Report No: PB1 U100-00-0999

DEPARTMENT OF WATER AFFAIRS
AND FORESTRY

in association with

UMGENI WATER
Corporate Services Division

# MKOMAZI/MOOI-MGENI TRANSFER SCHEME PRE-FEASIBILITY STUDY

## MKOMAZI-MGENI TRANSFER SCHEME

## SUPPORTING REPORT No 5

## ENVIRONMENTAL

## VOLUME 1

Report No 2787E/7856
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NINHAM SHAND
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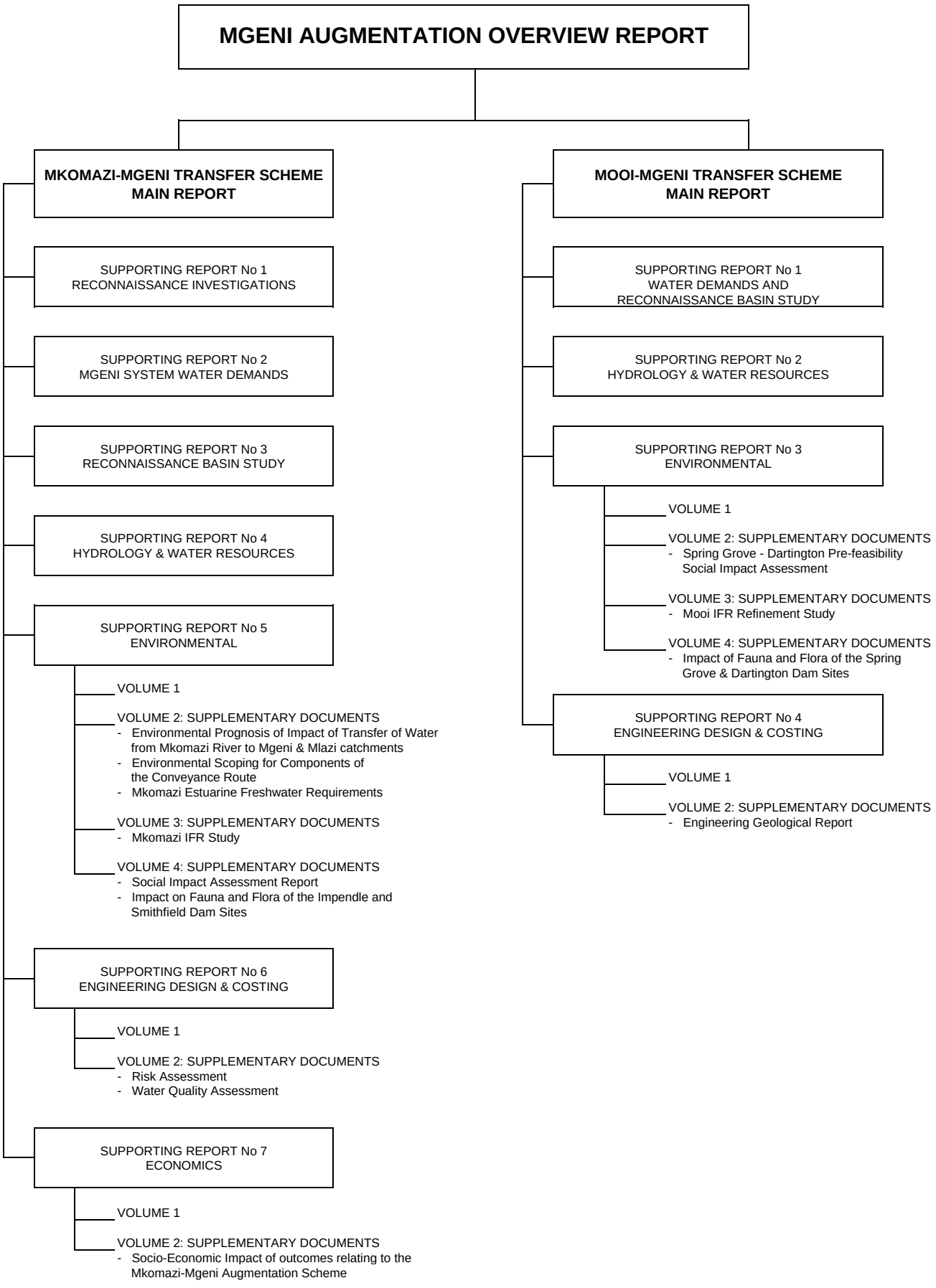
# MKOMAZI/MOOI-MGENI TRANSFER SCHEME PRE-FEASIBILITY STUDY REPORT STRUCTURE




\7856\Mgeni report structure.wb1

# MKOMAZI / MOOI-MGENI TRANSFER SCHEME PRE-FEASIBILITY STUDY

## PREFACE

In January 1997, the Department of Water Affairs & Forestry: Directorate of Project Planning, in conjunction with Umgeni Water: Corporate Services Division, invited various firms of consulting engineers to submit proposals to undertake a Pre-Feasibility Study for a scheme to transfer water from the upper Mkomazi River to the Mgeni System. In July 1997, a multi-disciplinary team led by Ninham Shand was appointed.

This Study follows on from the Mgeni River System Analysis Study carried out between 1991 and 1994, in which the Mkomazi River was identified as a potentially viable source of water for augmentation of the Mgeni System, and the Mooi-Mgeni Transfer Feasibility Study carried out in 1995, in which the first phase scheme to augment the Mgeni System from the Mooi River was investigated in detail and possible second phase schemes were identified.

This Study comprises two distinct parts; a pre-feasibility investigation of augmentation schemes on the Mkomazi River preceded by scheme identification and reconnaissance investigations, and a pre-feasibility investigation of second phase transfer schemes from the Mooi River. A comparison of the two main augmentation options is made at the culmination of the Study. The report structure is given overleaf.

Sub-consultants employed by Ninham Shand to undertake various aspects of the Study included:

- IWR Environmental: Environmental studies and IEM co-ordination
- Scott Wilson: Social studies
- Keeve Steyn: Engineering aspects of tunnels and pumpstations, and involvement with Basin Studies
- Simmer Biggar and Associates: Infrastructure aspects.

As part of the Study Team, the following Client departments were involved:

- Council for Geoscience: Geological Survey
- Department of Water Affairs & Forestry: Project Planning (East)
- Department of Water Affairs & Forestry: Environment Studies
- Department of Water Affairs & Forestry: Hydrology
- Umgeni Water: Corporate Services Division: Water Resources Planning
- Umgeni Water: Scientific Services Division: Water Quality
- Umgeni Water: Scientific Services Division: Hydro-biology.

## *EXECUTIVE SUMMARY*

*This report concerns itself with the environmental component of the Mkomazi-Mgeni Transfer Pre-Feasibility Study. It aims to summarise, integrate and prioritise information from the scoping process, various individual investigations and specialist studies to provide a structured information base for decision-making regarding the acceptability of the proposed development options.*

*Two augmentation development options are considered for the pre-feasibility study:*

- *Impendle Scheme: Dam at Impendle (built in two phases) and conveyance through a series of tunnels and pipelines, via Midmar and the Northern Feeder route, to Umlaas Road.*
- *Smithfield Scheme: First phase dam at Smithfield, Second phase dam at Impendle, and conveyance though a tunnel and pipeline, via a balancing dam in the Mlazi River near Baynesfield, to Umlaas Road.*

*In addition to these, the 'no development' option is also addressed in this report:*

- *Non-Augmentation Scenario: The proposed Mkomazi-Mgeni Transfer Scheme is not commissioned but water demand is managed by the relative authorities.*

*Before implementation of a large water resource development such as an interbasin transfer scheme, it is essential to investigate the potential biophysical and social implications associated with the scheme. The Department of Water Affairs and Forestry (DWAF) has developed a procedure for the phased implementation of Integrated Environmental Management (IEM) on large water resource development projects such as the Mkomazi-Mgeni Transfer Study. This procedure was followed during the course of this study.*

*The Mkomazi Environmental Task Group (ETG), a technical working group, was established to oversee the environmental component and the of the study. A Stakeholder Committee was established to involve stakeholder representatives in the development process.*

*The pre-feasibility environmental assessment for the Mkomazi-Mgeni Study concerned itself with the following environmental components:*

- *Environments affected by inundation;*
- *Environments affected by conveyance infrastructure;*
- *Riverine environments affected by changes in flow regime;*
- *Estuarine environment affected by changes in flow regime;*
- *The receiving river systems affected by augmentation transfers; and*
- *Water supply areas affected by augmentation.*

*Following the EIA Regulations, an EIA application for the project should be made with the relevant environmental authorities. At the time that this report was produced, the EIA registration had not yet been completed, but the relevant authorities had been informed about the project.*

*Environments Affected by Inundation*

*The biophysical impacts related directly to inundation by the two schemes are very similar and regarded as relatively low. Both areas are severely degraded. A few rare or threatened plant species occur in low numbers on both sites. Most of these could be propagated or relocated. The most significant impact (applicable to both schemes) is the loss of two Bald Ibis roosting/nesting sites at Impendle. However, the Environmental Task Group did not regard this as a fatal flaw.*

*From a social impact perspective, both schemes could be implemented. Negative impacts could be mitigated to between low and moderate. The Smithfield Scheme would be more complex and more expensive to implement but the potential positive impacts associated with the scheme are also more significant. In relation to the overall project cost, the cost for social mitigation and optimisation measures should be fairly insignificant.*

*Environments Affected by Conveyance Infrastructure*

*The conveyance infrastructure would involve a pumpstation, tunnel, pipelines, water treatment works, balancing dams and a bulk supply reservoir. The Impendle pipelines would be located along an existing servitude. The Smithfield pipelines would involve greenfields development, consultation and negotiation would therefore be more problematic. However, most of the impacts are temporary in nature (associated with the construction phase) or the size of the affected areas are relatively limited. An overall impact rating is provided in Table 1 at the end of this Executive Summary.*

*Riverine Environments Affected by Changes in Flow Regime*

*In terms of its present state, diversity of habitats and species, uniqueness, level of human use and reliance on the resource, the Mkomazi is a river of some importance. For this reason, it was found imperative that the present state and character of the river should, at least, be maintained. Impacts on the riverine environments downstream of the proposed dams relate to changes/ reduction in run-off from the catchment, with consequent changes in the flow regime and potential impacts on the functioning of ecosystems and way the river is utilised.*

*The Instream Flow Requirement (IFR) study made recommendations for maintenance flows and drought year flows. It also provided guidelines for capping flows and, in the case of the Smithfield Scheme, the operating rule between the two dams.*

*The recommended IFR's have been incorporated into the design capacity of both schemes but the final yield modeling has not yet been completed. At this stage the possible success of mitigation is therefore still uncertain. However, the impacts would possibly be mitigated to relatively low levels – if appropriate operational rules are observed. These operational rules still need to be developed.*

*However, the Smithfield Scheme involves two impoundments, one at Smithfield, located lower down in the catchment, and a second at Impendle. The Smithfield Scheme would impede a greater percentage of the mean annual runoff (MAR) and opportunities for natural mitigation are less than that for the Impendle Scheme. Although the IFR Study provided operational guidelines for elevated flows between the two dams, there is the added risk of exceeding the capping flows for this river reach. However the yield of the Impendle is lower than that of Smithfield and further augmentation, probably via another dam on the Mkomazi River would therefore be required in the future.*

*Estuarine Environment Affected by Change in Flow Regime*

*The Mkomazi Estuary is considered an important estuary due to its rarity of type, its general biological value and health, and because it is one of the few of the KwaZulu-Natal estuarine systems that is almost permanently open. However, it is also characterised by encroachment of sugarcane, the presence of alien vegetation and the existing (although relatively small) reduction in freshwater outflow due to water resource development and utilisation in the catchment area. The ecological integrity is therefore regarded as moderately modified. Based on the perceived importance of the Mkomazi Estuary it was concluded that the present state and character of the river should, at least, be maintained. The mouth should preferably be permanently open. However, it should at least remain open continuously during summer months. Should the mouth close during winter months it should only be for short periods of time.*
*Impacts on the estuarine environment are largely related to changes / reduction in run-off from the catchment, leading to an increase in closed mouth conditions.*

*The Estuarine Freshwater Requirement (EFR) study provided preliminary estimates for EFRs in terms of minimum baseflows, freshettes to replenish riverine-based nutrients and organic supplies, minor floods to move organic material through the estuary and major floods to reset the estuary.*

*If the EFR objectives are met, the impacts on the estuarine environment would be low. The relative impacts of the schemes were not compared, but it seems as if the Impendle Scheme, located higher in the catchment, will allow for a greater proportion of the catchment flow to be unimpeded and the larger downstream incremental catchment also provides better opportunity for natural mitigation. The risk of not meeting the EFR objectives are therefore slightly lower than in the case of the Smithfield Scheme.*

*Receiving River Systems Affected by Augmentation Transfers*

*Water transfer may lead to some habitat loss in the receiving streams, since these streams are already modified it is not regarded as a serious impact. Species likely to be transferred and to flourish probably already occur in the receiving streams. Impacts associated with the transfer of water from the Mkomazi River System to the Mgeni and Mlazi River Systems are therefore generally low and little mitigation is required. The only exception in this regard is the mitigation that would be required to address the potential geomorphological impacts of increased flow in the Mlazi River.*

*Supply Areas Affected by Augmentation* [F1]

*Achievable GGP and employment levels would be significantly higher with commissioning of the Mkomazi-Mgeni Transfer Scheme than with the Non-Augmentation Scenario. Non-Augmentation would result in a considerable cost in terms of lost output and constraints to employment generation.*

*Although the importance of water demand management was illustrated, the study concluded that, in the case of the Mgeni System, water demand management on its own is not a viable alternative to augmentation. Instead, water demand management and augmentation should be seen as complementing one another.*

*The summary of issues and concerns (see Table 1 on following page) clearly indicates that the environmental impacts, associated with the proposed Impendle and Smithfield Transfer Schemes, could be mitigated to within acceptable levels.*

*Generally, the Smithfield Scheme has slightly higher impacts than the Impendle Scheme. However, the available yield of the Impendle Scheme is lower than that of Smithfield and further augmentation will be required sooner (by approximately two years), therefore balancing out the impacts of the two schemes.*

F1 Areas dependent on water supply from the Mgeni System

*In conclusion, both schemes are regarded as acceptable from a biophysical and social point of view, provided the recommended future work is carried out and recommended mitigation measures are applied.*

*The Non-Augmentation Scenario proved to be problematic due to the unacceptable impacts on future economic development and employment opportunities in the water supply area, and within KwaZulu-Natal as a whole.*

*It is important to note that water demand management and catchment management would prove vital to ensure sustainable long term water supply in the region.*

**Table 1: Rating of Environmental Issues & Concerns**

| SUMMARY OF ENVIRONMENTAL IMPACTS AND ISSUES | ***Non Augmentation Option*** | | *Augmentation Options* | | | |
|---|---|---|---|---|---|---|
| | | | ***Impendle*** | | ***Smithfield*** | |
| | ***IMPACT RATING*** | | | | | |
| | without mitigation | with mitigation | without mitigation | with mitigation | without mitigation | with mitigation |
| ***BIOPHYSICAL IMPACTS*** | | | | | | |
| Environments Affected by Inundation | - | **-** | mod-high | **low-mod** | high | **mod** |
| Environments Affected by Conveyance infrastructure & Water Works | - | **-** | mod | **low** | mod-high | **low-mod** |
| Riverine Environments Affected by Changes in Flow Regime | - | **-** | high-severe | **possibly low-mod** | severe | **possibly mod** |
| Estuarine Environment Affected by Changes in Flow Regime | - | **-** | mod-high | **possibly low** | high | **possibly low-mod** |
| Receiving River Systems Affected by Augmentation Transfers | - | **-** | low | **none-low** | low | **none-low** |
| ***SOCIAL & ECONOMIC IMPACTS*** | | | | | | |
| Environments Affected by Inundation | - | **-** | high | **mod** | severe | **mod-high** |
| | - | **-** | - | **+** | - | **++** |
| Environments Affected by Conveyance infrastructure & Water Works | - | **-** | mod | **low** | high | **mod** |
| Riverine Environments Affected by Changes in Flow Regime | - | **-** | mod | **possibly none-low** | mod-high | **possibly none-low** |
| Estuarine Environment Affected by Changes in Flow Regime | - | **-** | ? | **possibly none** | ? | **possibly none** |
| Receiving River Systems Affected by Augmentation Transfers | - | **-** | none-low | **none-low** | none-low | **none-low** |
| Water Supply Areas Effected by Augmentation | **severe** | | | **++** | | **++** |

*Note: Impact ratings in this report are for the **final phases** of the development options.*

## GLOSSARY OF TERMS

DWAF : Department of Water Affairs & Forestry

EFR : Estuarine Freshwater Requirements

EIA : Environmental Impact Assessment

ETG : Environmental Task Group

FSL : Full Supply Level

GGP : Gross Geographic Product

IEM : Integrated Environmental Management

IFR : Instream Flow Requirements

masl : meter above sea level

MAR : Mean Annual Runoff

ROIP : Afrikaans acronym for 'Relevant Environmental Impact Prognosis'

**MKOMAZI-MGENI TRANSFER SCHEME PRE-FEASIBILITY STUDY**

**SUPPORTING REPORT NO 5: ENVIRONMENTAL**

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### *VOLUME 2 : SUPPLEMENTARY DOCUMENTS*

- Environmental Prognosis of Impact of Transfer of Water from Mkomazi River to Mgeni & Mlazi catchments
- Environmental scoping for Components of the Conveyance Route
- Mkomazi Estuarine Freshwater Requirements

### *VOLUME 3 : SUPPLEMENTARY DOCUMENTS*

- Mkomazi IFR Study

### *VOLUME 4 : SUPPLEMENTARY DOCUMENTS*

- Social Impact Assessment Report
- Impact on Fauna and Flora of the Impendle and Smithfield Dam Sites

**MKOMAZI-MGENI TRANSFER SCHEME PRE-FEASIBILITY STUDY**

**SUPPORTING REPORT NO 5: ENVIRONMENTAL**

***VOLUME 1***

# 1. INTRODUCTION

## 1.1 Focus of the Report

The Mkomazi-Mgeni Pre-Feasibility Study investigates the technical, economic and environmental implications of alternative development options for the Mkomazi-Mgeni Transfer Scheme.

