REPORT NO:
P WMA 11/U10/00/3413/3

water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

PROPOSED UMKHOMAZI WATER PROJECT PHASE 1

Raw Water Component

EIA REPORT

FOR ENVIRONMENTAL AUTHORISATION

DRAFT

June 2016

DEA Ref. No.:

- Smithfield Dam - **14/12/16/3/3/3/94**
- Water conveyance infrastructure - **14/12/16/3/3/3/94/1**
- Balancing Dam - **14/12/16/3/3/3/94/2**

EXECUTIVE SUMMARY

A. PROJECT BACKGROUND AND MOTIVATION

The current water resources of the Integrated Mgeni Water Supply System (WSS) are insufficient to meet the long-term water requirements of the system. Pre-feasibility investigations indicated that Phase 1 of the uMkhomazi Water Project (uMWP-1), which entails the transfer of water from the undeveloped uMkhomazi River to the existing Integrated Mgeni WSS, is the scheme most likely to fulfil this requirement.

The Mkomazi-Mgeni Transfer Pre-feasibility Study concluded that the first phase of the uMWP would comprise a new dam at Smithfield on the uMkhomazi River near Richmond, a multi-level intake tower and pump station, a water transfer pipeline/tunnel to a balancing dam at Baynesfield Dam or a similar in-stream dam, a water treatment works at Baynesfield in the uMlaza River valley and a gravity pipeline to the Mgeni bulk distribution reservoir system, below the reservoir at Umlaas Road. From here, water will be distributed under gravity to eThekwini and possibly low-lying areas of Pietermaritzburg.

The overall uMWP-1 Feasibility Study has been divided into the following three modules:

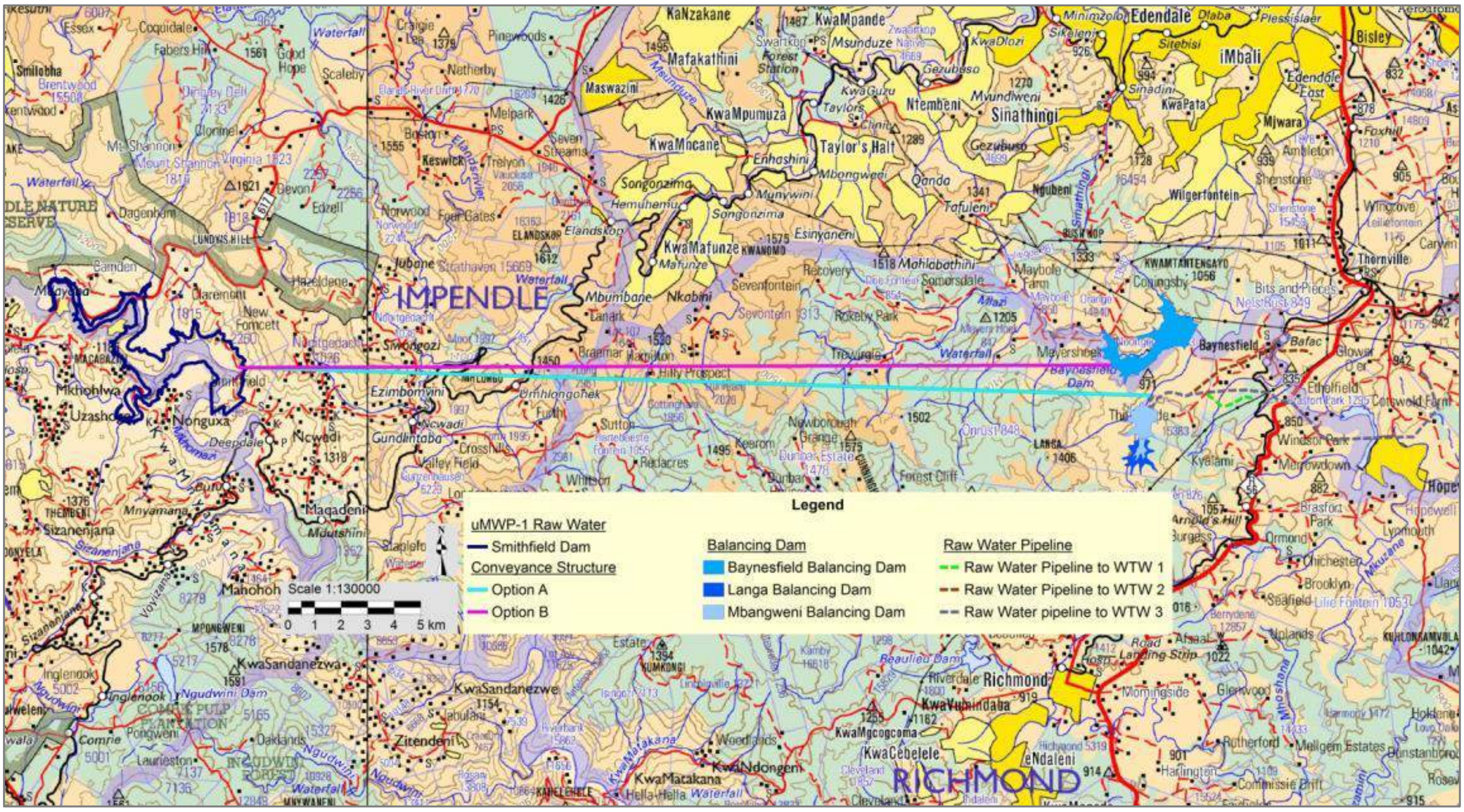
- **Module 1: Technical Feasibility Raw Water -** the Department of Water Affairs (DWA) is the project proponent and appointed AECOM (previously known as BKS) to undertake this study;
- **Module 2 Environmental Impact Assessment** (EIA) **-** Nemai Consulting was appointed as the independent Environmental Assessment Practitioner (EAP) by the separate project proponents (DWA and Umgeni Water) to undertake the respective EIAs for the proposed uMWP-1 Raw Water and Potable Water components; and
- **Module 3: Technical Feasibility Potable Water** - Umgeni Water is the project proponent and appointed Knight Piésold to undertake this study.

This document serves as the draft EIA Report for the proposed uMWP-1 Raw Water component.

B. PROJECT LOCATION

The project area is situated in the southern part of KZN. The western part of the project area falls within the Harry Gwala DM (Ingwe LM), whereas the eastern potion is located in the uMgungundlovu DM (Richmond LM and Mkhambathini LM).

The western portion of the project area, including Smithfield Dam and the first ± 21 km of the tunnel, falls under Traditional Authority and state land. The area is characterised by traditional homestead settlements and rural subsistence agriculture. The eastern part of the project area, which includes the remaining part of the tunnel (± 11.5 km), balancing dam and raw water pipeline, is privately owned and predominantly used for commercial farming and forestry.

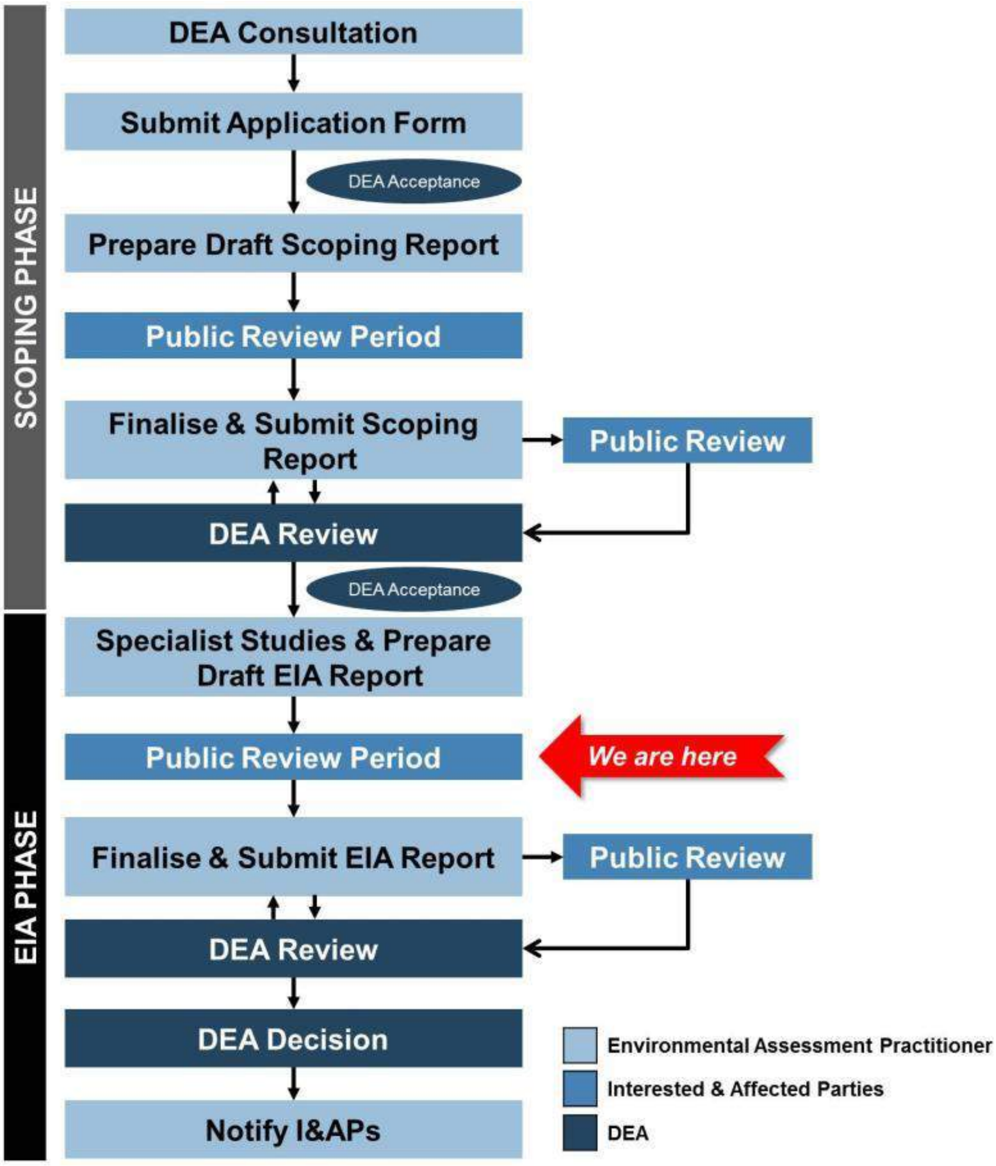


uMWP-1 - Condensed Locality Map

C. SCOPING AND EIA PROCESS

The process for seeking authorisation is undertaken in accordance with the EIA Regulations of 2010 (Government Notice No. R. 543 of 18 June 2010), promulgated in terms of Chapter 5 of the National Environmental Management Act (NEMA) (Act No. 107

of 1998). Based on the types of activities triggered in terms of Listing Notices 1, 2 and 3, the requisite environmental assessment for the project is a Scoping and EIA process. An outline of the process follows.

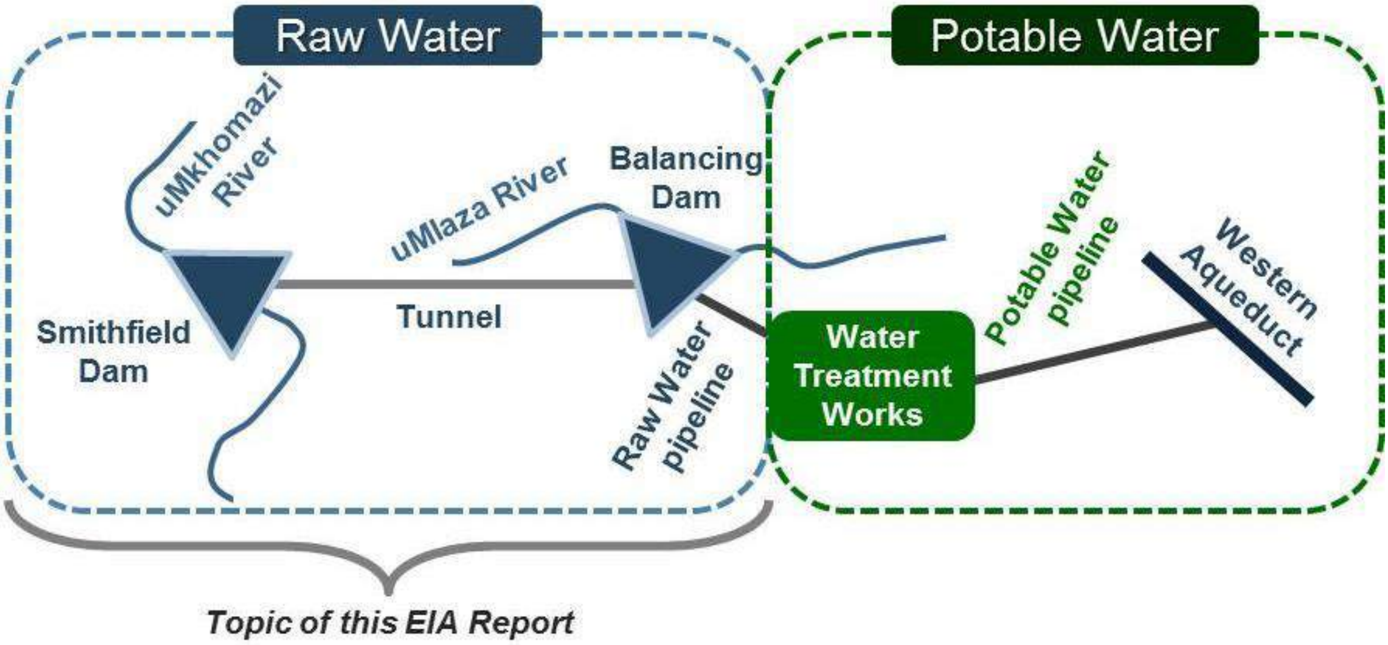


Scoping & EIA process

In terms of NEMA the lead decision-making authority for the environmental assessment is the National Department of Environmental Affairs (DEA), as the project proponent (DWA) is a national department. The Department of Mineral Resources (DMR) is the competent authority for the mining-related activities and separate approval will be sought from this Department for the relevant activities associated with the borrow areas and quarries in terms of the EIA Regulations of 2014 (Government Notice No. R. 983).

D. PROJECT DESCRIPTION

The uMWP-1 consists of both Raw Water and Potable Water components which are being undertaken by DWA and Umgeni Water, respectively. To assist with the overview of the project components, a simplified diagrammatic representation of the overall transfer scheme is provided below. As stated, this report only focuses on the uMWP-1 Raw Water component.



Simplified diagram of uMWP-1 components

The proposed uMWP-1 Raw Water consists of the infrastructure shown in the table to follow.

uMWP-1 Raw Water Project Components & Associated Infrastructure

Raw Water Component	Associated Infrastructure
Smithfield Dam	1. Dam embankment 2. Saddle dam embankment 3. Spillway (including approach area and plunge pool) 4. Tunnel intake tower 5. Dam outlet works (including dam intake tower, tunnel and outlet valve house) 6. Deviation of the R617 7. Access road to Nonguqa 8. Access road to intake tower 9. Access road to tunnel inlet portal 10. Access road to damwall 11. Construction roads 12. Relocation of power line

Raw Water Component	Associated Infrastructure
	13. Relocation of telephone lines 14. Quarries and earthfill borrow areas 15. Substation 16. Operator's offices 17. Gauging weir 18. Access road to gauging weir 19. Hydropower plant 20. Spoil site - inlet 21. Construction and permanent housing
Raw Water Conveyance Infrastructure	1. Tunnel 2. Tunnel intake tower 3. Raw water pipeline 4. Spoil sites (inlet, outlet and central portals) 5. Access road to Shaft 1 6. Access road to Shaft 2 7. Access road to Shaft 3 8. Access road to adit entry 9. Access road to tunnel outlet portal 10. Ventilation shaft 11. Adits 12. Hydropower plant
Balancing Dam	1. Dam embankment 2. Spillway 3. Bottom outlet / intake 4. Relocation of roads 5. Access roads 6. Quarry and earthfill borrow area 7. Construction and permanent housing 8. Spoil site - outlet

E. ALTERNATIVES

Various alternatives to supplying the demands of the Integrated Mgeni WSS are discussed, which include measures to increase the water resource, desalination, re-use, Water Conservation and Demand Management, as well as use of groundwater.

The Pre-feasibility Study included *inter alia* an investigation of eight augmentation schemes on the uMkhomazi River preceded by scheme identification and reconnaissance investigations. Following technical, environmental and economic comparisons of the schemes, the Pre-feasibility Study recommended that the Smithfield Scheme be taken forward to the next phase of investigation in a detailed Feasibility Study.

The alternatives for the Raw Water project components are shown in the table to follow.

uMWP-1 Raw Water Project Components – Alternatives

Components			Alternatives
Smithfield Dam Area	**Major storage dam - Smithfield Dam** (Full Supply Level & Purchase Line)		-
	Relocation of Eskom Transmission Line		1. Option 1
			2. Option 2
	Gauging weir (downstream and close to Smithfield Dam - U10F)		1. Option 1
			2. Option 2
	Roads – Smithfield Dam	• Deviation of the R617 • Road to Nonguqa • Access road to intake tower • Access road to tunnel inlet portal • Access road to dam wall • Construction roads	-
	Quarries & Borrow Areas – Smithfield Dam	• Quarries - o Quarry I o Quarry II o Quarry III o Quarry IV • Borrow areas - o Borrow area A o Borrow Area B o Borrow Area C	• Aggregates: Midmar crushers • Aggregates: Natal crushers • Natural sand: NPC
	Construction camp – Smithfield Dam		-
	Hydropower plant – Smithfield Dam		-
Conveyance Infrastructure	**Tunnel**		-
	Raw water pipeline		1. Route to WTW Option 1
			2. Route to WTW Option 2
			3. Route to WTW Option 3
	Ventilation shafts		-
	Adits		-
	Access roads - shafts		-
	Access roads - adits		-
	Tunnel outlet		-
	Hydropower plant – conveyance infrastructure		-
	Spoil / waste disposal sites (i.e. spoil areas)	Inlet portal (upstream)	-
		Outlet portal (downstream)	1. Option 1: Position 1
			2. Option 2: Spoil to be used in balancing dam wall
		Central portal	-
Balancing Dam Area	**Balancing dam** (Full Supply Level & Purchase Line)		1. Dam upstream of Mbangweni Dam
			2. Langa Balancing Dam
	Approach Area (Langa BD)		-
	Spillway chute (Langa BD)		-
	Road – Balancing Dam		1. Option 1
			2. Option 2
	Construction camp – Balancing Dam		-
	Quarries & Borrow Areas – Balancing Dam	Quarry & borrow area 1	• Aggregates • Natural sand

F. PROFILE OF THE RECEIVING ENVIRONMENT

The EIA Report provides a general description of the status quo of the receiving environment in the project area, and also provides local and site-specific discussions on those environmental features investigated by the respective specialists. This allows for an appreciation of sensitive environmental features and possible receptors of the effects of the proposed project.

The study area includes the entire footprint of all the project components, which includes the construction domain and surrounding receiving environment.

The receiving environment is assessed and discussed in terms of the following:

- Land Use and Land Cover;
- Climate;
- Geology;
- Soils;
- Geohydrology;
- Topography;
- Surface Water;
- Terrestrial Ecology;
- Protected Areas;
- Socio-Economic Environment;
- Planning;
- Agriculture;
- Air quality;
- Noise;
- Historical and Cultural Features;
- Planning;
- Existing Structures and Infrastructure;
- Land Claims;
- Services;
- Aesthetic Qualities; and
- Tourism.

G. SPECIALIST STUDIES

The requisite specialist studies ‘triggered’ by the findings of the Scoping process, aimed at addressing the key issues and compliance with legal obligations, include the following:

1. Terrestrial Ecological Impact Assessment;
2. Aquatic Impact Assessment;
3. Agricultural Impact Assessment;
4. Heritage Impact Assessment;
5. Visual Impact Assessment;
6. Socio-economic Impact Assessment;

7. Social Impact Assessment;
8. Avifauna Study; and
9. Relocation Framework Plan.

The information obtained from the respective specialist studies was incorporated into the EIA report in the following manner:

1. The information was used to complete the description of the receiving environment in a more detailed and site-specific manner;
2. A summary of each specialist study is provided, focusing on the approach to the study, key findings and conclusions drawn;
3. The specialists' impacts assessment, and the identified mitigation measures, were included in the overall project impact assessment;
4. The evaluations performed by the specialists on the alternatives of the project components were included in the comparative analysis to identify the most favourable option;
5. Specialist input was obtained to address comments made by Interested and Affected Parties (I&APs) that related to specific environmental features pertaining to each specialist discipline; and
6. Salient recommendations made by the specialists were taken forward to the final EIA Conclusions and Recommendations.

A host of studies were also conducted as part of the uMWP-1 Technical Feasibility Study for the Raw Water component. Some of these studies that are particularly important in terms of the EIA, and for which information was extracted to include in the EIA Report, include the following:

- Water Quality Analysis;
- Limnology Study;
- Sediment Yield Assessment;
- Geotechnical Investigation;
- Hydrological Assessment;
- Hydropower assessment;
- Economic Impact Assessment;
- Traffic Impact Assessment; and

- Potential impact of the proposed Smithfield Dam on the coastal sediment budget and shoreline stability.

H. IMPACT ASSESSMENT

The EIA Report assessed the pertinent environmental impacts that could potentially be caused by the proposed uMWP-1 Raw Water during the pre-construction, construction and operational phases of the project.

Impacts were identified as follows:
- An appraisal of the project activities and components;
- Impacts associated with listed activities contained in Government Notice No. R. 544, R. 545 and R. 546 of 18 June 2010, for which authorisation has been applied for;
- An assessment of the receiving biophysical, social, economic and built environment;
- Findings from specialist studies;
- Issues highlighted by environmental authorities; and
- Comments received during public participation.

The impacts and the proposed management measures are discussed on a qualitative level and thereafter quantitatively assessed by evaluating the nature, extent, magnitude, duration, probability and ultimately the significance of the impacts. The assessment considered impacts before and after mitigation, where in the latter instance the residual impact following the application of the mitigation measures is evaluated.

The proposed mitigation of the impacts associated with the project includes specific measures identified by the technical team (including engineering solutions) and environmental specialists, stipulations of environmental authorities and environmental best practices. The Pre-Construction and Construction Environmental Management Programme (EMPr) provides a comprehensive list of mitigation measures for specific elements of the project, which extends beyond the impacts evaluated in the body of the EIA Report.

Cumulative impacts are discussed in terms of water resource management, socio-economic environment, transportation network, biodiversity and agriculture.

I. ANALYSIS OF ALTERNATIVES

The EIA Report provides an appraisal of all the environmental and technical considerations associated with the various alternatives through a comparative analysis to eventually distil the Best Practicable Environmental Option (BPEO).

The implications of the 'no go' option are also assessed. The 'no go' alternative is not supported due to the following reasons:

- The long-term water deficit that will exist in the Integrated Mgeni WSS means that the water requirements of the supply area will not be met;
- Water supply shortfalls could adversely affect the various water user sectors, and would suppress development with related socio-economic implications; and
- Over-utilisation of water resources could adversely affect the ecological functioning of the Mgeni River system.

