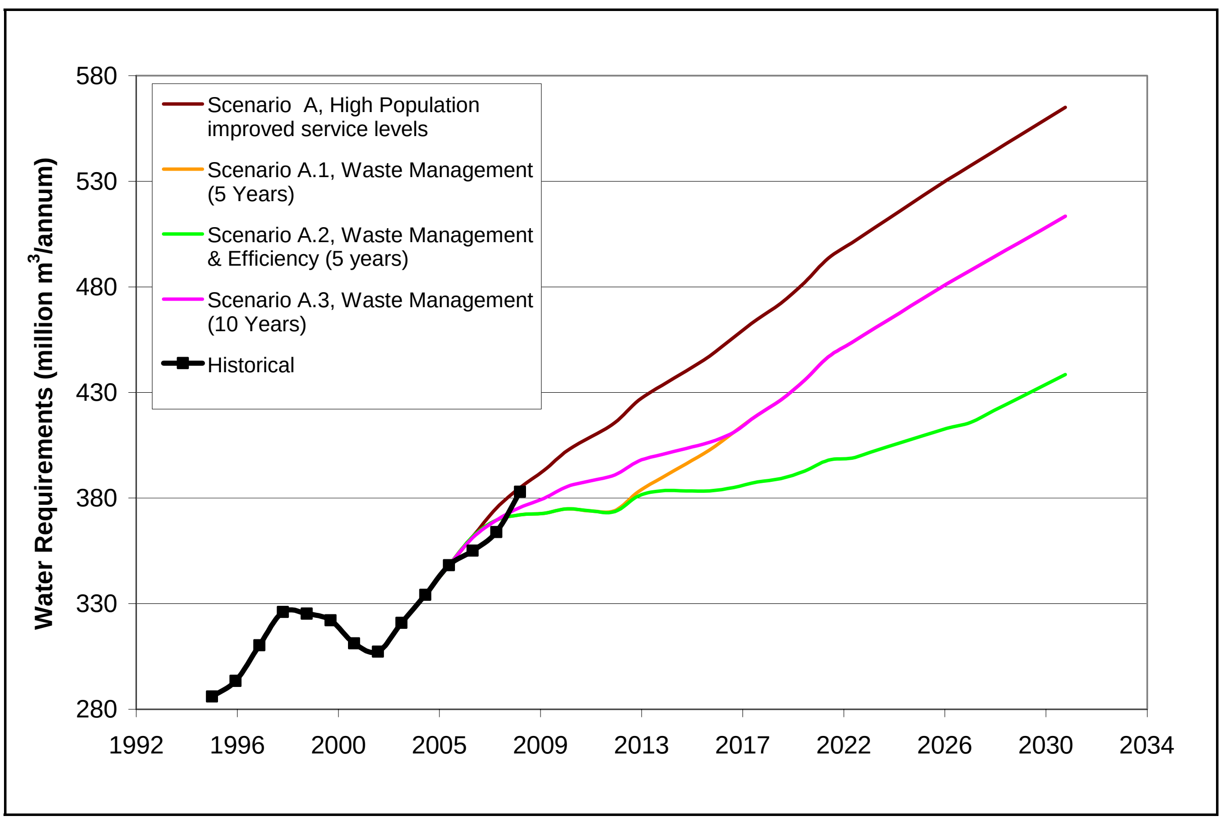


Figure 5.1: Summary of the Mgeni River System water requirement scenarios (WC/WDM)

These water requirements and return flows were used to compile the reconciliation scenarios, which are presented in **Section 7.3**.

5.3 WC/WDM RELATED CONCLUSIONS AND RECOMMENDATIONS

From the assessment of the scope for WC/WDM in the KZN metropolitan areas several key issues were identified, from which the following conclusions and recommendations were made:

- WC/WDM can provide a significant reduction in the water demands in the area if the measures are implemented properly and maintained indefinitely. The cost of implementing WC/WDM measures is often less that the maintenance costs, which are often overlooked with the result that the WC/WDM interventions fail within a year or two of being implemented.
- The potential savings that can be achieved in the study area range from a maximum optimistic estimate of approximately 86 million m3/annum (**Scenario 2**) in the year 2024 to a more conservative and possibly realistic estimate of 40 million m^3/annum (**Scenario 1** and **3**).
- Garden irrigation using potable water is a huge problem in many low income areas where indiscriminate use of hosepipes and potable water is creating both supply and pressure problems. The use of hosepipes must be either banned completely in such areas or the use restricted to an hour or two every 2nd day during off-peak periods. Irrigation during the hottest part of the day (from 10h00 to 18h00) should be prohibited simply on efficiency grounds.
- Government Departments must co-ordinate their efforts with regard to WC/WDM. The efforts of DWAF where the Department is spending large budgets to educate consumers on the evils of hosepipe irrigation is being undermined by the efforts of the Department of Agriculture, where it is providing free hosepipes to the same consumers to grow vegetables. Those wishing to grow vegetables in such areas should be provided with buckets or watering cans, which can still be used with good effect without causing the system problems mentioned previously. Alternatively, roof tanks should be provided to capture rainwater, which is ideal for such irrigation.
- DWAF should encourage WDM activities – e.g. fund projects like, provide subsidies for roof tanks and low flush toilets etc. The Department should not encourage use of low quality fixtures in township retrofitting projects and should rather use the highest quality pipes,

meters and fittings for poor areas since the taps and toilets in these areas experience highest use and lower quality fittings will not last.

- Lack of maintenance will result in many systems deteriorating into intermittent supply if action is not taken quickly – particularly in township systems where lack of maintenance has occurred over past 30 years.
- Municipalities should be encouraged to combine technical and financial services into a single unit – current trend of separate billing/treasury from water supply/technical is causing major problems and a proper water audit is often not possible since the split between real and apparent losses cannot be established with confidence.

6 INFRASTRUCUTRE INTERVENTION OPTIONS

6.1 OVERVIEW

Given the water requirement and return flow scenarios provided in **Section 4**, and the potential saving scenarios through WC/WDM measures presented in **Section 5.2.4**, the need for intervention (when further WC/WDM measure and/or the development of an augmentation scheme is required) can be determined by assessing the water reconciliation (water balance) situation over the planning period. This was undertaken by firstly defining the reconciliation scenarios and, secondly, carrying out scheduling analysis to determine the date when further intervention should be required.

Various studies have been completed on further possible water resources developments on the various river systems in the study area. The different augmentation options considered are summarised below. The reader is referred to the Infrastructure report of the same study for more details on the different water resources development options (**DWAF, 2008c**)

6.1.1 Mooi-Mgeni Transfer Scheme Phase 2 (Springrove Dam)

The Mooi-Mgeni Transfer Scheme currently consists of the Mearns Weir on the Mooi River, from where water is abstracted and pumped over the catchment divide as an inter basin transfer into Midmar Dam.

The Mgeni River System Analysis Study (**DWAF, 1994**), the Mooi-Mgeni Transfer Scheme Pre-feasibility Study (**DWAF, 1999**) and the Mooi-Mgeni River Transfer Scheme Phase 2 (MMTS-2) Feasibility Study (**DWAF, 2007c**) conducted by UW and DWAF have identified that further water resource developments on the Mooi River to transfer adequate water to the Mgeni system are feasible and it was confirmed that Phase 2 of the scheme should be implemented. The proposed scheme consists of a large storage dam on the Mooi River at Springrove and a pump station and transfer infrastructure to transfer the water to Mgeni system. The yield of the Spring Grove Dam has been determined as 60 million m^3/a (**DWAF, 2007c**).

DWAF recently approved the scheme and directed the Trans-Caledon Tunnel Authority (TCTA) to implement Phase 2 of the Mooi-Mgeni Transfer Scheme. According to the implementation programme the scheme should be completed by 2012.

6.1.2 Mkomazi-Mgeni Transfer Scheme Phase 1 (Smithfield Dam)

In 1997, DWAF initiated the Mkomazi-Mgeni Transfer Scheme Pre-Feasibility Study, which investigated transfer water from the upper Mkomazi River to the Mgeni System (**DWAF, 1999b**). Phase 1 of the scheme consists of a dam on the Mkomazi River near Smithfield, with a pump station and transfer tunnel to the Mlazi River near Baynesfield and conveyance and treatment and infrastructure supplying potable water to a proposed reservoir at Umlaas Road.

Only Phase 1 of the scheme was considered in this study. The yield for Smithfield Dam has been determined as 147 million m³/a (**DWAF, 1999b**). According to the implementation programme, 10.5 years are required for the implementation of the scheme. If the design were to commence in July 2008 along with approval processes and annual budget allocations, then it is estimated that the scheme will be able to supply water by the end of 2018.

6.1.3 Mvoti River development (IsiThundu Dam)

The Mvoti River Dam Feasibility Study was initiated in 1995 by DWAF and UW (**DWAF, 1996a**). The objective of the study was to find and develop an acceptable proposal to provide storage for all users on the Mvoti River. The study concluded that a 51 million m³ gross storage capacity dam at IsiThundu should be constructed, which could be raised by 15m (102 m³ gross storage) as phase 2 of the development.

The proposed option consists of the IsiThundu Dam (102 m³ gross storage) on the Mvoti River, upgraded abstraction works and transfer infrastructure to a new off-channel storage dam, a pump station and treatment infrastructure. The yield for IsiThundu Dam has been estimated as 46.3 million m³/a (**DWAF, 1996b**). According to the implementation programme 10 years are required for implementing the scheme. If it is assumed that planning is to commence in July 2008 along with approval processes and annual budget allocations, then it is estimated that the scheme will be able to produce water by 2018.

6.1.4 Lower Thukela Scheme

The lower Thukela River was defined as the river section between Kranskop and the Thukela Mouth for the purpose of this study. The maximum yield available in the Lower Thukela was estimated as 77 million m³/a. The yield included the available yield in the lower Thukela of 45 million m³/annum and the unused allocation to Mhlathuze Water of 32 million m³/annum (see **Section 7.1** for more detail).

The proposed scheme consists of constructing abstraction works, a pump station at the existing gauging weir at Mandini and transfer and water treatment infrastructure to supply the KwaDukuza and surrounding areas. According to the implementation programme, 5 years are required for the implementation of the scheme.

6.1.5 Waste water re-use options

Due to the long implementation periods of some of the development options identified, the possibility to implement sewage re-use options were investigated to bridge the gap in the short term period, as the implementation timeframes are relatively short.

Three types of re-use options were investigated:

- Direct Re-use (potable water)
- Indirect Re-use (into dam)
- Indirect Re-use (irrigation)

Based on the economic analysis results, indirect re-use was established as the most feasible option and was investigated further.

The total return flow volumes generated from the eThekwini and Msunduzi municipal areas in 2006 are 57% of the total water use (195.0 million m^3/annum). Of the total return flows generated, certain waste water treatment works (WWTW) were identified to be utilised for domestic re-use purposes based on their location, return flow volumes and the industrial component of the effluent. Effluent with an industrial component of 10% or less was regarded as suitable for domestic re-use purposes and effluent with an industrial component of more than 10% as only suitable for industrial purposes. The return flow and potential re-use projection volumes are shown in **Table 6.1.**

Table 6.1: eThekwini and Msunduzi return flow volumes

Description	Return Flow Volumes (million m^3/annum)					
	2006	2011	2016	2021	2026	2031
Total Effluent	195.0	206.4	219.0	234.5	246.8	256.6
Unsuitable Due to Location and Size (including Darvil)	40.2	43.0	46.0	49.5	52.9	55.7
Total Volume Remaining	154.8	163.4	173.0	185.1	193.9	200.8
Suitable for Industrial Re-use Only	89.4	92.5	95.7	100.3	102.5	104.4
Remaining Suitable for Urban Re-use	65.4	70.9	77.3	84.7	91.3	96.4
Total Re-use applied in Scenarios I-IV	48.0	48.0	48.0	48.0	48.0	48.0
Total Re-use applied in Scenarios V	65.4	70.8	77.2	84.6	91.2	96.2

The following WWTW were identified as possible re-use options for domestic purposes:

- Tongaat Central (Mdloti supply area)
- Verulam (Mdloti supply area)
- Phoenix (Mdloti supply area)
- Kwamashu (Mdloti or Mgeni supply area)
- Northern (Mgeni supply area)

Umhlanga and Amanzimtoti were also identified, but are not as favourable due to their small return flow volumes and location respectively. The locations of these WWTW are shown in **Figure 6.1**. At the time of the study, the implementation of infrastructure for the diversion of the Phoenix WWTW to the Mgeni System was in the process of being finalised. As a result, the Phoenix re-use option was not included in most of the reconciliation scenarios discussed in **Section 7**. Due to its favourable location with regards to the Mdloti system and the significant volumes available, the study team felt that it should still be seen as a possible re-use option should additional volumes be required in the Mdloti System, and was thus included in **Scenario V** was thus included in **Scenario V** of the reconciliation scenarios.

The advantage of re-use for augmenting the current water supply is that the implementation timeframes are faster than the larger infrastructure development options. Due to the current water resources situation in the study area (all river systems are currently in deficit), re-use formed part of all the reconciliation options (see **Section 7.4)** except for **Scenario VI**, where the aim of the scenario was to illustrate the impacts of not implementing the re-use options.

Development time frame for this option was reviewed and the result is that approximately 6 years are required for implementation.