This report concerns itself with the environmental component of the study. It aims to summarise, integrate and prioritise information from the various individual environmental investigations and specialist studies (see 'References') to provide a structured information base for decision-making regarding the acceptability of the proposed development options.

## 1.2 Structure of the Report

Section 1: Introduction (this section).

Section 2: Explains the need for augmentation of the Mgeni System. Describes the various options for augmentation. Provides detailed descriptions of the development options for the Mkomazi-Mgeni Pre-Feasibility Study.

Section 3: Provides details regarding the general scope of work, approach, procedures and study team. Describes the roles and involvement of the Environmental Task Group and Stakeholder Committee.

Section 4-9: Provides a description and assessment of impacts on environments affected by inundation, conveyances, changes in flow regime, water transfer and water supply. Identifies mitigation measures.

Section 10: In conclusion, this section summarises the issues and concerns. Evaluates the environmental acceptability of the development options. Provides recommendations for future work.

# 2. BACKGROUND

## 2.1 Mgeni River System – Need for Augmentation

The water resources of the Mgeni River, the main source of water for both domestic and industrial use in the Durban-Pietermaritzburg area, are already utilised close to full capacity. Supply shortages would have the effect of constraining economic growth and development in the region.

The Mgeni River System Analysis Study was commissioned to consider various augmentation options to supplement the Mgeni River System. The Mooi River was identified as the preferred first source and the Mkomazi was identified as the preferred second source of augmentation for the Mgeni River System.

## 2.2 Mgeni River System – Augmentation Options

The Department of Water Affairs and Forestry (DWAF) and Umgeni Water are currently investigating various options, including interbasin transfers from the Mooi River and the Mkomazi River, to supplement the water supply of the Mgeni catchment. These are briefly described below:

### *2.2.1 Raising of Midmar Dam*

The raising of Midmar Dam has been investigated at feasibility level and initial stages of the implementation process are under way. The raising is essential to maximise the yield of the Mooi-Mgeni transfer options.

Environmental scoping, in the form of a Relevant Environmental Impact Prognosis (ROIP) report, was completed by DWAF Directorate Social and Environmental Services. No fatal flaws were identified.

### *2.2.2 Mooi-Mgeni Transfer Phase I*

Initial studies of various Mooi River options identified Mearns, Spring Grove and Dartington Dams as the most viable alternatives. The Mooi-Mgeni Transfer Feasibility Study considered various combinations of dams, tunnels, pipelines and pumpstations. Based on the results of the Feasibility Study and recent reviews of the hydrology, yield analysis, water demand projections and cost estimates, the preferred Mooi-Mgeni Phase I Transfer Scheme was identified to be a weir/dam at Mearns, probably with an upgraded pumpstation and pipeline.

An Initial Environmental Assessment was completed as part of the Feasibility Study. This assessment did not identify any impacts so severe as to make the Mearns development option unviable.

### *2.2.3 Mooi-Mgeni Transfer Phase II*

In parallel with the Mkomazi-Mgeni Transfer Pre-Feasibility Study, alternative storage options in the Mooi River, at Spring Grove and Dartington, are being investigated. The preferred option will be implemented as Phase II of the Mooi-Mgeni Transfer. Pre-feasibility level social and biophysical impact assessments concluded that both Spring Grove and Dartington are acceptable from an environmental point of view, provided that the recommended further work is carried out and mitigatory measures are properly implemented.

### *2.2.4 Augmentation from the Mkomazi River System*

Second to the Mooi River, the Mkomazi River was identified as the most viable source of augmentation for the Mgeni System. Initially a number of alternative schemes were identified and evaluated. For various reasons, some of these schemes were eliminated. The remaining schemes, which consisted of dams, waterworks, pumpstations and conveyances made up of tunnels, pipelines, canals, siphons in various combinations, were assessed at a more detailed, pre-reconnaissance level. Phasing of the schemes was considered and an initial environmental scoping exercise was carried out. One scheme (Clayborne) was eliminated mainly on environmental grounds and a second (Ndonyane) was provisionally eliminated on economic and environmental grounds. A habitat integrity assessment of the latter scheme indicated that the dam would inundate a valuable and important resource base. The scheme was only to be reconsidered should the reconnaissance phase yield results render the remaining schemes less viable. These decisions were ratified by the Mkomazi Environmental Task group (ETG) and the Stakeholder Committee [F2]

At reconnaissance level, the remaining three schemes were investigated:

I. *Impendle Scheme:*
   Dam at Impendle; and
   Conveyance through a series of tunnels and pipelines, via Midmar Dam and the Northern Feeder route, to Umlaas Road.

F2 A summary of the ETG discussions and recommendations is supplied in Section 10 of this report.

II. *Smithfield-Richmond Scheme:*
First phase dam at Smithfield;
Second phase dam at Impendle; and
Conveyance though a tunnel and pipeline, via a balancing dam in the Lovu River near Richmond, to Umlaas Road.

III. *Smithfield-Baynesfield Schemes:*
First phase dam at Smithfield;
Second phase dam at Impendle; and
Conveyance though a tunnel and pipeline, via a balancing dam in the Mlazi River near Baynesfield, to Umlaas Road.

DWAF Directorate Social & Environmental Services completed initial environmental assessments, in the form of Relevant Environmental Impact Prognosis (ROIP) reports, (F3) on these options. The two Smithfield Schemes were found to have a greater ecological impact than Impendle, mainly due to their effect on the downstream flow regime. However, the Impendle Scheme was found to have relatively severe social impacts, but this which would also apply to the second phase dam of the Smithfield options. However, it was agreed that no fatal social or biophysical flaws were apparent.
Economic considerations and technical problems were encountered with the Smithfield-Richmond Scheme. It was therefore proposed and agreed to by the ETG and the Stakeholder Committee that only the Impendle and Smithfield-Baynesfield Schemes be investigated at pre-feasibility level.

F3 See Reference List

## 2.3 Mkomazi-Mgeni Transfer Pre-Feasibility Study

### *2.3.1 Augmentation Development Options*

The two augmentation development options considered for the pre-feasibility study, are described below (configurations and sizes are preliminary). An integral part of these options would be water demand management by the relevant authorities.

**Impendle Scheme**

C Impoundment – Impendle Dam

| | *Phase 1* | *Phase 2* | |
|---|---|---|---|
| Full supply level (FSL) : | 1 184 | 1 197 | masl |
| Buyout line: | | 1205 | masl |
| Surface area at FSL: | | 2580 | ha |
| Mean Annual Runoff (MAR): | 568 | 568 | $10^6m^3$ |
| Live storage capacity: | 546 | 823 | $10^6m^3$ |
| Ultimate water transfer: | | 32 | % of virgin MAR |

C Raw Water Conveyance (A) – Impendle-Midmar Tunnel
New tunnel from Impendle to KwaGqishi River, feeding Midmar Dam.

C Receiving Stream – KwaGqishi River
Tunnel outlet portal to Midmar Dam.

C Storage – Midmar Dam
Raising of Midmar Dam wall and expansion of outlet works (independent project).

C Pumpstation – Midmar
Extension of existing pumpstation.

C Raw Water Conveyance (B) – Midmar Pipelines
New pipelines between Midmar Dam, pumpstation and the water treatment works.

C Water Treatment Works – Midmar
Extension of existing water treatment works.

C Clear Water Conveyance:

– Linking clear water Tunnels and Pipelines
Upsizing / Duplication of existing pipelines (linking Midmar Water Treatment Works to the Northern Feeder route), Stuckenberg Tunnel, Upgrade of Ferncliffe Tunnel

– 'Northern Feeder' Pipeline
Widening of existing servitude (20 m wide) for additional pipeline, new width ± 30 m (37 km long).

– 'Northern Feeder' southern extension Pipeline
Extension of servitude, linking Northern Feeder southwards to Umlaas Road Reservoir (3 km long).

C Reservoir – Umlaas Road
New bulk supply reservoir.

**Smithfield Scheme**

C Impoundments – Smithfield and Impendle

| | *Phase 1* | *Phase 2* | |
|---|---|---|---|
| Location: | Smithfield | Impendle | |
| Height of wall: | 69 | 105 | m |
| Full supply level (FSL) : | 915 | 1 197 | masl |
| Buyout line: | 920 | 1205 | masl |
| Combined surface area at FSL: | | 3160 | ha |
| Mean Annual Runoff (MAR): | 731 | 568 | $10^6m^3$ |
| Live storage capacity: | 130 | 953 | $10^6m^3$ |
| Ultimate water transfer: | | 38 | % of virgin MAR |

C Pumpstation – Smithfield Pumpstation
New pumpstation within the Smithfield Dam intake tower.

C Raw water Conveyance (A) – Smithfield Tunnel
New Tunnel from Smithfield to raised existing irrigation dam in Mlazi River.

C Receiving Stream – Mlazi River
Outlet tunnel portal at the dam in the Mlazi River.

C Balancing Dam – Dam in Mlazi River
Raising of existing irrigation dam in Mlazi River.

C Raw Water Conveyance (B) – Smithfield Raw Water Pipeline (Mlazi to Baynesfield)
New pipeline, servitude ± 30 wide (± 4 km long).

C Water Treatment Works – Baynesfield
New water treatment works near Baynesfield Estate.

C Clear Water Conveyance – Smithfield Clear Water Pipeline (Baynesfield to Umlaas Road)
New pipeline, servitude ± 30 wide (± 21 km long).

C Reservoir – Umlaas Road
New bulk supply reservoir.

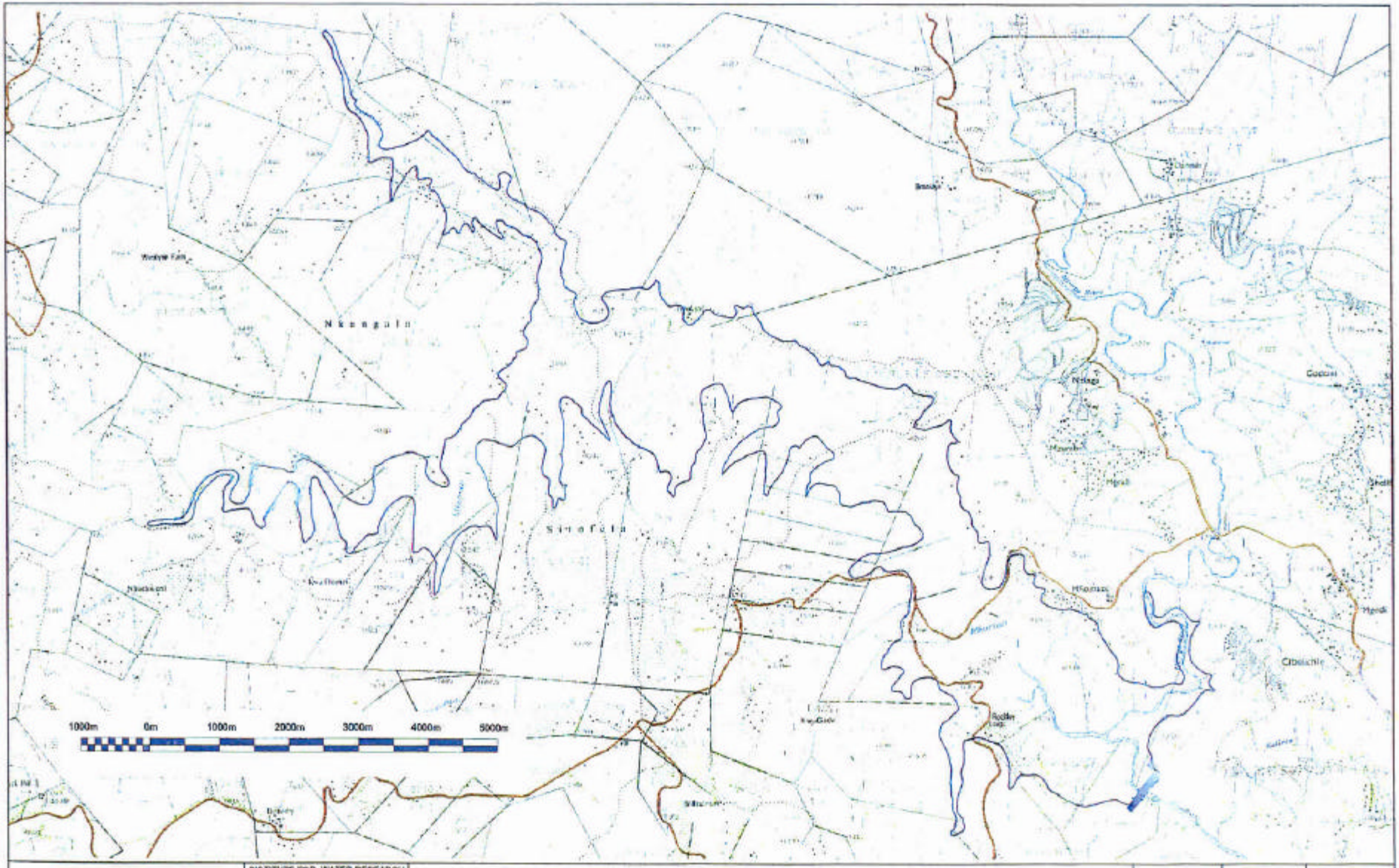
### *2.3.2 No Development Option*

**Non-Augmentation Scenario**

In addition to the two development options for augmentation, the non-augmentation scenario – where the proposed Mkomazi-Mgeni Transfer Scheme is not implemented but water demand is managed, is also addressed in this report.

## 2.4 The Way Forward

Based on the findings of the parallel pre-feasibility investigations on the Mooi-Mgeni and the Mkomazi-Mgeni Transfer Options, detailed feasibility studies on selected Mooi and Mkomazi Schemes will be carried out to identify the next augmentation scheme for the Mgeni System, for when the Phase I Mooi-Mgeni Transfer Scheme is fully utilised. Such a scheme can either be on the Mooi or the Mkomazi River.