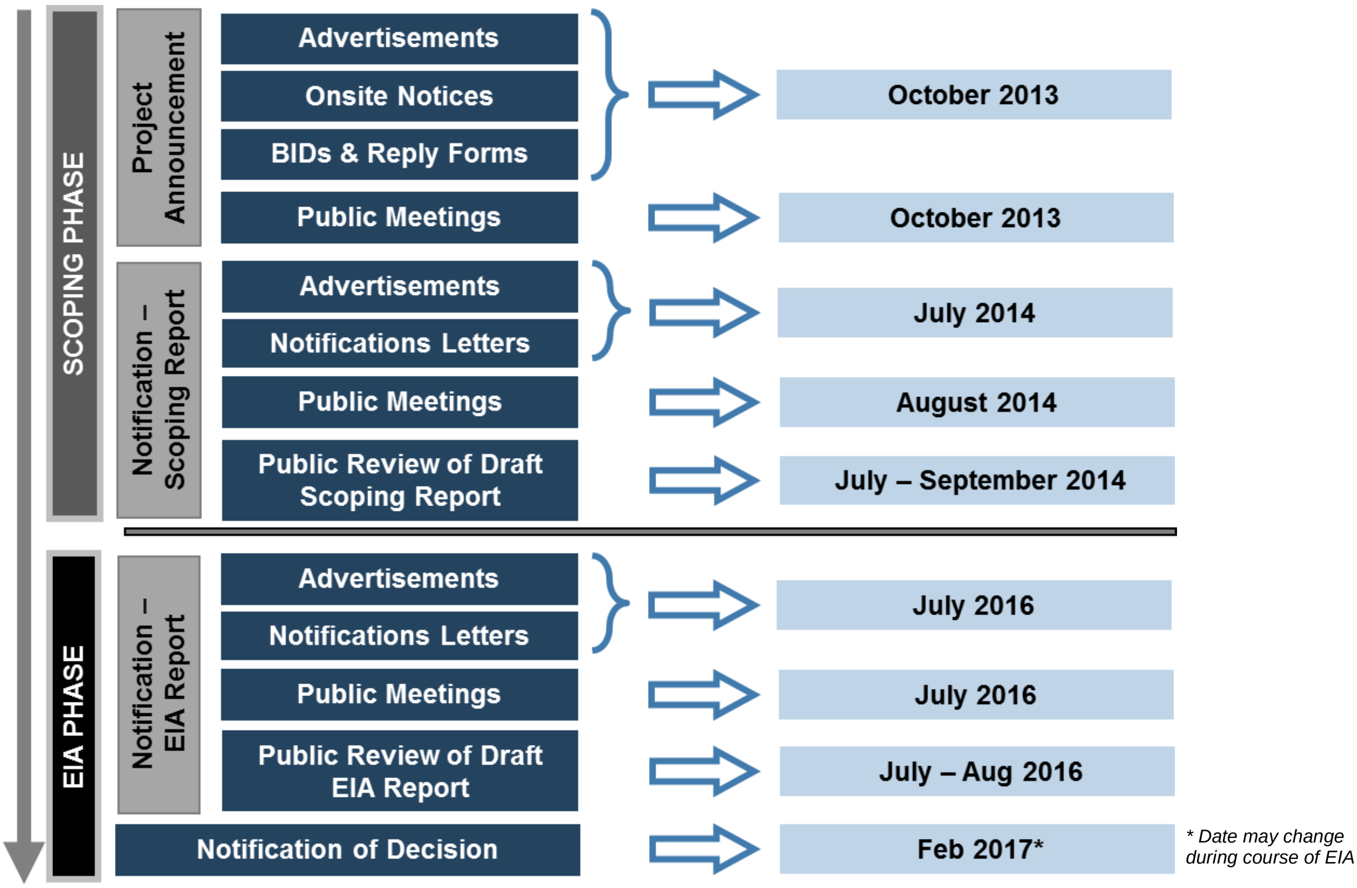
Based on the recommendations of the specialists, technical considerations and the comparison of the impacts, the following options were identified as the BPEOs for the related project components:

- Smithfield Dam Area:
  - **Relocation of Eskom Transmission Line -**
    - Option 1 (across the dam);
  - **Gauging weir -**
    - Option 1;
- Conveyance Infrastructure:
  - **Raw Water Pipeline -**
    - Route to WTW Option 1;
  - **Waste disposal site – Tunnel Outlet -**
    - Option 2: Spoil to be used in the balancing dam wall;
- Balancing Dam Area:
  - **Balancing dam -**
    - Langa Balancing Dam;
  - **Road – Balancing Dam -**
    - Option 2.

J. PUBLIC PARTICIPATION

The EIA Report provides a full account of the public participation process that was followed for the EIA phase for the proposed project.

The figure to follow outlines the public participation process for the Scoping phase (completed) and EIA phase (current).



Outline of Public Participation Process

K. EIA CONCLUSIONS AND RECOMMENDATIONS

Attention is drawn to specific sensitive environmental features for which mitigation measures are included in the EIA Report and EMPr.

An Environmental Impact Statement is provided and critical environmental activities that need to be executed during the project life-cycle are also presented.

With the selection of the BPEO, the adoption of the mitigation measures include in the EIA Report and the dedicated implementation of the EMPr, it is believed that the significant environmental aspects and impacts associated with this project can be suitably mitigated. With the aforementioned in mind, it can be concluded that there are no fatal flaws associated with the project and that authorisation can be issued, based on the findings of the specialists and the impact assessment, through the compliance with the identified environmental management provisions

The EIA Report is concluded with key recommendations, which may also influence the conditions of the Environmental Authorisation (where relevant).

TITLE AND APPROVAL PAGE

Project Name:	***Proposed uMkhomazi Water Project Phase 1 - Raw Water Component***
Report Title:	***Draft EIA Report***
Authors:	***D. Henning***
Authority reference no.:	• Smithfield Dam - **14/12/16/3/3/3/94** • Water conveyance infrastructure - **14/12/16/3/3/3/94/1** • Balancing Dam - **14/12/16/3/3/3/94/2**
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Status of report:	***Draft***
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CONSULTANTS: *NEMAI CONSULTING*

Approved for Consultants by:

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DEPARTMENT OF WATER AND SANITATION

Approved for Directorate: Options Analysis by:

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Prepared by Nemai Consulting for the

Department of Water and Sanitation

NEMAI CONSULTING

AMENDMENTS PAGE

Date	Nature of Amendment	Amendment No.	Signature
July 2016	Draft for Authorities' and Public Review	0	

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LIST OF ACRONYMS, ABBREVIATIONS & UNITS

AIDS	Acquired Immunodeficiency Syndrome
AIP	Alien Invasive Plant
BCM	Bank Cubic Meters
BID	Background Information Document
BPEO	Best Practicable Environmental Option
CBA	Critical Biodiversity Area
CFRD	Concrete Faced Rockfill Dam
COGTA	Cooperative Governance and Traditional Affairs
CR	Critically Endangered
°C	Degrees Celsius
DAFF	Department of Agriculture, Forestry and Fisheries
DBSA	Development Bank of Southern Africa
DBT	Drill And Blast Techniques
DEDTEA	Department of Economic Development, Tourism and Environmental Affairs
DEA	Department of Environmental Affairs
DEA&DP	Department of Environmental Affairs and Development Planning
DEAT	Department of Environmental Affairs and Tourism
DM	District Municipality
DMR	Department of Mineral Resources
DoT	Department of Transport
DRD&LR	Department of Rural Development and Land Reform
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EBA	Endemic Bird Area
ECRD	Earth Core Rockfill Dam
EFR	Estuarine Freshwater Requirements
EIA	Environmental Impact Assessment
EIP	Environmental Implementation Plan
EIA	Ecological Importance and Sensitivity
EKZNW	Ezemvelo KZN Wildlife
EMF	Environmental Management Frameworks
EMP	Environmental Management Plan
EMPr	Environmental Management Programme
EN	Endangered
ESA	Ecological Support Area
ESI	Evolutionary Studies Institute

EWR	Ecological Water Requirements
FEPA	Freshwater Ecosystem Priority Area
FRAI	Fish Response Assessment System
FSC	Full Supply Storage Capacity
FSL	Full Supply Level
GGP	Gross Geographic Product
GIS	Geographical Information System
GN	Government Notice
GRU	Groundwater Response Unit
ha	Hectare
HIV	Human Immunodeficiency Virus
HPP	Hydropower Plant
I&AP	Interested and Affected Party
IAIAsa	International Association of Impact Assessors South Africa
IDP	Integrated Development Plan
IFR	Instream Flow Requirements
IHI	Index of Habitat Integrity
IUA	Integrated Unit of Analysis
IWMP	Integrated Waste Management Plan
km	Kilometre
km^2	Square kilometre
kV	Kilovolts
kVA	Kilovolt-amps
kW	Kilowatt
KZN	KwaZulu-Natal
ℓ	Litres
l/s	Litres per second
LBD	Langa Balancing Dam
LCM	Loose Cubic Meters
LDL	Lowest Drawdown Level
LM	Local Municipality
m	Metre
masl	Meters above sea level
m/s	Metres per second
m^2	Square meters
m^3	Cubic metre
MAR	Mean Annual Runoff
MAP	Mean Annual Precipitation
MIRAI	Macro-invertebrate Response Assessment Index
MMTS-2	Mooi Mgeni Transfer Scheme Phase 2
MPRDA	Mineral and Petroleum Resources Development Act (Act No. 28 of 2002)

Mℓ	Mega litre
mm	Millimetre
MOL	Minimum Operating Level
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NEM:WA	National Environmental Management: Waste Act (Act No. 59 of 2008)
NFEPA	National Freshwater Ecosystem Priority Area
NOC	Non-overspill Crest
NWA	National Water Act (Act No. 36 of 1998)
OCS	Off-channel Storage
PES	Present Ecological State
RCC	Roller Compacted Concrete
RDF	Recommended Design Flood
REC	Recommended Ecological Category
RMP	Resource Management Plan
RQO	Resource Quality Objective
SAAB	South African Association of Botanists
SABAP	Southern African Bird Atlas Project
SACNASP	South African Council for Natural Scientific Professions
SAHRIS	South African Heritage Resources Information System
SAIEES	South African Institute of Ecologists and Environmental Scientists
SANBI	South African National Biodiversity Institute
SANCOLD	South African National Committee on Large Dams
SASAqS	South African Society for Aquatic Scientists
SASS-5	South African Scoring System, version 5
SAWS	South African Weather Services
SCA	South Coast Augmentation
SD	Smithfield Dam
SDF	Spatial Development Framework
SEA	Strategic Environmental Assessment
SEF	Safety Evaluation Flood
SEMP	Strategic Environmental Management Plan
SQ	Sub Quaternary
TBM	Tunnel Boring Machine
TDS	Total Dissolved Solids
TE	Threatened Ecosystem
ToR	Terms of Reference
UDP	uKhahlamba Drakensberg Park
uMWP-1	uMkhomazi Water Project Phase 1
UPN	Unique Positioning Number
URF	Unit Reference Value
VAPS	Vaal Augmentation Planning Study

VEGRAI	Vegetation Response Assessment Index
VU	Vulnerable
WDM	Water Demand Management
WHS	World Heritage Site
WMA	Water Management Area
WRPM	Water Resource Planning Model
WSA	Water Services Authority
WSS	Water Supply System
WTW	Water Treatment Works

DEFINITIONS OF KEY TERMS

Aggregate	*Crushed rock or gravel screened to sizes for use in road surfaces, concrete, or bituminous mixes. A mass or cluster of soil particles, often having a characteristic shape.*
Catchment	*The area of land drained by a watercourse.*
Dam	*A concrete or earthen barrier constructed across a river and designed to control water flow or create a reservoir.*
Decommissioning	*To take out of active service permanently or dismantle partly or wholly, or closure of a facility to the extent that it cannot be readily re-commissioned.*
Discharge	*Volume of water released from a dam at a given time.*
Ecological Water Requirements	*The quantity and quality of water of a resource that is required to maintain the said water resource in its assigned ecological category.*
Embankment	*An earth structure the top of which is higher than the adjoining surface. A shaped earth or rockfill dam. Fill material, usually earth or rock, placed with sloping sides and with a length greater than its height.*
Environment	*The surroundings in which humans exist and which comprise:* • *The land, water and atmosphere of the earth.* • *Micro-organisms, plant and animal life.* • *Any part or combination of a) and b) and the interrelationships among and between them.* • *The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that can influence human health and well-being.*
Environmental Aspect	*Those components of the company's activities, products and services that are likely to interact with the environment.*
Environmental Feature	*Elements and attributes of the biophysical, economic and social environment.*
Environmental Impact	*The change to the environment resulting from an environmental aspect, whether desirable or undesirable. An impact may be the direct or indirect consequence of an activity.*
Environmental Management Programme (EMPr)	*A detailed plan of action prepared to ensure that recommendations for enhancing positive impacts and/or limiting or preventing negative environmental impacts are implemented during the life-cycle of a project.*
Full Supply Level (FSL)	*The maximum normal operating level of a reservoir behind a dam.*
Gauging station	*A particular site on a stream, canal, lake, or reservoir where systematic observations of hydrologic data are obtained*

Government Waterworks	*A waterwork (e.g. water storage dams, water transfer schemes and flood attenuation works) owned or controlled by the Minister of Water and Sanitation and includes the land on which it is situated.*
Impervious	*Not permeable; not allowing liquid to pass through. Resistant to movement of water.*
Impoundment	*A body of water formed behind a dam.*
Mean Annual Runoff (MAR)	*The long term mean annual flow calculated for a specified period of time, at a particular point along a river and for a particular catchment and catchment development condition.*
Potable Water	*Water that is fit or suitable for drinking.*
Purchase Line	*The area below which the Department of Water and Sanitation will acquire property in order to be able to construct the dam and accommodate the dam basin.*
Raw Water	*Natural (untreated) water found in the environment, such as water from bodies like dams and rivers.*
Reserve	*The quantity and quality of water required -* • *to satisfy basic human needs by securing a basic water supply; and* • *to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource.*
Roller Compacted Concrete (RCC) Dam	*A concrete gravity dam constructed by the use of a dry mix concrete transported by conventional construction equipment and compacted by rolling, usually with vibratory rollers*
Rockfill Dam	*An embankment dam in which more than 50 percent of the total volume is comprised of compacted or dumped pervious natural or crushed rock.*
Spillway	*A structure that passes normal and/or flood flows in a manner that protects the structural integrity of the dam. Overflow channel of a dam or impoundment structure. A structure over or through which flow is discharged from a reservoir.*
Storage	*The volume of water in a reservoir at a given time.*
Watercourse	*A geomorphological feature characterized by the presence of a streamflow channel, a floodplain and a transitional upland fringe seasonally or permanently conveying surface water.*
Weir	*An overflow structure built across an open channel to raise the upstream water level and/or to measure the flow of water. A measuring or gaging weir is calibrated for depth of flow over the crest. A weir generally consists of a rectangular, trapezoidal, triangular, or other shaped notch, located in a vertical, thin plate over which water flows.*

1 PURPOSE OF THIS DOCUMENT

The uMkhomazi Water Project Phase 1 (uMWP-1), which entails the transfer of water from the undeveloped uMkhomazi River (also known as the Umkomaas or Mkomazi) to the existing Mgeni system, is currently being investigated through a **Feasibility Study**. This transfer scheme is deemed to be the most viable option to provide a large volume of water to fulfil the long-term water requirements of the Mgeni system. The uMWP-1 consists of both Raw Water and Potable Water components which are being undertaken by the Department of Water and Sanitation (DWS) (previously known as the Department of Water Affairs (DWA)) and Umgeni Water, respectively.

Nemai Consulting was appointed as the independent Environmental Assessment Practitioner (EAP) to undertake the Environmental Impact Assessment (EIA) for the proposed uMWP-1. According to Government Notice (GN) No. R. 543 (18 June 2010), an EIA means a systematic process of identifying, assessing and reporting environmental impacts associated with an activity.

This document serves as the Draft EIA Report (as contemplated in Regulation 31 of GN No. R. 543) for the proposed uMWP-1 <u>Raw Water</u> component, where DWS is acting as the project proponent. The proposed project consists of the following, based on the outcomes of the Feasibility Study:

- Smithfield Dam on the uMkhomazi River;
- The uMkhomazi – uMlaza Tunnel, with a finished internal diameter of 3.5 m and a length of 32.5 km;
- The Tunnel – Balancing Dam – Baynesfield Pipeline, with two sections of 2.6 and 1.6 m diameters and 5.2 and 1.3 km lengths, respectively; and
- Balancing Dam on the Mbangweni River, consisting of a concrete faced rockfill dam with a full supply level of 923 masl.

Note that a detailed technical and financial due diligence study will be undertaken prior to project implementation, which will confirm the specific parameters like dam type, height, crest length, full supply level, etc. The dimensions and specific information regarding the project infrastructure should this be regarded as approximate, which may be refined and optimised as part of the final design phase. Nonetheless, the technical information presented in this report was adequate to conduct an accurate and representative EIA. If any changes occur to the project design at a later stage the proponent will need to establish whether there are any substantive implications in terms of the receiving environment, as well as confirm the requirements of the relevant authorities in terms of the prevailing environmental governance framework.

To date, the Scoping phase of the overall environmental assessment for the project has been completed. The Final Scoping Report and Plan of Study for the EIA were approved by the Department of Environmental Affairs (DEA) on 26 March 2015. The Scoping Report incorporated the outcomes of the following environmental investigations that were undertaken as part of the pre-feasibility and feasibility studies:

1. uMkhomazi/Mooi-Mgeni Transfer Scheme Pre-Feasibility Study, Supporting Report No 5, Environmental (Department of Water Affairs and Forestry (DWAF), 1999b); and
2. uMWP Phase 1 Environmental Screening Report (DWA, 2012b).

2 DOCUMENT ROADMAP

As a minimum, the EIA Report aims to satisfy the requirements stipulated in Regulation 31 of GN No. R. 543 (18 June 2010). **Table 1** presents the document's composition in terms of the aforementioned regulatory requirements.

Table 1: EIA Report Roadmap in relation to GN No. R. 543

Chapter	Title	Correlation with GN No. R. 543	GN No. R. 543 Description
1	Purpose of this Document	–	–
2	Document Roadmap	–	–
3	Project Background and Motivation	–	–
4	Project Location	R31(2)(c)	A description of the property on which the activity is to be undertaken and the location of the activity on the property.
5	Legislation and Guidelines Considered	–	–
6	Scoping and EIA Process	R31(2)(a)(i-ii)	Details of - (i) the EAP who compiled the report; and (ii) the expertise of the EAP to carry out an environmental impact assessment.
7	Assumptions and Limitations	R31(2)(m)	A description of any assumptions, uncertainties and gaps in knowledge.
8	Need and Desirability	R31(2)(f)	A description of the need and desirability of the proposed activity.
9	Project Description and Alternatives	R31(2)(b)	A detailed description of the proposed activity.
10	Profile of the Receiving Environment	R31(2)(d)	A description of the environment that may be affected by the activity.
11	Summary of Specialist Studies	R31(2)(j)	A summary of the findings and recommendations of any specialist report or report on a specialised process.
12	Impact Assessment	R31(2)(d)	A description of the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity.
		R31(2)(h)	An indication of the methodology used in determining the significance of potential environmental impacts.
		R31(2)(k)	A description of all environmental issues that were identified during the environmental impact assessment process, an assessment of the significance of each issue and an indication of the extent to which the issue could be addressed by the adoption of mitigation measures.
		R31(2)(l)(i-vii)	An assessment of each identified potentially significant impact, including -
			(i) cumulative impacts;

Chapter	Title	Correlation with GN No. R. 543	GN No. R. 543 Description
			(ii) the nature of the impact; (iii) the extent and duration of the impact; (iv) the probability of the impact occurring; (v) the degree to which the impact can be reversed; (vi) the degree to which the impact may cause irreplaceable loss of resources; and (vii) the degree to which the impact can be mitigated.
13	Analysis of Alternatives	R31(2)(g)	A description of identified potential alternatives to the proposed activity, including advantages and disadvantages that the proposed activity or alternatives may have on the environment.
		R31(2)(i)	A description and comparative assessment of all alternatives identified during the environmental impact assessment process.
14	Public Participation	R31(2)(e)(i-iv)	Details of the public participation process, including: (i) steps undertaken in accordance with the plan of study; (ii) a list of persons, organisations and organs of state that were registered as interested and affected parties; (iii) a summary of comments received from, and a summary of issues raised by registered interested and affected parties, the date of receipt of these comments and the response of the EAP to those comments; and (iv) copies of any representations and comments received from registered interested and affected parties.
15	EIA Conclusions and Recommendations	R31(2)(n)	A reasoned opinion as to whether the activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation.
		R31(2)(o)(i-ii)	An environmental impact statement which contains - (i) a summary of the key findings of the environmental impact assessment; and (ii) a comparative assessment of the positive and negative implications of the proposed activity and identified alternatives.
16	References	–	–
Appendix I		R31(2)(p)	Draft environmental management programme containing the aspects contemplated in Regulation 33.
Appendix H		R31(2)(q)	Copies of any specialist reports and reports on specialised processes complying with Regulation 32.

3 PROJECT BACKGROUND AND MOTIVATION

3.1 DWS Project Life-cycle

The standard DWS project life-cycle consists of the phases presented in **Figure 1**. Both the Reconnaissance and Pre-feasibility Phases for the proposed uMkhomazi -Mgeni Transfer Scheme were completed in 1999. The uMWP-1 is currently in the Feasibility Phase, where the main goal is to refine the scheme configuration and costs and to investigate all aspects of the proposed option(s) in sufficient depth to enable the decision-maker to make an informed and accountable decision. The Feasibility Study, which includes the EIA, makes a final recommendation on the preferred option which is submitted with motivation to management for approval and funding. The Feasibility Study's recommendations will be investigated further during the detailed design phase, which Stake place once the project has received approval.