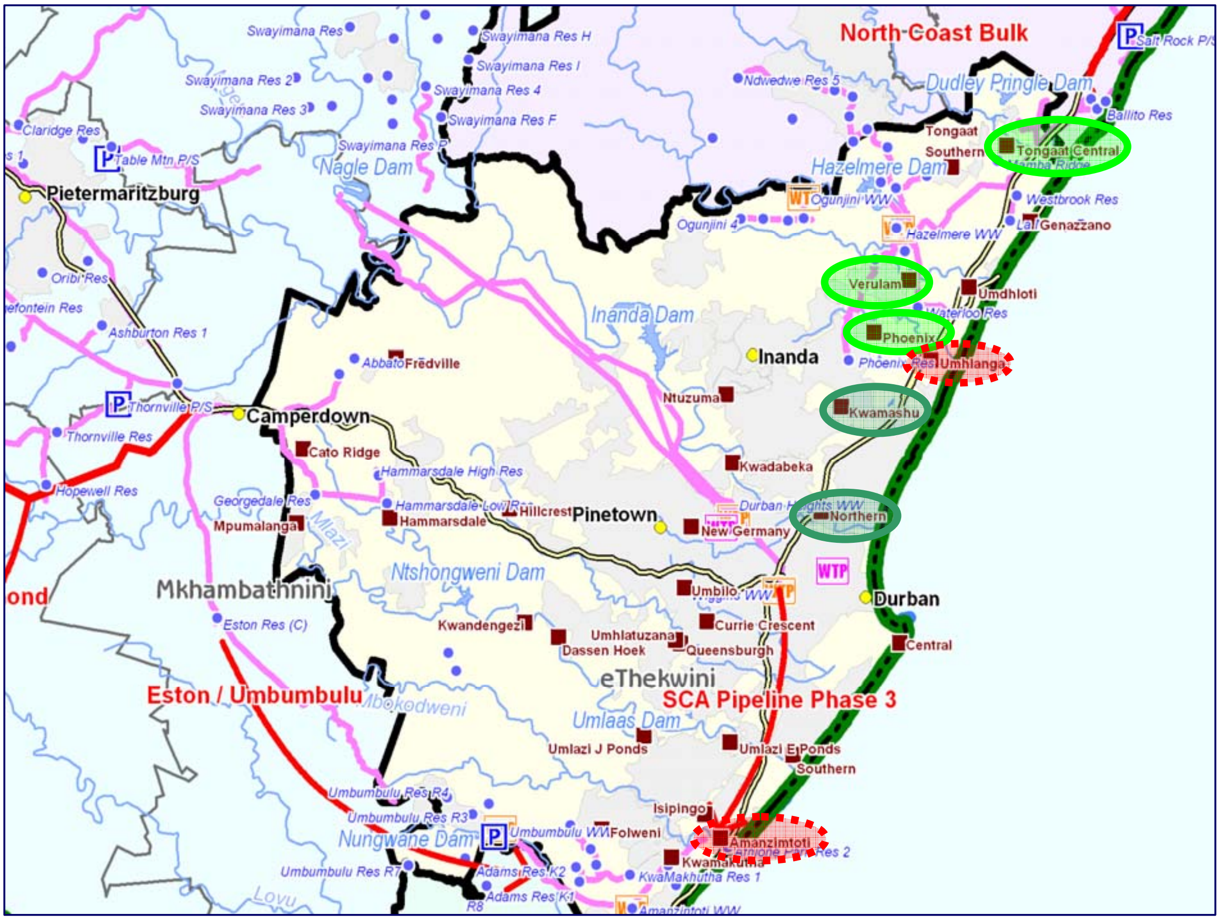


Figure 6.1: Location of identified re-use options

7 EXISTING SUPPLY SITUATION AND RECONCILIATION SCENARIOS

The projected water balance for the existing water resources (excluding interventions) within the various river systems was investigated. Based on the results, the need for interventions was identified. Several reconciliation options were formulated based on the scenarios described in this section and the augmentation options presented in **Section 6.2.** The findings are presented in the subsequent sections.

7.1 EXISTING SUPPLY SITUATION

The projected water balance for the existing water resources within the various river systems in the study area are shown in **Figures 6.2** to **6.6**. The total Mgeni System and the Upper Mgeni System are shown in **Figure 7.1** and **Figure 7.2** respectively. The Upper Mgeni System was analysed separately as the water is abstracted in the upper reaches of the river and thus has a limited source of supply. The water requirement **Scenario A** (no WC/WDM initiatives) is illustrated in both figures.

The total Mgeni System has a deficit (negative water balance) of 40 million m^3/annum in 2008, which grows to 201 million m^3/annum by 2030 and interventions are thus urgently required. The increase in yield illustrated in **Figure 7.1** is as a result of the growth in return flows at the Darvill treatment works that enter the Mgeni System below Pietermaritzburg and hence contribute to the yield of the lower Mgeni. The Upper Mgeni is in balance up to 2028 and a slight deficit is projected up to 2030.

The water balance for the Mdloti System is illustrated in **Figure 7.3** and the two water requirement scenarios, **Scenario M-A** (ILembe Master Plan + eThekwini **Scenario A**) and **Scenario M-B** (Umgeni Water scenario excluding the pending and conceptual planned developments) are illustrated. The two water requirement scenarios are similar, with **Scenario M-B** being the more conservative projection. The Mdloti System has a deficit of 2 million m^3/annum in 2008, which grows to 47 million m^3/annum by 2030 and interventions are urgently required. The decrease in yield illustrated in the figure is as a result of siltation in the Hazelmere Dam as described in the Raising of Hazelmere Dam Feasibility Study: Hydrology Report (**DWAF, 2003**).

The Mvoti System water balance is shown in **Figure 7.4**. The shown water requirement scenario was adapted from the ILembe Master Plan (**DWAF, 2007b**). The indicated system yield is for the current run-of-river abstraction for the Mvoti treatment works (undeveloped Mvoti System) that currently supplies KwaDukuza. The projection includes additional towns and villages in the surrounding area, currently supplied from other sources. Due to these additional demand centres, the projection gradient is steep for the period from 2006 to 2012. The system is currently in deficit as the additional supply to these areas is implemented and the projected deficit is 20 million m^3/annum in 2030. Interventions will thus be required.

According to the ISP: Thukela Water Management Area, the current available yield in the Lower Thukela River System is approximately 45 million m^3/annum (**Figure 7.5**), given that support is provided from Wagendrift and Spionkop dams (**DWAF, 2004c**). An additional volume of 32 million m^3/annum has been allocated to Mhlathuze Water for the proposed Fairbreeze Mine option, which has not been utilised over the past years. The total volume currently unutilised is thus 77 million m^3/annum. A planning analysis of the Mhlathuze River System (**Mhlathuze, 2004**) indicated that no augmentation is necessary for the planning period up to 2030, should the Medium Demand Scenario realise. If the High Demand Scenario realises, which excludes the impact of major additional WC/WDM initiatives, augmentation to the Mhlathuze River System is required in 2014. Based on these facts, the Mhlathuze allocation was incorporated into the total yield available from the Lower Thukela in some of the scenarios analysed. The indicated water requirement projection includes the projection for the villages north of the Thukela River, which are currently supplied by the Sundumbili treatment works.

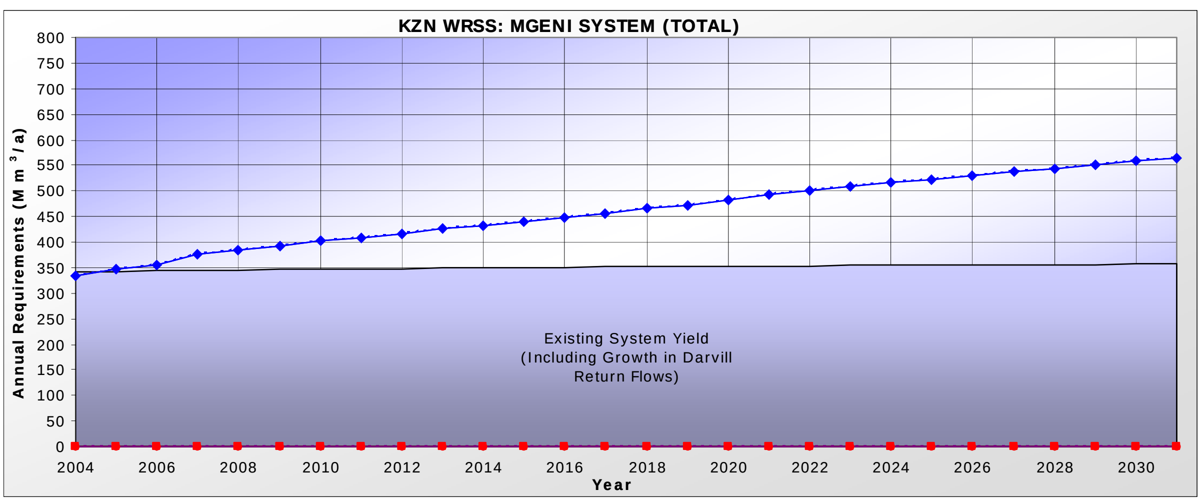


Figure 7.1: Water balance diagram of the existing total Mgeni River System

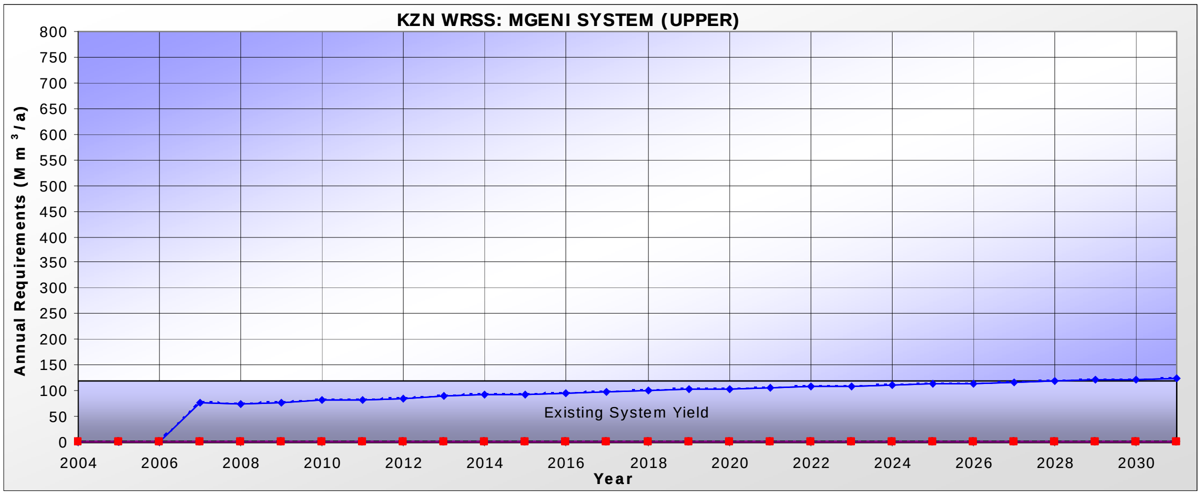


Figure 7.2: Water balance diagram of the existing Upper Mgeni River System

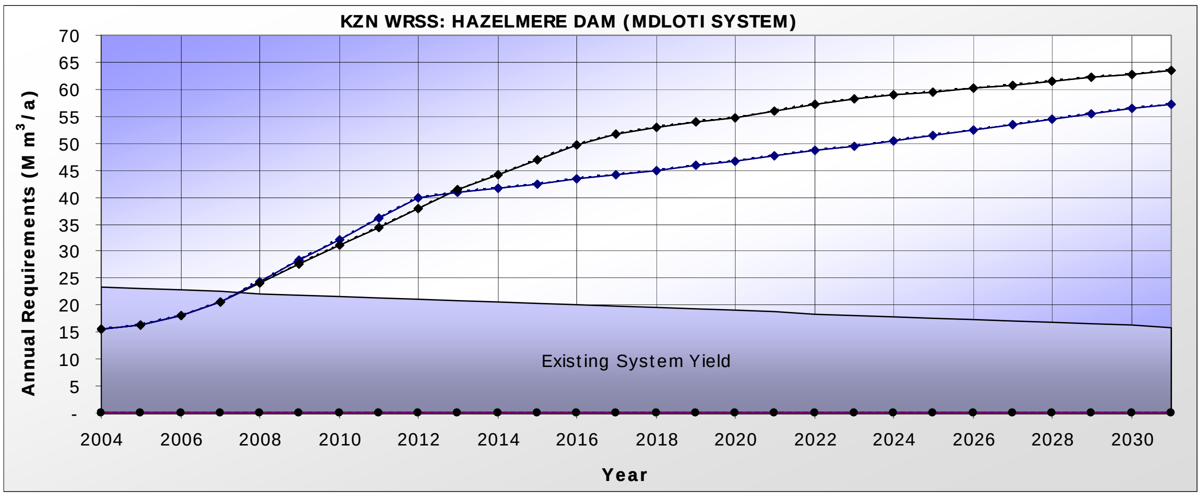


Figure 7.3: Water balance diagram of the existing Mdloti River System

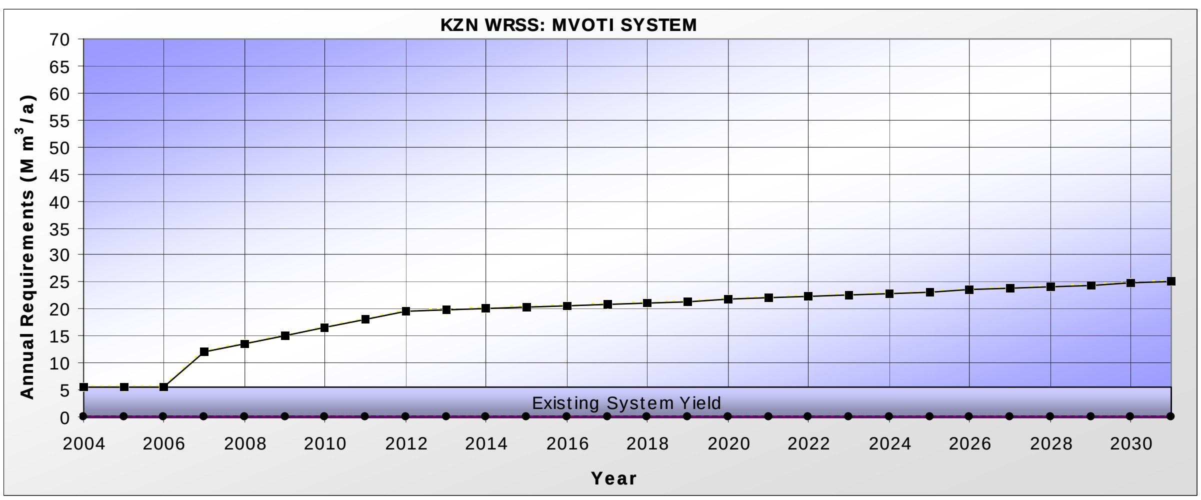


Figure 7.4: Water balance diagram of the existing Mvoti River System

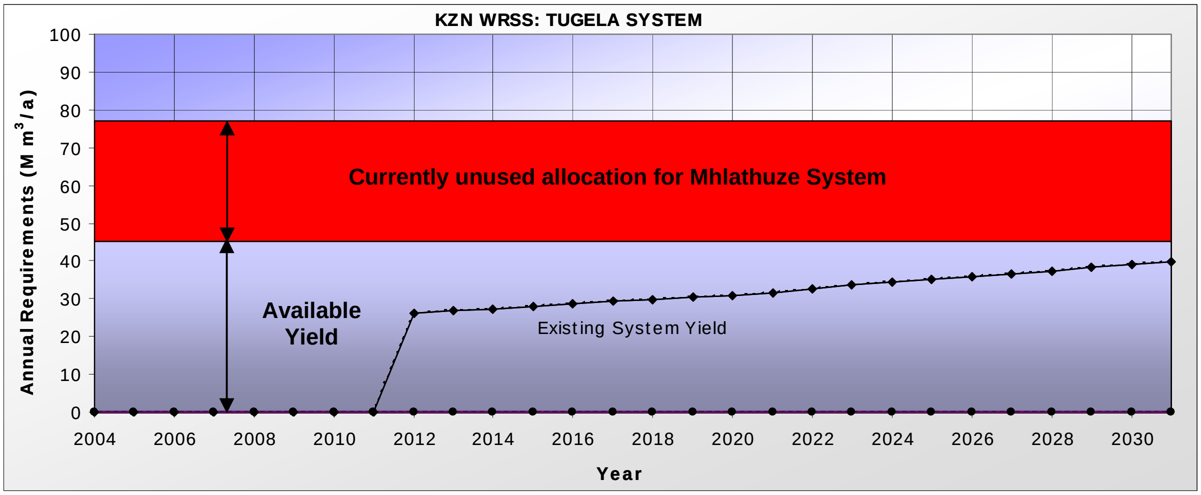


Figure 7.5: Water balance diagram of the existing Lower Thukela System

7.2 RECONCILIATION SCENARIOS

Based on the results of the existing supply situation, different scenarios were formulated to reconcile the future demands with supply. The six scenarios (**Scenario I** to **Scenario VI**) investigated are discussed in **Section 7.2.1** to Section **7.2.6**.