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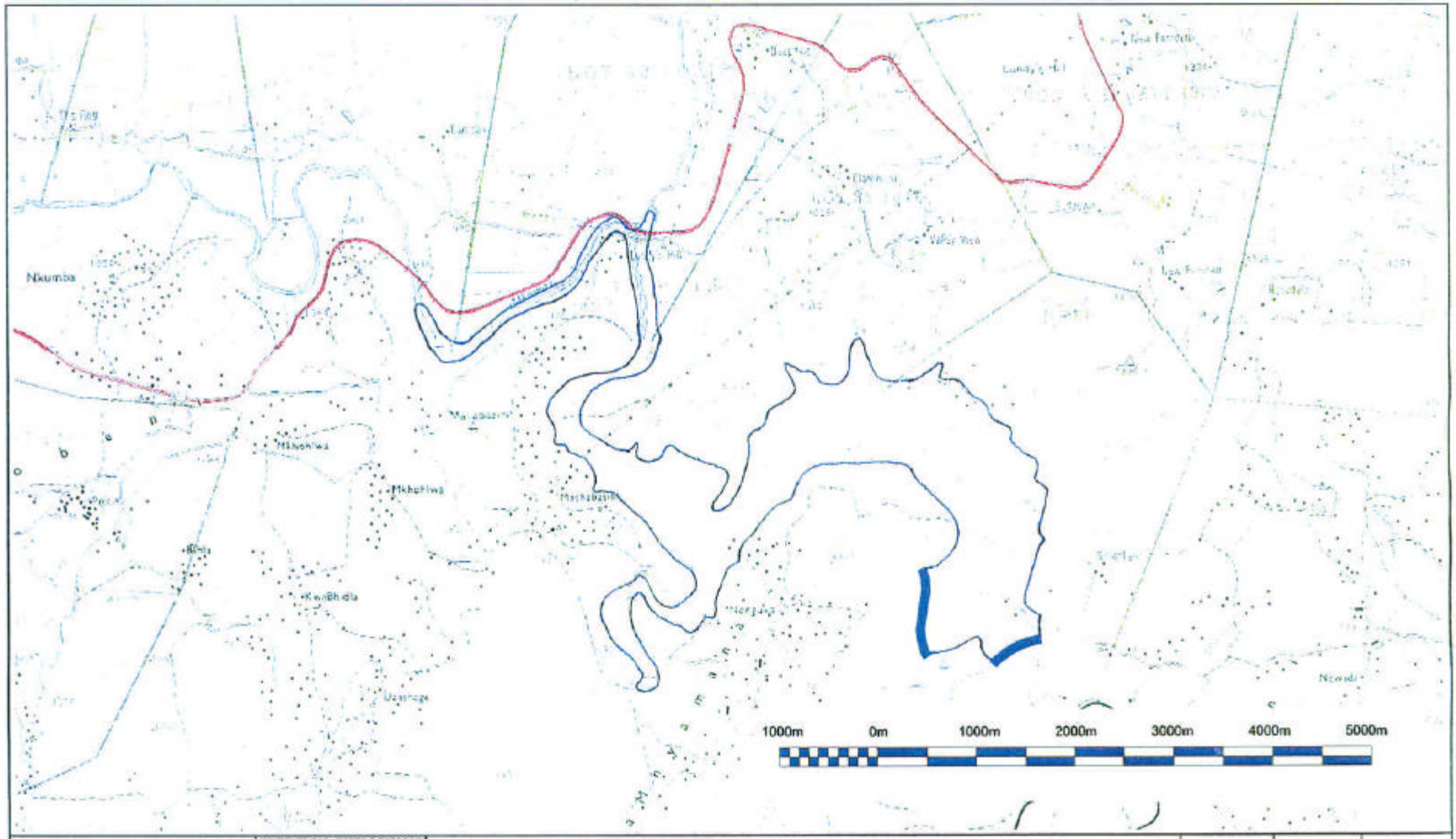
**IMPENDLE DAM BASIN**

UMGENI WATER - AMANZI

FIGURE No.
2.3.1

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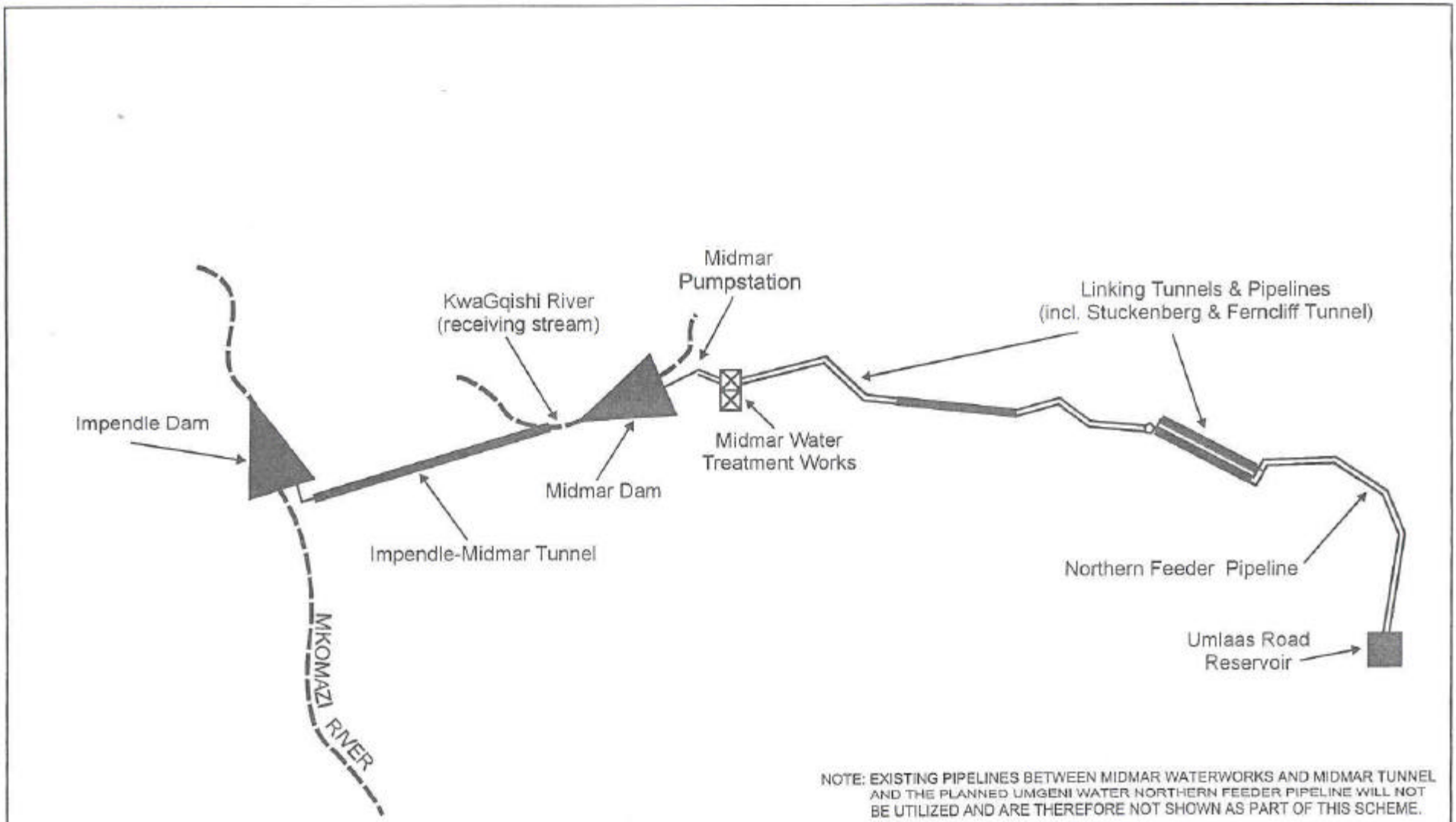
**SMITHFIELD DAM BASIN**

UMGENI WATER - AMANZI

FIGURE No.

2.3.2


Midmar
Pumpstation
KwaGqishi River
(receiving stream)
Linking Tunnels & Pipelines
(incl. Stuckenberg & Ferncliff Tunnel)
Impendle Dam
Midmar Water
Treatment Works
Midmar Dam
Impendle-Midmar Tunnel
Northern Feeder Pipeline
Umlaas Road
Reservoir
MKOMAZI RIVER
NOTE: EXISTING PIPELINES BETWEEN MIDMAR WATERWORKS AND MIDMAR TUNNEL AND THE PLANNED UMGENI WATER NORTHERN FEEDER PIPELINE WILL NOT BE UTILIZED AND ARE THEREFORE NOT SHOWN AS PART OF THIS SCHEME.
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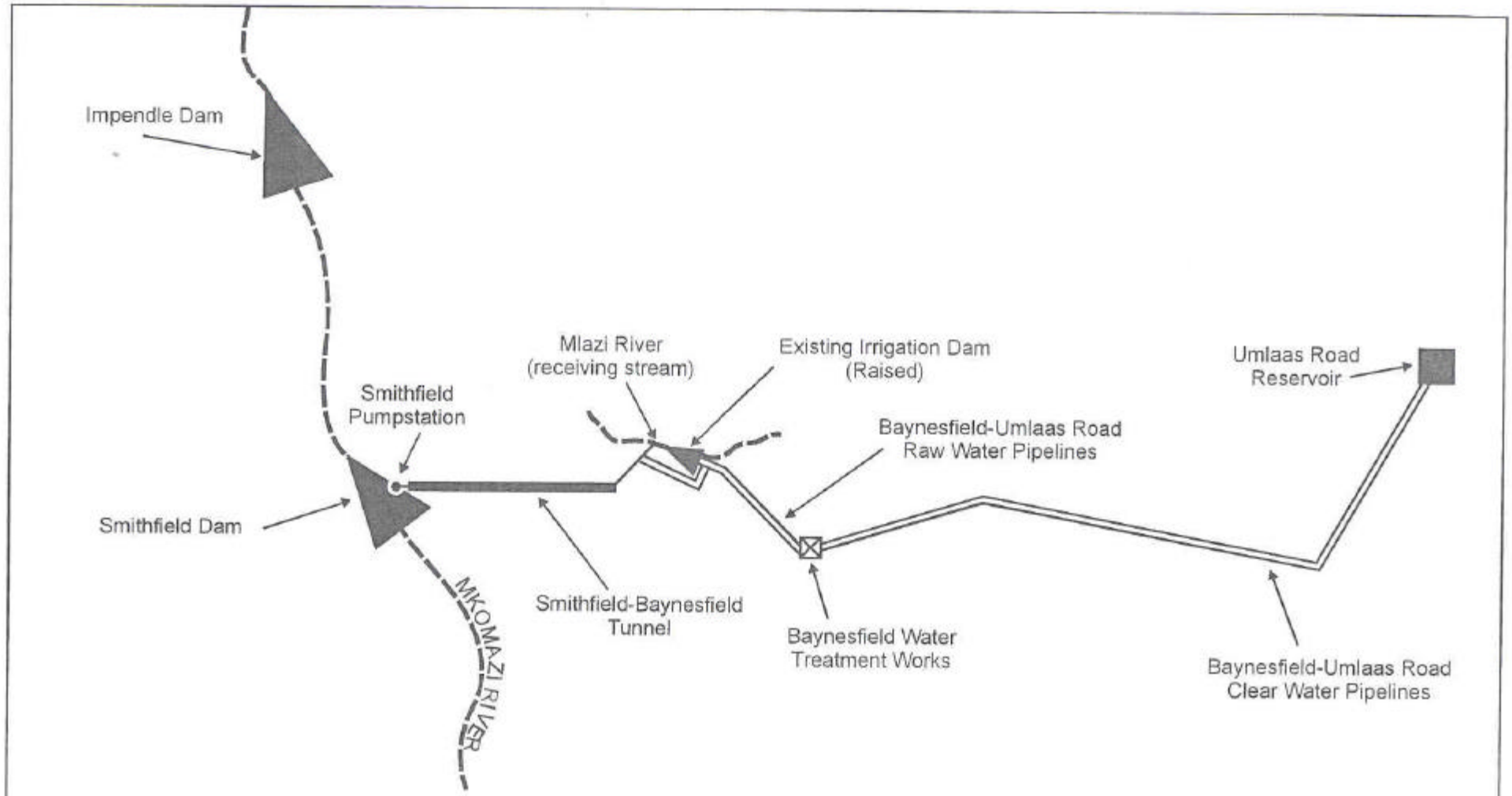
MKOMAZI-MGENI TRANSFER SCHEME PRE-FEASIBILITY STUDY
IMPENDLE TRANSFER SCHEME SCHEMATIC LAYOUT
UMGENI
WATER - AMANZI
FIGURE No.
2.3.3

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MKOMAZI-MGENI TRANSFER SCHEME PRE-FEASIBILITY STUDY

SMITHFIELD TRANSFER SCHEME SCHEMATIC LAYOUT

UMGENI WATER - AMANZI

FIGURE No.

2.3.4

# 3. GENERAL APPROACH AND PROCEDURES

## 3.1 Introduction

Before implementation of an interbasin transfer scheme, it is essential to investigate the potential biophysical and social implications associated with the scheme. The general approach and procedures for the pre-feasibility level environmental investigations are described below:

## 3.2 Integrated Environmental Management (IEM)

IEM has been in use in South Africa for some years and is generally widely accepted as an overall guideline for environmental impact management of projects that may significantly affect the environment through pollution and/or resource use. IEM is applied to ensure that environmental considerations are effectively and adequately taken into account at all stages of the development process. The general objectives of IEM, as set out in the draft National Environmental Management Bill (W 101D–1998), are to:

I. Ensure that all decisions which may have a significant effect on the environment take cognisance of the National Environmental Management Policy principles. This Policy concerns itself with, inter alia:
   – sustainability issues
     (including the avoidance of degradation / minimising of impacts / rehabilitation of ecosystems and cultural heritage sites),
   – environmental justice,
   – equitable access to environmental resources, etc.

II. Identify, predict and evaluate: the actual and potential biophysical, social and other relevant environmental effects; the risks and consequences of development alternatives; options for mitigation of projects, with a view to minimising negative impacts on the environment, maximising benefits, and promoting compliance with the principles of environmental management;

III. Ensure that the effects on the environment of projects receive adequate consideration before actions are taken in connection with them. Ensure adequate and appropriate opportunity for public participation in decisions that may affect the environment.

In order to give effect to these general objectives of IEM, the potential environmental impact of activities must be investigated and assessed prior to their implementation and

the relevant environmental authorities (charged by law with authorising, permitting, or otherwise allowing the implementation of the activity) should be notified and be involved in the process.

DWAF has developed a procedure for the phased implementation of IEM on large water resource development projects such as the Mkomazi-Mgeni Transfer Study. This DWAF IEM procedure, as applied for this study, is shown Overleaf.

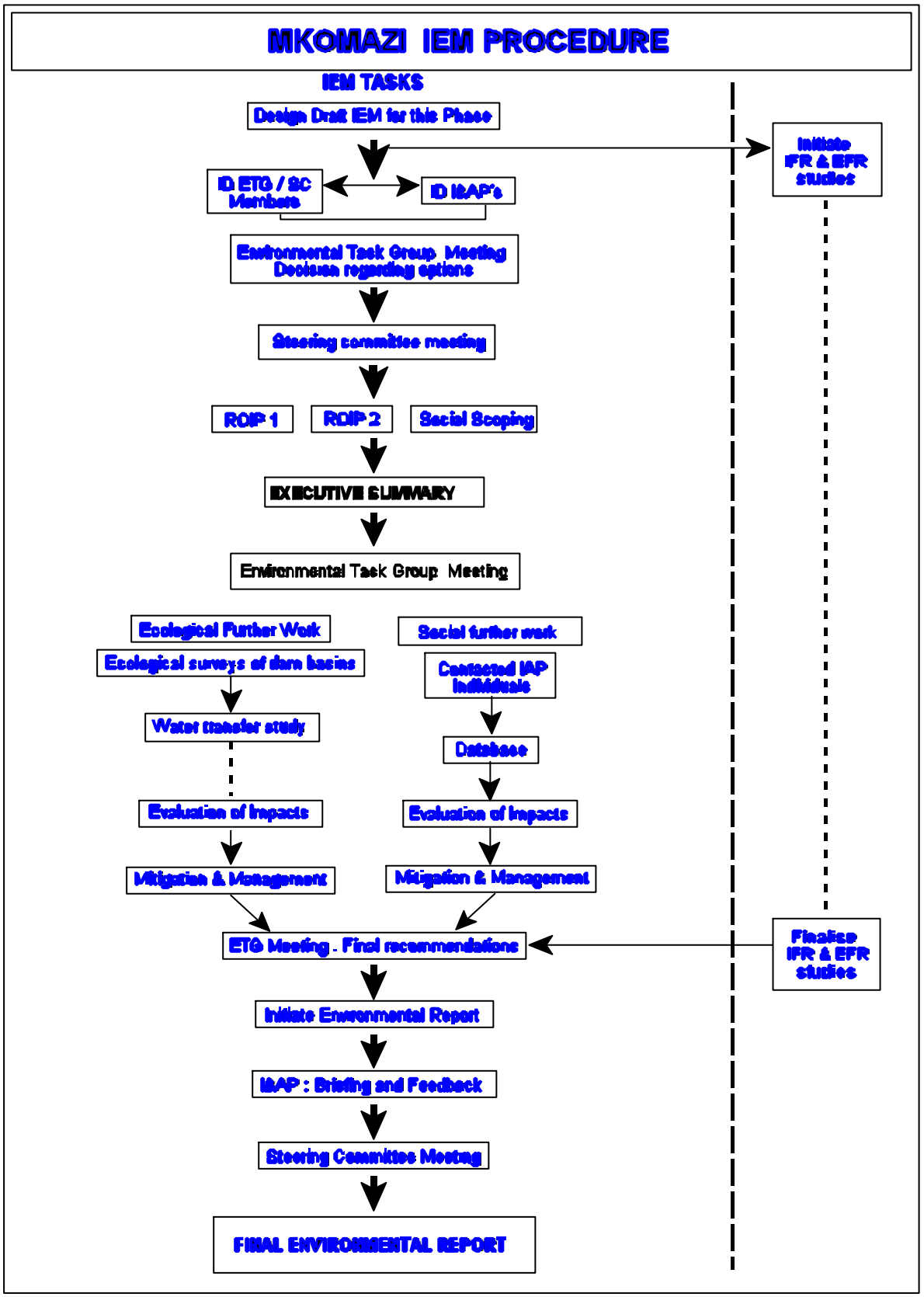


**Figure 3.2.1:Mkomazi IEM Procedure**

## 3.3 Environmental Impact Assessment (EIA) Registration

Following the EIA Regulations (regulations 1152 and 1153 of the Environment Conservation Act, Act 73 of 1998), an EIA application for the project should be made with the relevant environmental authorities. These authorities need to have input at various stages of the EIA process and need to review and authorise the EIA before the project can proceed to implementation.

In the case of the Mkomazi-Mgeni Transfer Scheme, the application should be lodged with KwaZulu-Natal Department of Traditional & Environmental Affairs, but, because a national department (DWAF) is the project applicant, this application will be referred to National Department of Environmental Affairs & Tourism.

*At the time this report was produced, the EIA registration had not yet been completed,* but the relevant authorities have been informed about the project.