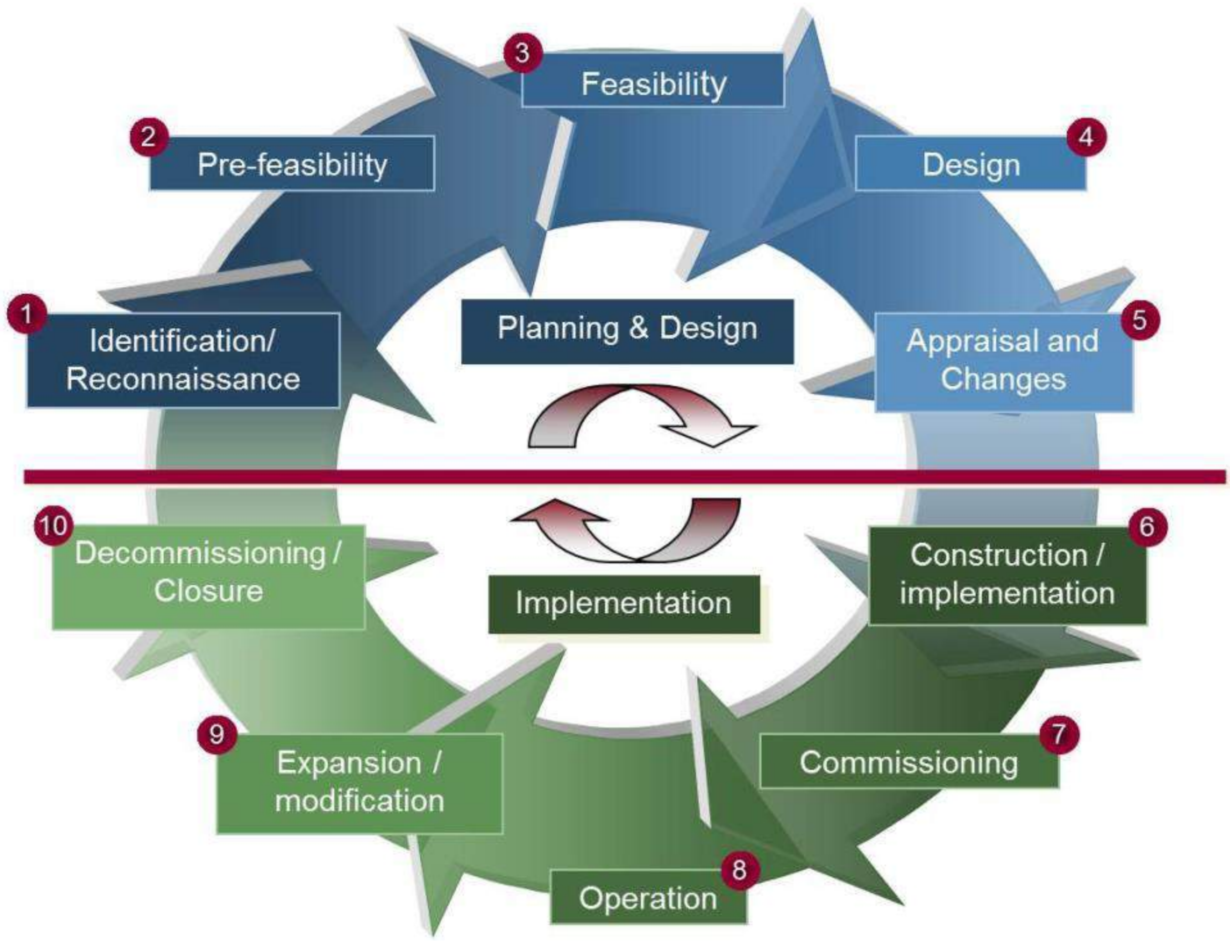


Figure 1: **Generic DWS Project Life Cycle for Water Resource Management**

3.2 Transfers to the Integrated Mgeni Water Supply System

3.2.1 Background

The information to follow was primarily sourced from the Technical Feasibility Study Raw Water - Water Requirements and Return Flows Report (DWA, 2014c).

The current water resources of the Integrated Mgeni Water Supply System (WSS) are insufficient to meet the long-term water requirements of the system. The Integrated Mgeni WSS is the main water source that supplies about fivex million people and industries in the eThekwini Municipality, uMgungundlovu District Municipality (DM) and Msunduzi Local Municipality (LM), all of which comprise the economic powerhouse of the KwaZulu-Natal (KZN) Province.

As shown in **Figure 2**, the Integrated Mgeni WSS comprises the Midmar, Albert Falls, Nagle and Inanda Dams, as well as Mearns Weir and Spring Grove Dam (commissioned in 2013). The current system has a stochastic yield of 334 million m³/a (measured at Inanda Dam) at a 99% assurance of supply. The short-term augmentation measure, Phase 2 of the Mooi Mgeni Transfer Scheme (MMTS-2), currently being implemented with the construction of Spring Grove Dam, will increase water supply from the Integrated Mgeni WSS by 60 million m³/a. However, this will not be sufficient to meet the long-term requirements of the system, as shown in **Figure 3**.

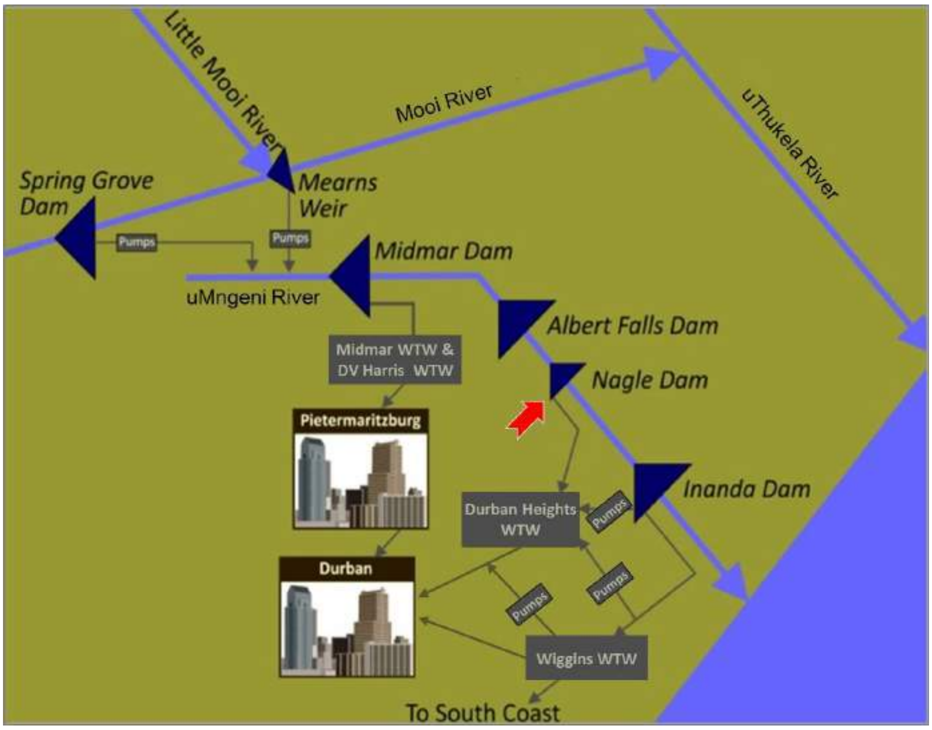


Figure 2: Schematic of integrated Mooi-Mgeni System

Pre-feasibility investigations indicated that Phase 1 of the uMkhomazi Water Project (uMWP-1), which entails the transfer of water from the undeveloped uMkhomazi River to the existing Integrated Mgeni WSS, is the scheme most likely to fulfil this requirement. The uMkhomazi River is the third-largest river in KZN in terms of mean annual runoff (MAR).

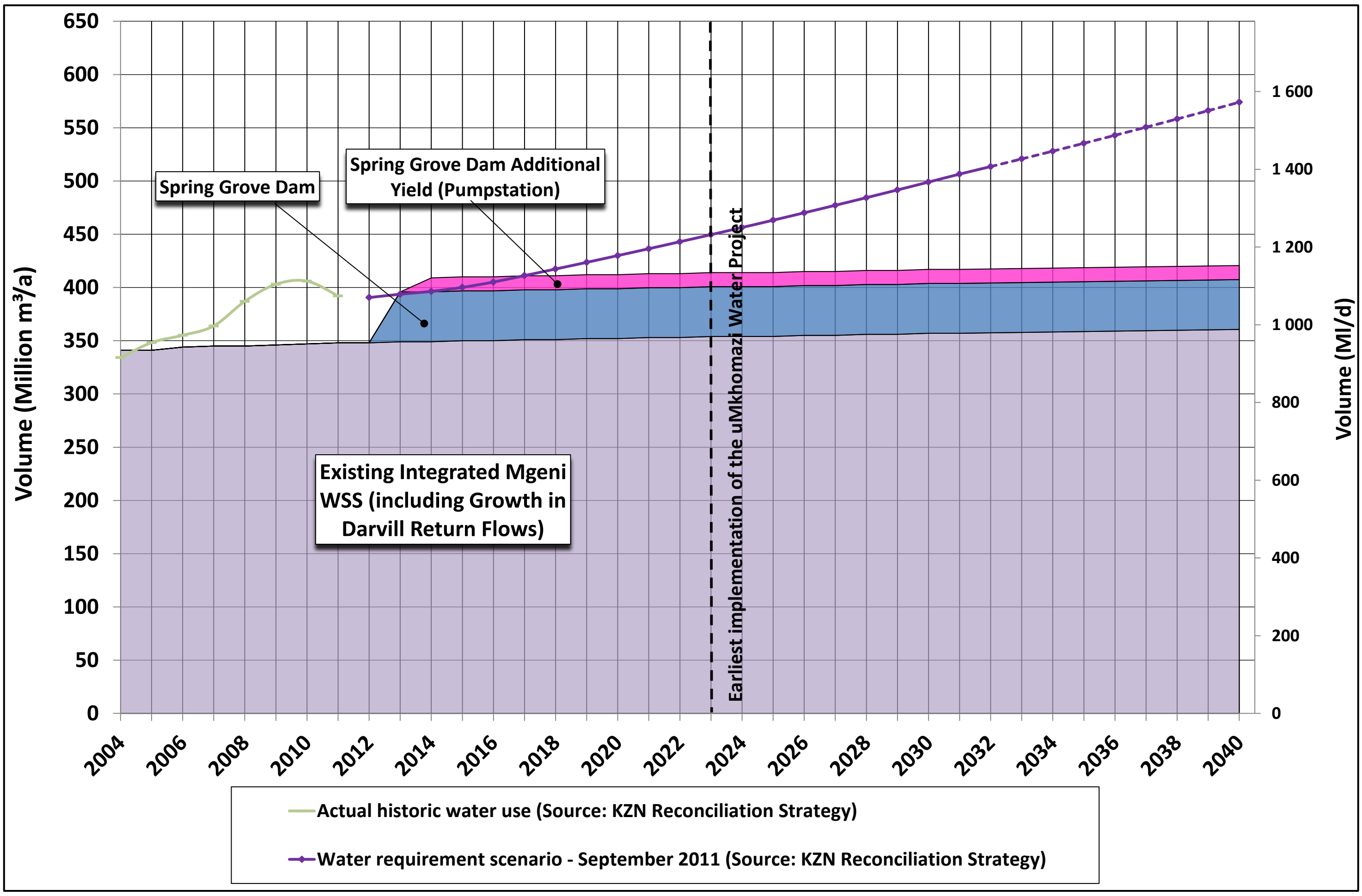


Figure 3: Long-term water balance projection for the Integrated Mgeni WSS

Note that the figures included in **Figure 3** were subsequently updated, and are provided in **Figure 6**.

The uMkhomazi-Mgeni Transfer Pre-feasibility Study concluded that the first phase of the uMWP would comprise a new dam at Smithfield on the uMkhomazi River near Richmond, a multi-level intake tower and pump station, a water transfer pipeline/tunnel to a balancing dam at Baynesfield Dam or a similar in-stream dam, a water treatment works at Baynesfield in the uMlaza River valley and a gravity pipeline to the Mgeni bulk distribution reservoir system, below the reservoir at Umlaas Road. From here, water will be distributed under gravity to eThekwini and possibly low-lying areas of Pietermaritzburg.

Phase two of the uMWP may be implemented when needed, and could comprise the construction of a large dam at Impendle further upstream on the uMkhomazi River to release water to the downstream Smithfield Dam. Together, these developments have been identified as having a 99% assured stochastic yield of about 388 million m^3/a. The DWS aims to have the uMWP-1 scheme implemented by 2023.

3.2.2 <u>The uMWP-1 Water Supply Area</u>

The uMWP-1 will support water requirements in the Integrated Mgeni WSS supply area by providing water to a selected portion of this water supply system. The proposed uMWP-1 water supply area is shown in **Figure 4** and comprises parts of the Integrated Mgeni WSS, downstream of Umlaas Road; also including areas of the eThekwini Municipality on the North Coast currently linked to the Mdloti River WSS (supplied from Hazelmere Dam).

Water will be supplied from the proposed Smithfield Dam on the uMkhomazi River near Bulwer via a series of conveyance infrastructure into the recently constructed Western Aqueduct and the planned extension of the Northern Aqueduct (shown in **Figure 5**). This planned Northern Aqueduct will connect to, and extend, the Western Aqueduct northwards into the Mdloti River catchment and will also connect to the existing Northern Aqueduct supplied from Durban Heights Water Treatment Works (WTW).

The supply areas of the proposed uMWP-1 are sub-divided into three main areas as follows:

- **Outer West Area:** The outer west area which is currently supplied from Midmar Dam via Umlaas Road.
- **Western Aqueduct Area:** Areas that are currently supplied from Durban Heights WTW that will be moved (or “shed”) onto the uMWP-1 when Durban Heights WTW reaches its operating capacity limit.

- **Northern Aqueduct Area:** Areas on the North Coast that are either currently supplied from Durban Heights WTW or Hazelmere Dam (which has limited yield) or requirements associated with new anticipated developments, particularly around the King Shaka Airport and planned housing developments.

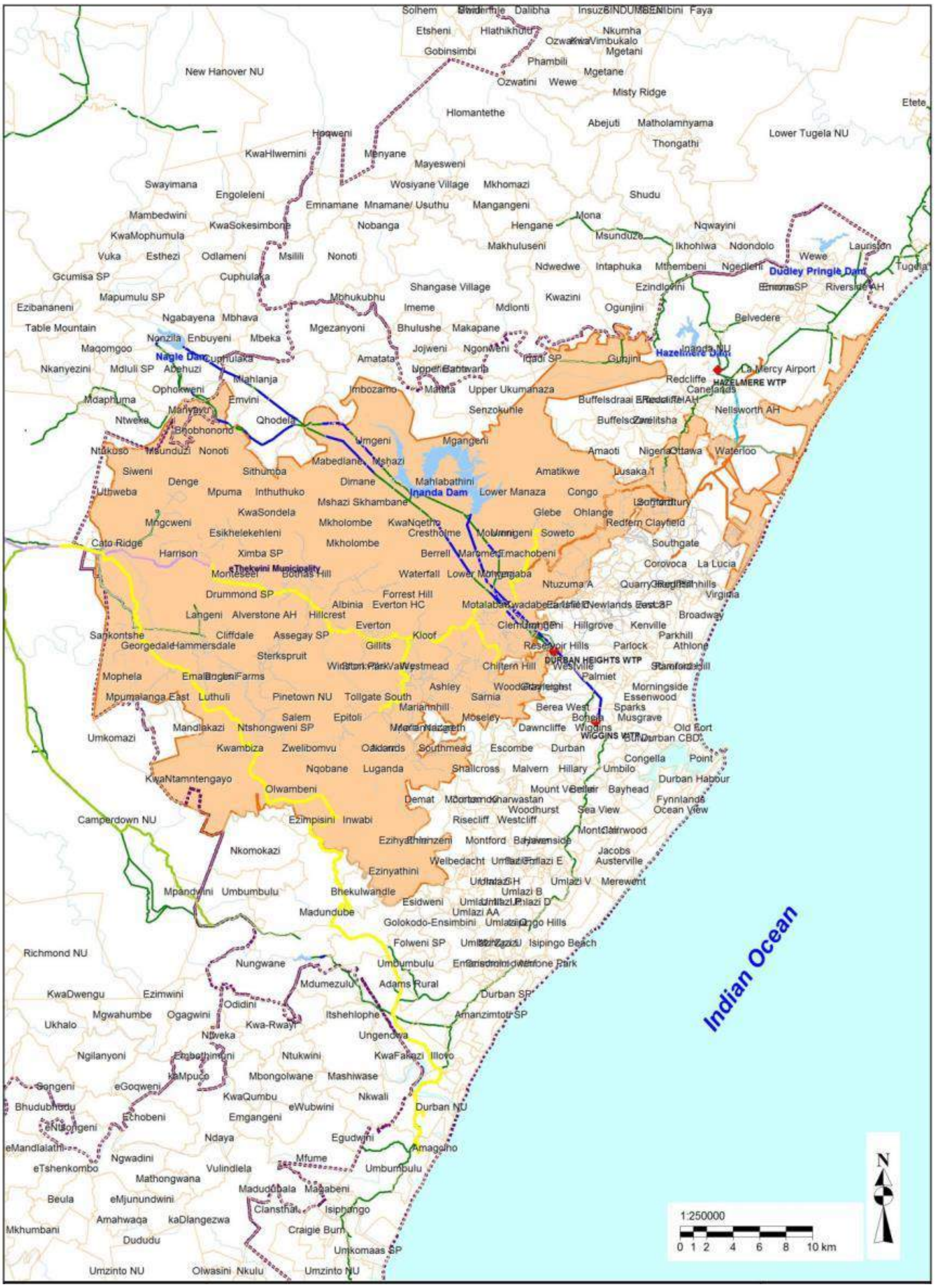


Figure 4: **The proposed water supply areas: uMWP, North Coast & South Coast**

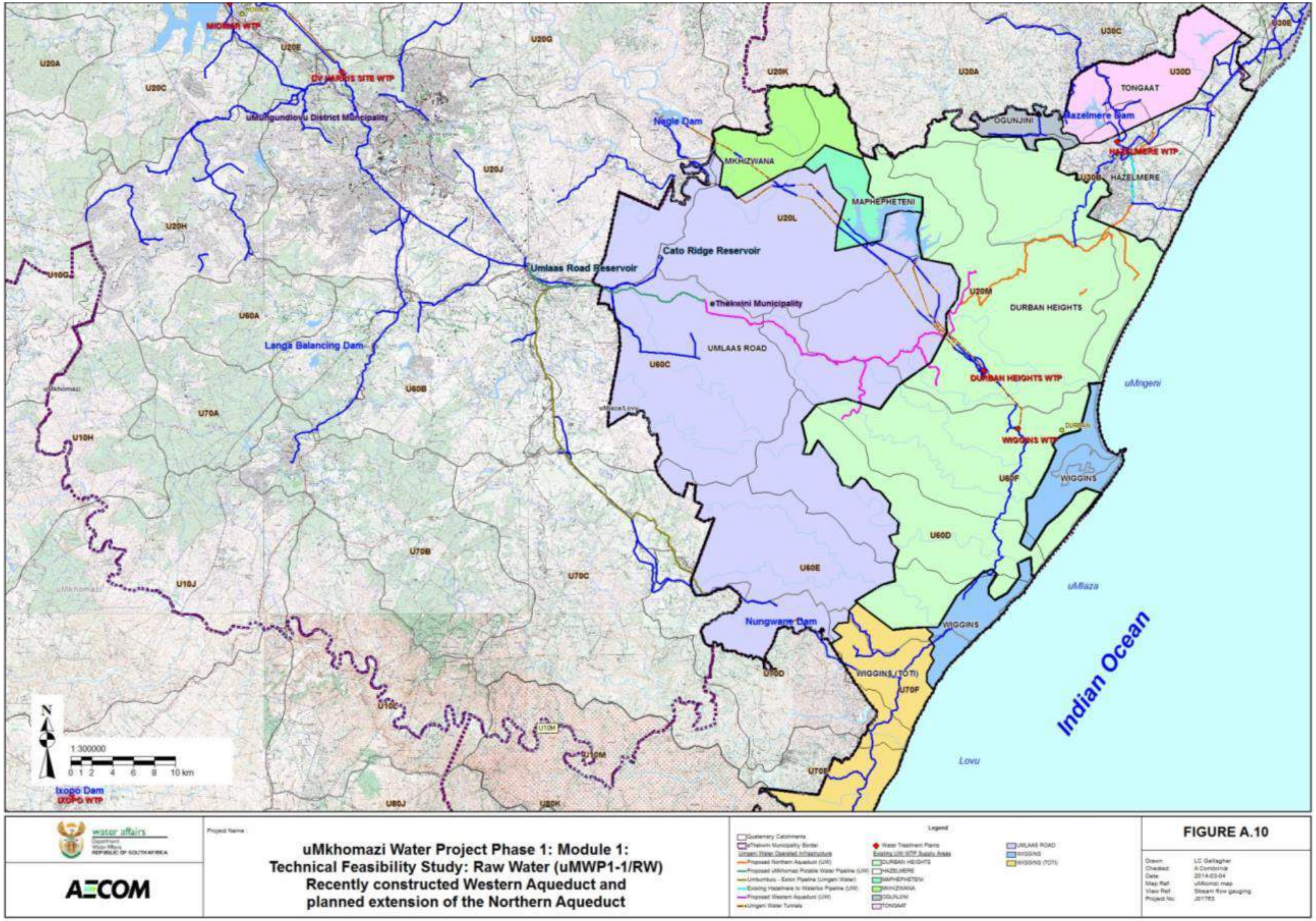


Figure 5: **Western and Northern Aqueduct**

3.2.3 The Integrated Mgeni WSS Water Requirements

Two water requirement projections, namely a “Low”- and “High”-road scenario were developed for the uMWP-1 supply areas. The “Low”-road scenario was considered to be the most realistic and appropriate for the purpose of sizing and timing uMWP-1 infrastructure. This was based on a number of considerations including the fact that the “Low”-road scenario more closely follows the 1.5% growth rate adopted by Umgeni Water for water requirement projections of the Integrated Mgeni WSS over recent years.

The water requirement projections are shown in **Figure 6**, including both the “Low”- and “High”-road scenarios, as well as scenarios based on a 1.5% growth rate for comparison purposes. **Figure 7** shows the “Low”-road scenario, separated into the three main uMWP-1 sub-areas of supply through key infrastructure.