7.2.1 Scenario I

Scenario I investigated the option of utilising the Lower Thukela Scheme for supplying and supporting the Mvoti and Mdloti supply areas respectively. The various interventions for the Mgeni System were also investigated. **Scenario I** included the following water requirement scenario and interventions:

- **Scenario A.1** water requirement projection (Mgeni System) i.e. Waste management over 5 years
- Implementation of the Lower Thukela Transfer Scheme to support KwaDukuza and the Mdloti System (Historic Firm Yield (HFY) = 77 million m^3/annum)
- Raising of Hazelmere Dam (1:100 Stochastic Yield = 8.90 million m^3/annum)
- Incorporation of indirect water re-use (KwaMashu WWTW= 23.00 million m^3/annum, North Coast WWTW's = 5.25 million m^3/annum, Northern WWTW = 19.70 million m^3/annum)
- Implementation of the Mooi-Mgeni Transfer Scheme (MMTS) Phase 2 (Springrove Dam: 1:100 Stochastic Yield = 60.00 million m^3/annum)

- Implementation of the Mkomazi-Mgeni Transfer Scheme (Smithfield Dam: 1:100 Stochastic Yield = 147.00 million m^3/annum)

7.2.2 Scenario II

Scenario II investigated the option of developing the Mvoti River for supplying and supporting the Mvoti and Mdloti supply areas respectively. The purpose of **Scenario I** and **II** was to investigate the two alternative options in order to observe their respective constraints and opportunities. The following assumptions were made:

- **Scenario A.1** water requirement projection (Mgeni System) i.e. Waste management over 5 years.
- Implementation of the IsiThundu Dam on the Mvoti River to support KwaDukuza and the Mdloti System (1:100 Stochastic Yield = 40.85 million m^3/annum – 102 million m^3 Dam Capacity)
- Raising of Hazelmere Dam (1:100 Stochastic Yield = 8.90 million m^3/annum)
- Incorporation of indirect water re-use (KwaMashu WWTW= 23.00 million m^3/annum, North Coast WWTW's = 5.25 million m^3/annum, Northern WWTW = 19.70 million m^3/annum)
- Implementation of the Mooi-Mgeni Transfer Scheme (MMTS) Phase 2 (Springrove Dam: 1:100 Stochastic Yield = 60 million m^3/annum)
- Implementation of the Mkomazi-Mgeni Transfer Scheme (Smithfield Dam: 1:100 Stochastic Yield = 146 million m^3/annum)

7.2.3 Scenario III

The purpose of **Scenario III** was to investigate the impacts of increased water savings (implementation of efficiency measures) through WC/WDM. The following assumptions were made:

- Similar to Scenario I
- **Scenario A.2** water requirement projection i.e. Waste management over 5 years and improvement of efficiency

7.2.4 Scenario IV

Scenario IV assumed that the treated wastewater from some of the WWTW's supply the estuarine water requirements for the Mdloti and Tongati Rivers. The scenario was conducted for investigative purposes and was not taken further. The following assumptions were made:

- Similar to **Scenario I**:
- Treated wastewater from Verulam and Tongaat WWTW was assumed to supply the estuarine water requirements for the Mdloti and Tongati Rivers (Further investigations will be necessary to confirm EWR and the water balance)

7.2.5 Scenario V

Scenario V was included to determine the impact on the water resources if the projected return flow growths of the re-use options and additional identified re-use options are included. The following assumptions were made:

- Similar to **Scenario I**
- Inclusion of return flow growth for water re-use options
- Incorporation of additional water re-use (Phoenix, Umhlanga & Amamzintoti WWTW)

7.2.6 Scenario VI

The purpose of **Scenario VI** was to determine the impact on the water resources systems if the re-use options were excluded as interventions in order to illustrate the importance of re-use. The following assumptions were made:

- Similar to **Scenario I**:
- Exclusion of water re-use

7.3 RECONCILIATION SCENARIO RESULTS

7.3.1 Scenario I

Scenario I included the utilisation of the Lower Thukela Scheme to supply and support the Mvoti and Mdloti supply areas respectively. Various additional interventions were also investigated for both the Mdloti and Mgeni Systems.

Mgeni River System

The water balance diagram of the total Mgeni System for **Scenario I** is shown in **Figure 7.6**. The **Scenario A.1** water requirement projection i.e. waste management over 5 years was adapted for planning purposes. The **Scenario A** projection is also illustrated and it can be seen that waste management has a significant impact on the water requirement projection.

The system has a maximum deficit of 28 million m^3/annum up to the 2012/2013 period, where additional yield of 60 million m^3/annum is made available through the implementation of the Spring Grove Dam Scheme. The yield is available to both the Upper and the Lower Mgeni System. Spring Grove Dam is the scheme with the shortest lead time compared to the other options as indicated. In order to avoid any further deficits after the implementation of Spring Grove Dam, the KwaMashu re-use option, Northern re-use option and the Smithfield Dam were phased to deliver water in 2017, 2018 and 2020 respectively. The re-use options were required to avoid additional deficits as the earliest possible implementation of Smithfield Dam is in 2019. The KwaMashu and Northern re-use options contribute 4.0 and 19.7 million m^3/annum. The remaining volume from KwaMashu (19 million m^3/annum) is used to support the Mdloti System. Smithfield Dam has a yield of 147 million m^3/annum, which is available only to the Lower Mgeni System.

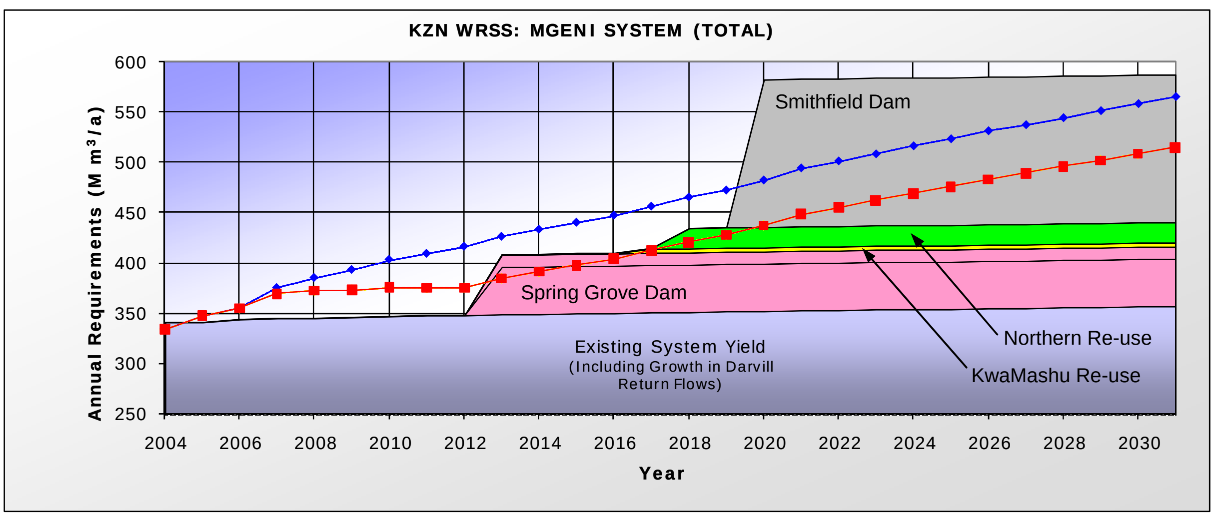


Figure 7.6: Scenario I: Water balance diagram of the Total Mgeni System

With the implementation of Spring Grove Dam, the Upper Mgeni System has surplus water throughout the planning horizon as shown in **Figure 7.2**. The water balance for the Upper Mgeni System will remain the same for all the scenarios and will thus not be shown in the remaining scenarios.

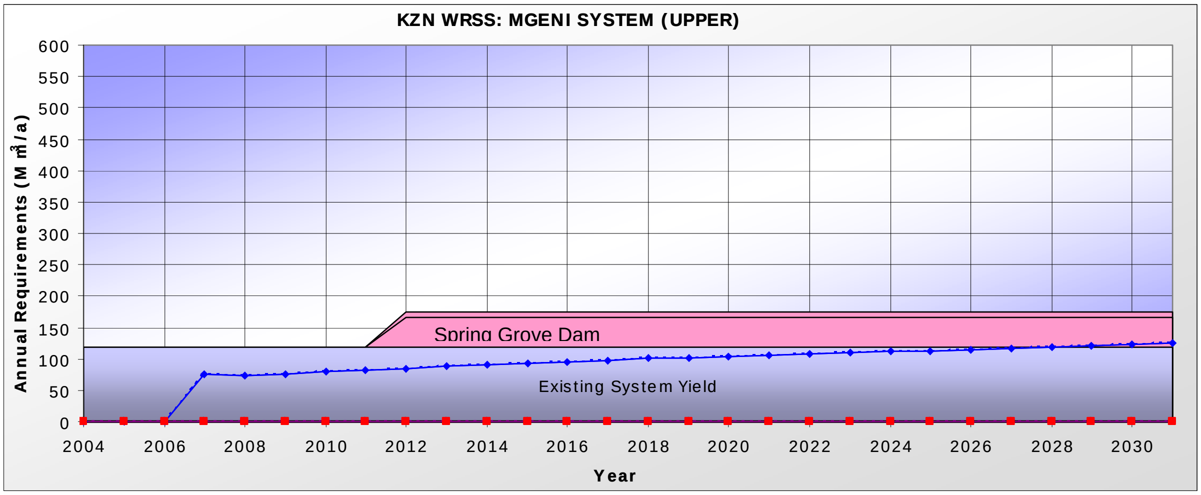


Figure 7.7: Scenario I: Water balance diagram of the Upper Mgeni System

Mdloti River System

The water balance diagram of the Mdloti System (Hazelmere Dam) is shown in **Figure 7.8**. From the figure it can be seen that various interventions are required to ensure that adequate water is available in the planning horizon. The two water requirement scenarios; **Scenario M-A** and **Scenario M-B** are shown.

The raising of Hazelmere Dam wall is the intervention with the quickest implementation schedule. It is scheduled to be completed in 2010 and will increase the Hazelmere Dam yield by 8.9 million m^3/annum. The system is in deficit for approximately two years (maximum 4 million m^3/annum) before the raising of the Hazelmere Dam wall is completed and also for approximately three years (maximum 8 million m^3/annum) from 2011until 2014, when additional support is provided from the surplus yield from the Lower Thukela once the Mvoti System water requirements have been provided. The Lower Thukela Scheme is scheduled to deliver water in 2014.

In order to meet the projected water requirements, additional support is required. The additional interventions included are indirect waste water re-use of the KwaMashu WWTW (KwaMashu Re-use) and the Verulam and Tongaat Central WWTW's (North Coast Re-use). The KwaMashu re-use option was scheduled to deliver water by 2014, which is the earliest implementation date for the re-use options. A volume of 19 million m^3/annum is available (4 million m^3/annum has been allocated to the Mgeni System) and once the limit was reached in 2025, the North Coast re-use option was implemented, which supplies a total volume of 5.25 million m^3/annum.

It is proposed that the EWR releases are imposed once sufficient water is available for meeting the projected water requirements. As a result the EWR releases were only imposed in 2014, which is illustrated by a sudden drop in yield in 2014.

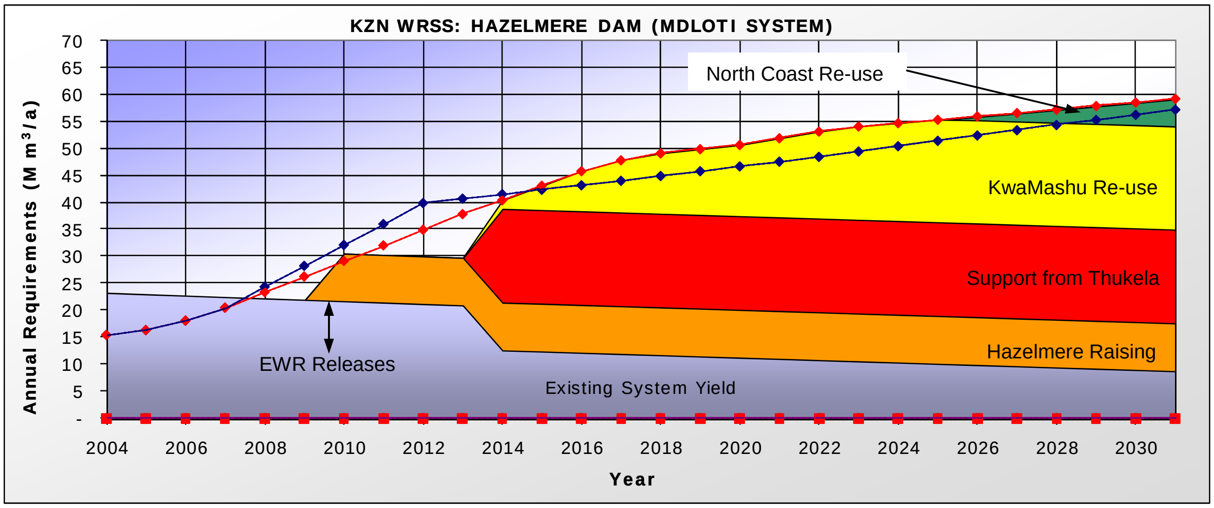


Figure 7.8: Scenario I: Water balance diagram of the Mdloti System

Mvoti System

The water balance diagram for the Mvoti System is shown in **Figure 7.9**. The figure shows that the system is in a deficit situation up to 2014, after which the system is supported form the available yield in the Lower Thukela. A maximum deficit of 14 million m^3/annum occurs in this period. The reason for the decrease in yield that is available from the Lower Thukela is due to the increasing demand that is being supplied to the villages north of the Thukela River i.e. the surplus yield after supplying the demand centres north of the Thukela is illustrated.

A significant portion of the unused allocation to Mhlathuze Water is required for the Mvoti System. Support is also provided to the Mdloti System mainly from this unused allocation. **Scenario I** would thus not be able to function without the use of the unused portion of the water allocated to Mhlathuze water.