## 3.4 Scope of the Pre-Feasibility Level Environmental Assessment

The pre-feasibility environmental assessment for the Mkomazi-Mgeni Study concerned itself with the following environmental components:

- Environments affected by inundation;
- Environments affected by conveyance infrastructure;
- Riverine environments affected by changes in flow regime;
- Estuarine environment affected by changes in flow regime;
- The receiving river systems affected by augmentation transfers; and
- Water supply areas affected by augmentation.

## 3.5 Rating System

- Environmental impacts are rated, both with and without mitigation, for the **final phases** of the the development options (refer to Section 2.3):

  – with mitigation: impacts are rated *with proper mitigation measures in place*
  (i.e IFR and EFR allocations to mitigate against impacts associated with changes in flow regime).

  **S** without mitigation: impacts are rated *without proper mitigation in place*, this rating provides an indication of the consequences

should mitigation fail / not be put in place properly. The importance of the mitigation is therefore emphasised.

- The impacts are rated according to the following impact categories:

  - - / none : no impact / impact not applicable to the specific scheme
  - ? : insufficient information to do impact rating
  - possibly : preliminary rating / further work required to confirm
  - low : slight / low impact expected
  - mod : moderate impact expected
  - high : high impact expected
  - severe : severely high impact expected
  - fatal flaw : unacceptable impact expected – development not to proceed
  - + : positive impact
  - ++ : exceptional positive impact

- Where data confidence levels are provided, they are based on the following:

  - ? : no data available
  - opinion : personal opinion / subjective issue
  - low : little data available – informed guess / value judgement
  - mod : known fact – lacks quantitative verification
  - high : well researched / well-known fact

## 3.6 Study Team

To undertake the study, the Department of Water Affairs and Forestry (DWAF) and Umgeni Water appointed Ninham Shand as their lead consultant. Ninham Shand subcontracted IWR Environmental to manage the Integrated Environmental Management (IEM) procedure, to undertake the Instream Flow Requirements (IFR) study and to manage the Estuary Flow Requirements (EFR) study.

The Relevant Environmental Impact Prognosis (ROIP) reports for both Impendle and Smithfield were compiled by DWAF Directorate Social and Environmental Services and the assessment of biophysical impacts related to the conveyance infrastructure was completed in-house by Ninham Shand. Various specialists participated, specifically in the EFR and IFR studies, the Ecological Dam Basin Survey, the Interbasin Transfer Study and on water quality issues. Ninham Shand subcontracted Scott Wilson Planning and Development Resource to undertake the Social Impact Assessment.

## 3.7 Mkomazi Environmental Task Group (ETG)

The Mkomazi ETG is an enviro-technical working group that was established to oversee the environmental component of the study, aiming to:

- ensure that IEM is applied during all phases of the study;
- supply factual and objective environmental information;
- identify environmental work to be addressed during the pre-feasibility and feasibility phases of the study;
- review environmental studies and reports; and
- make environmentally based recommendations to the Project Management Committee.

The ETG reports, evaluates and comments on factual information and representation on this task group is therefore limited to members who can make relevant contributions on biophysical and/or social environmental issues. For a list of ETG members and a summary of the discussions and recommendations refer to Addendum B.

## 3.8 Stakeholder Involvement

It is important that the outcome of the Mkomazi-Mgeni Transfer Scheme be appropriate for and in harmony with the initiatives of other stakeholders. It should meet the needs of the originally perceived and actual beneficiaries and should not have any severe or unforeseen negative impacts.

The Stakeholder Committee was established to:

- involve stakeholders in the development process;
- provide representatives of stakeholders with the opportunity to formulate informed objections and concerns regarding the project, to communicate their needs and to identify the advantages and benefits associated with the project; and
- make recommendations to the Project Management Committee.

For a list of Stakeholder Committee members refer to Addendum C.

# 4. ENVIRONMENTS AFFECTED BY INUNDATION

## 4.1 Data Sources

– Relevant Environmental Impact Prognosis (ROIP) Reports on the proposed Impendle Dam and Smithfield Dam.

– Pre-Feasibility Study of the Potential Impact on Fauna and Flora of the Impendle and Smithfield Dam sites.

– Pre-Feasibility Report: Social Impact Assessment of the proposed Mkomazi Schemes.

## 4.2 Scope of Work

This section of report concerns itself with a comparison of the environmental issues associated with impoundment and inundation of habitat/land by the proposed Impendle (phase 3) and Smithfield (combined impact of phase 1 & 2) Schemes.

– The ROIP reports provided scoping level checklists and an initial interpretation of potential negative and positive impacts associated with the dam sites.

– The study of potential impacts on fauna and flora was undertaken to assess the biotic integrity of the dam sites, identify rare and threatened fauna and flora species and consider the regional importance of these species.

– The Social Impact Assessment concerned itself with: identification of affected parties, pre-feasibility level public involvement; identification and analysis of claims, concerns and issues; initial analysis of potential costs and benefits; and an assessment of the cost of mitigation (i.e. resettlement).

## 4.3 Comparative Assessment of Biophysical Components [F4]

### *4.3.1 Habitat Integrity & Biodiversity*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD & IMPENDLE | – Both the Impendle and Smithfield sites are highly disturbed and degraded;<br>– Alien vegetation and altered communities are all that remain;<br>– It is likely that the level of human pressure would increase with time (with or without dam development);<br>– Areas with high biotic diversity are fragmented and limited to a few small, more inaccessible areas. Inundation would further aggravate habitat fragmentation. |
| SMITHFIELD | – Final phase would inundate approximately 2 000 ha of land. |
| IMPENDLE | – Final phase would inundate approximately 2 250 ha of land. |

*b. Proposed Mitigation:*

| | |
|---|---|
| SMITHFIELD & IMPENDLE | – No mitigation for inundation of habitats |

*c. Impact Rating:*

| IMPENDLE | | SMITHFIELD | |
|---|---|---|---|
| without mitigation | with mitigation | without mitigation | with mitigation |
| LOW-MOD | **LOW-MOD** | LOW-MOD | **LOW-MOD** |

F4 Only issues important for pre-feasibility decision-making are included in this report. A more comprehensive list of potential issues and dealt with in the ROIP reports (appendices to this report).

### *4.3.2 Rare & Threatened Fauna*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| IMPENDLE | – Two Bald Ibis colonies were observed, roosting/nesting sites would be inundated (the presence of juvenile and immature birds indicates that the species may breed locally at the two sites). The ETG did not regard this as a severe impact / fatal flaw.<br>– No other Red Data Book species were observed at the site. A few taxa may occur, but numbers are likely to be small. |
| SMITHFIELD | Phase one:<br>– The Smithfield Dam site provides better quality habitat than that of Impendle.<br>– No Red Data Book species were observed at the site. A few taxa may occur, but numbers are likely to be small.<br>Phase two:<br>– Impact on the Bald Ibis colonies at the Impendle site. |

*b. Proposed Mitigation:*

| | |
|---|---|
| SMITHFIELD | – No mitigation for inundation of Bald Ibis roosting/nesting sites. |
| IMPENDLE | – Relocation of suitable species (i.e. reptiles). |

*c. Impact Rating:*

| IMPENDLE | | SMITHFIELD | |
|---|---|---|---|
| without mitigation | with mitigation | without mitigation | with mitigation |
| MOD-HIGH | **MOD-HIGH** | MOD-HIGH | **MOD-HIGH** |

*c. Future Work:*

| | |
|---|---|
| – Sensitive areas to be surveyed, suitable species to be rescued and relocated. | Implementation |

### *4.3.3 Medicinal, Rare & Threatened Vegetation*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD & IMPENDLE | – Both sites have many medicinal plants, including *Scilla natalensis*;<br>– Both sites have a few Red Data Book species [F5] , in all instances populations of the species are relatively small and most of these species could be propagated and/or relocated. It is possible that these will come under increasing pressure in the future.<br>– Dam development would result in the loss of habitat for these species. |
| SMITHFIELD | – A rare and fairly unique plant, *Hydrostachys polymorpha*, is growing around the waterfall on the Luhane river. This species requires a highly specialised habitat and is not likely to be transplanted successfully. The plant also occurs at around other waterfalls in the region, but any distribution locality should have a high conservation rating. |

*b. Proposed Mitigation:*

| | |
|---|---|
| SMITHFIELD | – No mitigation for loss of habitat. |
| IMPENDLE | – Propagation and/or removal and relocation of specimens. |

*c. Impact Rating:*

| IMPENDLE | | SMITHFIELD | |
|---|---|---|---|
| without mitigation | with mitigation | without mitigation | with mitigation |
| HIGH | **LOW-MOD** | HIGH | **MOD** |

*d. Future Work:*

| | |
|---|---|
| – It is essential that sensitive areas are surveyed in more detail to identify medicinal, rare and threatened plant specimens for propagation and relocation; | Feasibility - Design |
| – Wherever possible, these plant specimens should be propagated and/or relocated to the nearest protected site and where not, to botanical institutions; | Implementation |
| – Medicinal plant specimens should be made available to interested parties. | Implementation |

F5 Details on the distribution and regional significance of the individual species are provided in the specialist report on the Impacts on Fauna and Flora of the Impendle and Smithfield Dams (Appendix to this report).

## 4.4 Comparative Assessment of Social Aspects

### *4.4.1 Agricultural Resources*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD | – 115 ha arable land affected,<br>– 870 ha grazing land affected. |
| IMPENDLE | – 100 ha arable land affected,<br>– 600 ha grazing land affected. |
| SMITHFIELD & IMPENDLE | – If not mitigated, the loss of agricultural resources would deprive the affected households of important staple food sources;<br>– Additional pressure would be placed on dwindling grazing resources. |

*b. Proposed Mitigation:*

| | |
|---|---|
| SMITHFIELD & IMPENDLE | – Ensure that the affected households are not made worse off by the development;<br>– Negotiate compensation with affected homestead owners;<br>– Improve opportunities by identifying alternative agricultural land or by identifying alternative income opportunities. |

*c. Impact Rating:*

| IMPENDLE | | SMITHFIELD | |
|---|---|---|---|
| without mitigation | with mitigation | without mitigation | with mitigation |
| MOD-HIGH | **LOW-MOD** | HIGH | **LOW-MOD** |

### *4.4.2 Useful Vegetation*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD & IMPENDLE | – A variety of fruit trees will be lost, although not a staple food source, fruit trees supplement the dietary needs of affected households;<br>– Woodland, thicket and especially the riparian vegetation are important resources in terms of fuelwood, medicinal and herbal plants, building material and raw products for handicrafts. |
| IMPENDLE | – Final phase would inundate approximately 2 250 ha of land. |
| SMITHFIELD | – Final phase would inundate approximately 2 000 ha of land;<br>– Most of the important species are located within the river course or on the river banks and terraces. The combined impact of the two dams are therefore greater than that of the single dam the Impendle Scheme. |

*b. Proposed Mitigation:*

| | |
|---|---|
| SMITHFIELD<br>IMPENDLE | – Provide seedlings to replace individually owned trees;<br>– Investigate woodlot programmes as part of rural development;<br>– Identify and remove medicinal plants and make available to interested parties. |

*c. Impact Rating:*

| IMPENDLE | | SMITHFIELD | |
|---|---|---|---|
| without mitigation | with mitigation | without mitigation | with mitigation |
| LOW-MOD | **LOW** | MOD | **LOW-MOD** |

*4.4.3 Household Structures*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD | Phase one:<br>– 2 households directly affected by inundation.<br>Phase two:<br>– 25-30 households directly affected by inundation;<br>– The possibility exists that, due to disturbance to community integrity, the entire Makhuzeni settlement might wish to be relocated – in this case the impact would be similar to that of the Impendle Scheme. Possible resistance to relocate might arise;<br>– Land restitution process will make relocation and compensation negotiation more complex. |
| IMPENDLE | – 40-50 households directly affected by inundation;<br>– The possibility exists that, due to disturbance to community integrity, the entire Makhuzeni settlement might wish to be relocated. Possible resistance to relocate might arise. |

*b. Proposed Mitigation:*

| | |
|---|---|
| SMITHFIELD<br>IMPENDLE | – In principle, affected households should be compensated with replacement housing rather than cash offers.<br>– All actively utilised structures should be replaced, regardless their condition. The fact that housing would be new and of better standard means that households would generally be better off in terms of the quality of their housing. |

*c. Impact Rating:*

| IMPENDLE | | SMITHFIELD | |
|---|---|---|---|
| without mitigation | with mitigation | without mitigation | with mitigation |
| SEVERE | **LOW** | MOD-HIGH or SEVERE | **LOW** |

*4.4.4 Graves*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD<br>IMPENDLE | – For many of the local inhabitants, the disturbance of graves (resting places of ancestors) is regarded as a serious matter. When graves are disturbed, a sacrifice should be made to the ancestors. The sacrifice would depend on the role the specific ancestor is seen to play. |
| SMITHFIELD | Phase one:<br>– A small number of graves could possibly be affected.<br>Phase two:<br>– Approximately 40 graves were identified that would be affected, but the number could be substantially more. |
| IMPENDLE | – Approximately 40 graves were identified that would be affected, but the number could be substantially more. |

*b. Proposed Mitigation:*

| | |
|---|---|
| SMITHFIELD<br>IMPENDLE | – Each case should be judged on its merits and appropriate compensation should be paid.<br>– Relocation of graves to be undertaken by a professional undertaker and according to the preferences of the households responsible for the graves. |

*c. Impact Rating:*

| IMPENDLE | | SMITHFIELD | |
|---|---|---|---|
| without mitigation | with mitigation | without mitigation | with mitigation |
| HIGH | **LOW-MOD** | HIGH | **LOW-MOD** |

*4.4.5 Transport Routes and River Crossings*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD & IMPENDLE | – Important transport routes would be inundated;<br>– During low flow conditions, people cross the river at various points. These crossings would be inundated for the length of the dam basin. It would affect social ties and relations, especially where tribal members are divided on opposite sides of the dam. |
| SMITHFIELD | Phase one:<br>– Loss of Deepdale access road;<br>– 6 footpaths (river crossings) affected.<br>Phase two:<br>– Loss of Himeville-Impendle access road and bridge;<br>– Loss of Mkomazana bridge and access road to Bulwer;<br>– 8-10 footpaths (river crossings) affected. |
| IMPENDLE | – Loss of Himeville-Impendle access road and bridge;<br>– Loss of Mkomazana bridge and access road to Bulwer;<br>– 8-10 footpaths (river crossings) affected. |

*b. Proposed Mitigation:*

| | |
|---|---|
| SMITHFIELD & IMPENDLE | – Replace / reroute roads;<br>– Bridge across the dam wall could replace the Mkomazana and Himeville-Impendle bridges;<br>– Provide alternative means (ferry, bridge, etc.) of crossing the dam at former major crossing points to maintain community links and communication - not always practical to implement. |

*c. Impact Rating:*

| IMPENDLE | | SMITHFIELD | |
|---|---|---|---|
| without mitigation | with mitigation | without mitigation | with mitigation |
| MOD-HIGH | LOW-MOD | HIGH | MOD |

*4.4.6 Access to Basic Needs*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD & IMPENDLE | – The proximity of a permanent water body could potentially enhance the viability of implementing rural water supply schemes and small irrigation schemes;<br>– Construction of the dam will entail the improvement of existing road infrastructure, bulk electrification and the construction of site buildings and infrastructure. |
| SMITHFIELD | – In the case of Smithfield, these impacts would be applicable for both dam sites. |

*b. Proposed Mitigation / Optimisation:*

| | | |
|---|---|---|
| SMITHFIELD<br>IMPENDLE | – | Optimise potential opportunities to improve access to basic needs. |

*c. Impact Rating:*

| IMPENDLE | | SMITHFIELD | |
|---|---|---|---|
| without optimisation | with optimisation | without optimisation | with optimisation |
| - | **+** | - | **++** |

*4.4.7 Local Economic Development*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD<br>&<br>IMPENDLE | Construction phase:<br>– Would provide employment for local labour and, on a limited scale, small scale contractors.<br>– Would provide opportunities for basic adult education and training, enhancing the skills base of the local workforce.<br>– Injections of wages and salaries would have important applications for the local economy. |
| SMITHFIELD | – In the case of Smithfield, these impacts would be applicable for both dam sites. |

*b. Proposed Mitigation / Optimisation:* [F6]

| | | |
|---|---|---|
| SMITHFIELD<br>&<br>IMPENDLE | –<br>–<br>– | Optimise development inputs to local communities;<br>Maximise employment opportunities for local workforce;<br>Rural development programmes. |

*c. Impact Rating:*

| IMPENDLE | | SMITHFIELD | |
|---|---|---|---|
| without optimisation | with optimisation | without optimisation | with optimisation |
| - | **+** | - | **++** |

F6 Detailed proposals for optimisation of potential benefits to the local community provided in the Social Impact Assessment report (Appendix to this report).

*4.4.8 Recreation*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD<br>IMPENDLE | Impact on canoeing ? |

*4.4.9 Further Social Work*

| | | |
|---|---|---|
| – | Cost/benefit analysis - negative impacts to be weighed against positive impacts | - Feasibility |
| – | Negotiations with affected communities regarding relocation | - Feasibility |
| – | Address land restitution issues | - Feasibility |
| – | Liaison with the Department of land Affairs | - Feasibility |
| – | Facilitate direct involvement of affected communities in further planning phases | - Feasibility |
| – | Set back area to be clarified for settlement negotiations | - Feasibility |

## 4.5 Assumptions and Limitations

The ecological surveys of both dam sites were conducted during a time when much of the land was ploughed, burned or heavily grazed and hot dry weather affected the growth of many plant species with the result that many plants were still emerging from senescence and therefore not in flower, especially so for geophyte and gladioli.