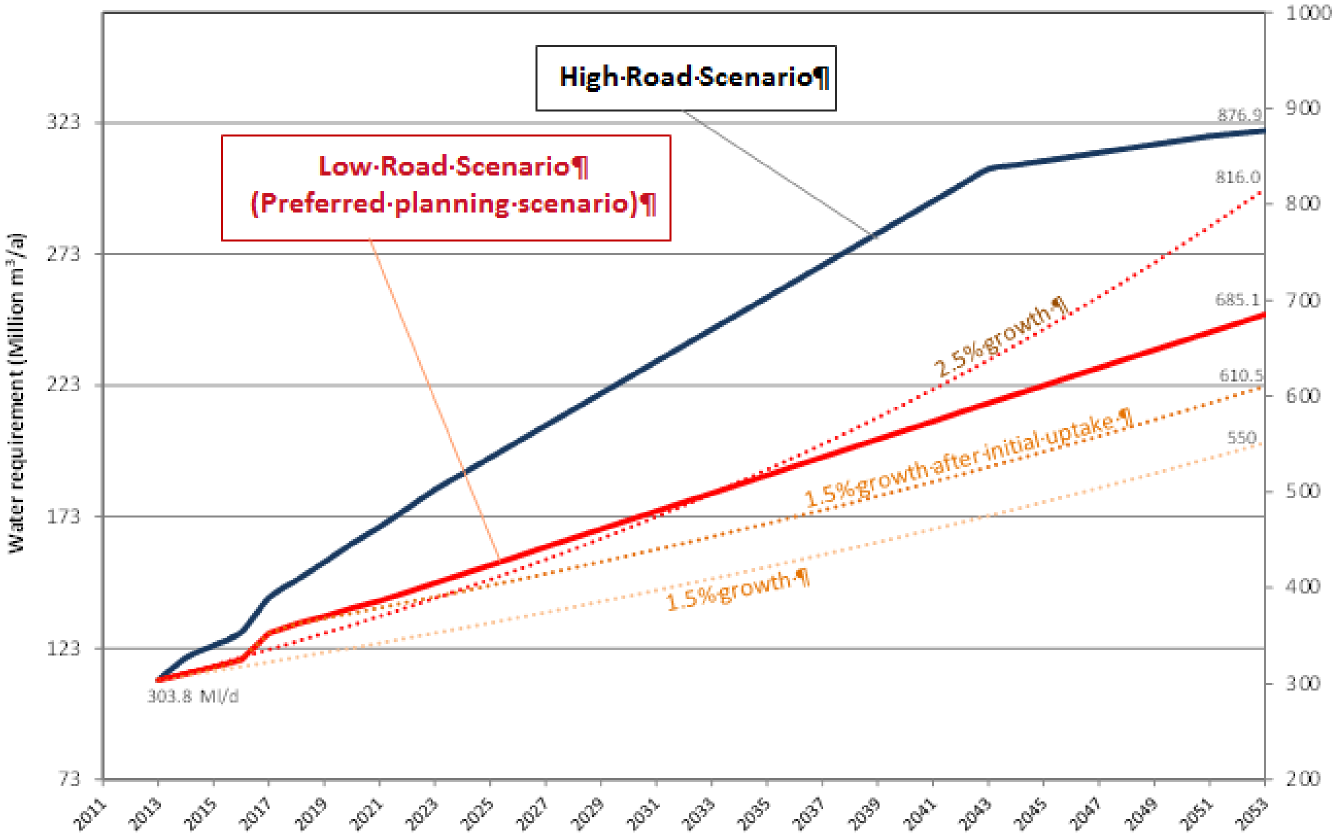


Figure 6: Updated water requirement projections for the uMWP-1 supply area

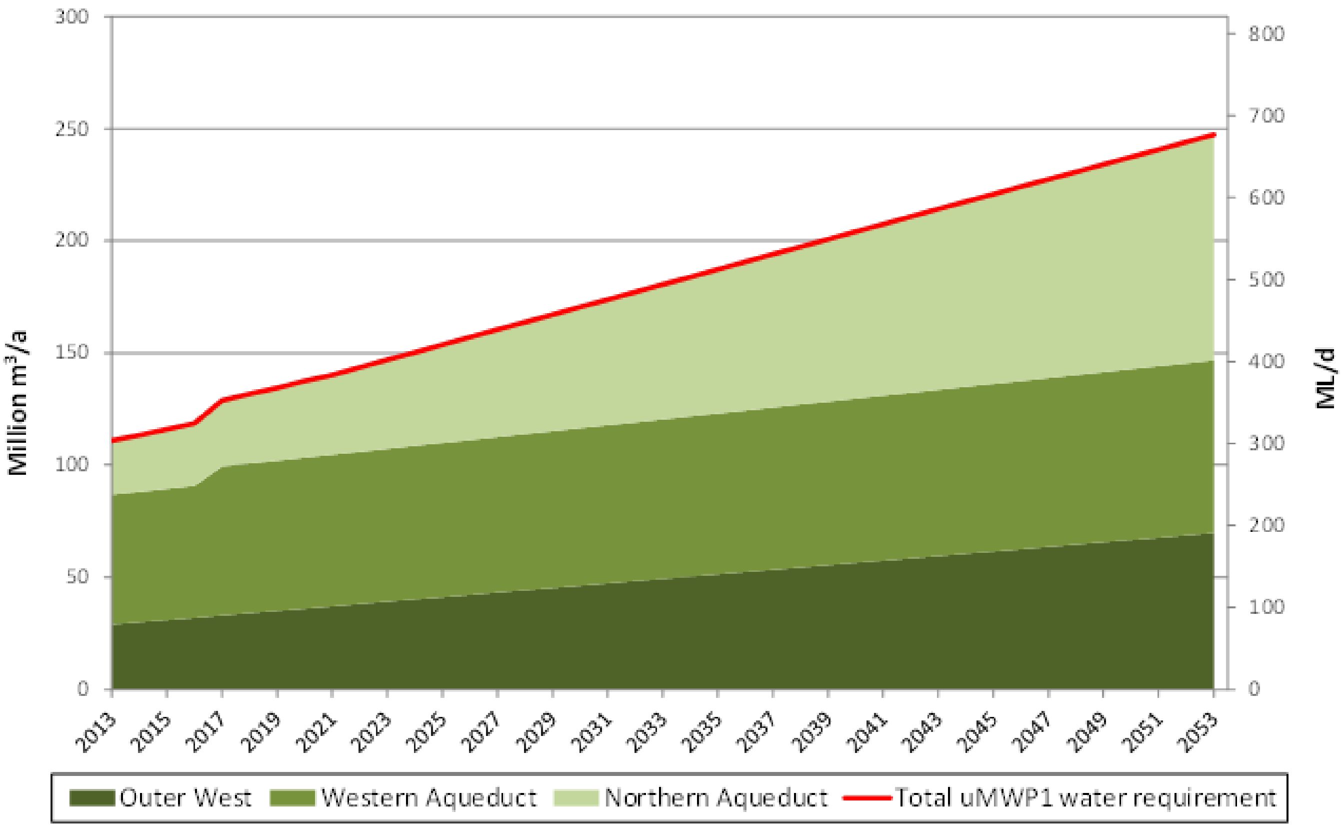


Figure 7: Selected water requirement projection scenario for the uMWP-1 supply area

The water requirement projections indicated for the Western and Northern Aqueduct sub-areas in **Figure 7** includes shed zones, which will be shed from Durban Heights WTW onto the uMWP-1. As such the water requirements shown in **Figure 7** are the maximum projected requirements for the supply areas in question. Initially the supply from the uMWP-1 will be lower and phased in up to the full requirements over time. This phasing will be based on growth in water requirements and infrastructure capacity constraints within the Integrated Mgeni WSS.

3.3 Distinction between uMWP-1 Modules

The overall uMWP-1 Feasibility Study has been divided into 3 modules, as presented in **Table 2** and **Figure 8**.

Table 2: uMWP-1 Feasibility Study Modules

Module 1: Technical Feasibility Raw Water	**Module 2: EIA**	**Module 3: Technical Feasibility Potable Water**
DWS, as the project proponent for the uMWP-1 Raw Water, appointed AECOM (previously known as BKS) to undertake this study, which entails the following: ❖ Smithfield Dam (Phase 1) to be investigated to a detailed feasibility level; ❖ Investigate the availability of water from Impendle Dam (Phase 2) as a future resource to release to Smithfield Dam, and refine the phasing of the selected schemes; ❖ Optimise the conveyance system between Smithfield Dam and the proposed Water Treatment Works (WTW); ❖ Undertake a water resources assessment of the uMkhomazi River Catchment, including water availability to the lower uMkhomazi; and ❖ Investigate the social and economic impact of the uMWP.	Nemai Consulting was appointed by the separate project proponents (DWS and Umgeni Water) to undertake the respective EIAs for the proposed uMWP-1 Raw Water and Potable Water components. Separate EIA applications were submitted for these two components, with a combined public participation process.	Umgeni Water, as the project proponent for the uMWP-1 Potable Water, appointed Knight Piésold to undertake this study, which entails the following: ❖ Investigate required sizing and possible locations for WTW and water reservoir; ❖ Determine diameter and pipeline routes for water pipelines between Baynesfield and the Umlaas Road precinct; ❖ Reconcile infrastructure sizing and timing with the projected growth in downstream water demands; ❖ Undertake geotechnical investigations at proposed WTW site and along the proposed pipeline route; and ❖ Undertake engineering survey at proposed WTW site and along the proposed pipeline route (includes determining the extent of public and privately owned land that may be affected).

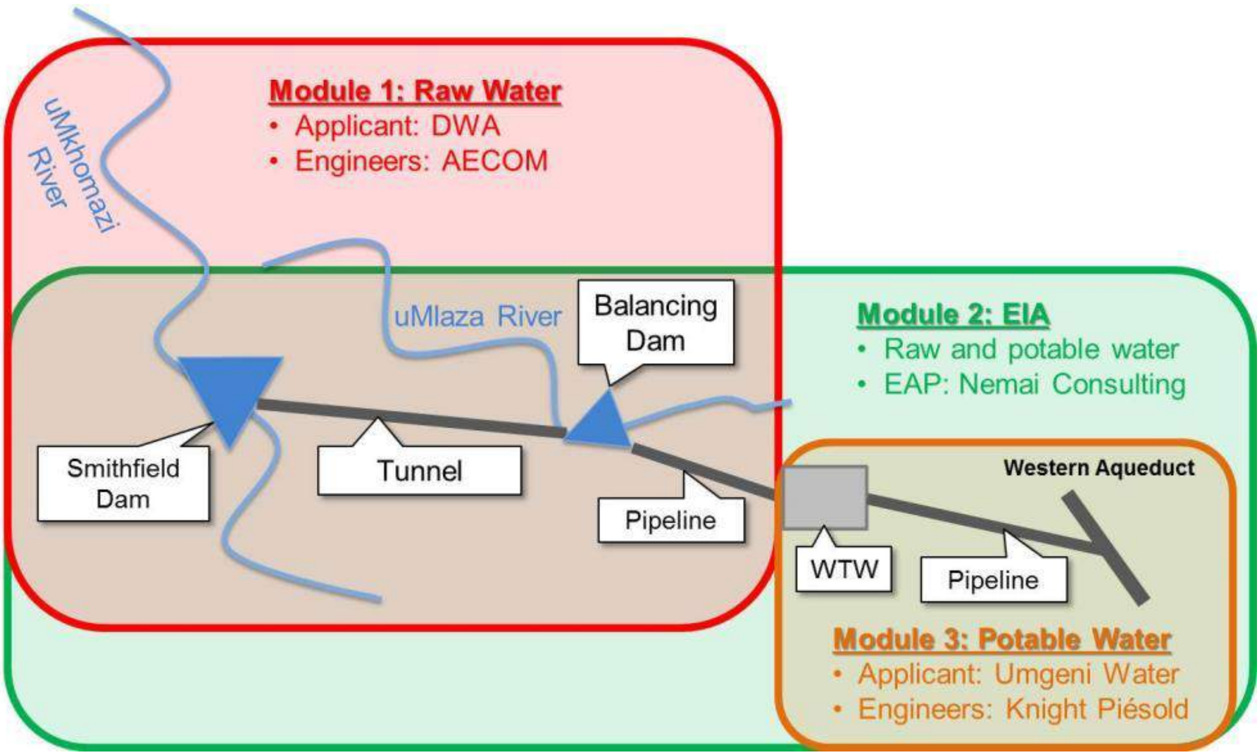


Figure 8: Distinction between uMWP-1 Modules

3.4 Impendle Dam

The proposed phasing of the uMWP-1 Raw Water infrastructure comprises the following:

- Phase 1 –
  - Smithfield Dam (1:100 year yield of 602 Ml/day);
  - One 3.5 metre internal diameter tunnel;
  - Balancing Dam;
  - Raw water pipeline from tunnel outlet to WTW;
- Phase 2 –
  - Impendle Dam, which together with Smithfield Dam would give a combined 1:100 year yield of 1020 Ml/day;
  - A second 3.5 metre internal diameter tunnel parallel to the first tunnel; and
  - A second raw water pipeline from the outlet of Tunnel No. 2 to the WTW.

Phase 2 of the uMWP thus includes the construction of the Impendle Dam further upstream on the uMkhomazi River to release water to the downstream Smithfield Dam (see **Figure 9**). This is intended to be implemented to address the long-term deficit in water supply in the Integrated Mgeni WSS, which is calculated to be after 2048 (see **Figure 10**).

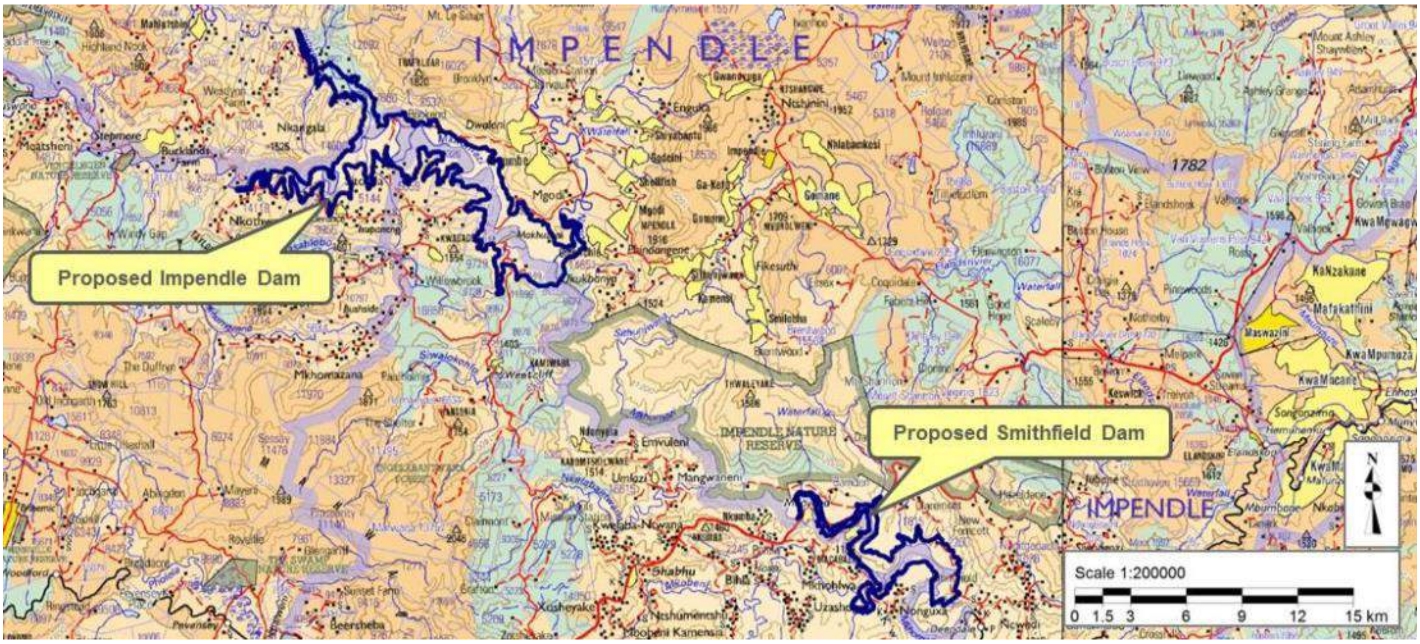


Figure 9: **Location of the proposed Impendle Dam in relation to Smithfield Dam**

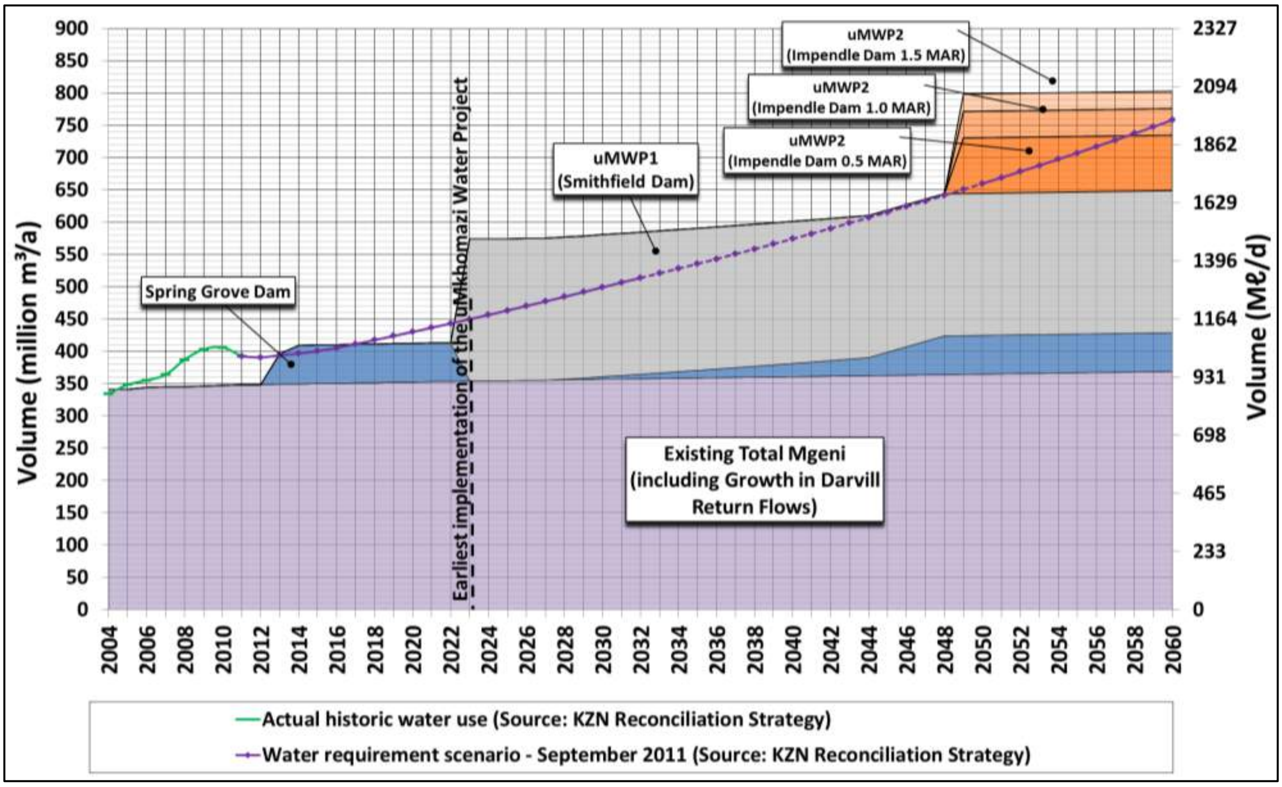


Figure 10: Long-term water requirement projection for the integrated Mgeni WSS (including Phases 1 and 2 of the uMWP)

Due to its timing, **Impendle Dam does not form part of this EIA** and it is merely discussed to allow for an understanding of future water augmentation to the Integrated Mgeni WSS.

3.5 Possible Water Supply from Smithfield Dam to Surrounding Communities

Figure 11 provides a summary of the 2013 total water sources being used by the communities surrounding the proposed Smithfield Dam.

As part of the feasibility study for the proposed Smithfield Dam, a desktop-level study was carried out to ascertain the following:

- The current water sources being used by the communities surrounding the dam; and
- The possibility of feasibly supplying these communities from Smithfield Dam in the future.

The supply area of the proposed Smithfield Dam local water supply scheme has been divided into two regions feeding communities to the south and north of the uMkhomazi River. For ease of reference these two regions will be referred to as the **south-western** and **north-eastern** regions respectively (refer to **Figure 12**).

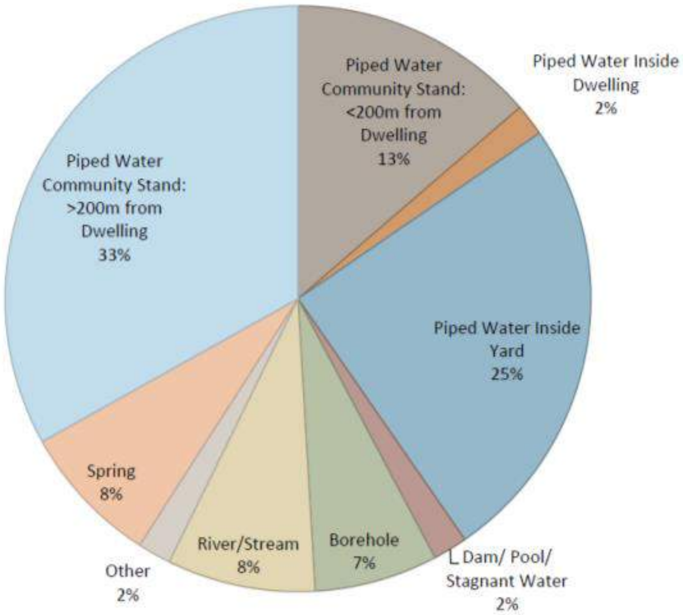


Figure 11: Total sources of water for communities within the Smithfield Dam local water supply scheme

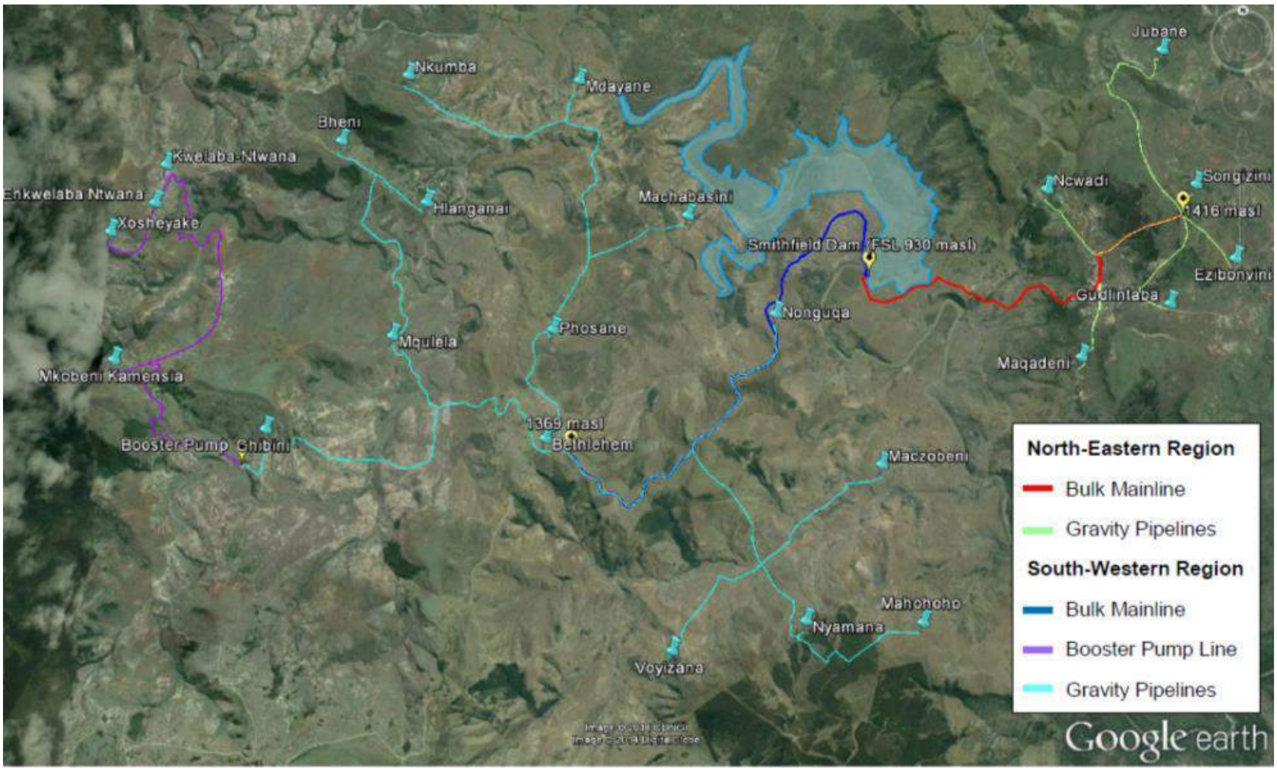


Figure 12: Proposed layout of the Smithfield Dam local water supply scheme

The proposed Smithfield Dam local water supply scheme has been designed to include the following infrastructure:

- A pipeline to abstract water from Smithfield Dam's outlet works;
- A water treatment works at the downstream side of the dam wall to treat the raw water from the dam to potable water standards;
- A pumpstation at the downstream side of the dam wall;
- Two bulk mainlines which would deliver water to bulk reservoirs;
- Reserve water storage reservoirs for each community and for each bulk supply line;
- A number of gravity lines to deliver water from the bulk reservoirs to the various communities; and
- A booster pump for the supply of water to Kwelaba-Ntwana, Enkwelaba Ntwana, Mkobeni Kamensia and Xosheyake.