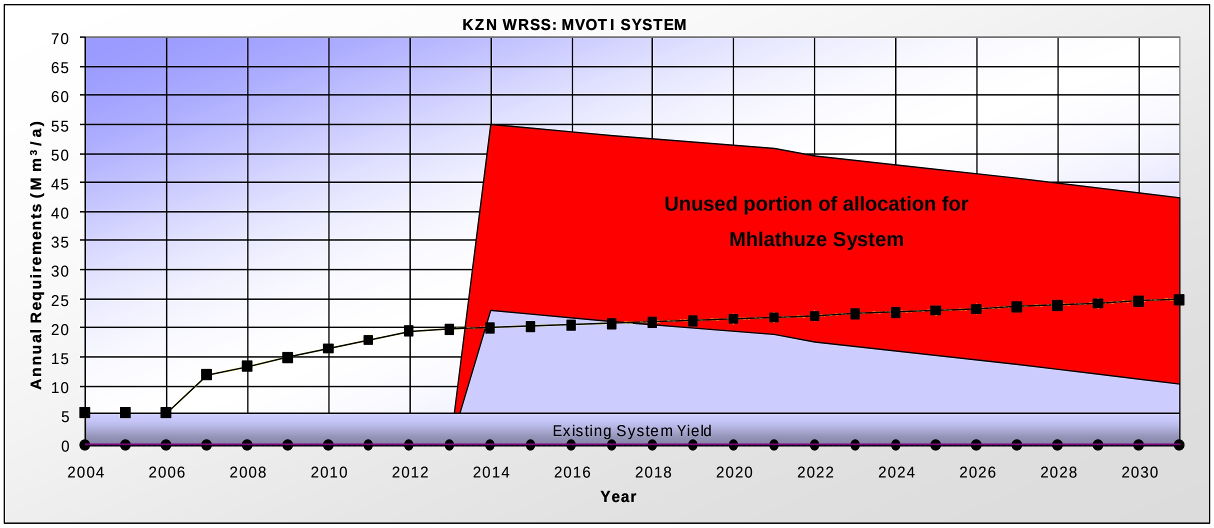


Figure 7.9: Scenario I: Water balance diagram of the Mvoti System

7.3.2 Scenario II

With Scenario **II** to the Mvoti Developments option was investigated as an alternative to the Lower Thukela Scheme for supply the Mvoti supply area and transferring water through to the Mdloti system.

Mgeni System

The water balance diagram for the Mgeni System is shown in **Figure 7.10**. The results for **Scenario II** are very similar to **Scenario I**. There is no support from the KwaMashu re-use option and as a result the Northern re-use option was implemented one year earlier to avoid further deficits i.e. 2017. The Mvoti System supplies a smaller volume to the Mdloti System than the Lower Thukela Scheme and hence additional support is required from the KwaMashu re-use option.

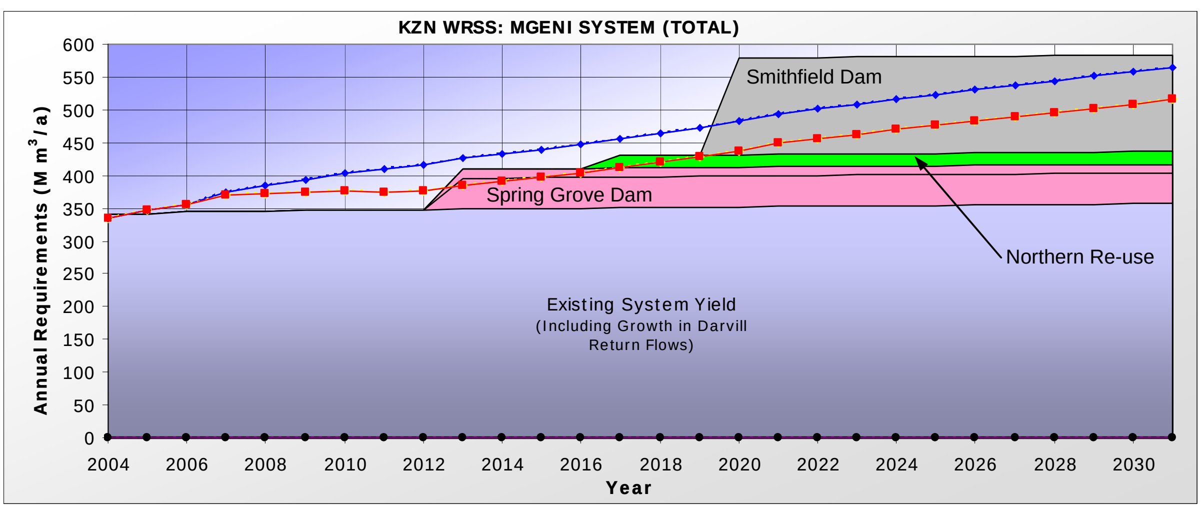


Figure 7.10: Scenario II: Water balance diagram of the Total Mgeni System

Mdloti System

The water balance diagram for the Mdloti System is shown in **Figure 7.11.** The deficits that occur are very similar to **Scenario I**. The main difference from Scenario I is that the IsiThundu Dam is scheduled to deliver water in 2019 while the Lower Thukela Scheme could provide support in 2014. Due to the longer lead time required for the implementation of the IsiThundu Dam, it is only possible to implement the EWR releases in 2019, which is five years later than in **Scenario I**.

The Mvoti Development also has slightly less water available for supporting the Mdloti System and hence both the North Coast and KwaMushu re-use options have been fully utilised.

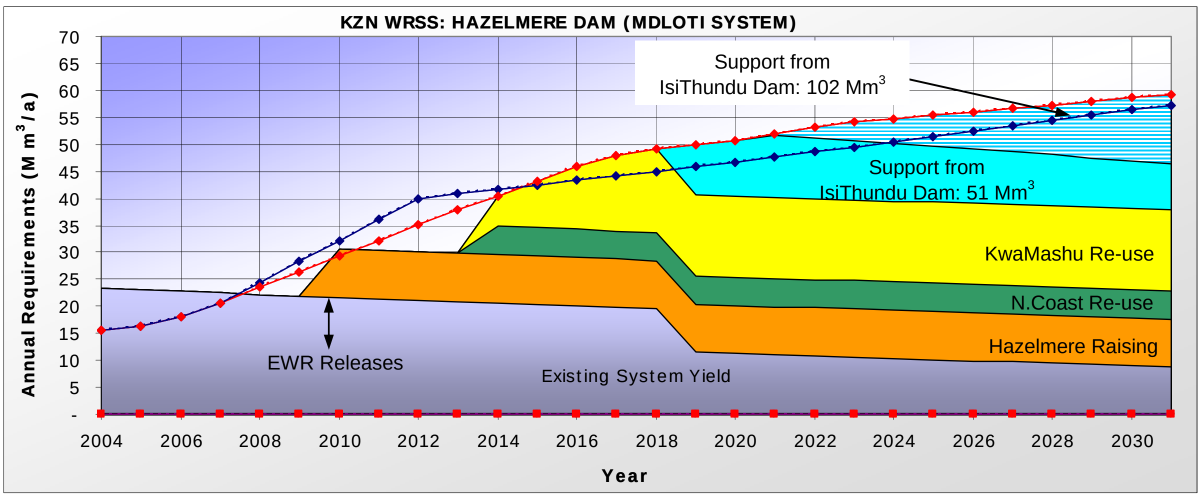


Figure 7.11: Scenario II: Water balance diagram of the Mdloti System

Mvoti System

The water balance diagram for the Mvoti System is shown in **Figure 7.12**. The figure shows that the system is in a deficit situation up to 2019 (maximum 16 million m^3/annum), after which the system is supported by the IsiThundu Dam. The system is in a deficit situation 5 years longer than with **Scenario I**, due to the longer lead time for the implementation of the IsiThundu Dam. The surplus yield from the Mvoti is used to support the Mdloti System. The yield for the IsiThundu Dam has been shown for two development levels, namely a 51 and a 102 million m^3 capacity dam. In order to supply sufficient support to the Mdloti System, the 102 million m^3 capacity dam will be required.

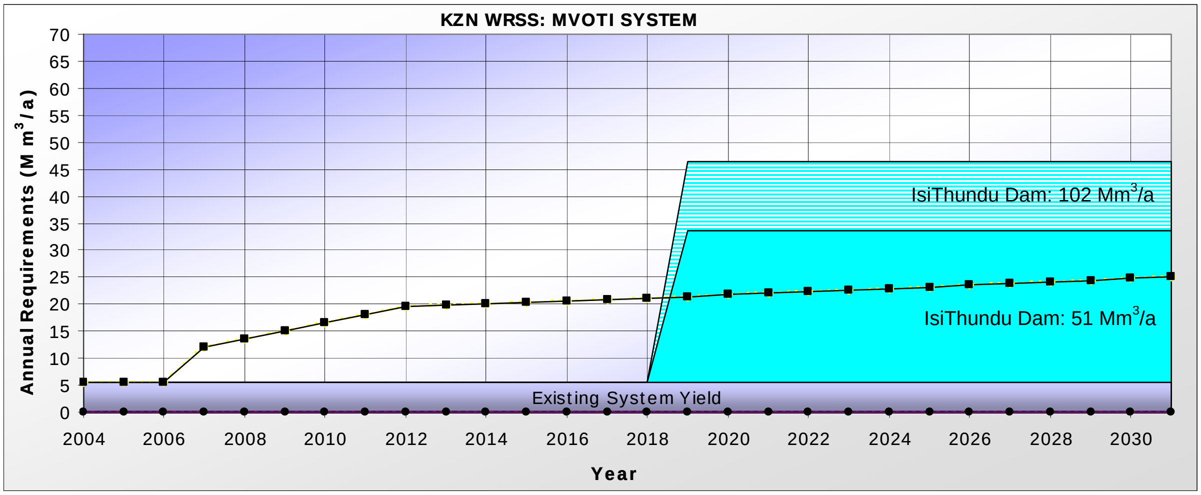


Figure 7.12: Scenario II: Water balance diagram of the Mvoti System

7.3.3 Scenario III

The impact of implementing both waste management and efficiency improvements as WC/WDM initiatives on the Mgeni system was investigated.

Mgeni System

The water balance diagram is shown in **Figure 7.13**. It can be seen that the initial deficit in the system up to the point where Spring Grove Dam is implemented is identical to **Scenario I** and **II**. The reason is because the water requirement projection **Scenario A.2** also assumes that waste management is implemented for the first 5 years (as with **Scenario A.1**) after which the efficiency improvements are introduced.

The impact of the improved efficiency is substantial and the implementation of the costly Smithfield Dam Scheme is not required in the illustrated planning horizon. Spring Grove Dam, KwaMashu re-use and Northern re-use are the only interventions required. The implementation of the KwaMashu and Northern re-use have been postponed to 2026 and 2028 respectively.

The water balance diagrams for the Mdloti and Mvoti Systems are identical to **Scenario I**.

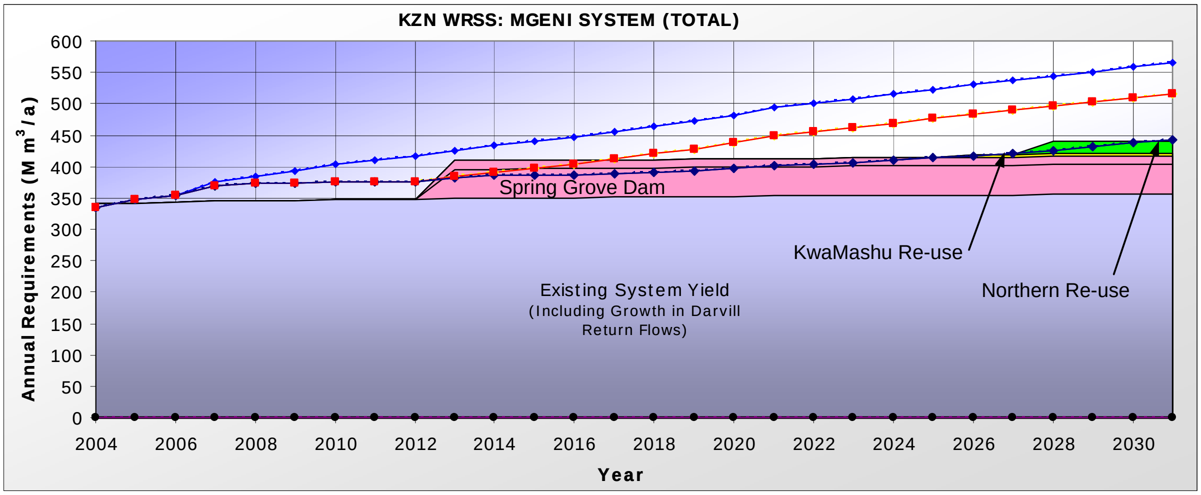


Figure 7.13: Scenario III: Water balance diagram of the Total Mgeni System

7.3.4 Scenario IV

Scenario IV assumed that the treated wastewater from some of the WWTW's supply the estuarine water requirements for the Mdloti and Tongati Rivers. The scenario was conducted for investigative purposes and was not taken further

Mgeni System

The water balance diagram is shown in **Figure 7.14**. The diagram is very similar to the Mgeni System water balance diagram for **Scenario I**. The only difference is that an additional 2 million m^3/annum is supplied to the Mgeni System through the KwaMashu re-use option (i.e. 6 million m^3/annum in total). The additional supply however has no effect on the implementation dates of the required interventions.

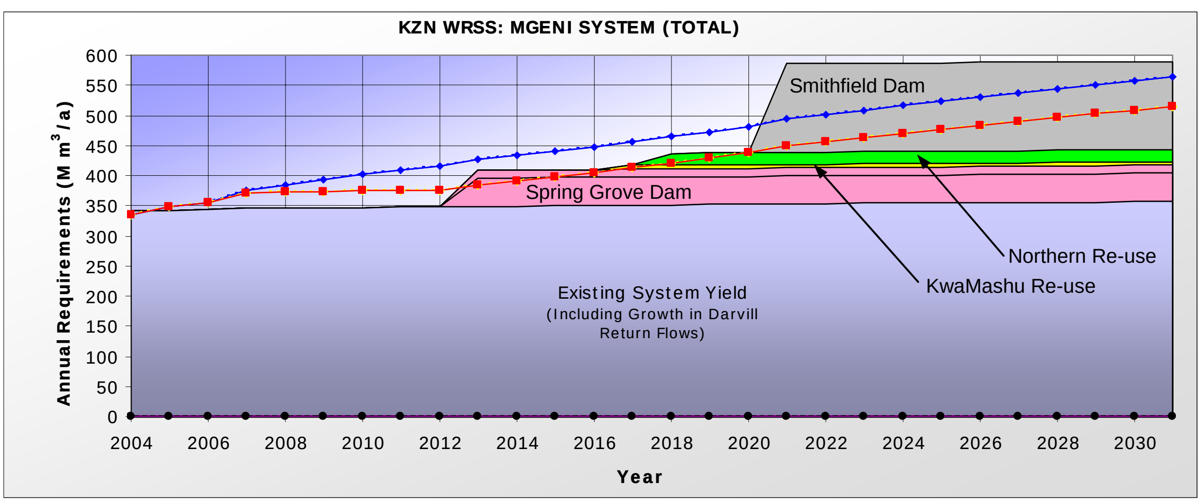


Figure 7.14: Scenario IV: Water balance diagram of the Total Mgeni System

Mdloti System

The water balance diagram for the Mdloti System is shown in **Figure 7.15**. The deficits that occur are similar to **Scenario I**. Since it was assumed that Varulam and Tongaat WWTW would supply the EWR's of the Tongati and Mdloti Rivers, the N. Coast re-use option was not included in the water balance and there is also no reduction in the existing yield of the Mdloti System due to the EWR releases. The result of **Scenario IV** was that an additional 2 million m^3/annum could be supplied to the Mgeni systems through the KwaMashu re-use option.