## 4.6 Synthesis

The biophysical impacts related directly to inundation by the two schemes are very similar and regarded as relatively low. Both areas are severely degraded. A few rare or threatened species occur in low numbers on both sites. Most of these could be propagated or relocated. The most significant impact (applicable to both schemes) is the loss of two Bald Ibis roosting/nesting sites at Impendle, however the Environmental Task Group did not regard this as a fatal flaw.

From a social impact perspective, both schemes could be implemented. Negative impacts could be mitigated to between low and moderate. The Smithfield Scheme would be more complex and more expensive to implement but the potential positive impacts associated with the scheme are also more significant. In relation to the overall project cost, the cost for social mitigation and optimisation measures should be fairly insignificant.

An overall rating of impacts are provided below:

| | IMPENDLE | | SMITHFIELD | | Non-Augmentation | |
|---|---|---|---|---|---|---|
| | without mitigation | with mitigation | without mitigation | with mitigation | without mitigation | with mitigation |
| *Biophysical* | MOD-HIGH | **LOW-MOD** | HIGH | **MOD** | - | **-** |
| *Social (negative)* | HIGH | **MOD** | SEVERE | **MOD-HIGH** | - | **-** |
| *Social (positive)* | - | **+** | - | **++** | - | **-** |

# 5. ENVIRONMENTS AFFECTED BY CONVEYANCE INFRASTRUCTURE

## 5.1 Data Sources

– Pre-Feasibility Report: Social Impact Assessment of the proposed Mkomazi Schemes.

– Mkomazi-Mgeni Transfer Scheme Pre-Feasibility Study: Environmental Scoping for Components of the Conveyance Routes.

– Comments on the potential impacts associated with the Impendle Clear Water Conveyance Routes, raising of Midmar Dam and the extension of Midmar Water Treatment Works (Mike Haynes, Umgeni Water).

## 5.2 Scope of Work

Scoping level assessments (social and biophysical) were completed for the various components of the conveyance infrastructure.

## 5.3 Comparative Assessment of Biophysical & Social Impacts

*a. Affected Environment / Impact Description:*

| Component | *IMPENDLE* | *SMITHFIELD* |
|---|---|---|
| *Raw water Conveyance A (tunnel route)* | Social and biophysical impacts along tunnel route should be minimal; Potential lowering of local water table, impacting on borehole yields. | |
| - Inlet Portal | ± 4 ha fairly natural grassland;<br>Close to river;<br>River crossing;<br>Spoil Dumps below FSL. | ± 2.5 ha fairly natural grassland;<br>± 1ha pristine shrub / woodland;<br>Spoil Dumps below FSL;<br>Steep slopes. |
| - Intermediate Adit | ± 11 ha commercial forestry;<br>Indigenous forest patches;<br>Steep slopes;<br>Spoil Dump. | ± 10 ha crops / grassland;<br>Soil Dump;<br>River crossing. |
| - Outlet Portal | ± 9 ha fairly natural grassland;<br>Spoil Dump;<br>River crossing. | ± 10 ha crops / grassland;<br>Soil Dump. |
| *Pumpstation* | n/a - separate scheme | ± 1 ha pristine shrub / woodland. |

| Component | *IMPENDLE* | *SMITHFIELD* |
|---|---|---|
| *Raw water Conveyance B* | Existing servitude to be widened. | Agricultural cropping;<br>Transformed grassland;<br>Drainage channels;<br>Steep slopes (small area);<br>Total length = freehold land. |
| *Balancing Dam* | n/a - separate scheme. | Modified habitat;<br>Agricultural cropping. |
| *Water Treatment* | Modified habitat;<br>Transformed grassland. | Modified habitat;<br>Historical / Cultural features;<br>Aesthetic considerations;<br>Agricultural cropping. |
| *Clear water Conveyance* | Current servitude to be widened. | Modified habitats;<br>Transformed grassland;<br>Small area of 'natural' vegetation;<br>Agricultural cropping and grazing;<br>Infrastructure;<br>Residential;<br>Total length = freehold land. |
| *Reservoir* | Modified habitats; commercial chicken farming; grazing; infrastructure. | |

*b. Proposed Mitigation:*

| | |
|---|---|
| SMITHFIELD & IMPENDLE | – Tunnel design to provide for a membrane in the tunnel lining to mitigate against the lowering of the local water table and impacts on boreholes yields;<br>– Erosion and topsoil protection;<br>– Measures to prevent increased sedimentation and pollution of water courses;<br>– Landscape rehabilitation and re-vegetation with indigenous species (steep slopes, spoil dumps, disturbed areas, temporary access);<br>– Compensation to affected property owners;<br>– Measures to prevent crime and disturbances to local residents during construction phase;<br>– Purchasing of affected agricultural land;<br>– Registering of servitudes. |

*c. Impact Rating:*

| Component | IMPENDLE | | SMITHFIELD | |
|---|---|---|---|---|
| | without mitigation | with mitigation | without mitigation | with mitigation |
| *Raw Water Conveyance A (Tunnel Route)* | MOD | **-** | MOD | **-** |
| - Inlet Portal | MOD | **LOW-MOD** | MOD | **LOW-MOD** |
| - Intermediate Adit | MOD | **LOW** | MOD | **LOW** |
| - Outlet Portal | MOD | **LOW-MOD** | MOD-HIGH | **MOD** |
| *Pumpstation* | - | **-** | MOD | **LOW-MOD** |
| *Raw Water Conveyance B* | LOW-MOD | **LOW** | MOD | **LOW-MOD** |
| *Balancing Dam / Storage* | - | **-** | MOD | **LOW-MOD** |
| *Water Treatment Works* | LOW | **-** | MOD | **LOW** |
| *Clear Water Conveyance* | MOD | **LOW** | MOD-HIGH | **MOD** |
| *Reservoir* | LOW | **-** | LOW | **-** |

## 5.4 Future Work

– Consultation with affected parties - Feasibility
– Compensation negotiations - Feasibility
– Detailed survey of 'natural' vegetation areas to identify medicinal, rare or threatened plant species for relocation. - Feasibility - Design

## 5.5 Synthesis

The Impendle pipelines would be located along an existing servitude. Smithfield pipelines would involve greenfields development, consultation and negotiation would therefore be more problematic. However, most of the impacts are temporary in nature (associated with the construction phase) or the size of the affected areas are relatively limited. An overall impact rating is provided below:

| | IMPENDLE | | SMITHFIELD | | Non-Augmentation | |
|---|---|---|---|---|---|---|
| | without mitigation | with mitigation | without mitigation | with mitigation | without mitigation | with mitigation |
| *Biophysical* | MOD | **LOW** | MOD-HIGH | **LOW-MOD** | - | **-** |
| *Social* | MOD | **LOW** | HIGH | **MOD** | - | **-** |

# 6. RIVERINE ENVIRONMENTS AFFECTED BY CHANGES IN FLOW REGIME

## 6.1 Data Source

– *Mkomazi Instream Flow Requirement Study* [F7] *– Specialist Meeting Proceedings*, March 1998, with specialist reports on: fish; aquatic invertebrates; riparian vegetation; fluvial geomorphology; social aspects; hydrology; water quality; ecological integrity; river importance and desired future state.

## 6.2 Scope of Work

The Instream Flow Requirement (IFR) Study concerned itself with environmental impacts on riverine environments downstream of the proposed dams. It considered the potential environmental impacts related to changes / reduction in run-off from the catchment and more specifically, it identified a conceptual flow regime (IFR) that would be required to mitigate and manage impacts. The process of determining the IFR's involved:

– Specialist input to provide background information on a range of relevant IFR components;
– Appraisal of the river's present state in terms of habitat integrity [F8] ;
– Establishing the river's environmental importance (socio-economic and biophysical);
– Allocation of a management class (desired future state) [F9] ;
– Selection of IFR sites (sites for which the flow requirements will be determined);
– Survey and collection of a range of data at each IFR site (i.e. hydrological, hydraulics, geomorphological and ecological);
– Evaluation of data to quantify IFR's for each IFR site, taking into account the predefined management class of the river; and
– Evaluation of development options to determine if the IFR's can be supplied.

---

F7 Instream Flow Requirement (IFR) is the flow regime required to maintain the essential ecological functioning of a river. It can be equated to the ecological (quantity) protection component of the 'Reserve' (SA Water Law).

F8 For purposes of this study, the 'present state' (habitat integrity) of a river is defined as its ability to support and maintain a balanced, integrated composition of physico-chemical and habitat characteristics, as well as biotic components on a temporal and spatial scale that is comparable to the characteristics of natural ecosystems of a specific region.

F9 For purposes of this report, the terms 'management class' and 'desired future state' are used synonymously.

## 6.3 Biophysical Components

### *6.3.1 Water Quality*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | – The present water quality is suitable to sustain the present river biodiversity and habitat, and also to satisfy the needs of other users;<br>– When dams are built in the upper reaches of the catchment, a change for the better can be expected for some users such as local inhabitants, irrigators, and people pursuing recreation. Water abstracted for treatment in the lower catchment will have an improved raw water quality;<br>– Less certainty exists regarding the potential impacts on river health and aquatic life:<br>- suspended materials (as food supply) will be removed to some degree;<br>- the normal variability in low-high concentrations of solids-related variables and high seasonality in these variables will be lost;<br>- greater and prolonged water clarity could increase algal growth, although reduced nutrient supplies could also limit algal growth;<br>- different algal genera could be introduced from the dams and differences in terms of numbers could develop;<br>- different temperature regime immediately below the dams. |

*b. Proposed Mitigation / IFR Objectives:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | – Changes in water quality variables that could impact on river health and aquatic life, need to be considered when defining IFR's for the other environmental components (i.e. aquatic invertebrates, fish, etc.). Should a certain water quality be required for these components, provision needs to be made for releases from appropriate dam positions such as the overflow (if possible), drawoff from a specific level or scour.<br>– Generally, the present water quality should at least be maintained or, more preferably, be improved.<br>- To reduce turbidity and suspended solids, reduce soil erosion through improved land management in the catchment area;<br>- To reduce bacterial contamination, control sanitation practices and keep cattle out of the river by providing off-stream watering points.<br>- Develop and implement a catchment management plan;<br>- Maintain moderate flows as high flows leads to high turbidity and high bacterial counts and very low flows lead to stagnant, poor quality water due to lack of dilution of natural pollution. Dilution through dam releases should be beneficial. |

*c. Future Work:*

| | |
|---|---|
| – Continued water quality monitoring, especially to determine the effects of low flows. | Immediate (Continued) |

*6.3.2 Geomorphology*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | – The geomorphology is characterised by a natural hydrological regime, increased sediment input from catchment, a degraded riparian zone and decreased river bank stability;<br>– Severe modification of the present flow regime would result in changes to the present sediment regime, subsequently impacting on water quality, aquatic invertebrate habitats, etc. |

*b. Proposed Mitigation / IFR Objectives:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | IFR allocations to:<br>– Maintain hydro-sedimentological dynamics – maintain medium sized floods at a relatively high frequency;<br>– Minimise the encroachment of lateral bars into the channel, minimise development of midchannel bars;<br>– Maintain present alluvial features using constructive flows;<br>– Maintain or improve riparian vegetation; and<br>– Scour algal silts. |

*c. Future Work:*

| | |
|---|---|
| To improve IFR confidence: | |
| – Determine the effect of flooding and grazing on the terraces; | Immediate / Feasibility |
| – Low flow survey of geomorphology / invertebrate habitats; | Immediate / Feasibility |
| – Investigate natural and present sediment regimes; | Feasibility |
| – Investigate the effect of dams. | Long term study |

*6.3.3 Fish*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | – The Mkomazi supports a moderate diversity of fish species, with many of these being limited to the lower reaches near the coast where the impact of the dam in the middle reached would probably be minimal.<br>– With IFR allocations in place, riffle habitats are likely to remain available for the mountain catfish (*Amphilius natalensis*), the only riffle dependent species, even if river flows become reduced.<br>– The release of IFR summer spate flows from the dam would probably stimulate successful breeding by the flood-dependent species. |

*b. Proposed Mitigation / IFR Objectives:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | IFR allocations to:<br>– Avoid species loss in a system with low natural species diversity.<br>– Maintain pool habitats for large fish species.<br>– Maintain natural fish migrations.<br>– Protect the abundance and distribution of the mountain catfish by facilitating breeding of this riffle-dependent species.<br>– Facilitate breeding of gravel-dependent species.<br>– Maintain seasonal inundation of marginal vegetation as egg-laying sites.<br>– maintain backwater nursery areas for juvenile fish.<br>– Retain seasonal variability of flow combination of floods and low flows. |

*c. Future Work:*

| | |
|---|---|
| To improve IFR confidence:<br>– Fish survey at IFR site 4.<br>– Investigate impacts of natural barriers on fish migration (to determine the need for fish ladders); | Immediate / Feasibility<br>Feasibility |

*6.3.4 Invertebrates*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | – The Mkomazi shows an exceptional diversity of aquatic invertebrates, several undescribed species exist.<br>– Functionally, aquatic macro-invertebrates are important processors of organic matter. They purify water and also provide a valuable food resource for larger animals. To continue functioning optimally, regular inputs of nutrients, sediments and water flow are required.<br>– No domination of species exists.<br>– The almost complete lack of problem or pest species in this river indicates that the natural flow regime is sufficiently abundant and varied in discharge to maintain a diverse invertebrate population.<br>– Modification in flow, sediment transport or nutrient loads will lead to changes in community structures and a reduction in species diversity through loss of certain species and increases in others.<br>– Severe changes in the natural flow pattern, substrate type and availability can lead to enhancement of conditions that favour pest and problem species such as blackflies, mosquitoes and snail vectors of bilharzia. |

*b. Proposed Mitigation / IFR Objectives:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | IFR allocations to:<br>– Maintain the fairly unique invertebrate community of the Mkomazi system:<br>– Maintain diversity of annual flow regimes to ensure that no species dominate;<br>– Allow for scouring floods to reset system;<br>– Maintain high diversity of hydropneustic species such as filter feeding caddis and blackfly;<br>– Ensure that predatory species are well represented;<br>– Minimise natural thermal and sediment regimes. |

*c. Future Work:*

| | |
|---|---|
| To improve IFR confidence: | |
| – Low flow survey of geomorphology / invertebrate habitats; | Immediate / Feasibility |
| – Aquatic invertebrate survey at IFR site 4; | Immediate / Feasibility |

*6.3.5 Riparian Vegetation*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | – As a consequence of past human disturbances, the river system has been heavily infested with alien species and the diversity of the riparian vegetation has been drastically reduced. It is postulated that all but the most resilient riparian species have been lost from most of the water course.<br>– Reed encroachment is notably absent from the present river.<br>– Reduced flow conditions and the removal of scouring floods can lead to further loss of riparian vegetation diversity and encroachment by reeds and exotic species. |

*b. Proposed Mitigation / IFR Objectives:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | IFR allocations to:<br>– Maintain hygrophilous vegetation and phreatic species on boulder beds;<br>– Scour out exotics with flood events;<br>– Maintain grazing lawns of *Cynodon dactylon* through water levels and scouring;<br>– Maintain Phragmites reed beds at reasonable population levels, without excessive choking. |

*c. Future Work:*

| | |
|---|---|
| To improve IFR confidence: | |
| – Confirm distribution and depth of hygrophilous community; | Immediate / Feasibility |
| – Verify riparian vegetation flood indicators at IFR site 4; | Immediate / Feasibility |
| – Determine the effect of flooding and grazing on the terraces; | Feasibility |

*6.3.6 Habitat Integrity (Present State)*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | *Instream*<br>– Instream habitats are generally in good condition and have a relatively high ecological integrity, averaging from Class B to Class C (F10) – largely natural to moderately modified.<br>– Riverbed modification in the form of sedimentation, inundation, water abstraction and changes in flow regime are the primary modifications attributing to the present integrity classes.<br>– The lower reaches towards the estuary are within Class D – largely modified;<br>– Severe changes in flow regime could result in degradation of instream habitats.<br>*Riparian Zone*<br>– Riparian zone habitats show a lower integrity than that of the instream habitats throughout the length of the river, with an overall average of Class C – moderately modified.<br>– Large scale exotic vegetation infestations, bank erosion and localised inundation are the major problems associated with the riparian zone.<br>– Severe changes in flow regime could lead to further degradation of the riparian zone, also impacting on the instream habitat component.<br>– The riparian zone is significantly affected by land use in the catchment and external pressures other than flow regime. These issues will need to be addressed by a catchment management programme. |

*b. Proposed Mitigation / IFR Objectives:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | IFR's allocations to:<br>– Ensure that the present state and character of habitats are, at least, maintained. |

F10 Descriptions of present state classes (habitat integrity) and future management classes (desired future state) provided in Addendum A.