Note that a separate EIA will be conducted for the Smithfield Dam local water supply scheme.

4 PROJECT LOCATION

For the sake on conveying the entire uMWP-1 footprint, **Figure 13** (enlarged map contained in **Appendix A**) shows both the Raw Water and the Potable Water components, although this report only focuses on the Raw Water component.

The project area is situated in the southern part of KZN. The western part of the project area falls within the Harry Gwala DM (Ingwe LM), whereas the eastern potion is located in the uMgungundlovu DM (Richmond LM and Mkhambathini LM). The western portion of the project area, including Smithfield Dam and the first ± 21 km of the tunnel, falls under Traditional Authority and state land. The area is characterised by traditional homestead settlements and rural subsistence agriculture. The eastern part of the project area, which includes the remaining part of the tunnel (± 11.5 km), balancing dam and raw water pipeline, is privately owned and predominantly used for commercial farming and forestry.

A description of the location of each of the major Raw Water project components follows (refer to **Figures 14 - 15**):

- The proposed Smithfield Dam is located 2 km upstream from the confluence of the uMkhomazi and Mfeneni Rivers, along the middle reaches of the uMkhomazi River, midway between Lundy's Hill Bridge and Deepdale Bridge. The site falls within Wards 7, 8 and 10 of the Ingwe LM.
- The proposed transfer tunnel runs in a west to east direction for approximately 32.5 km, with the inlet at Smithfield Dam and the outlet at the Baynesfield Estate. Areas passed include Ncwadi, Songizini, Mhlongo and Ndondwane (amongst others). There are access shafts and adits for maintenance purposes. The tunnel traverses Ward 7 of the Ingwe LM and Wards 7 and 3 of the Richmond LM.
- The raw water pipeline route options, which are dependent on the ultimate location of the WTW (apart from the link to the balancing dam), primarily traverse the Baynesfield Estate (diversified commercial farming operation) as well as privately owned farms in Wards 3 and 4 of the Richmond LM and Ward 3 of Mkhambathini LM.
- The area affected by the balancing dam options forms part of the Baynesfield Estate. The estate is predominantly surrounded by private farms. The sites fall within Ward 3 of the Richmond LM.

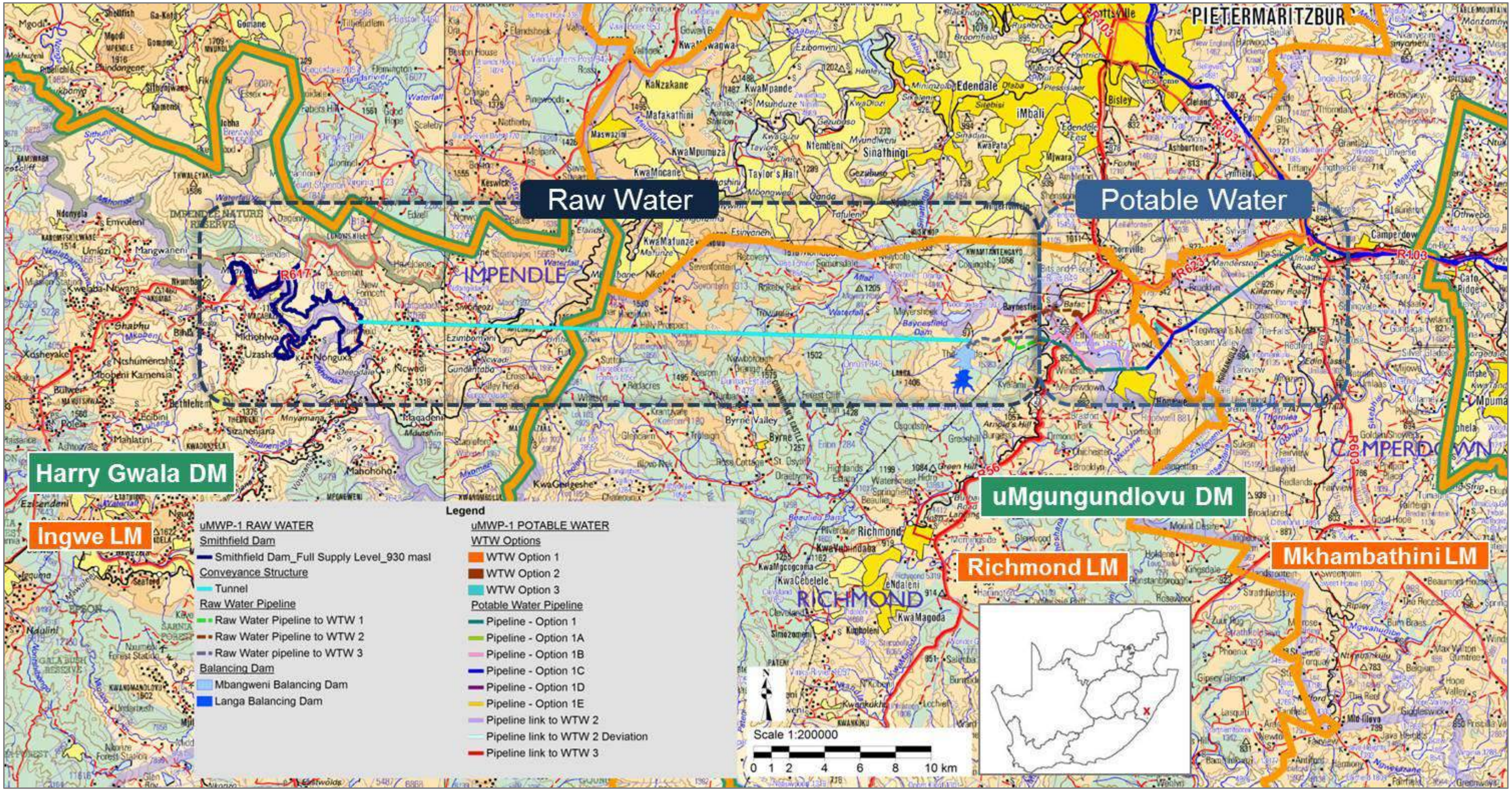


Figure 13: **Regional Map – uMWP-1 Raw Water & Potable Water** ***(Note – not all sub-components shown)***

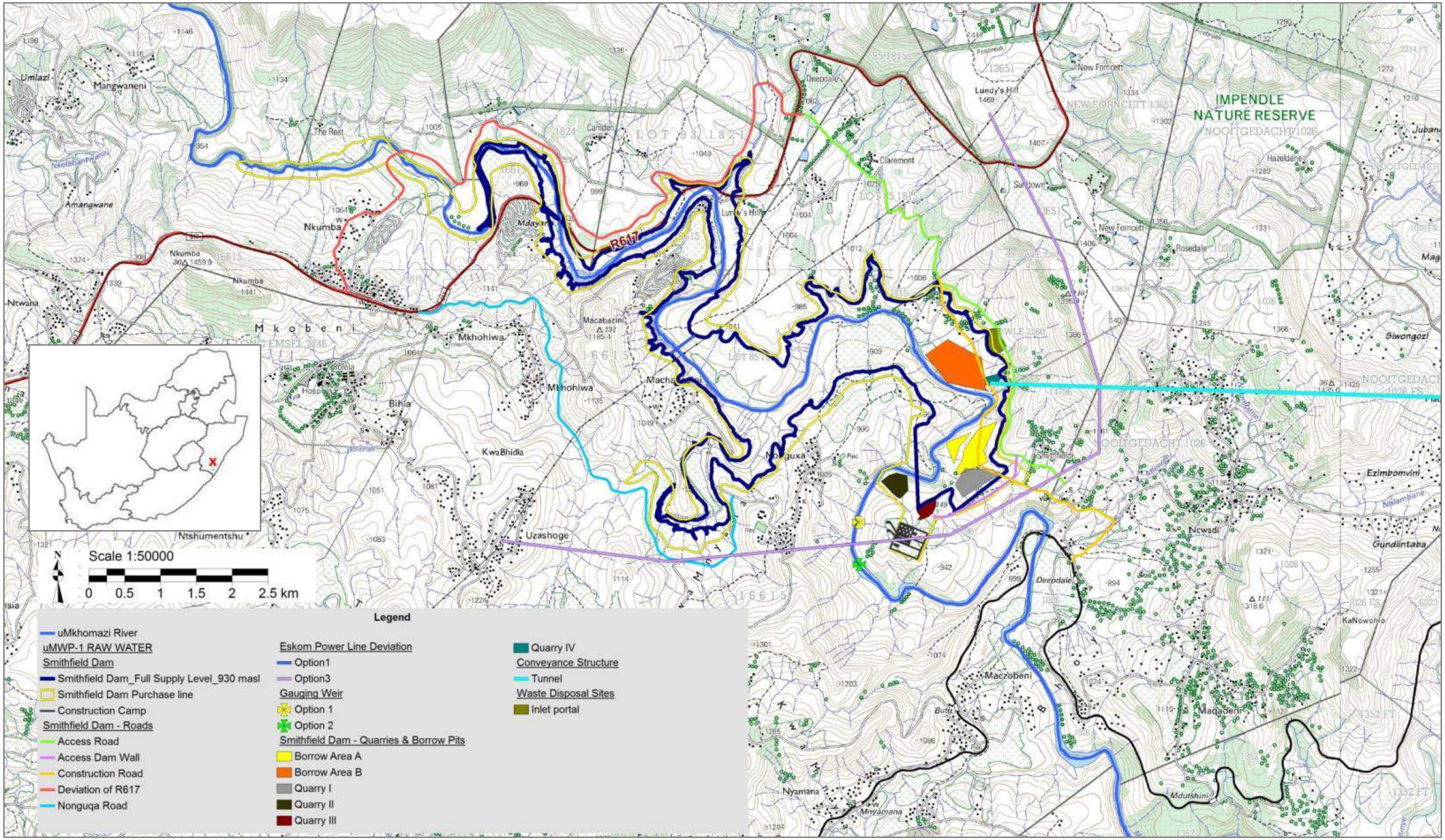


Figure 14: Locality Map – uMWP-1 Raw Water (western side)

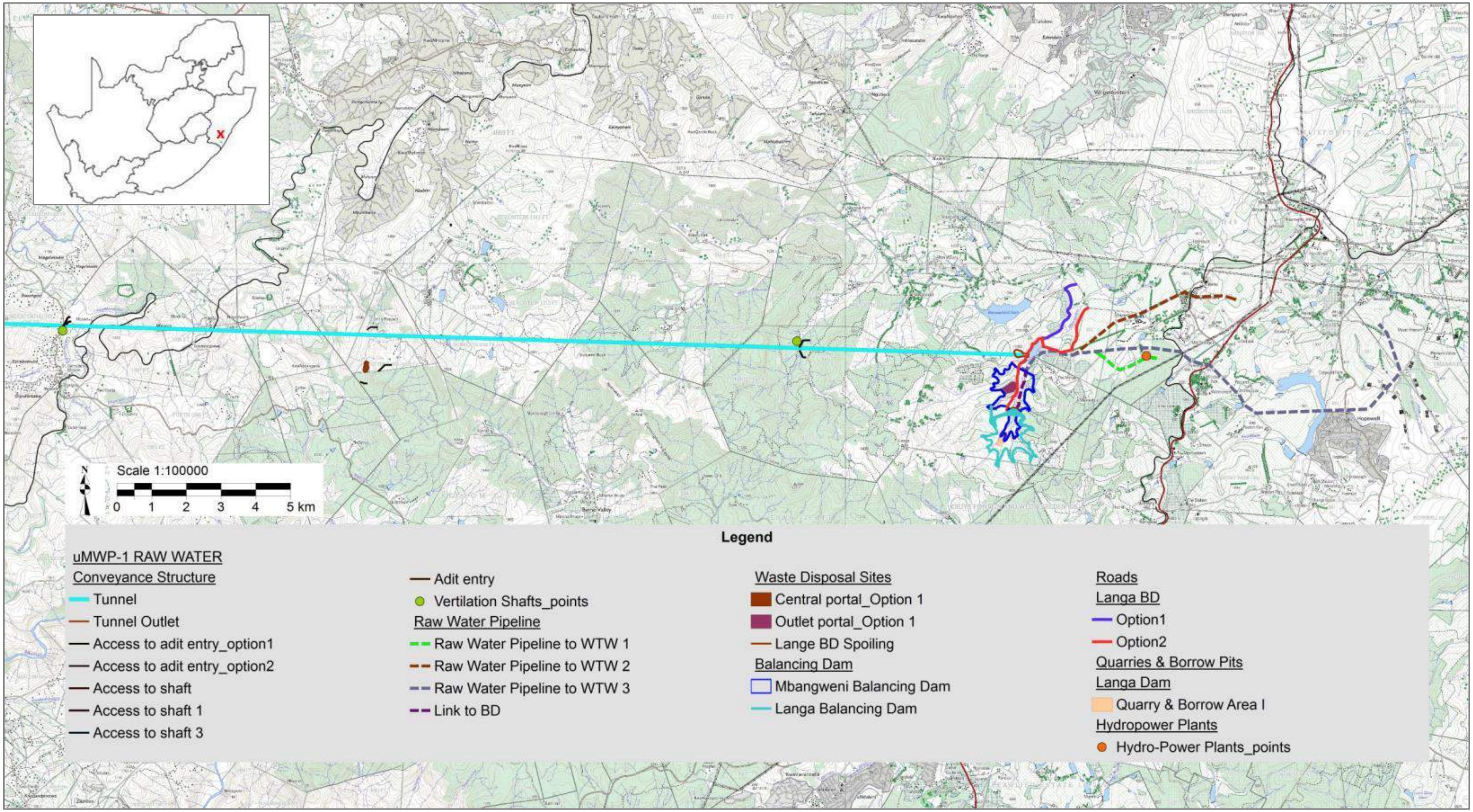


Figure 15: **Locality Map – uMWP-1 Raw Water (eastern side)**

5 LEGISLATION AND GUIDELINES CONSIDERED

5.1 Legislation

5.1.1 *Environmental Statutory Framework*

The legislation that has possible bearing on the proposed uMWP-1 Raw Water component from an environmental perspective is captured in **Table 3** below. **Note:** *this list does not attempt to provide an exhaustive explanation, but rather represents an identification of the most appropriate sections from pertinent pieces of legislation*.

Table 3: Environmental Statutory Framework

Legislation	Relevance
Constitution of the Republic of South Africa, (No. 108 of 1996)	• Chapter 2 – Bill of Rights. • Section 24 – Environmental Rights.
National Environmental Management Act (No. 107 of 1998)	• Section 24 – Environmental Authorisation (control of activities which may have a detrimental effect on the environment). • Section 28 – Duty of care and remediation of environmental damage. • Environmental management principles. • Authorities – Department of Environmental Affairs (DEA) (national) and KZN Department of Economic Development, Tourism and Environmental Affairs (provincial).
GN No. R. 543 of 18 June 2010	• Process for undertaking Scoping and the EIA.
GN No. R. 544 of 18 June 2010	9. The construction of facilities or infrastructure exceeding 1000 metres in length for the bulk transportation of water, sewage or storm water - (i) with an internal diameter of 0,36 metres or more; or (ii) with a peak throughput of 120 litres per second or more, excluding where: a. such facilities or infrastructure are for bulk transportation of water, sewage or storm water or storm water drainage inside a road reserve; or b. where such construction will occur within urban areas but further than 32 metres from a watercourse, measured from the edge of the watercourse.
	10. The construction of facilities or infrastructure for the transmission and distribution of electricity - (i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts; or (ii) inside urban areas or industrial complexes with a capacity of 275 kilovolts or more.
	11. The construction of: (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.
	13. The construction of facilities or infrastructure for the storage, or for the storage and handling, of

Legislation	Relevance
	a dangerous good, where such storage occurs in containers with a combined capacity of 80 but not exceeding 500 cubic metres;
	18. The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from (i) a watercourse; (ii) the sea; (iii) the seashore; (iv) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater- but excluding where such infilling, depositing, dredging, excavation, removal or moving (i) is for maintenance purposes undertaken in accordance with a management plan agreed to by the relevant environmental authority; or (ii) occurs behind the development setback line.
	19. Any activity which requires a prospecting right or renewal thereof in terms of section 16 and 18 respectively of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).
	20. Any activity requiring a mining permit in terms of section 27 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) or renewal thereof.
	22. The construction of a road, outside urban areas, (i) with a reserve wider than 13,5 meters or, (ii) where no reserve exists where the road is wider than 8 metres, or (iii) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Notice 545 of 2010.
	23. The transformation of undeveloped, vacant or derelict land to – (i) residential, retail, commercial, recreational, industrial or institutional use, inside an urban area, and where the total area to be transformed is 5 hectares or more, but less than 20 hectares, or (ii) residential, retail, commercial, recreational, industrial or institutional use, outside an urban area and where the total area to be transformed is bigger than 1 hectare but less than 20 hectares; - except where such transformation takes place for linear activities.
	24. The transformation of land bigger than 1000 square metres in size, to residential, retail, commercial, industrial or institutional use, where, at the time of the coming into effect of this Schedule such land was zoned open space, conservation or had an equivalent zoning.
	26. Any process or activity identified in terms of section 53(1) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).
	39. The expansion of (i) canals; (ii) channels; (iii) bridges; (iv) weirs; (v) bulk storm water outlet structures; (vi) marinas; within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, where such expansion will result in an increased development footprint but excluding where such expansion will occur behind the development setback line.
	40. The expansion of (i) jetties by more than 50 square metres; (ii) slipways by more than 50 square metres; (iii) buildings by more than 50 square metres; (iv) infrastructure by more than 50 square metres; within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, but excluding where such expansion will occur behind the development setback line.
	47. The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre - (i) where the existing reserve is wider than 13,5 meters; or (ii) where no reserve exists, where the existing road is wider than 8 metres – excluding widening or lengthening occurring inside urban areas.
	56. Phased activities for all activities listed in this Schedule, which commenced on or after the effective date of this Schedule, where any one phase of the activity may be below a threshold but where a combination of the phases, including expansions or extensions, will exceed a specified threshold.
GN No. R. 545 of 18	10. The construction of facilities or infrastructure for the transfer of 50 000 cubic metres or more

Legislation	Relevance
June 2010	water per day, from and to or between any combination of the following: (i) water catchments, (ii) water treatment works; or (iii) impoundments, excluding treatment works where water is to be treated for drinking purposes.
	15. Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more; except where such physical alteration takes place for: (i) linear development activities; or (ii) agriculture or afforestation where activity 16 in this Schedule will apply.
	18. The route determination of roads and design of associated physical infrastructure, including roads that have not yet been built for which routes have been determined before 03 July 2006 and which have not been authorised by a competent authority in terms of the Environmental Impact Assessment Regulations, 2006 or 2009, made under section 24(5) of the Act and published in Government Notice R385 of 2006 [if] – (i) it is a national road as defined in section 40 of the South African National Roads Agency Limited and National Roads Act, 1998 (Act 7 of 1998); (ii) it is a road administered by a provincial authority; (iii) the road reserve is wider than 30 metres; or (iv) the road will cater for more than one lane of traffic in both directions.
	19. The construction of a dam, where the highest part of the dam wall, as measured from the outside toe of the wall to the highest part of the wall, is 5 metres or higher or where the high-water mark of the dam covers an area of 10 hectares or more.
	20. Any activity which requires a mining right or renewal thereof as contemplated in sections 22 and 24 respectively of the Mineral and Petroleum /resources Development Act, 2002 (Act 28 of 2002).
	21. Any activity which requires an exploration right or renewal thereof as contemplated in sections 79 and 81 respectively of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002).
GN No. R. 546 of 18 June 2010	2(a)(iii). The construction of reservoirs for bulk water supply with a capacity of more than 250 cubic metres.
	4(a)(ii). The construction of a road wider than 4 metres with a reserve less than 13,5 metres.
	10(a)(ii). The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres.
	12. The clearance of an area of 300 square metres or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation.
	13. The clearance of an area of 1 hectare or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for: (1) the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), in which case the activity is regarded to be excluded from this list. (2) the undertaking of a linear activity falling below the thresholds mentioned in Listing Notice 1 in terms of GN No 544 of 2010.
	14. The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for: (1) purposes of agriculture or afforestation inside areas identified in spatial instruments adopted by the competent authority for agriculture or afforestation purposes; (2) the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the activity is regarded to be excluded from this list; (3) the undertaking of a linear activity falling below the thresholds in Notice 544 of 2010.
	16(a)(ii). The construction of: (i) buildings with a footprint exceeding 10 square metres in size; or (ii) infrastructure covering 10 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.
	19(a)(ii). The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre.