The water balance diagram for the Mvoti System remains unchanged.

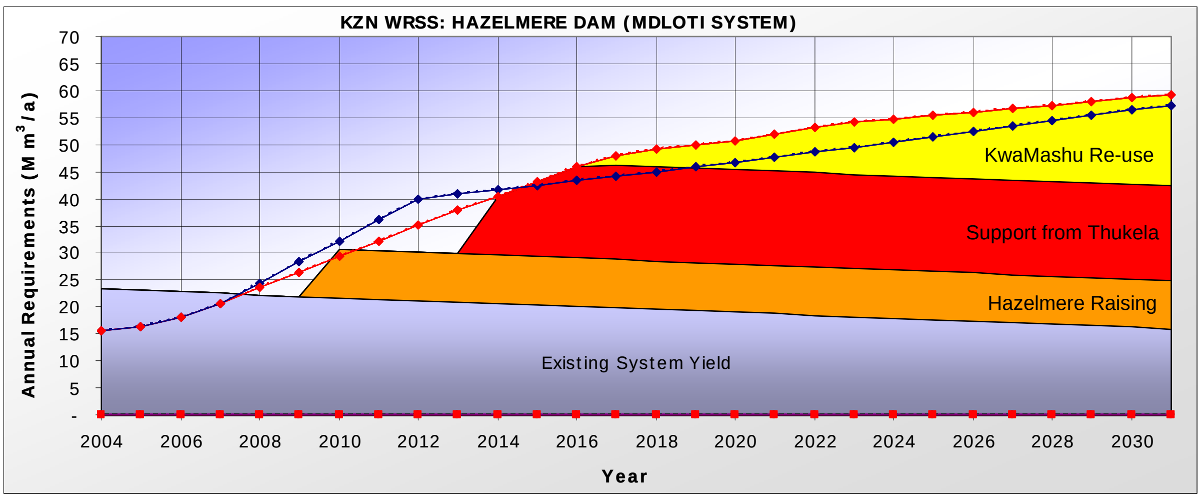


Figure 7.15: Scenario IV: Water balance diagram of the Mdloti System

7.3.5 Scenario V

The purpose of Scenario V was to investigate a scenario where all the possible re-use options and there projected growths were included.

Mgeni System

The water balance diagram is shown in **Figure 7.16**. Due to the growth and additional re-use options included in the Mdloti System (Umhlanga and Phoenix WWTW), only 2 million m^3/annum was required form the KwaMashu re-use option and the remaining volume was supplied to the Mgeni system in 2017 (27.6 million m^3/annum i.e. 23 million m^3/annum + growth until 2017). The Northern Re-use option is implemented in 2021, three years later than with **Scenario I**. The Amanzimtoti re-use option is implemented in 2024 and has a projected volume of 11.6 million m³/annum available in 2024. Due to the additional re-use options and the growth in return flows for each of the re-use options included, the implementation of the Smithfield Scheme has been postponed to 2026 i.e. 6 years later than **Scenario I**.

It must be noted that the Amanzimtoti re-use option is not ideally located and an investigation would need to be conducted to establish a suitable way of incorporating the option in the Mgeni supply system. The projected return flow growths that were incorporated were established as part of the study as discussed in **Section 4.3**.

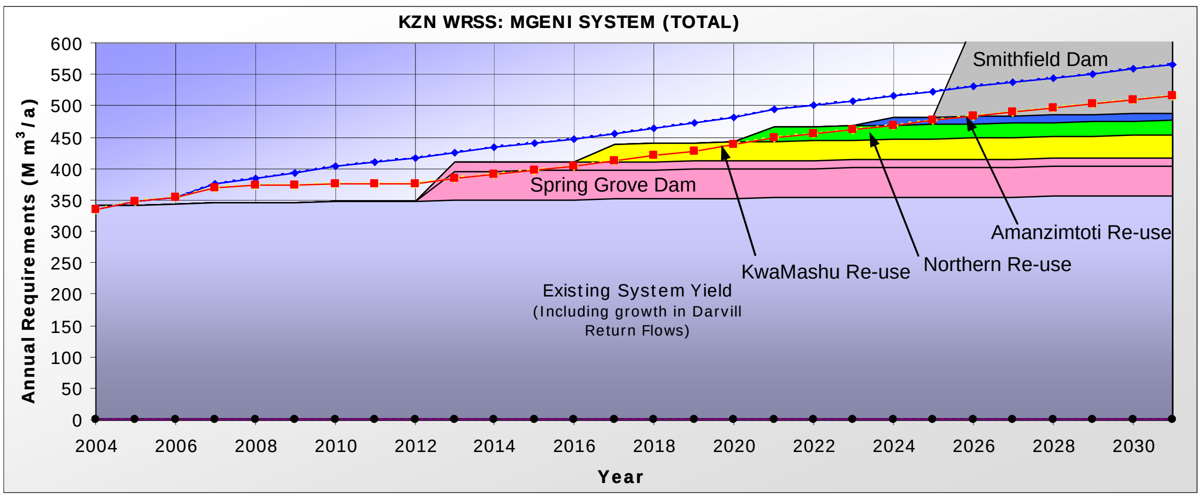


Figure 7.16: Scenario V: Water balance diagram of the Total Mgeni System

Mdloti System

The water balance diagram is shown in **Figure 7.17**. The deficits that occur are similar to **Scenario I**. The Umhlanga and Phoenix re-use options have been included under the N.Coast re-use option and they each supply a volume of 3.3 and 6.3 million m³/annum in 2014 respectively. Due to the inclusion of the return flow growths and the additional re-use options, only 2 million m³/annum is supplied by the Kwamashu Re-use option and the remainder is supplied to the Mgeni System.

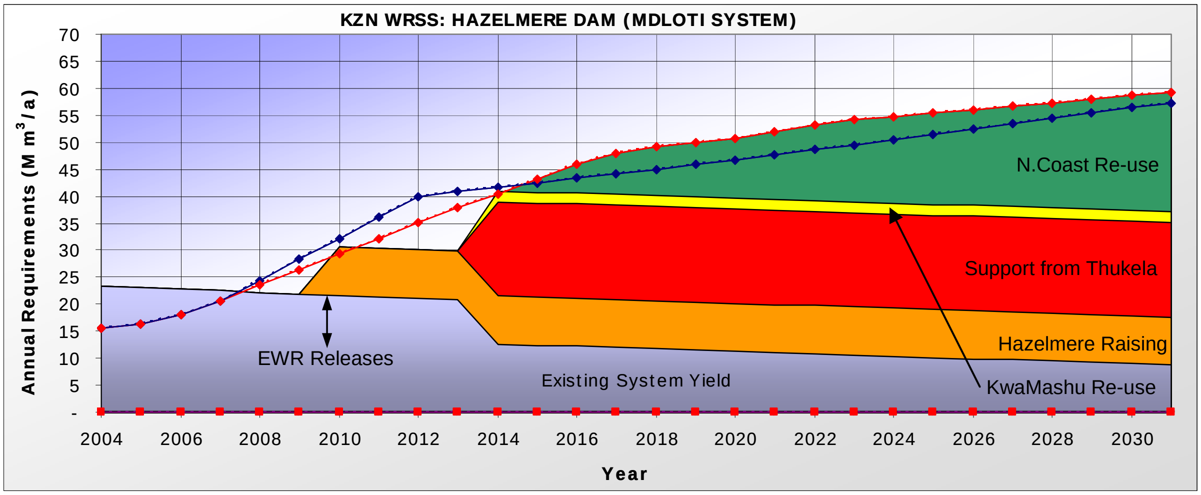


Figure 7.17: Scenario V: Water balance diagram of the Mdloti System

7.3.6 Scenario VI

Scenario VI excluded the all the re-use options and the purpose of the scenario was to illustrate the importance of the re-use options.

Mgeni System

The water balance diagram is shown in **Figure 7.18**. From the figure it can be seen that by excluding the re-use options, the Smithfield scheme is implemented in 2019, the earliest possible implementation date, which is a year earlier than when it was required with **Scenario I**. An additional deficit of 10 million m^3/annum also occurs in the 2017/2018 period. From the results it can be seen that the re-use options play a major role in reconciling the Mgeni system

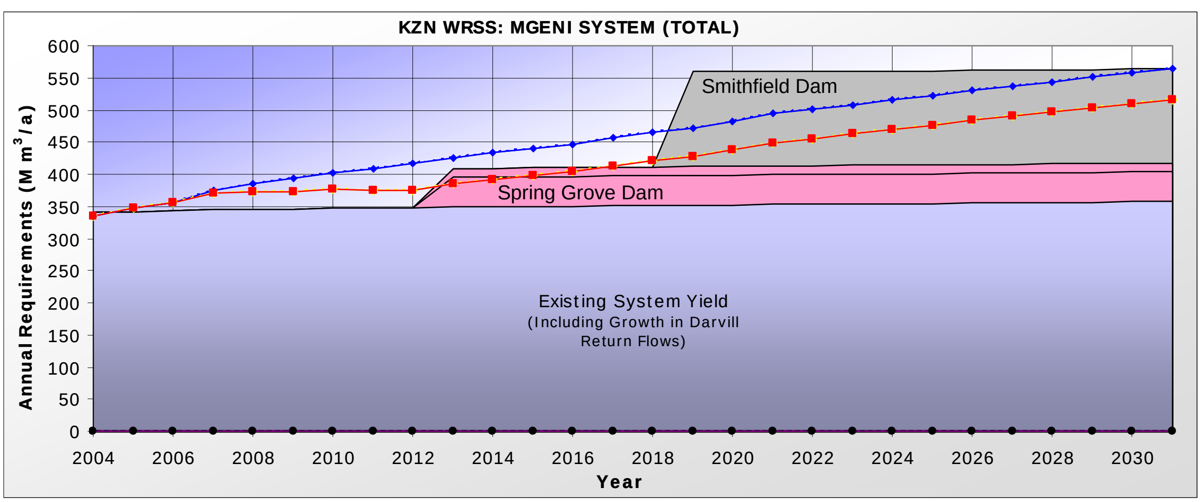


Figure 7.18: Scenario VI: Water balance diagram of the Total Mgeni System

Mdloti System

The water balance diagram is shown in **Figure 7.19**. From the diagram it can be seen that support from both the Lower Thukela Scheme and the IsiThundu Dam on the Mvoti System are required by the Mvoti System due to the exclusion of the re-use options. The initial deficits are similar to those of **Scenario I** with additional deficits occurring for a three your period in 2016 to 2019 (maximum deficit of 10 million m^3/annum).

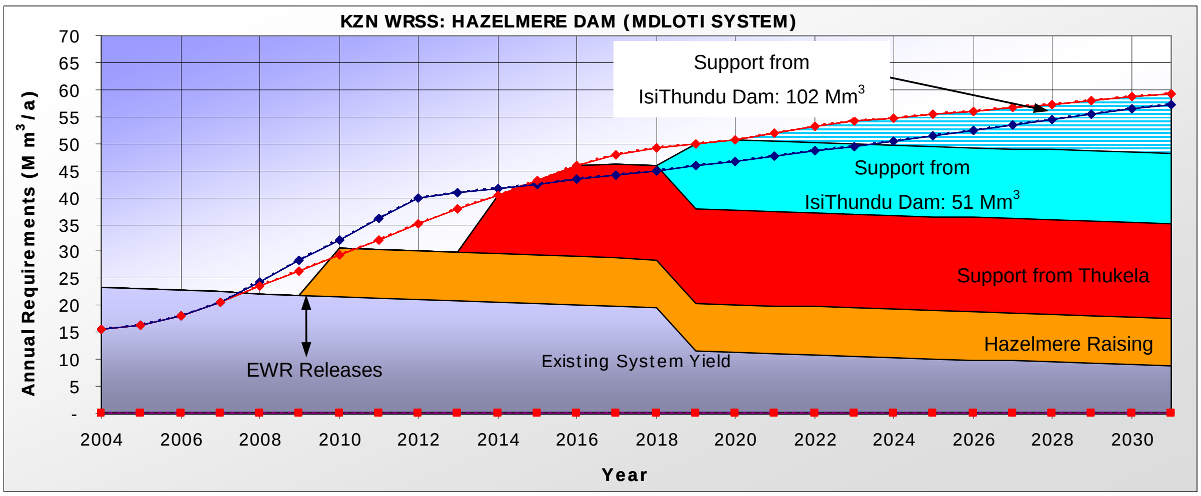


Figure 7.19: Scenario VI: Water balance diagram of the Mdloti System

By excluding the re-use options, the Smithfield Scheme needs to be implemented a year earlier. Both the Lower Thukela Scheme and the IsiThundu Dam on the Mvoti System will need to be implemented. These requirements will have a major impact on the expenditure that will need to take place on for the various development options. Both the Mgeni and the Mdloti Systems also experience additional deficits.

From the results of **Scenario VI** it can be concluded that the re-use options will need to be implemented and that feasibility studies for the identified options will need to commence as soon as possible

7.4 COSTING OF DEVELOPMENT OPTIONS

The unit reference value of water has been determined for an 8% discount rate for the various development options in both the Mgeni System and the Northern Supply Area (Mvoti and Mdloti Systems). The URV's were calculated purely for comparative purposes and they should be interpreted as such. More detail on the costing of the evelopment options is available in the Infrastructure Report of the same study (**DWAF, 2008c**).

The results for the Mgeni System and Northern supply areas are illustrated in **Figure 7.20** and **Figure 7.21** respectively. The URV for desalination was included as an additional option and resulted in the option with the highest cost. The WC/WDM intervention can be implemented with a range of interventions, which is why a range of costs have been shown. The URV for all the combined WC/WDM interventions is indicated.

From the URV's calculated for the Northern supply area it can be seen that the Lower Thukela Scheme is significantly cheaper than the development of the IsiThundu Dam on the Mvoti System. A further advantage of the Lower Thukela Scheme is the shorter lead time required for implementation.

The URV's for the re-use of waste water from the various WWTW's were calculated for the indirect re-use option. With the exception of the Springrove Dam, the costs of the re-use options are generally lower than the other development options. An advantage of the re-use options is that they have a shorter lead time for implementation, which helps to eliminate some of the earlier deficits occurring in the Mdloti and Mgeni Systems as discussed in **Section 7.3**.