## 6.4 Social Aspects

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | – The riverine environments have both a utilitarian and a recreational value;<br>– People use the run of the river for drinking, cooking, livestock watering, irrigation, building, washing, filling cattle dips, recreation, religious purposes and as an ingredient in medicines;<br>– The riparian zone is used as a source of sand for brick and block making, and gathering of building material, medicinal plants and material for handicrafts;<br>– The river is regarded as an exceptional and important recreational resource for canoeing;<br>– Fishing tends to be recreational and fish does not seem to form an important part of the local people's diets;<br>– Inundation and severe changes in flow regime could negatively impact on various users but for some of the local inhabitants, a regulated river would be a positive development if it would prevent or limit the situation whereby there was no water in the river and if it would prevent potentially destructive floods and river flows that impeded local access. |

*b. Proposed Mitigation / IFR Objectives:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | IFR's allocations for:<br>– *Flow* – to ensure that the flow of the river will continue to support the current patterns of utilisation;<br>– *Water Quality* – to ensure that the quality of the water is good enough to support the fundamental components of some aspects of utilisation;<br>– *Riparian Zone* – to manage the utilisation patterns in a negotiated manner that is as sustainable as possible. |

## 6.5 River Importance, Present State & Management Class

In terms of its present state, diversity of habitats and species, uniqueness, level of human use and reliance on the resource, the Mkomazi is a *river of some importance*. For this reason, it was found imperative that the present state and character of the river should, at least, be maintained and that the river should be treated as a continuum – with one management class allocated to the whole length of the river. Although the downstream section (towards the estuary) is degraded and has the potential to become even more degraded, the condition of this section of river is strongly linked to the condition of the

estuary. This section of river also important from a social use point of view and a lower protection class for this section would therefore not be appropriate.

Within the overall class for the river, a present class and a management class were allocated for each IFR component. These are listed below.

| *IFR STUDY COMPONENT* | *PRESENT CLASS* | *FUTURE MANAGEMENT CLASS* |
|---|---|---|
| Invertebrates | B + | B+ |
| Fish | B + | B+ |
| Vegetation | C/D | C |
| Geomorphology | C | C |
| Water Quality | B/C | B |
| Habitat Integrity – Instream | B/C | B/C |
| Habitat Integrity – Riparian Zone | C | C |
| Social – Flow | B | B |
| Social – Water Quality | B – | B |
| Social – Riparian Zone | C/D | C |
| Overall River Importance | B/C | B/C |

## 6.6 IFR Sites

In order to determine the IFR's of the Mkomazi, four IFR sites were selected along the length of the river as a representation of the river system. IFR's were identified for each of the four sites. Detailed investigations were completed for IFR sites 2 & 4 and recommendations made for these two sites were then matched to, and verified for IFR sites 1 & 3.

## 6.7 IFR Recommendations

### *6.7.1 Maintenance Flows and Drought Year Flows* (F11)

The recommended maintenance flows and drought year flows for IFR sites 1-4 are summarised below:

| *RECOMMENDED IFR* | *IFR SITE 1* | | *IFR SITE 2* | | *IFR SITE 3* | | *IFR SITE 4* | |
|---|---|---|---|---|---|---|---|---|
| | *$10^6m^3$* | *% MAR* | *$10^6m^3$* | *% MAR* | *$10^6m^3$* | *% MAR* | *$10^6m^3$* | *% MAR* |
| Maintenance Low Flows | 148,37 | 21,5 | 187,79 | 21 | 221,1 | 22 | 235,3 | 22,1 |
| Maintenance High Flows | 69,2 | 10,0 | 88,56 | 9,7 | 97,79 | 9,7 | 104,96 | 10 |
| **TOTAL** | **324,57** | **31,5** | **276,35** | **30,7** | **427,9** | **31,7** | **450,26** | **32,1** |
| Drought Year Low Flows | 67,8 | 9,8 | 89,66 | 9,9 | 100,4 | 10 | 107 | 10,1 |
| Drought Year High Flows | 14,13 | 2 | 16,12 | 1,8 | 13,75 | 1,4 | 17,83 | 1,7 |
| **TOTAL** | **81,93** | **11,8** | **105,78** | **11,7** | **114,15** | **11,4** | **124,83** | **11,8** |

### *6.7.2 Capping Flows* (F12)

It is extremely difficult to quantify capping flows, as the maintenance of variability is more important than actual discharge levels. General guidelines are as follows:

- No constant increase in winter base flows should be allowed;
- Constant winter baseflows should not exceed summer baseflows;
- Maintain as much of the natural flow variability as possible;
- For hydro-power releases:
  - no frequent flow rate changes (at daily/weekly scales),
  - changes in release rates should be gradual.

For the operating rule between the two dams (in the case of the Smithfield Scheme), the following guidelines were specified:

- No constant increase in winter base flows should be allowed;
- No frequent flow rate changes (at daily/weekly scales);

F11 Maintenance Flows – those flows that will maintain the system in the predefined management class. Drought Year Flows – flows that will only allow for survival of the most critical ecosystem components.

F12 Capping flows are defined as elevated base flows which, if exceeded for extended periods, would have undesirable effects on the communities and/or ecological processes in a river.

– Winter baseflows should not exceed summer baseflows;
– Maintain as much of the natural flow variability as possible;
– Slow rates of change in release rates.

### *6.7.3 Future Work*

| | | |
|---|---|---|
| – | Additional work (as listed in Section 4.3) to raise IFR confidence scores | - Immediate / Feasibility |
| – | Design Operational Management Plan to address IFR releases | - Design |
| – | Design and implement an IFR monitoring programme | - Feasibility - Design |
| – | Implement further work required in terms of setting the final 'Reserve' and 'Management Class' for the Mkomazi River System. | - Feasibility - Design |

## 6.8 Assumptions and Limitations

Due to the time schedule of the study and the seasonal high flows that were prevalent during the major part of the study, there was a lack of low flow observations during the study period – the primary a reason for the overall 'medium' confidence in the IFR results. Preferably. Ideally an IFR study should span a wet and dry period, or at least a dry period.

As access to potential IFR sites was a serious problem in the study area, some of the areas with the highest habitat integrity could not be used. The selected IFR sites may therefore not be the most sensitive or the most critical for the IFR.

## 6.9 Synthesis

Impacts on the riverine environments downstream of the proposed dams relate to changes / reduction in run-off from the catchment, with consequent changes in the flow regime and potential impacts on the functioning of ecosystems and way the river is utilised.

The recommended IFR's have been incorporated into the design capacity of both schemes but the final yield modeling has not yet been completed. At this stage the possible success of mitigation is therefore still uncertain. However, the impacts would possibly be mitigated to relatively low levels – if appropriate operational rules are observed. These operational rules still need to be developed.

However, the Smithfield Scheme involves two impoundments, one at Smithfield, located lower down in the catchment, and a second at Impendle. The Smithfield Scheme would impede a greater percentage of the mean annual runoff (MAR) and opportunities for natural mitigation are less than that for the Impendle Scheme. Although the IFR Study provided operational guidelines for elevated flows between the two dams, there is the added risk of exceeding the capping flows for this river reach.

An overall rating of impacts on riverine environments is provided below:

| | IMPENDLE | | SMITHFIELD | | Non-Augmentation | |
|---|---|---|---|---|---|---|
| | without mitigation | with mitigation | without mitigation | with mitigation | without mitigation | with mitigation |
| *Biophysical* | HIGH-SEVERE | **possibly LOW-MOD** | SEVERE | **possibly MOD** | - | **-** |
| *Social* | MOD | **possibly NONE-LOW** | MOD-HIGH | **possibly NONE-LOW** | - | **-** |

# 7. ESTUARINE ENVIRONMENT AFFECTED BY CHANGE IN FLOW REGIME

## 7.1 Data Source

– Mkomazi Estuarine Freshwater Requirements, an Initial Assessment (1998), with specialist reports on physical aspects, water quality, plants, fish, invertebrates and birds of the estuarine environment.

## 7.2 Scope of Work

The initial assessment of the Mkomazi Estuarine Freshwater Requirements (EFRs) concerned itself with:

– Specialist input on physical aspects, water quality, plants, invertebrates, fish and birds;
– Initial assessment of current ecosystem health and ecological integrity;
– Initial statement regarding the realistic 'management class' (future state);
– Preliminary scoping of anticipated impacts;
– Initial assessment of EFR's (maintenance flows and drought year flows); and
– Identification of further work required to improve the EFR's confidence score.

## 7.3 Ecological Integrity and Management Class

The Mkomazi Estuary is considered an important estuary due to its rarity of type, its general biological value and health, and because it is one of the few of the KwaZulu-Natal estuarine systems that is almost permanently open. However, it is also characterised by encroachment of sugarcane, the presence of alien vegetation and the existing (although relatively small) reduction in freshwater outflow due to water resource development and utilisation in the catchment area.

The ecological integrity is therefore regarded as moderately modified – Class C [F13] . Based on the perceived importance of the Mkomazi Estuary, the chosen future management class is also Class C.

F13 Descriptions of present state classes and future management classes provided in Addendum A.

## 7.4 Biophysical Components

### *7.4.1 Hydrodynamics / Physical Aspects*

*a. Affected Environment / Impact Description:*

<table>
<tr><td rowspan="6">SMITHFIELD<br>or<br>IMPENDLE</td><td colspan="3">– Reduction in run-off and flow rate would lead to an increase in closed mouth conditions, impacting on the ecology of the estuary.<br>– The probable mouth conditions for different flow rates are predicted as:</td></tr>
<tr><td>Monthly flow:</td><td>Mouth Condition:</td><td>Average Closure:</td></tr>
<tr><td>< 1 $m^3/s$</td><td>closure will occur</td><td>20 days</td></tr>
<tr><td>< 1-2 $m^3/s$</td><td>closed - 50% of time</td><td>8 days</td></tr>
<tr><td>< 2-4 $m^3/s$</td><td>occasionally closed</td><td>4 days</td></tr>
<tr><td>> 4 $m^3/s$</td><td>rarely closed</td><td>2 days</td></tr>
<tr><td colspan="4">– Simulated ‘future’ runoff [F14] indicates that the development of the proposed dams in the catchment and the consequent reduction in runoff will probably result in a limited increase in the current number and period of mouth closures, mainly from June to August. Provided baseflows are maintained, closures should be for up to 8 days at a time (rarely for more than 25 days).The mouth would normally be open during summer.<br>– The relative impacts of the schemes were not compared, but it seems as if Impendle, located higher in the catchment, will allow a greater proportion of the catchment flow to be unimpeded. Potentially, the impacts associated with Smithfield could be higher than for Impendle.</td></tr>
</table>

*b. Proposed Mitigation / EFR Objectives:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | – Ensure that the recommended IFR’s (specifically IFR site 4) and EFR’s are met (incorporated in the design capacity of the dams). |

*c. Impact Rating:*

| IMPENDLE | | SMITHFIELD | |
|---|---|---|---|
| without mitigation | with mitigation | without mitigation | with mitigation |
| HIGH | **LOW** | HIGH | **LOW-MOD** |

F14 This future runoff estimate allowed for IFR allocation upstream of the estuary (IFR site 4), but did not take into account dam overtopping.

*d.* *Future Work:* *Project Phase:*

| | |
|---|---|
| – Analyse information from recently-installed water level recorder.<br>– Finalising hydrological simulations.<br>– Further investigations on: mouth dynamics; sediment dynamics; estuary morphometry; salinities and the role of flooding. | Immediate (continued)<br>Feasibility<br>Feasibility - Design |

*7.4.2 Water Quality*

*a.* *Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | – Mkomazi Estuary is a well oxygenated shallow system;<br>– Lower Mkomazi shows characteristics of deteriorating water quality;<br>– In terms of inorganic salts, water quality is generally acceptable for irrigation and drinking water use.<br>– Mkomazi River is known to carry considerable quantities of silt for most of the summer high flow periods;<br>– The estuarine mouth area shows salinity stratification patterns; bottom water is more saline during winter; the relative stable conditions in the lower reaches of the river can be disrupted by rapid flow changes.<br>– With prolonged closure of the mouth, the current daily marine intrusions would not occur;<br>– No real change in water quality characteristics is expected, provided IFR allocations at IFR site 4, upstream of the estuary are met. |

*b.* *Proposed Mitigation / EFR Objectives:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | – EFR allocations for:<br>- Maintenance flows – ensure a constantly open mouth during summer, Nov-Mar.<br>- Drought year flows – maintain a consistently open mouth for 3 months during summer, Dec-Feb.<br>– In drought years the mouth could remain closed during winter, provided there is no contamination and water quality is maintained. |

*c. Impact Rating:*

| COMPONENT | IMPENDLE | | SMITHFIELD | |
|---|---|---|---|---|
| | without mitigation | with mitigation | without mitigation | with mitigation |
| Salinity (upper) | MOD | **LOW** | MOD | **LOW-MOD** |
| Salinity (lower) | MOD-HIGH | **LOW** | MOD-HIGH | **LOW-MOD** |
| N/P ratio | LOW | **LOW** | LOW | **LOW-MOD** |
| Dissolved $O_2$ | LOW | **LOW** | LOW | **LOW-MOD** |

*d. Future Work:*

| | |
|---|---|
| – Continue with current monitoring | Immediate (continued) |
| – Routine monitoring for chemical constituents | Immediate (continued) |
| – Investigate low flows under closed conditions | Feasibility |

*7.4.3 Fish*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | – Mkomazi Estuary is ranked as having a high fish species richness.<br>– The estuary is valuable nursery area for small numbers of subtropical marine and estuarine fish species.<br>– Peak recruitment of juvenile fish into estuaries occur in the spring and summer months.<br>– Flooding conditions are important in terms of sediment scouring processes that reset the system.<br>– Increased frequency of mouth closure could impact on the migration of eels through the estuary.<br>– Under future development scenarios the magnitude and frequency of minor floods and riverine pulses are likely to be attenuated. This, together with increased closure of the mouth are likely to influence the recruitment of juvenile fish from the marine environment during winter. |

*b. Proposed Mitigation / EFR Objectives:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | – EFR's allocations to:<br>- Preferably maintain permanently open mouth conditions, at least continuously during Nov-Mar, and most of the time during Apr, May and Oct. During Jun-Sep the mouth should open at least periodically. |

*c. Impact Rating:*

| COMPONENT | IMPENDLE | | SMITHFIELD | |
|---|---|---|---|---|
| | without mitigation | with mitigation | without mitigation | with mitigation |
| Marine spawners | MOD | **LOW** | MOD | **LOW** |
| Estuarine spawners | MOD-LOW | **LOW** | MOD-LOW | **LOW** |
| Eels | LOW | **LOW** | LOW | **LOW** |

*d. Future Work:*

| | |
|---|---|
| – Further seasonal sampling of fish fauna, ideally under open and closed mouth phases. | Immediate - Feasibility |

*7.4.4 Invertebrates*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | – Limited faunal abundance and diversity due to the combined influence of sustained low salinities, unstable sediments and small intertidal area. Minimal stable, intertidal mud or sandbanks present.<br>– Several invertebrate species require access to estuaries in order to complete a certain phase of their life cycles.<br>– Most invertebrates of the Mkomazi appear to need open mouth conditions between spring and autumn, however, some species might also migrate through the estuary during winter.<br>– Should the frequency and period of mouth closure increase, the intertidal fauna would disappear and a greater degree of domination by the strictly fresh or brackish water species could be expected. |

*b. Proposed Mitigation / EFR Objectives:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | – EFR's allocations for:<br>- Maintenance flows – ensure an open mouth condition from Sep-Apr.<br>- Drought year flows – ensure an open mouth condition from Nov-Mar. |

*c. Impact Rating:*

| COMPONENT | IMPENDLE | | SMITHFIELD | |
|---|---|---|---|---|
| | without mitigation | with mitigation | without mitigation | with mitigation |
| Intertidal residents | HIGH | **LOW** | HIGH | **LOW** |
| Subtidal residents | MOD-HIGH | **LOW** | MOD-HIGH | **LOW** |
| Migrants | HIGH | **LOW** | HIGH | **LOW** |

*d. Future Work:*

| | |
|---|---|
| – Baseline invertebrate survey, particularly on benthic, subtidal and intertidal habitats. | Immediate - Feasibility |
| – Investigate the utilisation of the estuary by recruiting megalopa (especially during winter months). | Immediate - Feasibility |

*7.4.5 Birds*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | – Preliminary information indicates that a low number of bird species and individuals occur in the area, it seems that the estuary does not play an important role in terms of bird species.<br>– Substantial human disturbances and recreational activities were observed, these are likely to increase and can have a negative effect on the attractiveness of the estuary for bird species.<br>– Should the mouth close more frequently and for longer periods, this will impact on all the water associated fauna of the estuary.<br>– Benthic feeding bird species are the most likely to be affected by mouth closure as intertidal mud flats will be inundated.<br>– If water levels overtop the banks, suitable shallow areas for hunting would become inaccessible to wading species.<br>– Assuming that the EFR meets the needs of most fish species, and that fish densities are not reduced, piscivorous bird predators are not likely to be affected. |

*b. Proposed Mitigation / EFR Objectives:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | – EFR's allocations to:<br>- Ensure that should the mouth closure occur in summer, it is not for more than two to three days. |