Legislation	Relevance
	24(a)(ii). The expansion of (a) buildings where the buildings will be expanded by 10 square metres or more in size; or (b) infrastructure where the infrastructure will be expanded by 10 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.
	26. Phased activities for all activities listed in this Schedule and as it applies to a specific geographical area, which commenced on or after the effective date of this Schedule, where any phase of the activity may be below a threshold but where a combination of the phases, including expansions or extensions, will exceed a specified threshold.
National Water Act (Act No. 36 of 1998)	• Chapter 3 – Protection of water resources. • Section 19 – Prevention and remedying effects of pollution. • Section 20 – Control of emergency incidents. • Chapter 4 – Water use. • Chapter 12 – Safety of Dams. • Authority – DWS.
Environment Conservation Act (Act No. 73 of 1989):	• Environmental protection and conservation. • Section 25 – Noise regulation. • Section 20 – Waste management. • Authority – DEA
National Environmental Management Air Quality Act (Act No. 39 of 2004)	• Air quality management • Section 32 – Dust control. • Section 34 – Noise control. • Authority – DEA.
National Environmental Management: Biodiversity Act (Act No. 10 of 2004)	• Management and conservation of the country's biodiversity. • Protection of species and ecosystems. • Authority – DEA.
National Environmental Management: Protected Areas Act (Act No. 57 of 2003)	• Protection and conservation of ecologically viable areas representative of South Africa's biological diversity and natural landscapes.
National Environmental Management: Waste Act (Act No. 59 of 2008)	• Chapter 5 – licensing requirements for listed waste activities (Schedule 1) (if applicable). • Authority – DEA.
National Forests Act (Act No. 84 of 1998)	• Section 15 – Authorisation required for impacts to protected trees. • Authority – Department of Agriculture, Forestry and Fisheries (DAFF)
Minerals and Petroleum Resources Development Act (Act No. 28 of 2002)	• Permit required for borrow pits and quarries. • Authority – Department of Mineral Resources (DMR).
Occupational Health & Safety Act (Act No. 85 of 1993)	• Provisions for Occupational Health & Safety. • Authority – Department of Labour.
Hazardous Substances Act (Act No. 15 of 1973)	• Control of hazardous substances. • Authority – Department of Labour
National Heritage Resources Act (Act No. 25 of 1999)	• Section 34 – protection of structure older than 60 years. • Section 35 – protection of heritage resources. • Section 36 – protection of graves and burial grounds. • Section 38 – Heritage Impact Assessment for linear development exceeding 300m in length; development exceeding 5 000m^2 in extent. • Authority – Amafa aKwaZulu-Natali.
KZN Heritage Act (Act No. 04 of 2008)	• Conservation, protection and administration of both the physical and the living or tangible heritage resources of KZN. • Authority – Amafa aKwaZulu-Natali.
Conservation of Agricultural Resources Act (Act No. 43 of 1983)	• Control measures for erosion. • Control measures for alien and invasive plant species. • Authority – Department of Agriculture.
Spatial Planning and Land Use Management Act (Act No. 16 of 2013)	• National regulatory framework for spatial planning, land use management and land development. • Authority - Department of Rural Development and Land Reform (DRD&LR)

Legislation	Relevance
Kwazulu-Natal Planning and Development Act (Act No. 06 of 2008)	• Directs and regulates planning and development in KZN. • An application may be required before land may be used or developed for a particular purpose. • All developments need to be in accordance with the municipality's planning scheme. • Authority – Municipality
KwaZulu-Natal Nature Conservation Management Act (Act No. 09 of 1997).	• Institutional bodies for nature conservation in KZN. • Establish control and monitoring bodies and mechanisms. • Authority – Ezemvelo KZN Wildlife (EKZNW).
Integrated Coastal Management Act (Act No. 24 of 2008)	• Management of uMkhomazi Estuary. • Authority – DEA.
National Road Traffic Act (Act No. 93 of 1996)	• Authority – Department of Transport.
Tourism Act of 1993	• Authority – South African Tourism Board.

The relationship between the project and certain key pieces of environmental legislation is discussed in the subsections to follow.

5.1.2 <u>National Environmental Management Act</u>

According to Section 2(3) of the National Environmental Management Act (NEMA) (Act No. 107 of 1998), "*development must be socially, environmentally and economically sustainable*", which means the integration of these three factors into planning, implementation and decision-making so as to ensure that development serves present and future generations.

The proposed uMWP-1 requires authorisation in terms of NEMA and the EIA is being conducted in accordance the EIA Regulations (2010) that consist of the following:

- EIA procedures - Government Notice No. R. 543;
- Listing Notice 1 - Government Notice No. R. 544;
- Listing Notice 2 - Government Notice No. R. 545; and
- Listing Notice 3 - Government Notice No. R. 546.

The project triggers activities under Listing Notices 1, 2 and 3, and thus needs to be subjected to a Scoping and EIA process. The listed activities are explained in the context of the project (Smithfield Dam, Water Conveyance Infrastructure and Balancing Dam) in the table to follow. Note that the dimensions should be regarded as approximates due to the dynamic nature of the planning and design process. As a conservative approach, all possible activities that could possibly be triggered by the project were included in the

Application Form that was submitted to the Department of Environmental Affairs (DEA), and a refinement of these activities took place as the EIA process unfolded.

Table 4: Relevance of activities triggered in the EIA Regulations (2010)

GN	Activity No.	Relevance of Listed Activity	Smithfield Dam	Water Conveyance Infrastructure	Balancing Dam
544, 18 June 2010	9	The proposed tunnel is in the region of 34 km long, and the internal diameter of the tunnel is 3.5 m. A raw water pipeline will link the tunnel to the new balancing dam on the uMlaza River (in-stream), and the proposed WTW. Water is transferred from the uMkhomazi River (from Smithfield Dam) to the Umlaas Road reservoir at a rate of 8.65m^3/s.	✓	✓	✓
544, 18 June 2010	10	Existing power lines at the Smithfield Dam need to be relocated.	✓	✓	✓
544, 18 June 2010	11	• A number of watercourses could be impacted on by this development. The extent and significance of this impact will be determined through the EIA process. • The uMkhomazi River will be affected by Smithfield Dam primarily in terms of the basin (in-stream impoundment) and the river diversion. • Three flow gauging stations are proposed on the uMkhomazi River. • The uMlaza River will be impacted on by the proposed balancing dam to receive the transferred water from the uMkhomazi River. • In addition, tributaries of the uMkhomazi and uMlaza Rivers may be modified by (a) inundation from the dams, (b) crossings for related facilities (e.g. pipeline crossings, access road crossings, power lines, culverts, footprints of infrastructure intruding into the floodplain / 32 m buffer area along watercourses, tunnel related infrastructure at entrance and exit points, etc.).	✓	✓	✓
544, 18 June 2010	13	"Dangerous goods" that are likely to be associated with the greater project, are fuel stores for generators at the various pumping station sites, as well as any such goods used during the construction phase.	✓	✓	✓
544, 18 June 2010	18	The uMkhomazi and uMlaza Rivers will be affected during the construction of various dam related infrastructure, gauging weir, linking pipelines, tunnel, balancing dam and access roads.	✓	✓	✓
544, 18 June 2010	19	Quarries and borrow areas to be created to obtain construction material (e.g. concrete aggregates and earth embankment).	✓		✓
544, 18 June 2010	20		✓		✓
544, 18 June 2010	22	Access roads to the various sites (dam wall, outlet structure, tunnel portals, spoil areas, etc.) as well as relocation of roads that will be inundated.	✓	✓	✓
544, 18 June 2010	23	• Significant area to be inundated by the Smithfield Dam and the balancing dam. • Quarries and borrow areas to be created to obtain construction material (concrete aggregates and earth embankment) - sizes to be confirmed. • Operator housing / offices and fencing to be built.	✓	✓	✓
544, 18 June 2010	24	Operator housing / offices and fencing to be built.	✓	✓	✓
544, 18 June 2010	26	Given the sheer size of the area impacted on by the proposed project the potential to impact on a species of biodiversity importance, as well as areas that show a combination of biodiversity relevant factors, is highly probable.	✓	✓	✓
544, 18 June 2010	39	Existing infrastructure not specifically related to the project may be impacted on by the proposed development, such as the possible upgrading of existing road bridges and other infrastructure within 32m of	✓	✓	✓

GN	Activity No.	Relevance of Listed Activity	Smithfield Dam	Water Conveyance Infrastructure	Balancing Dam
		a watercourse.			
544, 18 June 2010	40	Existing infrastructure not specifically related to the project may be impacted on by the proposed development.	✓	✓	✓
544, 18 June 2010	47	Widening or lengthening of existing roads to create access roads, and for the relocation of roads that will be inundated.	✓	✓	✓
544, 18 June 2010	56	Possible phased activities that may collectively trigger this listed activity.	✓	✓	✓
545, 18 June 2010	10	Water is transferred from the uMkhomazi River (from Smithfield Dam) to the Umlaas Road reservoir at a rate of 8.65m^3/s.	✓	✓	✓
545, 18 June 2010	15	Large areas to be inundated by the Smithfield Dam and balancing dam.	✓	✓	✓
545, 18 June 2010	18	Relocation of existing road R617, which is administered by the Kwazulu-Natal Department of Transport.	✓		
545, 18 June 2010	19	Dam wall height for Smithfield Dam (at 930 masl) and balancing dam (at 923 masl) will exceed thresholds.	✓		✓
545, 18 June 2010	20	Borrow areas to be created to obtain construction material (concrete aggregates and earth embankment) - sizes to be confirmed.	✓		✓
545, 18 June 2010	21		✓		✓
546, 18 June 2010	2(a)(iii)	Possible occurrence of sensitive biodiversity features at affected areas. The balancing dam is located in a potentially sensitive area.	✓	✓	✓
546, 18 June 2010	4(a)(ii)	Access roads to the various sites (dam wall, outlet structure, tunnel portals, spoil areas, etc.) as well as relocation of roads that will be inundated, which may be located in areas that are deemed to be important from a biodiversity perspective.	✓	✓	✓
546, 18 June 2010	10(a)(ii)	Temporary storage of dangerous goods (e.g. fuel) during the construction phase. Possible occurrence of sensitive biodiversity features in the project area.	✓	✓	✓
546, 18 June 2010	12	Construction activities will involve extensive clearance of vegetation (300 square metres or more, where 75% or more of the vegetative cover constitutes indigenous vegetation). Possible occurrence of sensitive biodiversity features at affected areas.	✓	✓	✓
546, 18 June 2010	13	Construction activities will involve extensive clearance of vegetation (1 hectare or more, where 75% or more of the vegetative cover constitutes indigenous vegetation). Possible occurrence of sensitive biodiversity features at affected areas.	✓	✓	✓
546, 18 June 2010	14	Construction activities will involve extensive clearance of vegetation (5 hectares or more, where 75% or more of the vegetative cover constitutes indigenous vegetation). Possible occurrence of sensitive biodiversity features at affected areas.	✓	✓	✓
546, 18 June 2010	16(a)(ii)	Construction of infrastructure within watercourse. Possible occurrence of sensitive biodiversity features at affected areas.	✓	✓	✓
546, 18 June 2010	19(a)(ii)	Access roads as well as relocation of roads that will be inundated. Possible occurrence of sensitive biodiversity features at affected areas.	✓	✓	✓
546, 18 June 2010	24(a)(ii)	Construction of infrastructure within watercourse. Possible occurrence of sensitive biodiversity features at affected areas.	✓	✓	✓
546, 18 June 2010	26	Possible phased activities that may collectively trigger this listed activity.	✓	✓	✓

The new EIA Regulations (GN No. R. 982 – R. 985) came into effect on 4 December 2014 and they replaced the previous EIA Regulations that had been promulgated on 18 June 2010. The following transitional arrangements apply to the applications submitted for this project (explained in **Section 5.3.3**):

- According to Regulation 53(1) of GN No. R. 982, an application submitted in terms of the previous NEMA Regulations and which is pending when the new Regulations take effect, must despite the repeal of those Regulations be dispensed with in terms of those previous NEMA Regulations as if those previous NEMA Regulations were not repealed.
- In terms of Regulation 53(3) of GN No. R. 982, where an application submitted in terms of the previous NEMA Regulations is pending in relation to an activity of which a component of the same activity was not identified under the previous NEMA notices, but is now identified in terms of section 24(2) of the Act, the competent authority must dispense of such application in terms of the previous NEMA Regulations and may authorise the activity identified in terms of section 24(2) as if it was applied for, on condition that all impacts of the newly identified activity and requirements of these Regulations have also been considered and adequately assessed. All the activities triggered by the project in terms of the new EIA Regulations of 2014 are shown in **Table 5**. These activities will be assessed as part of the EIA process. Their relevance to the project is the same as discussed in **Table 4**.

Table 5: Activities triggered in terms of the new EIA Regulations (2014)

GN	Activity No.	Description of Listed Activity	Smithfield Dam	Water Conveyance Infrastructure	Balancing Dam
983 4 Dec 2014	9	The development of infrastructure exceeding 1000 metres in length for the bulk transportation of water or storm water- (i) with an internal diameter of 0,36 metres or more; or (ii) with a peak throughput of 120 litres per second or more; excluding where- (a) such infrastructure is for bulk transportation of water or storm water or storm water drainage inside a road reserve; or (b) where such development will occur within an urban area.	✓	✓	✓
983 4 Dec 2014	11	The development of facilities or infrastructure for the transmission and distribution of electricity- (i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts; or (ii) inside urban areas or industrial complexes with a capacity of 275 kilovolts or more.	✓	✓	✓
983 4 Dec 2014	12	The development of- (i) canals exceeding 100 square metres in size; (ii) channels exceeding 100 square metres in size; (iii) bridges exceeding 100 square metres in size; (iv) dams, where the dam, including infrastructure and water surface area, exceeds 100 square metres in size;	✓	✓	✓

GN	Activity No.	Description of Listed Activity	Smithfield Dam	Water Conveyance Infrastructure	Balancing Dam
		(v) weirs, where the weir, including infrastructure and water surface area, exceeds 100 square metres in size; (vi) bulk storm water outlet structures exceeding 100 square metres in size; (vii) marinas exceeding 100 square metres in size; (viii) jetties exceeding 100 square metres in size; (ix) slipways exceeding 100 square metres in size; (x) buildings exceeding 100 square metres in size; (xi) boardwalks exceeding 100 square metres in size; or (xii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs- (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse; - excluding- (aa) the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such development occurs within an urban area; or (ee) where such development occurs within existing roads or road reserves.			
983 4 Dec 2014	14	The development of facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 cubic metres or more but not exceeding 500 cubic metres.	✓	✓	✓
983 4 Dec 2014	19	The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from- (i) a watercourse; (ii) the seashore; or (iii) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater - but excluding where such infilling, depositing , dredging, excavation, removal or moving- (a) will occur behind a development setback; (b) is for maintenance purposes undertaken in accordance with a maintenance management plan; or (c) falls within the ambit of activity 21 in this Notice, in which case that activity applies.	✓	✓	✓
983 4 Dec 2014	21	Any activity including the operation of that activity which requires a mining permit in terms of section 27 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including associated infrastructure, structures and earthworks directly related to the extraction of a mineral resource, including activities for which an exemption has been issued in terms of section 106 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).	✓		✓
983 4 Dec 2014	22	The decommissioning of any activity requiring - (i) a closure certificate in terms of section 43 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002); or (ii) a prospecting right, mining right, mining permit, production right or exploration right, where the throughput of the activity has reduced by 90% or more over a period of 5 years excluding where the competent authority has in writing agreed that such reduction in throughput does not constitute closure.	✓		✓
983	24	The development of-	✓	✓	✓

GN	Activity No.	Description of Listed Activity	Smithfield Dam	Water Conveyance Infrastructure	Balancing Dam
4 Dec 2014		(i) a road for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Government Notice 545 of 2010; or (ii) a road with a reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 metres; but excluding- (a) roads which are identified and included in activity 27 in Listing Notice 2 of 2014; or (b) roads where the entire road falls within an urban area.			
983 4 Dec 2014	27	The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for- (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.	✓	✓	✓
983 4 Dec 2014	28	Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 01 April 1998 and where such development: (i) will occur inside an urban area, where the total land to be developed is bigger than 5 hectares; or (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare; excluding where such land has already been developed for residential, mixed, retail, commercial, industrial or institutional purposes.	✓	✓	✓
983 4 Dec 2014	30	Any process or activity identified in terms of section 53(1) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).	✓	✓	✓
983 4 Dec 2014	48	The expansion of- . (i) canals where the canal is expanded by 100 square metres or more in size; (ii) channels where the channel is expanded by 100 square metres or more in size; (iii) bridges where the bridge is expanded by 100 square metres or more in size; (iv) dams, where the dam, including infrastructure and water surface area, is expanded by 100 square metres or more in size; (v) weirs, where the weir, including infrastructure and water surface area, is expanded by 100 square metres or more in size; (vi) bulk storm water outlet structures where the bulk storm water outlet structure is expanded by 100 square metres or more in size; or (vii) marinas where the marina is expanded by 100 square metres or more in size; where such expansion or expansion and related operation occurs- (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse; excluding- (aa) the expansion of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such expansion activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such expansion occurs within an urban area; or (ee) where such expansion occurs within existing roads or road reserves.	✓	✓	✓
983 4 Dec 2014	49	The expansion of - (i) jetties by more than 100 square metres; (ii) slipways by more than 100 square metres;	✓	✓	✓

GN	Activity No.	Description of Listed Activity	Smithfield Dam	Water Conveyance Infrastructure	Balancing Dam
		(iii) buildings by more than 100 square metres; (iv) boardwalks by more than 100 square metres; or (v) infrastructure or structures where the physical footprint is expanded by 100 square metres or more; where such expansion or expansion and related operation occurs- (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse; excluding- (aa) the expansion of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such expansion activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such expansion occurs within an urban area; or (ee) where such expansion occurs within existing roads or road reserves.			
983 4 Dec 2014	56	The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre- (i) where the existing reserve is wider than 13,5 meters; or (ii) where no reserve exists, where the existing road is wider than 8 metres; excluding where widening or lengthening occur inside urban areas.	✓	✓	✓
983 4 Dec 2014	67	Phased activities for all activities - i. listed in this Notice, which commenced on or after the effective date of this Notice; or ii. similarly listed in any of the previous NEMA notices, which commenced on or after the effective date of such previous NEMA Notices; where any phase of the activity may be below a threshold but where a combination of the phases, including expansions or extensions, will exceed a specified threshold; excluding the following activities listed in this Notice- 17(i)(a-d); 17(ii)(a-d); 17(iii)(a-d); 17(iv)(a-d); 17(v)(a-d); 20; 21; 22; 24(i); 29; 30; 31; 32; 34; 54(i)(a-d); 54(ii)(a-d); 54(iii)(a-d); 54(iv)(a-d); 54(v)(a-d); 55; 61; 62; 64; and 65.	✓	✓	✓
984 4 Dec 2014	11	The development of facilities or infrastructure for the transfer of 50 000 cubic metres or more water per day, from and to or between any combination of the following - (i) water catchments; (ii) water treatment works; or (iii) impoundments; excluding treatment works where water is to be treated for drinking purposes.	✓	✓	✓
984 4 Dec 2014	15	The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for- (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.	✓	✓	✓
984 4 Dec 2014	16	The development of a dam where the highest part of the dam wall, as measured from the outside toe of the wall to the highest part of the wall, is 5 metres or higher or where the highwater mark of the dam covers an area of 10 hectares or more.	✓		✓
984 4 Dec 2014	17	Any activity including the operation of that activity which requires a mining right as contemplated in section 22 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including associated infrastructure, structures and earthworks, directly related to the extraction of a mineral resource, including activities for which an	✓		✓

GN	Activity No.	Description of Listed Activity	Smithfield Dam	Water Conveyance Infrastructure	Balancing Dam
		exemption has been issued in terms of section 106 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).			
984 4 Dec 2014	21	Any activity including the operation of that activity associated with the primary processing of a mineral resource including winning, reduction, extraction, classifying, concentrating, crushing, screening and washing but excluding the smelting, beneficiation, refining, calcining or gasification of the mineral resource in which case activity 6 in this Notice applies.	✓		✓
984 4 Dec 2014	27	The development of - (i) a national road as defined in section 40 of the South African National Roads Agency Limited and National Roads Act, 1998 (Act No. 7 of 1998); (ii) a road administered by a provincial authority; (iii) a road with a reserve wider than 30 metres; or (iv) a road catering for more than one lane of traffic in both directions; but excluding the development and related operation of a road for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Government Notice 545 of 2010, in which case activity 24 in Listing Notice 1 of 2014 applies.	✓		
985 4 Dec 2014	4(d)	The development of a road wider than 4 metres with a reserve less than 13,5 metres.	✓	✓	✓
985 4 Dec 2014	10(d)	The development of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres.	✓	✓	✓
985 4 Dec 2014	12(b)	The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.	✓	✓	✓
985 4 Dec 2014	14(d)	The development of- (i) canals exceeding 10 square metres in size ; (ii) channels exceeding 10 square metres in size; (iii) bridges exceeding 10 square metres in size; (iv) dams, where the dam, including infrastructure and water surface area exceeds 10 square metres in size; (v) weirs, where the weir, including infrastructure and water surface area exceeds 10 square metres in size; (vi) bulk storm water outlet structures exceeding 10 square metres in size; (vii) marinas exceeding 10 square metres in size; (viii) jetties exceeding 10 square metres in size; (ix) slipways exceeding 10 square metres in size; (x) buildings exceeding 10 square metres in size; (xi) boardwalks exceeding 10 square metres in size; or (xii) infrastructure or structures with a physical footprint of 10 square metres or more; where such development occurs - (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse; excluding the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour.	✓	✓	✓
985 4 Dec 2014	15(c)	The transformation of land bigger than 1000 square metres in size, to residential, retail, commercial, industrial or institutional use, where, such land was zoned open space, conservation or had an equivalent zoning, on or after 02 August 2010.	✓		
985 4 Dec 2014	18(d)	The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre.	✓	✓	✓

GN	Activity No.	Description of Listed Activity	Smithfield Dam	Water Conveyance Infrastructure	Balancing Dam
985 4 Dec 2014	23(e)	The expansion of- (i) canals where the canal is expanded by 10 square metres or more in size; (ii) channels where the channel is expanded by 10 square metres or more in size; (iii) bridges where the bridge is expanded by 10 square metres or more in size; (iv) dams where the dam is expanded by 10 square metres or more in size; (v) weirs where the weir is expanded by 10 square metres or more in size; (vi) bulk storm water outlet structures where the structure is expanded by 10 square metres or more in size; (vii) marinas where the marina is expanded by 10 square metres or more in size; (viii) jetties where the jetty is expanded by 10 square metres or more in size; (ix) slipways where the slipway is expanded 10 square metres or more in size; (x) buildings where the building is expanded by 10 square metres or more in size; (xi) boardwalks where the boardwalk is expanded by more than 10 square metres or more in size; or (xii infrastructure or structures where the physical footprint is expanded by 10 square metres or more; where such development occurs- (a) within a watercourse; (b) in front of a development setback adopted in the prescribed manner; or (c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse; excluding the expansion of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour.	✓	✓	✓
985 4 Dec 2014	26	Phased activities for all activities – i. listed in this Notice and as it applies to a specific geographical area, which commenced on or after the effective date of this Notice; or ii. similarly listed in in any of the previous NEMA notices, and as it applies to a specific geographical area, which commenced on or after the effective date of such previous NEMA Notices where - any phase of the activity may be below a threshold but where a combination of the phases, including expansions or extensions, will exceed a specified threshold; - excluding the following activities listed in this Notice - 7; 8; 11; 13; 17; 20; 21; 24.	✓	✓	✓

5.1.3 *National Environmental Management: Waste Act*

Amongst others, the purpose of the National Environmental Management: Waste Act (NEM:WA) (Act No. 59 of 2008) includes the following:

1. To reform the law regulating waste management in the country by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development;
2. To provide for institutional arrangements and planning matters;
3. To provide for specific waste management measures;

4. To provide for the licensing and control of waste management activities;
5. To provide for the remediation of contaminated land; and
6. To provide for compliance and enforcement.