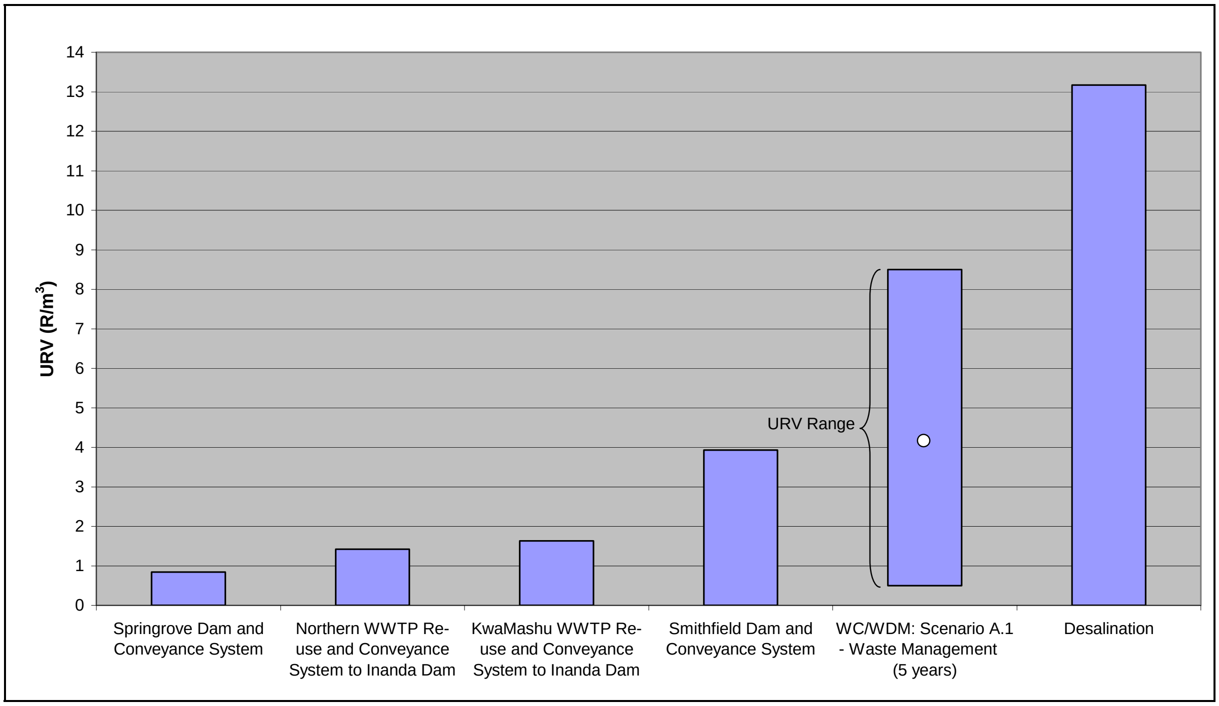


Figure 7.20: URV's for augmentation options of the Mgeni System supply area (8% discount rate)

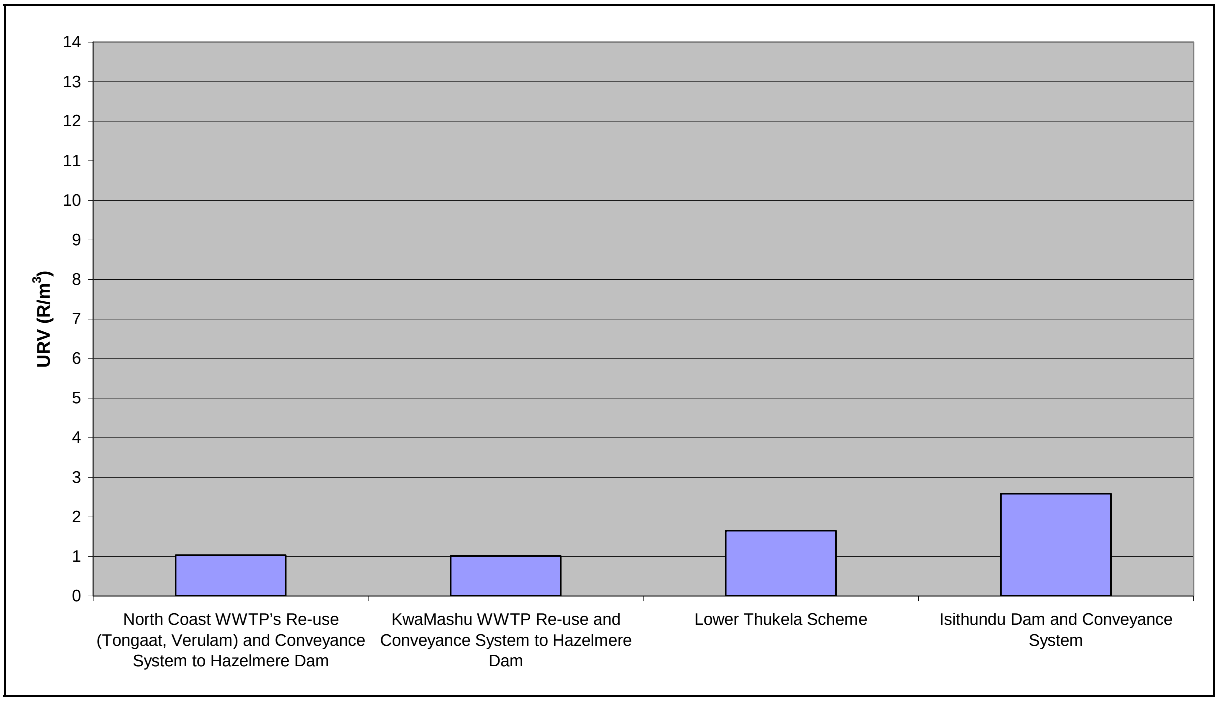


Figure 7.21: URV's for augmentation options of the Northern supply area (8% discount rate)

7.5 MGENI SYSTEM ECOLOGICAL WATER REQUIREMENTS

The Mgeni System yield illustrated in the water balance diagrams of the Mgeni System in **Section 7.3** included compensation flow releases from the dams on the river system as shown in **Table 7.1**. The low confidence EWR's that have been established at the various sites are also shown in the table. The EWR's are significantly larger than the compensation flows that have been accounted for. The HFY's of the three dams for both the compensation releases and EWR scenarios are shown in **Table 7.2**. The differences are quite substantial and significant volumes will be required to meet the EWR's.

The water volumes available for ecological purposes in the Mgeni System downstream of Inanda Dam are shown in **Table 7.3**. These volumes are available through either surplus yield of the Smithfield Dam or through return flows from the WWTW's, with the growth in retrun flows included. The volumes were calculated as the difference between the total return flow volume and the support provided to the Mgeni System in **Scenario I**. The treatment works that contribute to the Mgeni System downstream of Inanda Dam are Northern, KwaMashu, New Germany and Phoenix.

Northern and KwaMashu form part of the re-use options in **Scenario I**. They are implemented for support in the 2014/2016 period which is the reason for the reduction in return flow volume in 2016 as illustrated in **Table 7.3**.

The volumes available are lower than the volumes required for the EWR's. An increase in deficits would occur in the Mgeni System should the additional required volumes be sourced directly from the Mgeni System.

The EWR's shown in the tables are low confidence estimates and as mentioned in **Section 3.5**, the DWAF RDM Directorate is in the planning process to commission high confident reserve determination studies for Mgeni System amongst others. The results of these studies would need to be available before any further decisions can be made regarding the EWR supply.

Table 7.1: Mgeni System release scenarios

Location	Natural Flow (MAR)	Compensation Flows	EWR Scenario (Class C)
Midmar Dam	201.7	28.4	47 (23.4%)
Nagle Dam	472.8	22.4	153 (32.3%)
Inanda Dam	629.7	47.3	216 (34.2%)

*Values are given in million m^3/annum

Table 7.2: Mgeni System yields

Subsystem	Historical Firm Yields (million m^3/annum)		Differences
	Compensation Release Scenario	EWR Scenario	
Midmar Dam	177	149	28
Nagle Dam	284	162	122
Inanda Dam	384	210	174

Table 7.3: Water available for ecological purposes downstream of Inanda Dam

Location	Flows (million m³/annum)					
	2006	2011	2016	2021	2026	2031
WWTW RF's	50.8	49.4	14.9	19.8	23.7	27.3
Smithfield Dam* (Surplus Yield)	0.0	0.0	0.0	135.1	102.4	72.3
Total	50.8	49.4	14.9	154.9	126.1	99.6

7.6 OPTIMUM UTILISATION OF RIVER RUNOFF ABSTRACTION

Combined operation of the Mvoti and Mdloti River systems through linked transfer infrastructure could (conceptually) increase the water availability of the integrated system. This would require sufficient transfer capacities between the different resources.

System analysis was undertaken to estimate the potential benefit of the integrated supply option. The combined system was operated in such a way that the water from the Mvoti would be utilised first when available, with the shortage supplemented from the Mdloti System. The results of the analysis indicated that there is no noteworthy additional yield available through the combined operation.

7.7 RAINWATER HARVESTING

A preliminary analysis was conducted to evaluate the potential yield that could be achieved through rainwater harvesting in the eThekwini Municipal Area. An Excel spreadsheet was set up for simulation purposes and the daily rainfall information of four stations in the area was extracted an incorporated in to the model and the average daily historic rainfall was calculated by the model. The following additional parameters are entered as input data into the model for the yield analysis:

- Roof size
- Recovery efficiency
- Tank size
- Starting storage

The HFY's were estimated for a 5 000 l and 10 000 l tank capacity of varying roof sizes. The HFY estimated with the assumption that rainwater tanks would be installed in all the formal housing units in the eThekwini municipal area. The HFY estimated for both the 5 000 l and 10 000 I tank capacities for an average roof size of 150 m^2 was 7.6 million m^3/annum and 13.5 million m^3/annum respectively.

Although rainwater harvesting would not have a major impact on reduction of municipal water demand when analyzed with conventional methods of yield determination, it does have considerable benefits. It would allow users to limit their dependence on formal water supply, it could assist with subsistence food gardening, in times of severe water restrictions it would provide important relief for basic needs and above all it would stimulate a culture of efficient water use. Rainwater harvesting should thus be actively encouraged and it was proposed by the STC that an economic analysis be conducted to investigate these benefits from a user's perspective. This will be conducted as part of the Second Stage Strategy.

8 PERSPECTIVE ON WATER QUALITY MANAGEMENT

8.1 OVERVIEW

A water quality review was conducted in the study area and the main purpose was to use the available water quality data and water quality reports from previous studies to develop an understanding of the water quality profiles of the major rivers in the study area. The understanding achieved was used to provide qualitative input of the impact that the reconciliation options could have on water quality.

The review was conducted for the various stages of the Mgeni System and its major tributaries and for the Mdloti, Mvoti and Mkomazi River Systems and is summarised below. Further details are available in the Water Quality Review report of the same study (**DWAF, 2008d**)

8.2 MGENI RIVER RESOURCE UNIT

The Mgeni River serves the Pietermaritzburg-Durban region, which is controlled by the four dams. The water quality of the Mgeni River has been good over the past few years. However, over the past 10 years a slight deterioration in water quality has been observed at a number of monitoring points, especially in the Lower Mgeni System.

The water at Midmar Dam in the upper Mgeni is of good quality and meets the water user requirements of all the water users. The available data however did show deterioration in water quality due to the significant increase in nutrient concentrations, in particular phosphorus. This could be ascribed to agriculture, in particular dairies, piggeries and maize production, impacting moderately on the river health through excessive nutrient input into the rivers. An increase in pollution from the growing Mphophomeni settlement could also have an effect.

The water quality in the upper Mgeni deteriorates on its passage from Midmar Dam through Howick to Albert Falls Dam and an increase in nitrate, phosphate and metal concentrations occurs. The Bacteriological contamination also exceeds the water quality guideline for full contact recreation with a relatively high turbidity. Effluent discharges from the towns Howick and Hilton and runoff and return flows from agriculture are assumed to be the cause of the deteriorating water quality.

The conductivity in Albert Falls Dam has increased about 28 % during the past 10 years. The average *E.coli* count is low and the dissolved inorganic nitrogen is the lowest in the Mgeni System.

The SRP concentration has however increased significantly over the past 10 years and the tropic status of the dam could trend towards a mesotrophic status, if it increases further.

Increasing trends in the conductivity and the SRP concentrations occur in the Mgeni system on its passage from Albert Falls Dam to Nagle Dam. The water quality data of Nagle Dam showed that the average phosphate concentration was low but on a slight increasing trend. The nitrate concentrations were relatively low and showed a decreasing trend.

A distance below Nagle Dam, the Mgeni River is joined by the Msunduzi tributary and continues in an easterly direction towards Inanda Dam. The water quality in the middle and lower Msunduzi is very poor, with high faecal coliform content and nutrient over-enrichment. There is a significant risk of possible health effects if the water is used for drinking or contact recreation. The high nutrient concentrations in the lower Msunduzi River contribute significantly to the eutrophication process in the lower Mgeni River.

The water quality in the Mgeni River after the Msunduzi confluence is poor. High conductivity, very high faecal contamination indicating sewage pollution, very high nitrate concentrations, high ammonium, high phosphorus and high turbidity occur.

The water quality data in the Inanda Dam (300m from the dam wall) showed an increasing trend in salinity over the past 10 years. The ammonium, phosphates and SRP concentrations also showed an increasing trend and the dam is well within the mesotrophic range.

8.3 MOOI RIVER RESOURCE UNIT

The Mgeni River System is augmented by an inter-basin transfer from the Mooi River in the Tugela Basin. The water is currently transferred from the Mearns Weir to the Midmar Dam. An additional development option necessary for supporting the Mgeni System by increasing the volumes transferred to Midmar Dam is the construction of the Spring Grove Dam on the Mooi River.

The data from the Mooi River indicate generally good water quality, with no significant changes during the past years for most of the parameters. However, high *E.coli* counts upstream in the river (at Spring Grove and Mearns) and the significant increase in the ammonium concentration in Mearns Weir is a matter of concern. Umgeni Water has also reported that the water quality assessment of Mearns Weir showed increased trends in nutrient levels. Analysis indicated that highly intensive agriculture is the cause of the eutrophication.

The additional transfer from Spring Grove Dam could have an impact on the microbiological status of the receiving stream.

8.4 MDLOTI RIVER RESOURCE UNIT

The average conductivity in the Mdloti River at the inflow of Hazelmere Dam is higher than in the upper reaches of the Mgeni River System but have been fairly stable over the past 10 years. The turbidity is very high, which indicates a high silt load that could contribute to a high siltation rate. The turbidity has however decreased over the past view years.

The water quality at the outflow of the Hazelmere Dam is very similar to the quality in the dam. It is only the ammonium concentration that is slightly higher indicating that the water was released from the lower layers of the water column where higher ammonium concentration accumulated due to decomposition.