*c. Impact Rating:*

| COMPONENT | IMPENDLE | | SMITHFIELD | |
|---|---|---|---|---|
| | without mitigation | with mitigation | without mitigation | with mitigation |
| Invertebrate feeders | MOD | **LOW** | MOD | **LOW** |
| Fish feeders | MOD | **LOW** | MOD | **LOW** |

*d. Future Work:*

| | |
|---|---|
| – Monitoring of invertebrate feeders and piscivorous feeders. | Immediate - Feasibility |
| – Summer and winter bird counts. | Immediate - Feasibility |

*7.4.6 Marine Environment*

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | – In the case of the Mkomazi, riverine input to the marine environment is thought to be particularly important as it is one of the largest contributors of flow to the KwaZulu-Natal marine environment. |

*b. Impact Rating:*

| IMPENDLE | | SMITHFIELD | |
|---|---|---|---|
| without mitigation | with mitigation | without mitigation | with mitigation |
| ? | **?** | ? | **?** |

*c. Future Work:*

| | |
|---|---|
| – Further investigate this issue - monitor the importance of freshwater flow to the marine environment. | Feasibility - Long term |

## 7.5 Social Aspects

*a. Affected Environment / Impact Description:*

| | |
|---|---|
| SMITHFIELD or IMPENDLE | – General recreation occurs along the beach adjacent to the mouth and water sports (jet skis, inflatable boats and water skiers) occurs along the seaward shoreline of the estuary. Human activities in the area are likely to increase in future.<br>– No formal assessment of impacts on the social environment of the estuary has been conducted but it can be assumed that the IFR and EFR allocations for the biophysical environment would also mitigate / prevent potential negative impacts on the social environment. |

*b. Proposed Mitigation / EFR Objectives:*

| | | |
|---|---|---|
| SMITHFIELD or IMPENDLE | – | IFR allocations for social components upstream of the estuary and EFR allocations for the biophysical components of the estuary. |

*c. Impact Rating:*

| IMPENDLE | | SMITHFIELD | |
|---|---|---|---|
| without mitigation | with mitigation | without mitigation | with mitigation |
| ? | **NONE** | ? | **NONE** |

## 7.6 Preliminary EFR Estimates

The following represents a *preliminary* estimate of EFR's to maintain and manage the estuary to the predefined management class:

C Minimum baseflows ($m^3/s$):

| *MONTH* | *Maintenance flows* | *Confidence* | *Drought year flows* | *Confidence* | *Min weeks* |
|---|---|---|---|---|---|
| Oct | > 4 | mod | 2-4 | low-mod | 4 |
| Nov | > 4 | low-mod | 2-4 | low-mod | 4 |
| Dec | > 4 | low-mod | > 4 | mod | 4 |
| Jan | > 4 | low-mod | > 4 | mod | 4 |
| Feb | > 4 | low-mod | > 4 | mod | 4 |
| Mar | > 4 | low-mod | 2-4 | low | 4 |
| Apr | 2-4 | low | 2-4 | low | 4 |
| May | 2-4 | low | 1-2 | low | 4 |
| Jun | 1-2 | low | 1 | low | 4 |
| Jul | 1-2 | low | 1 | low | 4 |
| Aug | 1-2 | low | 1 | low | 4 |
| Sep | 1-2 | low-mod | 1-2 | low-mod | 4 |

C Freshettes (30-50 $m^3/s$) to replenish riverine based nutrients and organic supplies:

| *MONTH* | *'Maintenance' flows* | *'Drought' year flows* |
|---|---|---|
| Nov-Dec | 2 | 1 |
| Jan-Feb | 3 | 2 |
| Mar | 1 | |

C Minor Floods (> 50 $m^3/s$) to move organic material through the estuary:

| *MONTH* | *'Maintenance' flows* | *'Drought' year flows* |
|---|---|---|
| Dec-Feb | 3 | 1 |

C Major Floods to reset the estuary:

| *SIZE OF MAJOR FLOOD* | *Frequency* |
|---|---|
| Major Flood (± 1 200 50 $m^3/s$) | every 5 years |
| Major Flood (> 2 000 50 $m^3/s$) | every 10 years |

## 7.7 Assumptions and Limitations

The level of confidence in the recommended EFR's are relatively low due to the following:

- The Mkomazi Estuary has not been well studied, limited information is available;
- Specialist inputs were primarily desktop, with limited site visits and/or field investigations;
- Techniques used in the initial assessment are being developed and therefore in their infancy;
- EFR estimates are based on limited datasets, are provisional and for planning purposes only;
- No comparative assessment of the development options was made as hydrological simulations were not available at the time of the study.

## 7.8 Synthesis

Impacts on the estuarine environment are largely related to changes / reduction in run-off from the catchment, leading to an increase in closed mouth conditions. The initial assessment concluded that the mouth should preferably be permanently open. However, it should at least remain open continuously during summer months. Should the mouth close during winter months it should only be for short periods of time. Mechanical

breaching, as mitigation measure for mouth closure, should only be relied upon as a last resort. Natural maintenance of the mouth to promote estuarine conditions is the safest and preferred means of maintaining the ecological integrity. Both proposed dams are located relatively high up in the catchment. It is likely that IFR flood mitigation releases will not be a major considerations for the EFR. The use of pulsed release flows to regulate the estuary therefore does not seem viable.

If the EFR objectives are met, the impacts on the estuarine environment would be low. The relative impacts of the schemes were not compared, but it seems as if the Impendle Scheme, located higher in the catchment, will allow for a greater proportion of the catchment flow to be unimpeded and the larger downstream incremental catchment also provide better opportunity for natural mitigation. The risk of not meeting the EFR objectives are therefore slightly lower than in the case of the Smithfield Scheme. An overall rating of impacts on the estuarine environment is presented below:

| | IMPENDLE | | SMITHFIELD | | Non-Augmentation | |
|---|---|---|---|---|---|---|
| | without mitigation | with mitigation | without mitigation | with mitigation | without mitigation | with mitigation |
| *Biophysical* | MOD-HIGH | **possibly LOW** | HIGH | **possibly LOW-MOD** | - | **-** |
| *Social* | ? | **possibly NONE** | ? | **possibly NONE** | - | **-** |

# 8. RECEIVING RIVER SYSTEMS AFFECTED BY AUGMENTATION TRANSFERS

## 8.1 Data Sources

– ROIP on the Impact of the Transfer of Water from the Mkomazi River to the Mgeni Catchment and Mlazi Catchment.

## 8.2 Scope of Work

A scoping level assessment, based on the ROIP procedure, was undertaken to identify and assess the possible impacts associated with the transfer of water from the Mkomazi River System to the Mgeni and Mlazi River Systems. More specifically, the assessment concerned itself with the potential transfer of organisms between donor and recipient rivers and the possible changes in composition of the recipient stream communities due to changes in flow regimes.

## 8.3 Assessment of Impacts

*a. Affected Environment / Impact Description:*

<table>
<tr><th>IMPENDLE</th><th>SMITHFIELD</th></tr>
<tr><td>– Transfers water to the Mgeni System;<br>– Outlet portal located in the KwaGqishi River, upstream of Midmar Dam (portal to be inundated);</td><td>– Transfers water to the Mlazi System;<br>– Outlet portal located in the Mlazi River, upstream of and existing irrigation dam on the Mlazi River (Baynesfield Dam);</td></tr>
<tr><td colspan="2">– Both the KwaGqishi and the Mlazi Rivers flow through state forests, agricultural land and several small dams/weirs.<br>– Small pockets of indigenous forest and large numbers of exotic tree species are found along both receiving streams.<br>– There will be increased inputs into the receiving streams.<br>– Water quality in the receiving streams should not deteriorate since the transferred water quality is not worse than that of the recipient systems - water quality may improve.<br>– Water transfer may lead to some habitat loss in the receiving streams, since these streams are already modified it is not regarded as a serious impact.<br>– Transfer of organisms is likely to occur from the donor to the recipient systems. However, no significant problems are expected as the recipient systems are already highly modified and probably already contain all the species likely to be transferred and to flourish.</td></tr>
<tr><td>Geomorphological impacts insignificant.</td><td>Severe geomorphological impacts due to increased flow (scouring, sedimentation, and undercutting of the river banks) in the Mlazi River if not mitigated.</td></tr>
</table>

*a. Proposed Mitigation:*

| | | |
|---|---|---|
| SMITHFIELD | – | Engineering of Mlazi River channel to accommodate increased flow. |
| SMITHFIELD & IMPENDLE | – | Control on the introduction of fish species for angling. |

*b. Impact Rating:*

| Component | IMPENDLE | | SMITHFIELD | |
|---|---|---|---|---|
| | without mitigation | with mitigation | without mitigation | with mitigation |
| *Hydrology* | LOW | **NONE-LOW** | LOW | **NONE-LOW** |
| *Water Quality* | ? / LOW | **NONE-LOW** | ? / LOW | **NONE-LOW** |
| *Geomorphology* | - | **-** | HIGH | **NONE-LOW** |
| *Riparian Vegetation* | LOW | **NONE-LOW** | LOW | **NONE-LOW** |
| *Aquatic Invertebrates* | LOW | **NONE-LOW** | LOW | **NONE-LOW** |
| *Fish* | LOW | **NONE-LOW** | LOW | **NONE-LOW** |

## 8.4 Assumptions and Limitations

For the purposes of the morphological aspects of this study it was assumed that the transferred water will not flow downstream of the Midmar and Baynesfield Dams.

## 8.5 Future Work

– In the event that increased flows occurring downstream of the Midmar and Baynesfield Dams, an assessment of impacts must be made.

– Further assessment of possible changes in water quality, aquatic invertebrate and fish communities in the donor system (due to impoundment) to adequately assess the potential changes in the recipient body as a result of water transfer from the donor system.

## 8.6 Synthesis

Water transfer may lead to some habitat loss in the receiving streams, since these streams are already modified it is not regarded as a serious impact. Species likely to be transferred and to flourish probably already occur in the receiving streams. Impacts associated with the transfer of water from the Mkomazi River System to the Mgeni and Mlazi River Systems are therefore generally low and little mitigation is therefore required. The only exception in this regard is the mitigation that would be required to address the potential geomorphological impacts of increased flow in the Mlazi River.

An overall impact rating is provided below:

| | IMPENDLE | | SMITHFIELD | | Non-Augmentation | |
|---|---|---|---|---|---|---|
| | without mitigation | with mitigation | without mitigation | with mitigation | without mitigation | with mitigation |
| *Biophysical* | LOW | **NONE-LOW** | LOW | **NONE-LOW** | - | **-** |
| *Social* | NONE-LOW | **NONE-LOW** | NONE-LOW | **NONE-LOW** | - | **-** |

# 9. SUPPLY AREAS AFFECTED BY AUGMENTATION [F10]

## 9.1 Data Source

Socio-Economic Impact of Outcomes relating to the Mkomazi-Mgeni Augmentation Scheme (Graham Muller & Associates).

## 9.2 Scope of Work

The main focus of the study was to identify the socio-economic impacts associated with constrained water supply, should the Mkomazi-Mgeni Transfer Scheme not be implemented.

The gross geographic product (GGP) and employment within the study area (supply area) and within KwaZulu-Natal were projected for the period 1998-2038. In addition to this, the effectiveness of improvements in water-use productivity, as a result of water demand management, were tested.

Two alternative scenarios were compared:

– *Non-Augmentation Scenario:*
Unconstrained economic growth occurs within the study area until such time as water becomes a constraint to further growth. The proposed Mkomazi-Mgeni Transfer Scheme is not commissioned but water demand is managed by the relative authorities.

– *Augmentation Scenario (Smithfield or Impendle):*
Unconstrained economic growth occurs within the study area and the Mkomazi-Mgeni Transfer Scheme is commissioned according to the time frame specified by Umgeni Water. In addition, water demand is managed by the relative authorities.

F10 Areas dependent on water supply from the Mgeni System: Magisterial Districts of Durban, Chatsworth, Pinetown, Ntuzuma, Inanda, Ndwedwe, Camperdown, Mpumalanga (KZN), Pietermaritzburg, New Hanover, Lions River, Mooi River and Vulindlela.

## 9.3 Assessment of Socio-Economic Impacts

| | |
|---|---|
| Augmentation Scenario<br><br>(SMITHFIELD / IMPENDLE) | – Cumulative gross geographic product (GGP) throughout the study period, within the supply area and KwaZulu-Natal, is 26% higher than for the Non-Augmentation Scenario.<br>– Employment in the study area (and for KwaZulu-Natal as a whole), over the lifetime of the study, is 34% higher than for the Non-Augmentation Scenario. |
| Non-Augmentation Scenario | – The water use productivity analysis showed that a 10% improvement in water-use productivity would result in a 7% improvement in cumulative GGP throughout the study period, as opposed to the 26% improvement resulting from augmentation.<br>– The implication of non-augmentation on formal employment is a cumulative loss of 3.27 million potential new jobs in the study area by the year 2038 and a total loss of 4.99 million potential new jobs in whole of KwaZulu-Natal. |

## 9.4 Synthesis

Achievable GGP and employment levels would be significantly higher with commissioning of the Mkomazi-Mgeni Transfer Scheme than with the Non-Augmentation Scenario. Non-Augmentation would result in a considerable cost in terms of lost output and constraints to employment generation.

Although the importance of water demand management was illustrated, the study concluded that, in the case of the Mgeni System, water demand management on its own is not a viable alternative to augmentation. Instead, water demand management and augmentation should be seen as complementing one another.

An overall rating of the socio-economic impacts are provided below:

| Augmentation Scenario | Non-Augmentation Scenario |
|---|---|
| IMPENDLE / SMITHFIELD | |
| **++** | **severe** |

# 10. CONCLUSIONS

## 10.1 Summary of Issues and Concerns

**Table 10.1.1: Description and Rating of Biophysical Impacts**

| POTENTIAL IMPACTS & ISSUES | *Non Augmentation Option* | | *Augmentation Options* | | | |
|---|---|---|---|---|---|---|
| | | | *IMPENDLE* | | *SMITHFIELD* | |
| | Impact Rating | | | | | |
| | without mitigation | with mitigation | without mitigation | with mitigation | without mitigation | with mitigation |
| I. ENVIRONMENTS AFFECTED BY INUNDATION | | | | | | |
| – Both areas are severely degraded. A few rare or threatened plant species occur in low numbers on both sites. Most of these could be propagated or relocated.<br>– The most significant impact (applicable to both schemes) is the loss of two Bald Ibis roosting/nesting sites at Impendle. However the Environmental Task Group did not regard this as a fatal flaw. | - | **-** | mod-high | **low-mod** | high | **mod** |
| II. ENVIRONMENTS AFFECTED BY CONVEYANCE INFRASTRUCTURE & WATER Works | | | | | | |
| – The Impendle pipelines would be located along an existing servitude, mostly brown-fields development, upgrading of existing Water Works.<br>– The Smithfield pipelines would involve green-fields development (however modified), development of new Water Works.<br>– However, most of the impacts are temporary in nature (associated with the construction phase) or the size of the affected areas are relatively limited (i.e. portal sites). | - | **-** | mod | **low** | mod-high | **low-mod** |

| POTENTIAL IMPACTS & ISSUES | *Non Augmentation Option* | | *Augmentation Options* | | | |
|---|---|---|---|---|---|---|
| | | | *IMPENDLE* | | *SMITHFIELD* | |
| | **Impact Rating** | | | | | |
| | without mitigation | with mitigation | without mitigation | with mitigation | without mitigation | with mitigation |
| III. RIVERINE ENVIRONMENTS AFFECTED BY CHANGES IN FLOW REGIME | | | | | | |
| – Impacts on the riverine relate to changes / reduction in run-off from the catchment, with consequent changes in the flow regime and potential impacts on the functioning of ecosystems.<br>– The recommended IFR's have been incorporated into the design capacity of both schemes but the final yield modeling has not yet been completed. At this stage the possible success of mitigation is therefore still uncertain. However, the impacts would possibly be mitigated to relatively low levels – if appropriate operational rules are observed. These operational rules still need to be developed.<br>– Smithfield Scheme involves two impoundments (one lower down in the catchment) that would impede a greater percentage of the mean annual runoff (MAR) and opportunities for natural mitigation are less than that for the Impendle Scheme. Although the IFR Study provided operational guidelines for elevated flows between the two dams, there is the added risk of exceeding the capping flows for this river reach. | - | **-** | high-severe | **possibly low-mod** | severe | **possibly mod** |
| IV. ESTUARINE ENVIRONMENT AFFECTED BY CHANGES IN FLOW REGIME | | | | | | |
| – Changes/reduction in run-off from the catchment, leading to an increase in closed mouth conditions, impacting on the ecological components of the area..<br>– Impendle, located higher in the catchment and will allow a greater proportion of the catchment flow to be unimpeded – the potential for natural mitigation is therefore better.<br>– IFR & EFR allocations incorporated into design criteria – mitigating potential severe negatives impacts. | - | **-** | mod-high | **possibly low** | high | **possibly low-mod** |
| V. RECEIVING RIVER SYSTEMS AFFECTED BY AUGMENTATION TRANSFERS | | | | | | |
| – Water transfer may lead to some habitat loss in the receiving streams, since these streams are already modified it is not regarded as a serious impact.<br>– Species likely to be transferred and to flourish probably already occur in the receiving streams.<br>– Impacts associated with the transfer of water from the Mkomazi River System to the Mgeni and Mlazi River Systems are therefore generally low and little mitigation is therefore required. The only exception in this regard is the mitigation that would be required to address the potential geomorphological impacts of increased flow in the Mlazi River. | - | **-** | low | **none-low** | low | **none-low** |