The original Integrated Application Forms applied for approval of waste management activities listed in GN No. 718 of 03 July 200, which primarily related to the disposal of excess spoil material (soil and rock) that will be generated as part of the bulk earthworks during construction at three new disposal sites that will be created at the inlet portal, central adit portal and outlet portal of the tunnel. The Scoping Report included a discussion on the possible relevance of the project with regards to the amended list of waste management activities published in GN No. 921 of 29 November 2013. However, following a meeting held with DEA on 03 December 2014 it was confirmed by the Department that the spoiling of excess soil and rock would not require a Waste Management Licence in terms of NEM:WA. Accordingly, the Application Forms were amended to only relate to NEMA activities.

Waste management activities linked to Category C of GN No. 921, which may pertain to the storage of more than $100m^3$ general waste on the construction site (e.g. temporary storage of waste types at the waste transfer stations prior to final disposal at a permitted waste disposal site) will comply with the standards for that activity.

5.1.4 Mineral and Petroleum Resources Development Act

The purpose of the Mineral and Petroleum Resources Development Act (MPRDA) (Act No. 28 of 2002) is to make provision for equitable access to and sustainable development of the nation's mineral and petroleum resources and to provide for matters related thereto. This act defines mining as "any operation or activity for the purposes of winning any mineral on, in or under the earth, water or any residue deposit, whether by underground or open working or otherwise and includes any operation or activity incidental thereto".

In terms of the MPRDA, as amended, a mining permit applies when the mineral in question can be mined in 2 years and the area does not exceed 5 hectares. For larger areas a mining right will need to be applied for.

Borrow areas and quarries have been identified to source construction material for the project. Under Section 106(1) of the MPRDA, and in accordance with GN No. R. 762 of 25 June 2004, DWS is exempt from the provisions of Sections 16, 20, 22 and 27 "*in respect of any activity to remove any mineral for road construction, building of dams or other purpose which may be identified in such notice*". In terms of Section 106(2) of the MPRDA, DWS still needs to submit Environmental Management Programmes for all borrow areas and quarries for approval by the Department of Mineral Resources (DMR).

Based on a Memorandum of Understanding in 2007 between the then DWAF and Department of Mineral and Energy (DME), it was agreed between these parties that for the construction and maintenance of Government Waterworks undertaken by DWS's own Construction Unit, this Department shall be deemed to comply with the requirements of financial provision. Provided that the estimated costs for the management, rehabilitation and closure of such quarries and borrowed areas or works are provided for within the approved budget for such Government Waterworks.

Section 106(2) of the MPRDA was amended as follows: "*Despite subsection (1), the organ of state so exempted must submit relevant environmental reports required in terms of Chapter 5 of the National Environmental Management Act, 1998, to obtain an environmental authorisation*."

The new EIA Regulations of 2014 include a number of provisions in terms of the transition of the environmental regulation of mining from the MPRDA to NEMA and the introduction of the One Environmental System. Amongst others, this is facilitated by the inclusion of mining activities under the 2014 Listing Notices. Approval will be sought from DMR for the relevant activities associated with the borrow areas and quarries (i.e. GN No. R. 983 Activities 21 and 22; GN No. R. 984 Activities 17, 18, 19 and 21) (refer to activities identified in **Table 3**).

5.1.5 National Water Act

The project entails the following activities that constitute water uses in terms of Section 21 of the National Water Act (NWA) (Act No. 36 of 1998):

- Section 21(a) - Taking water from a water resource (transfer scheme and taking water from the uMkhomazi and uMlaza Rivers);
- Section 21(b) - Storing water (Smithfield Dam and balancing dam);
- Section 21(c) - Impeding or diverting the flow of water in a watercourse (instream works for Smithfield Dam, balancing dam, gauging weir, road realignment, access roads, raw water pipeline, etc.); and
- Section 21(i) - Altering the bed, banks, course or characteristics of a watercourse (instream works for Smithfield Dam, balancing dam, gauging weir, road realignment, access roads, raw water pipeline, etc.); and
- Section 21(g) - Disposing of waste in a manner which may detrimentally impact on a water resource (wastewater discharges from construction activities and discharges from tunnelling).

An Integrated Water Use Licence Application will be submitted separately to the DWS KZN Regional Office. The following requirements of the NWA will be catered for:

- Releases from Smithfield Dam and the balancing dam will make provision for the Reserve requirements;
- Existing water use entitlements will not be affected by the transfer scheme; and
- In terms of Chapter 12 of the NWA DWS will satisfy the requirements of the Departmental Dam Safety Office and will ensure compliance with the requirements of the Dam Safety Regulations (GN No. R. 139 of 24 February 2012). Only dams with a safety risk (i.e. dams with a maximum wall height that exceeds 5,0 m and with a storage capacity of more than 50 000 m^3, or any other dam declared as a dam with a safety risk) are subject to these Regulations.

5.2 Guidelines

Amongst others, the following guidelines were considered during the EIA:

- Integrated Environmental Management Information Series, in particular Series 2 – Scoping (DEAT, 2002);
- Guideline on Alternatives, EIA Guideline and Information Document Series (DEA&DP, 2010a);

- Guideline on Need and Desirability, EIA Guideline and Information Document Series (DEA&DP, 2010b);
- Integrated Environmental Management Guideline Series 5: Companion to the EIA Regulations 2010 (DEA, 2010a);
- Integrated Environmental Management Guideline Series 7: Public Participation in the EIA Process (DEA, 2010b); and
- Guidelines for Involving Specialists in the EIA Processes Series (Brownlie, 2005).

5.3 Regional Plans

Amongst others, the following regional plans were considered during the EIA:

- Municipal Spatial Development Frameworks (SDFs) (where available);
- Municipal Integrated Development Plans (IDP);
- Relevant provincial, district and local policies, strategies, plans and programmes;
- uMgungundlovu DM Strategic Environmental Assessment (SEA) and Strategic Environmental Management Plan (SEMP); and
- uMgungundlovu DM and Harry Gwala DM Biodiversity Sector Plans.

5.4 Protocols

The following strategic priorities and corresponding policy principles as part of the World Commission on Dams, published in November 2000, need to be adhered to:

- Gaining public acceptance;
- Comprehensive options assessment;
- Addressing existing dams;
- Sustaining rivers and livelihoods;
- Recognising entitlements and sharing benefits;
- Ensuring compliance, and
- Sharing rivers for peace, development and security.

The guide to best practice in the operation, maintenance and safety of dams, developed by the Development Bank of Southern Africa (DBSA), will also be adhered to by DWS.

6 SCOPING AND EIA PROCESS

6.1 Environmental Assessment Triggers

As mentioned, the uMWP-1 consists of both Raw Water and Potable Water components with different applicants, where separate EIAs are being undertaken for these respective components.

An Application for Integrated Environmental Authorisation and Waste Management Licence was made for the Raw Water component of the uMWP-1 in terms of (refer to **Section 4** for the project's legal framework):

- NEMA and the EIA Regulations (2010); and
- NEM:WA and GN No. 921 of 29 November 2013 (originally applied for activities under GN No. 718 of 2009).

As explained in **Section 5.1.3**, the original Application Forms needed to be amended after DEA confirmed during the Scoping phase that approval was not required in terms of NEM:WA for the spoiling of excess soil and rock generated during construction. The Amended Application Forms, which are included in **Appendix C**, now only relate to NEMA.

Based on the types of activities involved, which include activities listed in GN No. R. 544, R. 545 and R. 546 of 18 June 2010 (see **Table 4**), the requisite environmental assessment for the project is a Scoping and EIA process which is being undertaken in accordance with GN No. R. 543 of 18 June 2010.

Although the new EIA Regulations (GN No. R. 982 – R. 985) came into effect on 4 December 2014, in terms of the transitional arrangements the EIA is being undertaken in accordance with the previous EIA Regulations of 18 June 2010 as if they had not been repealed (refer to discussion in **Section 5.1.2**).

Although separate EIAs are being conducted for the uMWP-1 Raw Water and Potable Water components, a combined public participation process was adopted due to the interrelationship between these two components and to provide I&APs with a holistic perspective of the overall project.

6.2 Environmental Assessment Authorities

In terms of NEMA the lead decision-making authority for the environmental assessment is the National Department of Environmental Affairs (DEA), as the project proponent (DWA) is a national department. However, due to the geographic location of the project the KZN Department of Economic Development, Tourism and Environmental Affairs (DEDTEA) is regarded as one of the key commenting authorities in terms of NEMA during the execution of the EIA, and all documentation will thus be copied to this Department (amongst others).

Various other authorities with jurisdiction over elements of the receiving environment or project activities (refer to **Section 5.1**) were also consulted and involved in the EIA.

6.3 Environmental Assessment Practitioner

Nemai Consulting was appointed by DWS as the independent Environmental Assessment Practitioner (EAP) to undertake the environmental assessment for the proposed uMWP-1 Raw Water component.

In accordance with Regulation 31(2)(a) of GN No. R. 543 of 18 June 2010, this section provides an overview of Nemai Consulting and the company's experience with EIAs, as well as the details and experience of the EAPs that form part of the Scoping and EIA team.

Nemai Consulting is an independent, specialist environmental, socio-economic and Occupational Health and Safety (OHS) consultancy, which was founded in December 1999. The company is directed by a team of experienced and capable environmental engineers, scientists, ecologists, sociologists, economists and analysts. The company has offices in Randburg (Gauteng) and Durban (KZN).

The core members of Nemai Consulting that are involved with the Scoping and EIA process for the project are captured in **Table 6** below, and their respective Curricula Vitae are contained in to **Appendix E**.

Table 6: Scoping and EIA Core Team Members

Name	Qualifications	Experience	Duties
Ms D. Naidoo	B.Sc Eng (Chem)	20 years	• Project Manager • Quality Control • EIA Process
Mr D. Henning	• B.Sc (Hons) Aquatic Health • M.Sc River Ecology	15 years	• Project Leader • EIA Process • Scoping & EIA Reports
Mr C. Chidley	• B.Sc Eng (Civil); • BA (Economics, Philosophy) • MBA	22 years	• Quality Reviewer • Technical Input • EMPr
Ms R. Maharaj	BA (Hons) Environmental Management	5 years	Public Participation Coordinator

6.4 The Environmental Assessment to Date

The following milestones have been reached as part of the environmental assessment to date:

1. A Pre-Application Consultation Meeting was convened with DEA on 21 January 2013.
2. An initial Environmental Authorities Meeting and site visit were held on 14 February 2013.
3. An Integrated Application Form for Scoping and EIA was originally submitted to DEA on 30 August 2013. Thereafter, it was deemed more appropriate to rather submit three separate Integrated Application Forms for the following project components (DEA reference numbers provided):
   - Smithfield Dam - 14/12/16/3/3/3/94;
   - Water conveyance infrastructure - 14/12/16/3/3/3/94/1; and
   - Balancing Dam - 14/12/16/3/3/3/94/2.
4. The project was announced through the distribution of Background Information Documents and Reply Forms and notification of I&APs via onsite notices, newspaper advertisements and public meetings in October 2014.
5. Amended Integrated Applications Forms, which re-considered the original list of activities applied for under the GN No. R. 544, 545 and 546 of 18 June 2010 and the

new waste management activities under GN No. 921 of 29 November 2013, were appended to the Scoping Report.

6. A Draft Scoping Report, which conformed to Regulation 28 of GN No. R. 543 (18 June 2010), was compiled. This document included the following salient information (amongst others):
   a. A Scoping-level impact assessment to identify potentially significant environmental issues for detailed assessment during the EIA phase;
   b. Screening and investigation of feasible alternatives to the project for further appraisal during the EIA phase; and
   c. A Plan of Study, which explained the approach to be adopted to conduct the EIA for the proposed project.
7. Notification of review of the Draft Scoping Report was undertaken in July 2014. The Draft Scoping Report was lodged for review from 29 July - 08 September 2014.
8. Various public meetings were held in August 2014 to present the Draft Scoping Report.
9. An Environmental Authorities Meeting was held on 03 September 2014 to provide an overview of the draft Scoping Report.
10. A site visit was held with DEA on 04 September 2014.
11. A Comments and Response Report was compiled (which was updated during the execution of the Scoping process), which summarised the issues raised by I&APs and the project team's response to these matters.
12. A meeting to clarify the project's possible relation to NEM:WA was held with DEA on 03 December 2014.
13. DEA issued approval for the Scoping Report on 26 March 2015 (refer to **Appendix B**), which allowed the commencement of the EIA phase.

Various other meetings were also held with authorities, stakeholder and I&APs during the Scoping phase.

6.5 EIA Methodology

6.5.1 Formal Process

An outline of the Scoping and EIA process for the proposed uMWP-1 Raw Water is provided in **Figure 16**.

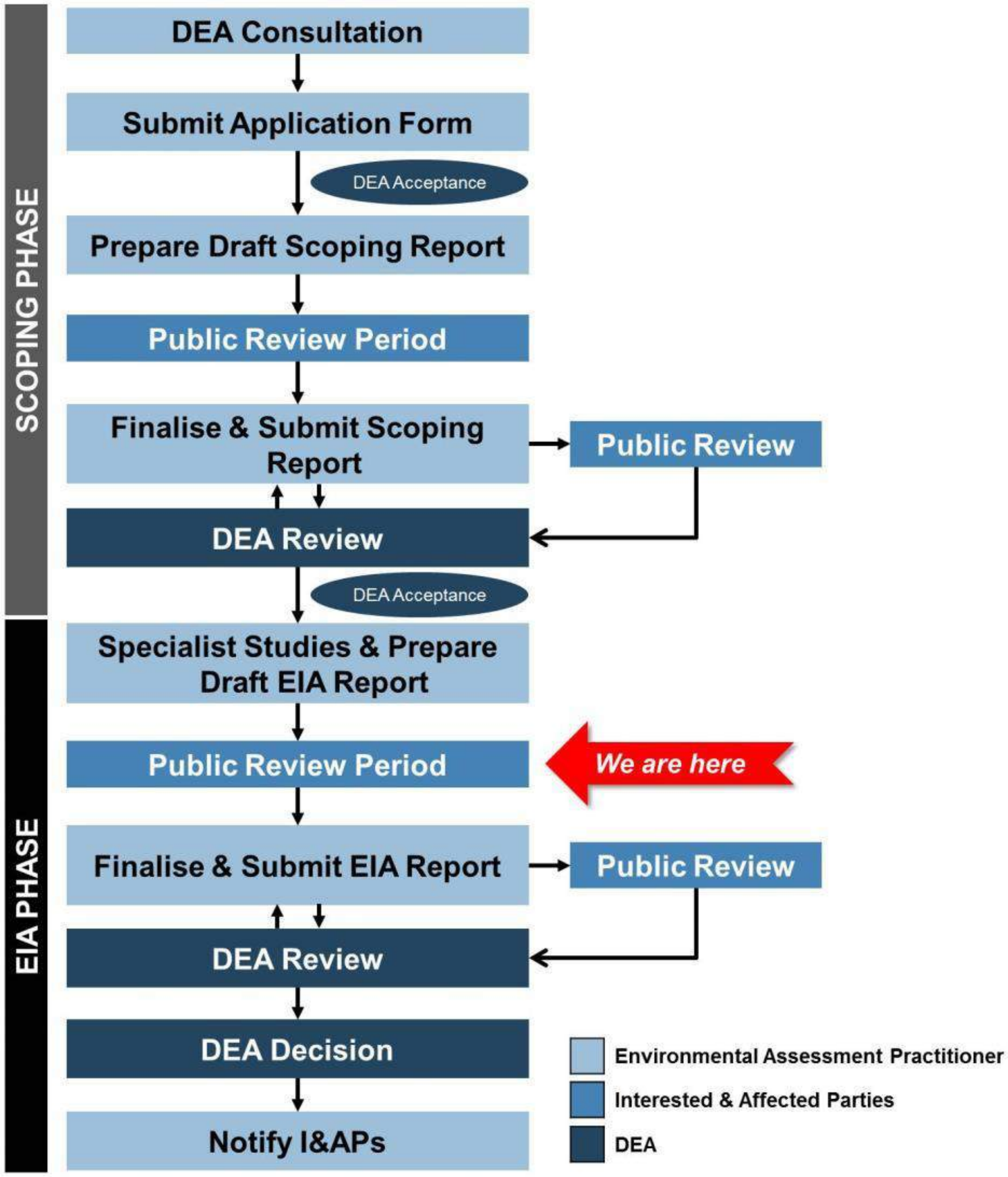


Figure 16: Outline of Scoping and EIA process

6.5.2 Objectives of the EIA Phase

Key objectives of the EIA phase include the following:

- Carry out relevant specialist studies;
- Conduct public participation;
- Assess receiving environment;
- Undertake quantitative assessment of significant environmental impacts and identify concomitant mitigation measures;
- Evaluate project alternative through a comparative analysis; and
- Compile EIA Report in accordance with the requirements stipulated in Regulation 31 of GN No. R. 543 (18 June 2010) for review by authorities and I&APs. Refer to **Section 2** for the document's composition, in terms of the regulatory requirements.

6.5.3 Alignment with the Plan of Study

The Plan of Study, which was contained in the Scoping Report and was approved by DEA, explained the approach to be adopted to conduct the EIA for the proposed project. The manner in which the EIA Report addresses the requirements of the Plan of Study is shown in **Table 7**.

Table 7: Alignment of EIA Report with Plan of Study

Plan of Study Requirement	EIA Report Reference
Assess pertinent environmental issues identified during Scoping through: 1. Applying an appropriate impact assessment methodology; 2. Conducting specialist studies; 3. Obtaining technical input; and 4. Identifying suitable mitigation measures.	• **Section 11** • **Section 12**
Specialist studies to be completed in accordance with Terms of Reference.	• **Section 11** • **Appendix H**
Public participation to include the following: • Update the I&AP Database; • Notification – Approval of Scoping Report; • Convene public meetings; • Compile and maintain a Comments and Response Report; • Allow for the review of the Draft EIA Report; and • Notification of DEA Decision.	**Section 14**
EIA Report to satisfy the minimum requirements stipulated in Regulation 31 of GN No. R. 543 (18 June 2010).	**Section 2**
Authority Consultation.	**Section 14**

The EIA included the following deviations from the Plan of Study:

- The following specialist replaced the individual initially listed in the Plan of Study -
  - Agricultural Potential Study – Eugene Gouws.
- Due to the dynamic nature of the EIA process, the timeframes indicated in the Plan of Study were altered as the subsequent tasks of the process were conducted.
- The following specialist studies that were included in the Plan of Study were not executed (reasons provided for exclusion):
  - Ichthyological Study –
    - The potential impacts to ichthyofauna were assessed as part of the Aquatic Assessment (see **Section 11.1.2**) and there was no need for a separate study in this regard;
  - Estuarine Study –
    - The Ecological Categories associated with different operational scenarios, which included uMWP-1, were assessed as part of the Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area (WMA) (refer to **Section 12.7**).
    - The water quality and quantity released from Smithfield Dam will need to comply with the requirements of the Ecological Reserve for uMkhomazi Estuary;
  - Relocation Action Plan –
    - A socio-economic survey (**Appendix H6**) of the people living within the buffer strip around Smithfield Dam was undertaken as part of the EIA to gather information necessary for a Social Impact Assessment, Socio-Economic Impact Assessment and Relocation Framework Plan. This survey provided baseline data on the socio-economic environment as well as information on the structures and land use activities within the buffer strip.
    - As the project is only at a feasibility stage, a Relocation Framework Plan (see **Section 11.1.9**) was developed to inform the EIA. Detailed social consultation with the affected communities will take place during the Implementation Phase of the project when a Relocation Action Plan (RAP) will be developed. The RAP will include arrangements for resettling and compensating each household which has to be relocated as a consequence of acquiring land for

the proposed project. An outline of the project lifecycle showing the timing of the Implementation Phase is shown in **Figure 17**.

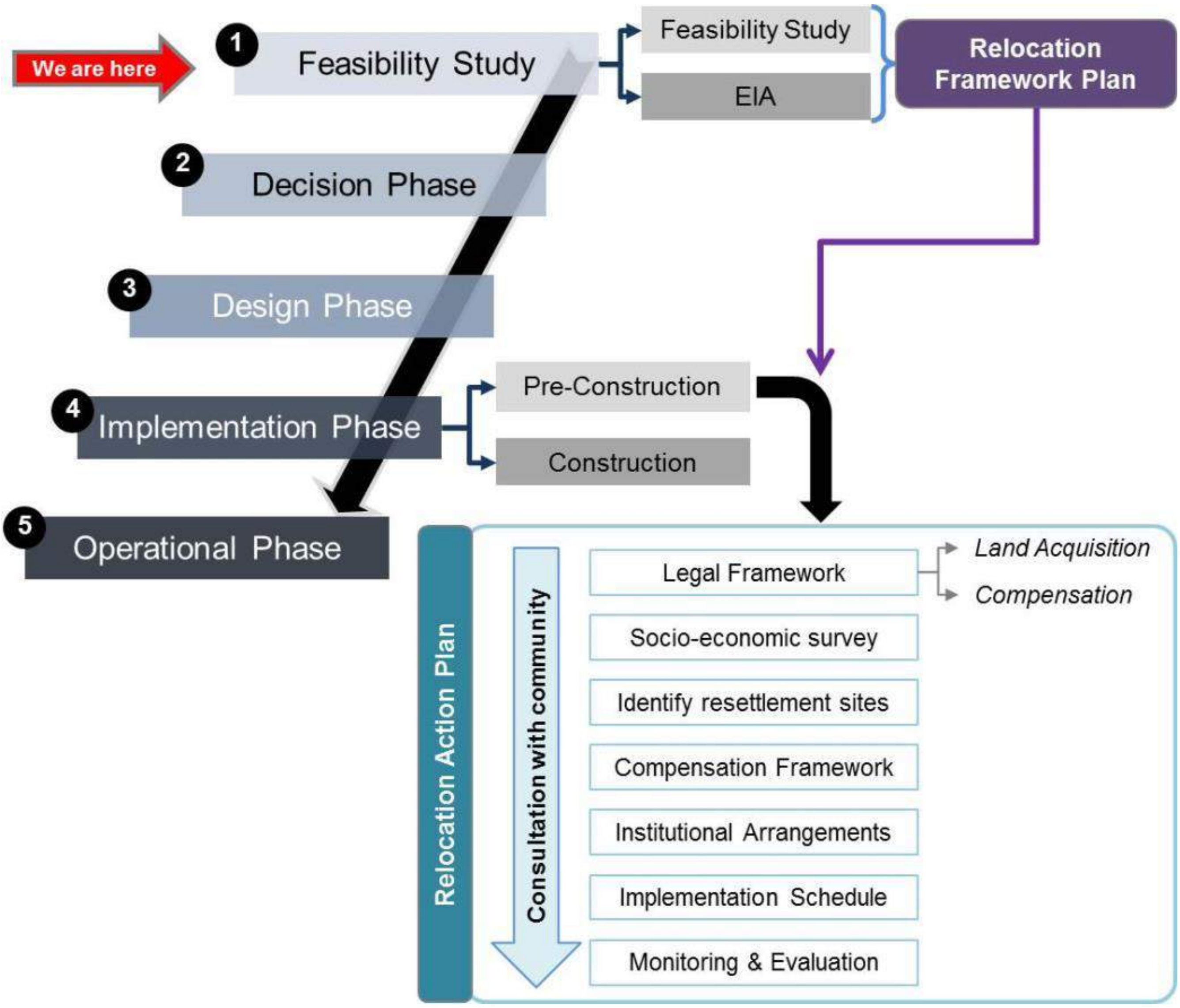


Figure 17: Relocation Action Plan in relation to the Project Life-Cycle

- Biodiversity Offset Study -
  - Refer to discussion in **Section 12.11**, based on the findings of the Terrestrial Ecological Impact Assessment and the Aquatic Impact Assessment, as well as the recommendations in **Section 15.3** regarding biodiversity offsets.