8.5 MVOTI RIVER RESOURCE UNIT

The available data showed a deterioration in water quality further downstream on the Mvoti River due to runoff and return flows from agriculture, return flows from urban areas and industrial discharges. The water quality is overall good when compared to the fitness for water use quality requirements.

8.6 MKOMAZI RIVER RESOURCE UNIT

The available data for the upper Mkomazi River showed that the TDS and SRP concentrations are low. The TDS concentration is higher in the lower reaches. The water quality data showed a relatively stable water quality profile over time.

9 CONCLUSIONS

Given the reconciliation situation as presented in the previous chapter the following main conclusions can be drawn:

- The short-term deficit situation in the study area needs to be managed through WC/WDM as well as early drought restrictions.
- Saving of water through the implementation of WC/WDM waste management measures in the urban sector needs to be implemented immediately in order to minimize the short term deficits (water requirement **Scenario A.1**).
- The Mooi-Mgeni Transfer Scheme Phase 2 (Spring Grove Dam) and the raising of Hazelmere Dam should be implemented immediately and fast tracked if possible.
- The North Coast Pipeline for short-term support to Kwadukuza and long-term support to the Mdloti System (bi-directional pipeline) should be implemented.
- Feasibility studies of the Lower Thukela Scheme and the Mvoti Development Option IsiThundu Dam) for supply to the northern areas should be commissioned.
- A flow gauge should be constructed in the Mvoti River in order to improve the unacceptably low level of confidence in the hydrological modelling of the system.
- Feasibility studies for the water re-use options for the supply to the North Coast and Mgeni River System should be commissioned.
- The feasibility study of the Mkomazi River Transfer Scheme should be proceeded with.
- A feasibility study for confirming the efficiency improvements, represented by water requirement projection **Scenario A.2**, should be commissioned.
- The revised release rules from Inanda Dam for benefiting the ecology need to be assessed.
- A Water Use Validation Study in the Mooi River catchment should be implemented.
- Implement mechanisms for the monitoring and management of the poor water quality in the Msunduzi and lower Mgeni River System. This should also be implemented in the Mooi River System, where the water quality is depreciating.

- The utilisation of local water resources in the South Coast Supply Area should be maximised in order to minimise the augmentation requirements imposed on the Mgeni River System over the medium term until such time as Mgeni River System can be augmented.

10 UNCERTAINTIES CONCERNING RECONCILIATION PERSPECTIVE OVERVIEW

10.1 RE-USE OPTIONS

The re-use options play a significant role in the proposed strategy. An increase in deficits occurs in both the Mgeni and Mdloti Systems if the re-use options are removed as possible interventions as illustrated in **Scenario VI**. An increase in deficits occurs and both the Lower Thukela Scheme and the development of the Mvoti River system (IsiThundu Dam) are also required should the re-use options not implemented.

Indirect re-use has been targeted as the most favourable option and the treatment technologies required for discharging the effluent into the dam were investigated and costed. However the indirect re-use impact on the receiving water quality of dams needs to be further assessed. This process requires detailed modelling. The possibilities of salt build up in the system due to re-use also needs to be investigated. These assessments will be conducted as part of the Second Stage Strategy

The institutional and funding mechanisms for the construction and operation of the plants and the public acceptance of re-use are additional aspects that need to be addressed.

10.2 IMPACTS OF WATER USE RIGHTS TRADING

The possibility of water use rights trading within the irrigation sector could have a significant impact on the reconciliation scenarios presented. A perspective on the issue will be included in the Second Stage Strategy.

10.3 IMPACTS OF CLIMATE CHANGE

Climate change could have an influence on the reconciliation scenarios presented in the document. Umgeni Water is in the process of conducting a study on the impacts that climate change could have on the water resources. The results of the study will be incorporated once they are available as part of the Second Stage Strategy.

11 STRATEGIC PERSPECTIVES

11.1 OVERVIEW

The findings from the water reconciliation scenario results, and the conclusion presented in the previous sections, point to specific strategies that are required for the sustainable management of the water resources in the KZN study area.

These strategies are presented in the subsequent sections, and the intention is that projects and programmes need to be developed and the human and financial resources also need to be made available to achieve the underlying objectives. A programme of the proposed activities is illustrated graphically in **Figure B-1** in **Appendix B**.

11.2 EARLY DROUGHT RESTRICTIONS

The short-term deficits occurring in the various water resource systems will need to be managed by early drought restrictions in dry periods to ensure water availability. The monitoring of the water resources situation and the implementation of restriction will be conducted by the Operational Forum discussed in **Section 11.15**.

11.3 IMPLEMENT WC/WDM WASTE MANAGEMENT MEASURES.

The continuation of current, and the initiation of further WC/WDM projects, is essential to minimise the deficits in water balance of the Mgeni River System.

The responsibility for the implementation of WC/WDM measures reside primarily with the municipalities and their water service providers. DWAF and provincial government should provide an active supporting role in the form of appropriate legislation and regulations, as well as making dedicated financing available in areas where resources are limited or lacking at municipalities.

<u>Action</u>: Ethekwini MM, Ilembe DM, Msunduzi LM

<u>Timing</u>: End 2008

The WC/WDM approach to be followed in the irrigation sector is that all possible savings to be achieved, will be made available for further irrigation developments with priority given to the establishment of resource poor farmers.

11.4 ENCOURAGE RAINWATER HARVESTING

Rainwater harvesting should be encouraged in the study area, as it is a further method of extending the water resource investigated in the study area. Although it does not have a major impact on reducing the municipal water demands when analyzed with conventional methods of yield determination, rainwater harvesting has a number of benefits from the users point of view.

Action: All

Timing: Ongoing

11.5 IMPLEMENT THE MOOI-MGENI TRANSFER SCHEME.

Implement the Mooi-Mgeni Transfer Scheme Phase 2A, consisting of the construction of Springrove Dam in the Mooi River Catchment. Current indications are that the dam could deliver water by 2012. The additional yield available from the option is 46.8 million m^3/annum (Total yield of Mooi-Mgeni System of 380.8 million m^3/annum).

Implement the Mooi-Mgeni Transfer Scheme Phase 2B, consisting of a pump station and pipeline transferring water directly from Springrove Dam to the Mgeni River System. Delivery by 2013 with an additional yield of 13.2 million m^3/annum (Total yield of the Mooi-Mgeni System of 394.0 million m^3/annum).

The scheme has the shortest lead time of all the development options proposed for the Mgeni System. It is thus important that the scheme is implemented as soon as possible to minimise the deficits illustrated in the water balance diagrams. DWAF has recently directed the Trans-Caledon Tunnel Authority (TCTA) to implement Phase-2 of the Mooi-Mgeni Transfer Scheme (MMTS-2 - Spring Grove Dam and associated transfer infrastructure).

Action: DWAF:NWRIB, TCTA

Timing: Immediate

11.6 IMPLEMENT THE RAISING OF HAZELMERE DAM.

Raise Hazelmere Dam to provide an additional yield of approximately 9 million m^3/annum (assumed 2015 sediment projection and excluding the implementation of the Ecological Water Requirements). The total yield of the Mdloti System after raising of Hazelmere Dam is approximately 30 million m^3/annum. It is proposed that the EWR releases from Hazelmere Dam in the Mdloti River System are implemented when sufficient resources are available for meeting the requirements o the system.

Umgeni Water is planning to extend the water treatment capacity and construct additional pipelines to convey the additional yield from the proposed raising of Hazelmere Dam to the water users. This includes the proposed North Coast Augmentation Pipeline to convey water to KwaDukuza and adjacent areas.

Action: DWAF:OA, DWAF:NWRIB

Timing: Immediate

11.7 IMPLEMENT THE NORTH COAST AUGMENTATION PIPELINE

Implement the bi-directional North Coast Augmentation Pipeline for short-term support to Kwadukuza and long-term support to the Mdloti System from either the Lower Thukela or Mvoti system.

Action: Umgeni Water

Timing: 2009

11.8 COMMISSION A FEASIBILITY STUDY OF THE THUKELA AND MVOTI SYSTEMS

Although the primary purpose of the Lower Thukela Scheme or the proposed water resource development options in the Mvoti River would be to support the far northern areas (KwaDukuza and surrounding developments), the scheme would also be required to augment the water resources of the North Coast Metropolitan Area (support the Mdloti System) as discussed in **Section 7.3**. This could be achieved by reversing the flow in the proposed North Coast Augmentation Pipeline currently being planned.

A feasibility study needs to be commissioned to assess the two alternative augmentation options.

Alternative Augmentation Option 1: Lower Thukela Augmentation Option

The existing surplus yield in the Lower Thukela River System is 45 million m^3/annum, given that support is provided from Spioenkop and Wagendrift dams to the Lower Thukela River. The above excess yield is over an above the currently unused allocation of 32 million m^3/annum that has been granted to Mhlathuze Water for supply to the proposed Fairbreeze Mine option. (Total available surplus yield currently not taken up by users, 77 million m^3/annum).

The total yield of 77 million m^3/annum will be required to supply both the Kwadukuza and surrounding developments and the North Coast Metropolitan Area (Mdloti System). It has been indicated that the Mhlathuze River System will not require the Thukela allocation for the planning period up to 2030, should the Medium Demand Scenario for the system realise. If the High Demand Scenario realises, augmentation to the Mhlathuze River System is required in 2014 (The High Demand Scenario excludes the impact of major additional WC/DM measures.)

Alternative Augmentation Option 2: Mvoti River Augmentation Scheme

The proposed components of the Mvoti River Augmentation Scheme consist of IsiThundu Dam and conveyance infrastructure.

The proposed IsiThundu Dam has a yield of 47 million m^3/annum and 63 million m^3/annum for a storage capacity of 51 million m^3 and 102 million m^3 respectively. The IsiThundu dam with a capacity on 102 million m^3 will be required as illustrated in **Section 7.3**.

A flow gauge needs to be constructed on the Mvoti River in order to improve the unacceptably low level of confidence in the hydrological modelling of the system.

Action: DWAF:OA

Timing: Begin study Jan 2009

11.9 COMMISSION A FEASIBILITY STUDY FOR WATER RE-USE OPTIONS

The feasibility study should investigate the option to reuse treated wastewater from the Northern and Kwamashu Waste Water Treatment Works for transfer to Inanda Dam. This will involve secondary treatment processes, collection systems and transfer infrastructure to convey the water into Inanda Dam. KwaMashu is positioned in such a way that the treated wastewater could be transferred to either Inanda or Hazelmere Dam and both options should be investigated. The total volume available in 2006 is 43 million m^3/ annum.

The feasibility study should also investigate the option to reuse treated wastewater from the Verulam, Phoenix as well as the Tongaat Central Waste Water Treatment Works for transfer to Hazelmere Dam. This will involve secondary treatment processes, collection systems and transfer infrastructure to convey the water into Hazelmere Dam. The total volume available in 2006 is 9.8 million m^3/ annum.

Action: eThekwini MM

Timing: Begin study Jan 2009

11.10 PROCEED WITH THE FEASIBILITY STUDY OF THE MKOMAZI RIVER TRANSFER SCHEME

The Phase 1 of the Mkomazi-Mgeni Transfer Scheme consists of the Smithfield Dam with gravity conveyance infrastructure transferring water to Umlaas Road. The yield for delivery to the Mgeni River System for the scheme is estimated to be 136 million m^3/annum. The earliest time for delivery is estimated to be December 2018. (Total yield of the Mooi-Mkomazi-Mgeni System is 530 million m^3/annum).

According the water balance diagram for the Mgeni System (**Scenario I**), the scheme is required in 2019 and hence the feasibility study of the Mkomazi River Transfer Scheme should be implemented.

Action: DWAF:OA

Timing: Begin study Jan 2009

11.11 COMMISSION A FEASIBILITY STUDY TO CONFIRM EFFICIENCY IMPROVEMENTS

Of the three scenarios developed for the potential savings through WC/WDM in the urban sector of the eThekwini and Msunduzi municipal areas, the greatest savings were achieved with Scenario A.2 (waste management over 5 years and the implementation of efficiency measures). The impacts of Scenario A.2 on the required development options are illustrated in Scenario **III** of the reconciliation scenarios.

A feasibility study for confirming the efficiency improvements represented by water requirement projection **Scenario A.2** needs to be commissioned.

Action: Ethekwini MM, iLembe DM, Msunduzi LM

Timing: Begin study in Jan 2009

11.12 SOUTH COAST WATER RESOURCES SITUATION

The utilisation of local water resources in the South Coast Supply Area should be maximised in order to minimise the augmentation requirements imposed on the Mgeni River System over the medium term until such time as Mgeni River System can be augmented.

11.13 UNDERTAKE A WATER USE VALIDATION STUDY IN THE MOOI RIVER CATCHMENT

A water use validation study should be implemented in the Mooi River Catchment to obtain a reliable estimate of the situation regarding the irrigation water use in the Mooi River System. The product of the validation study should be an assessment of the lawful water use. The results of the study should be used to revise the yield estimate of the Spring Grove Dam and in turn the water balances of the Mgeni System.

Action: DWAF Regional Office

Timing: January 2009

11.14 REVIEW RECONCILIATION OPTIONS BASED ON THE RESULTS FROM THE RESEVE STUDIES

The DWAF Directorate: Resource Directed Measures (RDM) is in the process of commissioning high confident reserve determination studies for Mvoti, Mkomazi and Mgeni river systems amongst others.

The results of these studies are available, the implications thereof on the reconciliation options will need to be determined and evaluated.

The results are expected to only be available once the study has been completed.

Action: DWAF: NWRP

Timing: Once reserve determination study results are available

11.15 STUDY OPERATIONAL FORUM

At the Study Technical Committee Meeting held on 30. May 2008, it was recommended that an Operational Forum be established. The function of the Operational Forum would be to monitor and manage the short-term deficit in the Mgeni System. The forum would consist of high level individuals from the DWAF and the various stakeholders in the study area.

Action: DWAF Regional Office

Timing: August 2008

11.16 STRATEGY IMPLEMENTATION COMMITTEE

At the Steering Committee Meeting held on 29 March 2006, it was recommended that the current Study Steering Committee should be converted into a Strategy Implementation Committee. The committee will be responsible for the implementation of the strategy once the study has been completed.