**Table 10.1.2: Description and Rating of Social & Economic Impacts**

| POTENTIAL IMPACTS & ISSUES | *Non Augmentation Option* | | *Augmentation Options* | | | |
|---|---|---|---|---|---|---|
| | | | *IMPENDLE* | | *SMITHFIELD* | |
| | **Impact Rating** | | | | | |
| | without mitigation | with mitigation | without mitigation | with mitigation | without mitigation | with mitigation |
| I. ENVIRONMENTS AFFECTED BY INUNDATION | | | | | | |
| – From a social impact perspective, both schemes could be implemented. The Smithfield Scheme would be more complex and more expensive to implement but the potential positive impacts associated with the scheme are also more significant. In relation to the overall project cost, the cost for social mitigation and optimisation measures should be fairly insignificant. | - | **-** | high | **mod** | severe | **mod-high** |
| | - | **-** | - | **+** | - | **++** |
| II. ENVIRONMENTS AFFECTED BY CONVEYANCE INFRASTRUCTURE & WATER WORKS | | | | | | |
| – The Impendle pipelines would be located along an existing servitude.<br>– The Smithfield pipelines would involve green-fields development - consultation and negotiation would therefore be more problematic.<br>– Most of the impacts are temporary in nature (associated with the construction phase). | - | **-** | mod | **low** | high | **mod** |
| III. RIVERINE ENVIRONMENTS AFFECTED BY CHANGES IN FLOW REGIME | | | | | | |
| – Impacts on the riverine environments downstream of the proposed dams relate to changes / reduction in run-off from the catchment, with consequent changes in the flow regime and the way the river is utilised.<br>– IFR's have been incorporated into the design capacity of both schemes. The impacts should therefore be mitigated to relatively low levels – if appropriate operational rules are observed. | - | **-** | mod | **possibly none-low** | mod-high | **possibly none-low** |
| IV. ESTUARINE ENVIRONMENT AFFECTED BY CHANGES IN FLOW REGIME | | | | | | |
| – No formal assessment of impacts on the social environment of the estuary has been conducted.<br>– IFR allocations for the social components upstream of the estuary and EFR allocations for the biophysical components of the estuary should address potential impacts on the social environment. | - | **-** | ? | **possibly none** | ? | **possibly none** |

| POTENTIAL IMPACTS & ISSUES | *Non Augmentation Option* | | *Augmentation Options* | | | |
|---|---|---|---|---|---|---|
| | | | *IMPENDLE* | | *SMITHFIELD* | |
| | **Impact Rating** | | | | | |
| | without mitigation | with mitigation | without mitigation | with mitigation | without mitigation | with mitigation |
| V. RECEIVING RIVER SYSTEMS AFFECTED BY AUGMENTATION TRANSFERS | | | | | | |
| – Social impacts associated with the transfer of water from the Mkomazi River System to the Mgeni and Mlazi River Systems are minimal. | - | **-** | none-low | **none-low** | none-low | **none-low** |
| VI. WATER SUPPLY AREAS EFFECTED BY AUGMENTATION | | | | | | |
| – Achievable GGP and employment levels would be significantly higher with commissioning of the Mkomazi-Mgeni Transfer Scheme than with the Non-Augmentation Scenario.<br>– Non-Augmentation would result in a considerable cost in terms of lost output and constraints to employment generation.<br>– In the case of the Mgeni System, water demand management on its own is not a viable alternative to augmentation. | severe | | | **++** | | **++** |

## 10.2 Environmental Acceptability of the Development Options

The above summary of issues and concerns (Section 10.1) clearly indicates that the environmental impacts, associated with the proposed Impendle and Smithfield Transfer Schemes, could be mitigated to within acceptable levels.

Generally, the Smithfield Scheme has slightly higher impacts than in the case of the Impendle Scheme. However, the available yield of the Impendle Scheme is lower than that of Smithfield and further augmentation will be required sooner (by approximately two years), therefore balancing out the impacts of the two schemes.

In conclusion, both schemes are regarded as acceptable form a biophysical and social point of view, provided the recommended future work is carried out and mitigation measures are put in place.

The Non-Augmentation Scenario proved to be problematic due to the unacceptable impacts on future economic development and employment opportunities in the water supply area, and within KwaZulu-Natal as a whole.

It is important to note that water demand management and catchment management would prove vital to ensure sustainable long term water supply in the region.

## 10.3 Summary of Future Work

The following represents a summary of future work identified by the various specialist studies:

### *10.3.1 Environments affected by inundation*

*Vegetation*

| | |
|---|---|
| C It is essential that sensitive areas are surveyed in more detail to identify medicinal, rare and threatened plant specimens for propagation and relocation; | Feasibility - Design |
| C Wherever possible, these plant specimens should be propagated and/or relocated to the nearest protected site and where not, to botanical institutions; | Implementation |
| C Medicinal plant specimens should be made available to interested parties. | Implementation |

*Fauna*

| | |
|---|---|
| C Sensitive areas to be surveyed, suitable species to be rescued and relocated. | Implementation |

*Social*

| | |
|---|---|
| C Cost/benefit analysis - negative impacts to be weighed against positive impacts | Feasibility |
| C Negotiations with affected communities regarding relocation | Feasibility |
| C Address land restitution issues | Feasibility |
| C Liaison with the Department of land Affairs | Feasibility |
| C Facilitate direct involvement of affected communities in further planning phases | Feasibility |
| C Set back area to be clarified for settlement negotiations | Feasibility |

*10.3.2 Environments affected by Conveyance Infrastructure*

***Fauna & Flora***

| | |
|---|---|
| C Detailed survey of 'natural' vegetation areas to identify medicinal, rare or threatened plant species for relocation. | Feasibility - Design |

***Social***

| | |
|---|---|
| C Consultation with affected parties | Feasibility |
| C Compensation negotiations | Feasibility |

*10.3.3 Riverine environments affected by changes in flow regime*

- C Short term practical work to raise confidence in IFR's (for completion before or during the feasibility phase):
  - – Low flow hydraulic measurements, calibrate the stage discharge curve;
  - – Low flow photographs (associated with above);
  - – Confirm distribution and depth of hygrophilous community;
  - – Determine the effect of flooding and grazing on the terraces;
  - – Low flow survey of geomorphology / invertebrate habitats;
  - – Aquatic invertebrate survey at IFR site 4;
  - – Fish survey at IFR site 4.
  - – Investigate impacts of natural barriers on fish migration ( need for fish ladders);

– Verify riparian vegetation flood indicators at IFR site 4;
– Investigate natural and present sediment regimes (geomorphology).

- Continued water quality monitoring, especially to determine the effects of low flows.

- Geomorphology – investigate the effect of dams (long term study).

- Further work required in terms of setting the 'Reserve' and 'Management Class' for the Mkomazi River System.

*10.3.4 Estuarine environment affected by changes in flow regime*

***Hydrodynamics***

| | |
|---|---|
| C Analyse information from recently installed water level recorder. | Immediate (continued) |
| C Finalising hydrological simulations. | Feasibility |
| C Further investigations on: mouth dynamics; sediment dynamics; estuary morphometry; salinities and the role of flooding. | Feasibility - Design |

***Water Quality***

| | |
|---|---|
| C Continue with current monitoring | Immediate (continued) |
| C Routine monitoring for chemical constituents | Immediate (continued) |
| C Investigate low flows under closed conditions | Feasibility |

***Fish***

| | |
|---|---|
| C Further seasonal sampling of fish fauna, ideally under open and closed mouth phases. | Immediate - Feasibility |

***Invertebrates***

| | |
|---|---|
| C Baseline invertebrate survey, particularly on benthic, subtidal and intertidal habitats. | Immediate - Feasibility |
| C Investigate the utilisation of the estuary by recruiting megalopa (especially during winter months). | Immediate - Feasibility |

***Birds***

| | |
|---|---|
| C Monitoring of invertebrate feeders and piscivorous feeders. | Immediate - Feasibility |
| C Summer and winter bird counts. | Immediate - Feasibility |

***Marine Environment***

| | |
|---|---|
| C Monitoring of the importance of freshwater flow to the marine environment. | Immediate - Feasibility |

*10.3.5 Long-Term Management*

C Catchment Management Plan to be put in place and implemented.

C Water Demand Management to be implemented in the Mgeni supply areas.

REFERENCES


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b. A Pre-Feasibility Study of the Potential Impact on Fauna and Flora of the Impendle and Smithfield Dam sites on the Mkomazi River, KwaZulu-Natal. 1997. NHG Jacobsen.

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e. Mkomazi Estuarine Freshwater Requirements, an Initial Assessment. 1998. Documentation by N Quinn and A Whitfield.

f. Mkomazi Instream Flow Requirement (IFR) Study: Specialist Meeting Proceedings. March 1998. Compiled by D Louw, *IWR Environmental, Institute for Water Research.*

g. Mkomazi-Mgeni Transfer Scheme Pre-Feasibility Study: Environmental Scoping for Components of the Conveyance infrastructure. 1998. ME ELS, *Ninham Shand.*

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i. Relevant Environmental Impact Prognosis (ROIP) on the proposed Impendle Dam. 1997. GJ Munro, *DWAF Directorate Social and Environmental Services.*

j. Relevant Environmental Impact Prognosis (ROIP) on the proposed Smithfield Dam. 1997. GJ Munro, *DWAF Directorate Social and Environmental Services.*

k. Socio-Economic impact of outcomes relating to the Mkomazi-Mgeni Augmentation Scheme. 1998. Graham Muller Associates.

**ADDENDUM A:**

## A.1 Present State (Ecological / Habitat Integrity) Classes

| *CLASS* | *DESCRIPTION* |
|---|---|
| **A** | – Unmodified, natural;<br>– Resource base has not been decreased;<br>– Resource capability has not been exploited. |
| **B** | – Largely natural with few modification;<br>– Resource base has been decreased to a small extent;<br>– Small change in natural habitats and biota may have taken place but ecosystem functions are essentially unchanged. |
| **C** | – Moderately modified;<br>– Resource base has been decreased to a moderate extend;<br>– Change of natural habitat and biota has occurred, but the basic ecosystem functions are still predominantly unchanged. |
| **D** | – Largely modified;<br>– Resource base has been decreased to a moderate extend;<br>– Large changes in natural habitat, biota and basic ecosystem functions have occurred. |
| **E** | – Seriously modified;<br>– Resource base has been significantly decreased;<br>– Loss of natural habitat, biota and basic ecosystem functions is extensive. |
| **F** | – Critically modified;<br>– Resource base has been critically decreased;<br>– Modifications have reached a critical level and the resource has been modified completely with almost total loss of natural habitat and biota. In worst instances the basic ecosystem functions have been destroyed and the changes are irreversible. and basic ecosystem functions is extensive. |

## A.2 Future Management (Desired State) Classes

| *CLASS* | *DESCRIPTION* |
|---|---|
| **A** | – Unmodified, natural – the natural abiotic template should not be modified;<br>– The characteristics of the resource should be completely determined by unmodified natural disturbance regimes. |
| **B** | – Largely natural with few modification – only a small risk of modifying the natural abiotic template and exceeding the resource base should be allowed.<br>– The risk to the well-being and survival of intolerant biota (depending on the nature of the disturbance) may be slightly higher than expected under natural conditions. |
| **C** | – Moderately modified – a moderate risk of modifying the abiotic template may be allowed.<br>– Risks to the well-being and survival of intolerant biota (depending on the nature of the disturbance) may generally be increased with some reduction of resilience and adaptability at a small number of localities. |
| **D** | – Largely modified – large risk of modifying the abiotic template and exceeding the resource base may be allowed.<br>– Risks to the well-being and survival of intolerant biota (depending on the nature of the disturbance) may generally be allowed to increase substantially with resulting low abundances and frequency of occurrence. |

## ADDENDUM B: ENVIRONMENTAL TASK GROUP (ETG)

### B.1 ETG Representation

The following persons were involved (attended one or more of the ETG meetings):

- Mr M Taylor : Town & Regional Planning Commission
- Ms M D Louw : IWR Environmental
- Mr J J Geringer : DWAF, Pretoria
- Mr. W Addison : Natal Conservancies Organisation
- Ms J Davey : Scott Wilson
- Mr J David : DWAF, Pretoria
- Mr A Tanner : Ninham Shand
- Ms M Els : Ninham Shand
- Mr M J Munro : DWAF, Pretoria
- Mr P C Blersch : Ninham Shand
- Mr S W Gillham : Umgeni Water
- Mr W Schäfer : Umgeni Water
- Mr D E Simpson : Umgeni Water
- Mr D B Nothnagel : iNdlovu Regional Council
- Mr G C Anderson : Natal Museum
- Mr C D Tylcoat : DWAF, KZN
- Ms C Murphy : Natal Parks Board
- Mr D Airey : SAPPI SAICCOR
- Mr R Philip : DWAF, KZN
- Mr H Karodia : DWAF, KZN
- Mr NHG Jacobson : IWR Environmental
- Prof J H O'Keeffe : IWR, Rhodes
- Dr C Dickens : Umgeni Water
- Mr G Huggins : Scott Wilson
- Ms J Moran : Scott Wilson
- Mr N Kemper : IWR Environmental
- Mr J Alletson : Msinsi Trust
- Mr K Cooper : Wildlife & Environment Society
- Mr B Wahl : Natal Museum
- Mr M Calverley : SARA
- Mr L Calverley : SARA
- Mr A Whitfield : JLB Smith Institute

The following organisations were invited but did not send representatives to the ETG meetings:

- Department of Environmental Affairs & Tourism
- KwaZulu-Natal Nature Conservation

## B.2 Summary of ETG Discussions and Recommendations

It was recommended that an impact rating table should show the various components of the two options in order to adequately compare them. For ease of comparison the common elements between the two schemes should be eliminated and only the differences between the two schemes should remain in the table.

The major differences of the two schemes being:

*Impendle Scheme*

- Dam basin - additional area of inundation for Phase 2
- Tunnel
- Northern feeder bulk water pipeline (upgrade)
- Other infrastructures

*Smithfield Scheme*

- Dam basin at Smithfield site
- Umlazi River balancing dam
- Tunnel (dam to balancing dam)
- Raw water pipeline
- Water Treatment works - additional
- Water transfers between Impendle and Smithfield

In order to facilitate the comparisons, it was recommended that gaps in our knowledge should be addressed. It was noted that full ROIPs have already been required for all components of the scheme. These were according to the TOR, to be undertaken in-house by DWAF - Environmental Studies. During the reconnaissance stage, it was agreed that the ROIPs of the infrastructure could be delayed until the layouts for the Pre-Feasibility has been selected because a scoping exercise was sufficient for the reconnaissance stage decision.

## ADDENDUM C: STAKEHOLDER COMMITTEE

### C.1 Stakeholder Committee Representation

The following individuals and organisations were involved (attended one or more of the Stakeholder Committee meetings):

- Mr. J Geringer : DWAF, Pretoria
- Mr. J G David : DWAF, Pretoria
- Mr. G Munro : DWAF, Pretoria
- Mr. N A Ward : DWAF, Durban
- Mr. J Perkins : DWAF, Durban
- Mr. H E Karodia : DWAF, Durban
- Mr. S Gillham : Umgeni Water
- Mr. W Schäfer : Umgeni Water
- Mr. D E Simpson : Umgeni Water
- Mr. M Haynes : Umgeni Water
- Mr R S Ackerman : Umgeni Water
- Mr. G Huggins : Scott Wilson
- Mr. P Gardiner : Mondi Forest
- Mr. D D Airey : SAPPI SAICCOR
- Mr. M N Mbele : Ilembe Regional Council
- Mr. P C Blersch : Ninham Shand
- Mr. A Tanner : Ninham Shand
- Mr. D M Taylor : TRPC
- Mr. F B Stevens : Durban Metro Water
- Mrs. B Soni : Durban Metro Water
- Mr. D McDonald : KZNPA, Coastoal
- Mr. R Turner : DLG&H, PMB
- Mr. Y Goga : Pietermaritzburg-Msunduzi TLC
- Mr G Jewitt : KwaZulu-Natal Canoe Union
- Mr. A Whittal : KZNDA: Agriculture
- Mr. I E Anderson : Ugu Regional Council
- Mr. S K Armour : Department of Agriculture
- Mrs J Davey : Scott Wilson
- Mr. N Kemper : IWR Environmental
- Mr. J D Black : KWAZULU

The following individuals were invited but did not attend any meetings:

- Dr. F Kars : Department of Agriculture
- Mr. M Newton : Ilembe Regional Council
- Mr. D Nothnagel : iNdlovu Regional Council
- Mr. L Howard : iNdlovu Regional Council
- Mr. K Knox-Davies : Pmb-Msunduzi TLC
- Mr. J Scotcher : SAPPI Forests
- Mr. C Boake : SAPPI Forests
- Mr. G Louwrens : DLG&H, Durban
- Mr. P Sapsford : Department of Land Affairs
- Mr. A Rennie : KZNCU
- Ms C Murphy : Natal Parks Board