Action: DWAF: NWRP, SSC

Timing: Immediate

12 RECOMMENDATIONS FOR THE SECOND STAGE RECONCILIATION STRATEGY

Based on the issues presented in this report and raised by the stakeholder, it is recommended that the following aspects be considered in the development of the Second Stage Strategy.:

- Additional tasks for the water quality and re-use will include:
    - Audit the WWTW selected for re-use in terms of infrastructure and consistency of performance
    - Conform the industrial contribution to the return flows
    - Carry out a water quality profile on treated effluent-emerging pollutant types
    - Refine conceptual design and costs
    - Conduct quantitative modelling on eutrophication impact on Inanda and Hazelmere Dams
    - Assess salt build up potential in system
    - Design monitoring program if required
    - Revisit estuary requirements if available
    - Provide input to TOR for feasibility studies
    - Include desalination results from Umgeni Water Study
- Develop and implement the monitoring process for the implementation of WC/WDM measures to achieve the savings presented in **Scenario A.1**
- Initiate the formation of the Study Operational Forum
- Investigate the impact of water use rights trading on the reconciliation scenarios.
- Refine the rainfall harvesting analysis with the following:
    - Incorporate input data changes proposed by the Study Technical Committee
    - Conduct an economical analysis to investigate the benefit form an individuals perspective

- Climate change could have an influence on the reconciliation scenarios presented in the document. Umgeni Water is in the process of conducting a study on the impacts that climate change could have on the water resources. The results of the study will be incorporated once they are available

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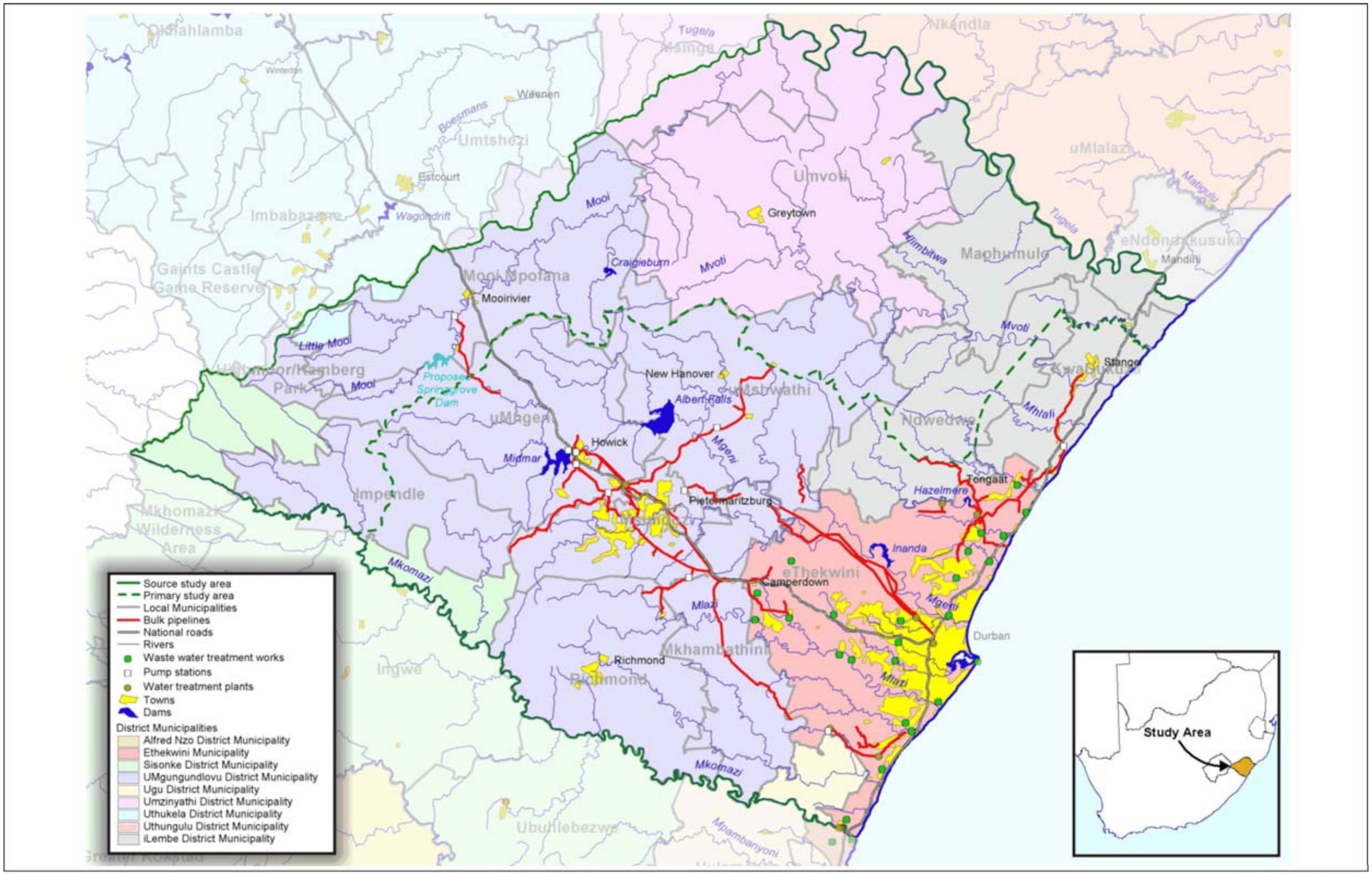
Appendix A

No:	Description
A-1	Study area
A-2	Irrigation development within study area
A-3	Water resource systems and demand centres

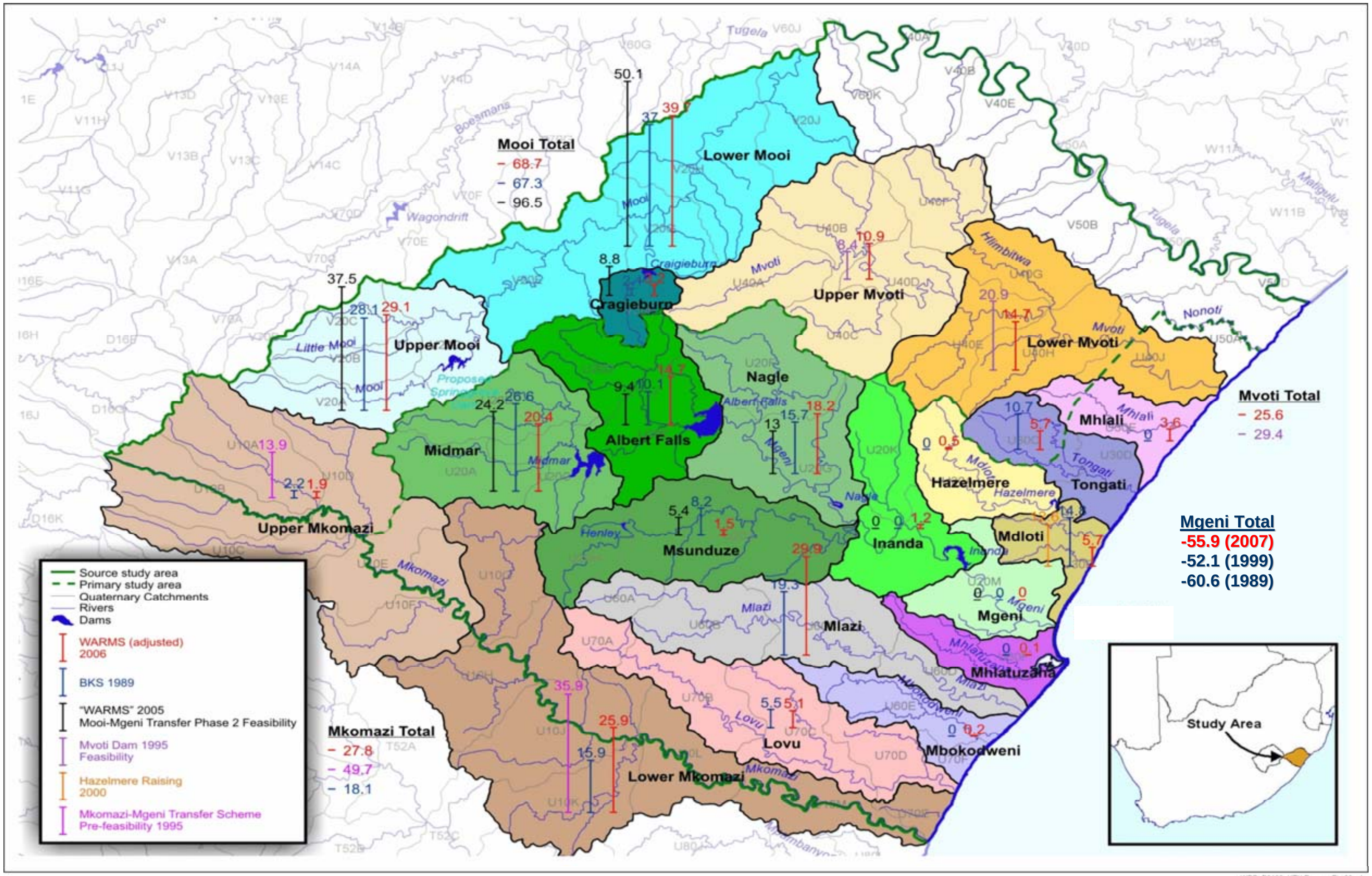


WRP_P0183_KZN Recon._Fig 22.cdr

WATER RECONCILIATION STRATEGY STUDY FOR THE KWAZULU-NATAL COASTAL METROPOLITAN AREAS

Study Area

A-1

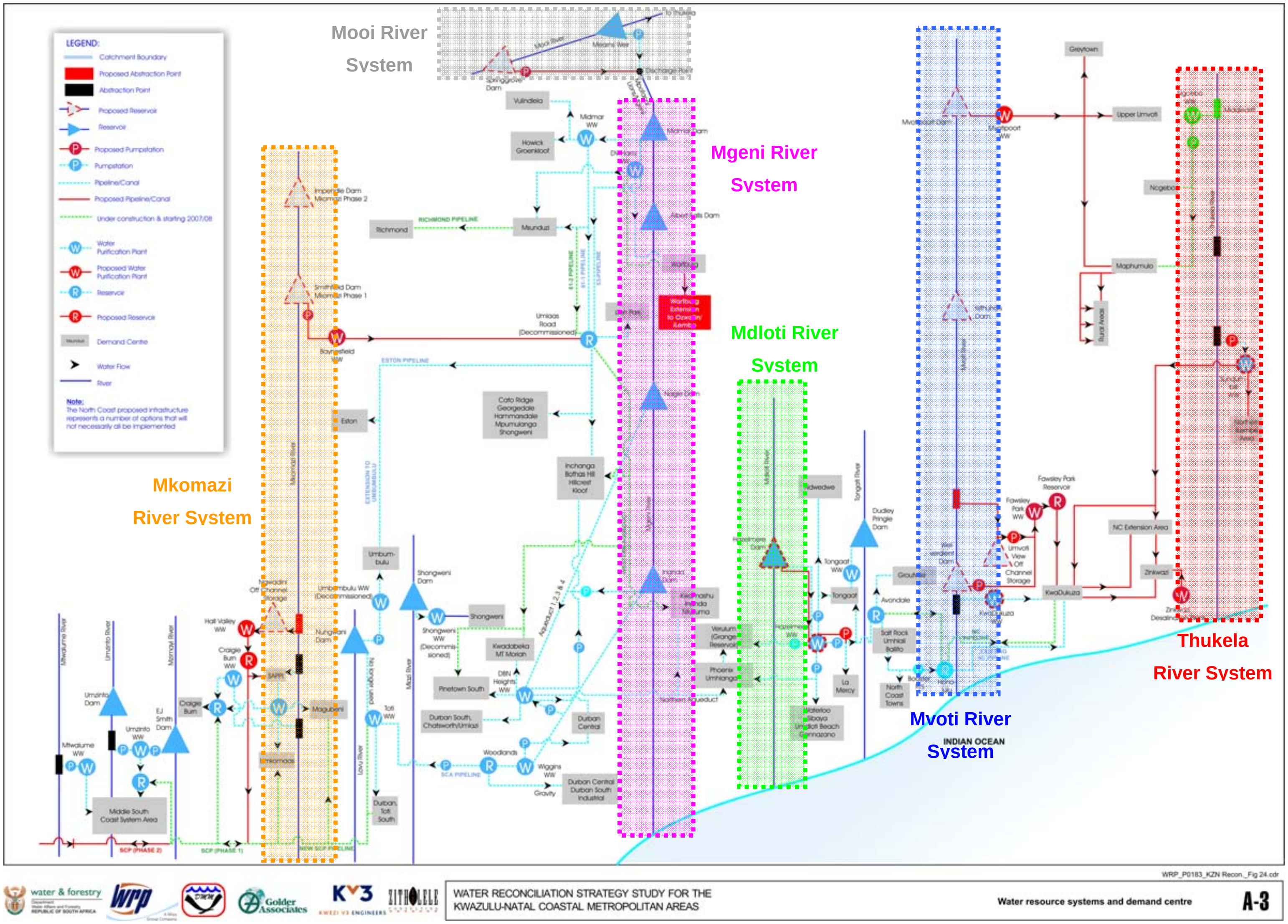


WRP_P0183_KZN Recon._Fig 23.cdr

water & forestry | WRP | Golder Associates | KV3 | ZITHOLELE

WATER RECONCILIATION STRATEGY STUDY FOR THE KWAZULU-NATAL COASTAL METROPOLITAN AREAS

Irrigation development within study area **A-2**


Mooi River System
Mgeni River System
Mdloti River System
Mkomazi River System
Mvoti River System
Thukela River System
INDIAN OCEAN
LEGEND:
WATER RECONCILIATION STRATEGY STUDY FOR THE KWAZULU-NATAL COASTAL METROPOLITAN AREAS
Water resource systems and demand centre
A-3

Appendix B

No:	Description
B-1	Gantt Chart: Strategic perspective

Gantt Chart: Strategic Perspective

ID	Task Name
1	**MGENI RIVER SYSTEM**
2	WC/WDM Waste Management Implementation
3	WC/WDM Efficiency Measures Feasibility Study
4	**> WC/WDM Feasibility Study Report**
5	Implementation of WC/WDM Efficiency Measures
6	Mooi-Mgeni Transfer Scheme Phase 2 Implementation
7	**> MMTS2 Implementation Complete**
8	Feasibility Study for Re-Use Options
9	**> Feasibility Study Report**
10	Implement Re-use Options
11	Mooi River Catchment Water Use Validation Study
12	**> Validation Study Report**
13	Mkomazi-Mgeni Transfer Scheme Feasibility Study
14	**> Feasibility Study Report**
15	Mkomazi-Meni Transfer Scheme Implementation
16	**> Mkomazi Scheme Implementation Complete**
17	High Confidence Reserve Determination Study
18	**> High Confidence Reserve Results**
19	**MDLOTI & MVOTI RIVER SYSTEMS**
20	Raise Hazelmere Dam Wall
21	North Coast Augmentation Pipeline Implementation
22	Feasibility Study for the LowerThukela & Mvoti Development Options
23	**> Development Options Feasibility Report**
24	Implement Lower Thukela or Mvoti Development Option
25	**> Lower Thukela Implementation Complete**
26	**> Mvoti Implementation Complete**
27	High Confidence Reserve Determination Studies
28	**> High Confidence Reserve Results**
29	**OVERALL STUDY AREA**
30	Review Reconciliation Options Based on Reserve Study Results
31	Early Drought Restrictions
32	Study Operational Forum - Continuous
33	Strategy Implementation Committee