6.5.4 Addressing DEA's Requirements

The manner in which DEA's specific requirements, as listed in the letter received from this Department for the approval of the Scoping Report (refer to **Appendix B**), have been attended to are described in **Table 8**.

Table 8: DEA's Specific Requirements

DEA Requirements	Response/Status
a) Details of the future plans for the site and infrastructure after decommissioning in 20-30 years and the possibility of upgrading the proposed infrastructure to more advanced technologies.	Under suitable maintenance the lifespan of the dam is estimated to be more than 50 years. Depending on water supply requirements, the dam could possibly be upgraded or at least maintained to cater for projected needs. Decommissioning is thus not considered applicable to the scheme. However, should decommissioning be required the activity will need to comply with the appropriate environmental legislation and best practices at that time.
b) The total footprint of the proposed development should be indicated. Exact locations of the whole raw water infrastructure should be mapped at an appropriate scale.	Maps of the project components and dimensions of the infrastructure are provided in **Section 9** (Description of the Project) and **Section 10** (Profile of the Receiving Environment), as well as in the drawings in **Appendix F**.
c) Should a Water Use Licence be required, proof of application for a licence needs to be submitted.	A meeting and site visit with the DWS Water Use Authorisation officials were held on 22 July 2014. The WULA will be submitted separately to DWS.
d) Possible impacts and effects of the development on the vegetation ecology with regard to lowland-highland interface in the locality should be indicated.	Refer to copy of specialist Terrestrial Fauna and Flora Study contained in **Appendix H1**.
e) The impacts of the proposed facility on avifauna and bats must be assessed in the EIA phase.	Refer to copy of specialist Avifauna Study contained in **Appendix H8**.
f) Possible impacts and effects of the development on the surrounding industrial area.	The footprint of the uMWP-1 Raw Water component does not directly encroach on industrial land use. Agricultural and timber industries occur in the greater area. The loss of agricultural and timber land, which feed the aforementioned industries, as a result of the project are discussed in the Agricultural Impact Assessment contained in **Appendix H3**. Note that as part of the planning of the transfer scheme, all historical, current and future water requirements for all water use sectors within the uMkhomazi and upper uMlaza River catchments were factored into the calculations, which included the industrial sector.
g) The EIR should include information on the following: • Environmental costs vs benefits of the water project activities; and • Economic viability of the facility to the surrounding area and how the local	The Economic Impact Assessment (**Appendix H10**) reviews the locality, the drivers of water resource demand in the catchment areas and provides an overview of the anticipated impacts of the total development. Emphasis is placed on understanding both the costs of the

DEA Requirements	Response/Status
community will benefit.	establishment of the scheme, as well as the long term benefits within an economic cost-benefit framework that reviews the opportunity costs associated with the proposed scheme. Refer to further related discussions in **Section 12.22**.
h) Information on services required on the site, e.g. sewage, refuse removal, water and electricity. Who will supply these services and has an agreement and confirmation of capacity been obtained?	Refer to **Section 9.20** for a discussion on the services required during the construction and operational phases of the project. Due to the project's life-cycle timeframes, agreements will be sought from the relevant service providers in the design phase.
i) A construction and operational phase EMPr to include mitigation and monitoring measures.	Suitable mitigation measures are proposed to manage (i.e. prevent, reduce, rehabilitate and/or compensate) the environmental impacts, and are included in the EMPr (see **Appendix I**). It is recommended that the EMPr for the Operational Phase be developed as further information becomes available (following the project's design phase), which will then be submitted to DEA for review.
j) Should blasting be required, appropriate mitigation measures should be provided.	Blasting will be required, based on geotechnical conditions encountered. All blasting will comply with the relevant legislation and SANS stipulations. Specific mitigation measures are contained in the EMPr, including the use of blast mats to safeguard against fly-rock, and the protection of property and accompanying monitoring practices.
k) Submit the amended normal Application Form (not Application Form for Integrated Environmental Authorisation) with original signatures to de-list the NEM:WA listed activities as are no longer applicable to the proposed development.	The Amended Application Forms are included in **Appendix C**.

6.5.5 <u>Screening of Alternatives</u>

Various options to meeting the project's objectives were considered during previous studies (including the Pre-Feasibility Study), which eventually lead to the identification of alternatives to be investigated as part of the Feasibility Study. Refer to further discussion on screened alternatives under **Section 9.1**.

The Scoping exercise considered feasible alternatives in terms of the alternative sites and alignments for the project infrastructure. The alternatives that were considered during Scoping but were subsequently eliminated based on technical and environmental considerations are discussed in **Section 9**. The "no go" option was also evaluated to understand the implications of the project not proceeding (refer to **Section 12.22**).

The feasible options are taken forward in the impact prediction (see **Section 12**), where the potential positive and adverse effects to the environmental features and attributes are examined further.

A comparative analysis of the alternatives from environmental (including specialist input) and technical perspectives in provided in **Section 13**. This includes a systematic comparison of the implications of the project options to enable the selection of a Best Practicable Environmental Option (BPEO).

6.5.6 Impact Prediction

Refer to **Section 12** for the impact assessment.

The potential environmental impacts associated with the project were identified through an appraisal of the following:

- Proposed locations and footprint of the project infrastructure and components, which included site investigations and a desktop evaluation with a Geographical Information System (GIS) and aerial photography;
- Project infrastructure and design considerations;
- Activities associated with the project life-cycle (i.e. pre-construction, construction, operation and decommissioning);
- Nature and profile of the receiving environment and potential sensitive environmental features and attributes;
- Input received during public participation from I&APs;
- Findings of specialist studies;
- Legal and policy context; and
- Cumulative impacts.

The Scoping exercise aimed to identify significant environmental impacts for further consideration and prioritisation during the EIA stage. Note that “significant impacts” relate to whether the effect (i.e. change to the environmental feature / attribute) is of sufficient importance that it ought to be considered and have an influence on decision-making. During Scoping the impact prediction was executed on a qualitative level, where the main impacts where distilled by considering factors such as the nature, extent, magnitude, duration, probability and significance of the impacts.

During the EIA stage a detailed assessment is conducted to identify all impacts, which are evaluated via contributions from I&APs, the project team and requisite specialist studies, and through the application of the impact assessment methodology contained in **Section 12.1.7**. Suitable mitigation measures are proposed to manage (i.e. prevent, reduce, rehabilitate and/or compensate) the environmental impacts, and are included in the EMPr for the pre-construction and construction phases (see **Appendix I**).

7 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations accompany the EIA process:

- As the design of the project components is still in feasibility stage, and due to the dynamic nature of the planning environment, the dimensions and layout of the infrastructure may change as the technical study advances. The need for amendments to the Environmental Management Programmes and Environmental Authorisation will need to be established at that stage, in accordance with the provisions in the EIA Regulations (2014).
- Regardless of the analytical and predictive method employed to determine the potential impacts associated with the project, the impacts are only predicted on a probability basis. The accuracy of the predictions is largely dependent on the availability of environmental data and the degree of understanding of the environmental features and their related attributes, as determined through detailed technical and environmental investigations as well as public participation.
- A relatively unknown impact associated with the project is the potential contributions to greenhouse gas emissions caused by to decomposition of inundated vegetation within the dam basin. This impact was evaluated on a desktop level through literature research on the topic. Mitigation measures and recommendations are included in the EIA Report to address this matter further.
- The Heritage Impact Assessment noted the following assumptions and limitations (Beater & Prins, 2015):
  - Although a considerable time was spent undertaking on site investigations not all areas that will be impacted by the proposed dam and associated infrastructure were closely inspected due to the large size of the area. Limited or no inspection of some areas such as the inlet portal of the dam was undertaken due to the areas being thickly vegetated.
  - It is also assumed that the residents with whom discussions were held do not know of all the heritage sites including grave locations hence the recommendation of a Phase 2 investigation.
- The Avifauna Study noted the following assumptions and limitations (Wildskies, 2015):

- This study made the assumption that the above sources of information are reliable. The following factors may potentially detract from the accuracy of the predicted results -
  - This report is the result of a short term study, no long term studies were conducted on site.
  - This study therefore depends heavily upon secondary or existing data sources. This study assumes a reasonable degree of accuracy of these data.
  - Predictions in this study are based on experience of these and similar species in different parts of South Africa, through the authors' experience. However bird behaviour can't be reduced to formulas that will hold true under all circumstances.

- ❖ The Terrestrial Ecological Impact Assessment noted the following assumptions and limitations (Nemai Consulting, 2016b):
  - The majority of threatened plant species are seasonal and only flower during specific periods of the year and so desktop surveys were used to provide additional information based on the current state of the receiving environment.
  - Species of conservation concern are hard to find and to identify; consequently the species described in this report do not comprise an exhaustive list.
  - Since environmental impact studies deal with dynamic natural systems additional information may come to light at a later stage and Nemai Consulting can thus not accept responsibility for conclusions and mitigation measures made in good faith based information gathered or databases consulted at the time of the investigation.
- ❖ The Aquatic Impact Assessment noted the following assumptions and limitations (Enviross, 2016):
  - The conclusions to the Present Ecological State (PES) and the overall perceived potential impacts alluded to within this report represents the results of a single survey. Certain assumptions have been made regarding the future trends and the influence of seasonality that have been based on professional judgement and experience gained by the field ecologists whilst surveying within similar areas. The confidence of the trend analysis will increase when more surveys have been undertaken, which is especially relevant to fish sampling throughout the system that are strongly influenced by seasonality.

- The Social Impact Assessment noted the following assumptions and limitations (Dr Neville Bews & Associates, 2016):
  - It is assumed that the information provided by the project proponents was accurate and that the Feasibility Study for the proposed uMWP-1 was undertaken with integrity and is an accurate reflection of the situation on the ground.
  - It is assumed that all information provided by the independent EAP was accurate as was the information provided in other specialist studies used in this report.
  - It was assumed that the information gathered through the public participation process was a true reflection of the attitude of the public towards the project and as such was accurately recorded.
  - The study is based on data obtained by Statistics SA during Census 2011 which, dating back to October, 2011, is becoming somewhat outdated.
  - Although an attempt was made within the available timeframe and budgetary constraints to gather as wide a range of data as possible there was a limitation to the data that could be gathered.
  - Parts of the study area are administered through the Traditional Authority structure making it difficult to freely consult with people who are reluctant to participate outside of these structures.
  - Information regarding the up- and down-stream situation for both dams (main storage dam, balancing dam) was not available at the time of writing and consequently these effects were not assessed.
  - On 28 May 2015 the survey being conducted at the time was disrupted by the community of Sheshi which falls within the Emacabazini region and is under the Bhidla Traditional Authority. Due to this disruption only half of the dwellings were surveyed as the community voiced its disapproval of the project and refused any further participation in the survey. Although listed here as a limitation this protest is a clear indication of the sentiments of this community towards the project and is noted as such. *It must be noted that through subsequent engagements this matter was resolved.*
  - No clear indication regarding the full details of the relocation and the host community were available at the time of writing.

- The Socio-Economic Impact Assessment noted the following assumptions and limitations (Nemai Consulting, 2016a):
  - It is assumed that information obtained during the stakeholder engagements provide an honest account of the community structure and community relationship to the project. It must be noted, however, that the engagements are not statistically representative.
  - It must be assumed that all the interview reports are based on reflections provided by those present and may or may not be a true reflection of events.
  - The study was done with the information available to the specialist at the time of executing the study, within the available timeframes and budget. The sources consulted are not exhaustive, and additional information which might strengthen arguments, contradict information in this report and/or identify additional information might exist. However, the specialist did endeavour to take an evidence-based approach in the compilation of this report and did not intentionally exclude information relevant to the assessment.
  - The information is based on the outcomes of site visits and engagements with the I&APs.
- The Traffic Impact Assessment noted the following assumptions (DWA, 2015b):
  - The trip generation calculations were based on the latest available (feasibility stage) information of the uMWP-1. Final quantities, construction method and program information will only be available later and therefore realistic assumptions were made regarding:
    - Required construction material quantities;
    - Construction material sources;
    - Construction programme; and
    - Required workforce.

8 NEED AND DESIRABILITY

In terms of Regulation 31(2)(f) of GN No. R. 543 (18 June 2010), this section discusses the need and desirability of the project. The format contained in the Guideline on Need and Desirability (DEA&DP, 2010b) has been used in **Table 9**.

Table 9: Need and Desirability of the Project

No.	Question	Response
		NEED ('timing')
1.	Is the land use (associated with the activity being applied for) considered within the timeframe intended by the existing approved Spatial Development Framework (SDF) agreed to by the relevant environmental authority? (i.e. is the proposed development in line with the projects and programmes identified as priorities within the IDP).	According to the SDF for the Harry Gwala DM, the area to the north of the uMkhomazi River at Smithfield Dam is categorised as 'land claims' and to the south falls under 'Traditional Authority Area'. The first portion of the tunnel that falls within the Harry Gwala DM traverses both of the aforementioned categories. The uMWP-1 is acknowledged in the uMgungundlovu DM's IDP as one of Umgeni Water's projects for 2013/2014 – 2043/2044. According to the uMgungundlovu DM's SDF, the remaining portion of the tunnel as well as the balancing dam and raw water pipeline fall within an area categorised as 'Agricultural Priority Areas' with a section of the tunnel also traversing an area categorised as 'Strategic Water Production Area'. There are no indications that the timing of the uMWP-1 is in conflict with the project and programmes listed in either the Harry Gwala or uMgungundlovu DMs' IDPs.
2.	Should development, or if applicable, expansion of the town/area concerned in terms of this land use (associated with the activity being applied for) occur here at this point in time?	As explained in **Section 9.1**, several detached development options (each supplying a portion of the area) were identified as potential solutions to augment the water needs of the KZN Coastal Metropolitan Areas. The uMkhomazi River was identified as a potential viable source of water to augment the Mgeni WSS. As part of the uMkhomazi-Mgeni Transfer Pre-feasibility Study, various augmentation schemes were evaluated and it was found that the Smithfield and Impendle Schemes were most favourable from technical, economic and environmental reasons. According to the long-term water requirement projections and water balance of the Mgeni WSS, it is intended for the Smithfield Scheme (uMWP-1) to be implemented by 2023.

No.	Question	Response
3.	Does the community/area need the activity and the associated land use concerned (is it a societal priority)? This refers to the strategic as well as local level (e.g. development is a national priority, but within a specific local context it could be inappropriate)	The strategic need for the project is explained in **Section 3.2**. Within the context of the local community, the project is not a direct requirement as the affected areas form part of separate water supply systems. However, various engineering investigations found that the transfer of water from the uMkhomazi River to the existing Integrated Mgeni WSS was the best option to provide the required augmentation for this system's long-term water requirements. Localised impacts associated with the project (e.g. resettlement of households) are assessed in **Section 12**.
4.	Are the necessary services with appropriate capacity currently available (at the time of application), or must additional capacity be created to cater for the development?	Services required are explained in **Section 9.20**. The spoil material that will be generated by the project will be disposed of at dedicated sites that form part of this application. These spoil sites will be created and rehabilitated by DWS during the construction phase. Domestic waste will be transported and disposed of at the municipal waste facilities. Provision made for the realignment of roads that will be affected by Smithfield Dam.
5.	Is this development provided for in the infrastructure planning of the municipality, and if not what will the implication be on the infrastructure planning of the municipality (priority and placement of services)?	Although the uMWP-1 is acknowledged in the uMgungundlovu DM's IDP, it is listed as a project that will be implemented by other sectors and departments. Umgeni Water will possibly operate the uMWP-1 scheme once completed. The hydro-power potential of the transfer scheme is being assessed as part of the uMWP-1 Feasibility Study.
6.	Is this project part of a national programme to address an issue of national concern or importance?	As mentioned, the Integrated Mgeni WSS is the main water source that supplies about five million people and industries in the uMgungundlovu DM, eThekwini Municipality and Msunduzi LM, incorporating the greater Pietermaritzburg and Durban metropolitan areas. This is the third largest economic hub in SA with the second most people living in it. This project aims to increase the yield of this system to supply the long-term water requirements of these areas.
	DESIRABILITY ('placing')	
7.	Is the development the best practicable environmental option (BPEO) for this land/site?	A number of factors were considered in selecting the site for the Smithfield Dam, such as streamflow hydrology, geological conditions, topography, availability of construction material, seismic hazard, sediment yields, cost, etc. The BPEO is determined in **Section 13** and is based on a comparative analysis of the feasible alternatives.
8.	Would the approval of this application compromise the integrity of the existing approved municipal IDP and SDF as agreed to by the relevant authorities?	It is not anticipated that the proposed uMWP-1 will contradict or be in conflict with the municipal IDPs and SDFs (refer to discussion above and **Section 10.12**).

No.	Question	Response
9.	Would the approval of this application compromise the integrity of the existing environmental management priorities for the area (e.g. as defined in EMFs), and if so, can it be justified in terms of sustainability considerations?	The compatibility of the project with the Biodiversity Sector Plan for the uMgungundlovu DM, the KZN Systematic Conservation Plan, as well as other environmental management and planning tools were assessed as part of the EIA. The impact of this project on the free-flowing characteristics of the uMkhomazi River were also assessed in the EIA Report and as part of the Aquatic Impact Assessment.
10.	Do location factors favour this land use (associated with the activity applied for) at this place? (this relates to the contextualisation of the proposed land use on this site within its broader context).	As part of the technical analysis, a number of locational factors were considered in selecting the sites for the proposed Smithfield Dam and associated infrastructure, such as streamflow hydrology, geological conditions, topography, availability of construction material, seismic hazard, sediment yields, cost, etc. The specialist studies investigated the locations based on sensitive environmental features and receptors.
11.	How will the activity or the land use associated with the activity applied for, impact on sensitive natural and cultural areas (built and rural/natural environment)?	Refer to **Section 12** for an assessment of the project's potential impacts.
12.	How will the development impact on people's health and wellbeing (e.g. in terms of noise, odours, visual character and sense of place, etc.)?	
13	Will the proposed activity or the land use associated with the activity applied for, result in unacceptable opportunity costs?	Opportunity costs, which are associated with the net benefits forgone for the development alternative, were considered in the Socio-economic Study and cost-benefit analysis (**Section 12.22**).
14	Will the proposed land use result in unacceptable cumulative impacts?	Cumulative impacts are assessed in **Section 12.23**.

9 PROJECT DESCRIPTION AND ALTERNATIVES

9.1 Screened Alternatives

9.1.1 Measures to Increase the Water Resource

The information to follow was primarily sourced from the Water Reconciliation Strategy for the KZN Coastal Metropolitan Areas (DWA, 2009).

Due to the orientation and layout of the individual rivers flowing to the ocean and the stretched-out urban development along the coast, several detached development options (each supplying a portion of the area) were identified as potential solutions to augment the water needs of the KZN Coastal Metropolitan Areas. Numerous previous studies investigated these development options at varying levels of detail with the result that the implementation readiness of the developments varies.

9.1.1.1 Options for immediate and short-term implementation

Mgeni River System Supply Area

The supply areas receiving water from the Mgeni River System consist of the Mgeni System Coastal Supply Area (eThekwini Municipality) and the Mgeni System Inland Supply Area, comprising Mzunduzi LM as well as surrounding areas serviced by the water supply infrastructure managed by Umgeni Water.

Phase-2 of the Mooi-Mgeni Transfer Scheme (MMTS-2 - Spring Grove Dam and associated transfer infrastructure) will add 60 million cubic meters of water annually to the system yield.

South Coast Area

The water resources supplying the Ugu DM, located in the southern part of the area, are not sufficient with the results that substantial drought curtailments had to be implemented in the recent past.

Umgeni Water in its role as regional Water Services Provider implemented the South Coast Augmentation Pipeline (SCA) to augment the water supply of the South Coast System from the water resources of the Mgeni River System.

Augmentation options for the South Coast Area include the following:

- Ngwadini Off-channel Storage Dam;
- Lovu Desalination Plant; and
- A proposed weir on the Lower Umkhomazi River.

North Coast Metropolitan Area

The Mdloti River System with Hazelmere Dam, operated by Umgeni Water, is the primary water resource for the North Coast Metropolitan Area.

The projected water balance for the Mdloti River System indicates that augmentation of the water resources is necessary. The Reconciliation Strategy Study as well as feasibility studies conducted by the DWA Directorate: Options Analysis recommended that Hazelmere Dam should be raised to augment the water supply and reduce the risks of shortages.

Augmentation options for the South Coast Area include the following:

- Tongaat Desalination Plant; and
- Raising the Hazelmere Dam.

Far North Coast Supply Area

This covers the northern portion of the metropolitan area from Tongaat River to the Thukela River and forms part of the Ilembe DM. KwaDukuza is the main urban centre, which receives water from the Mvoti River as well as from Hazelmere Dam via a pipeline operated by Umgeni Water. The capacity of this pipeline is however insufficient to supply the water requirements and Umgeni Water is currently investigating the construction of a further pipeline to alleviate the short term water shortage.

9.1.1.2 Options for implementation over the medium and long term

The water requirement of the metropolitan areas is expected to continue to increase over the next 20 years and additional augmentation will be required.

Mgeni River System Supply Area

The following options were proposed:

- uMkhomazi-Mgeni Transfer Scheme consists of a proposed dam on the uMkhomazi River near Smithfield, with a tunnel to transfer the water to the Mgeni System. The Reconciliation Strategy Study confirmed through findings from previous investigations that the development of the water resources of the uMkhomazi River, for transfer to eThekwini Municipality should be investigated. The Feasibility Study for this scheme is currently underway, and of which this EIA forms part of.
- Indirect re-use of return flows from selected Waste Water Treatment Works of eThekwini Municipality. The implementation timeframe is 5 years.
- Desalination of sea water was also investigated. Initial results showed that desalination is more costly than the above options, however further investigations have indicated that the costs are significantly closer to the above options than initially calculated. It is proposed that the desalination of sea water should be investigated further in more detail.

North Coast and Far North Coast Supply Area

Due to the proximity of the Mvoti and Thukela rivers to the northern parts of the metropolitan area, possible developments on these rivers were found to be viable options that could supply the medium and long term future water requirements. It is therefore recommended to commission a detailed feasibility study to determine which water resource development is most beneficial to secure the future water requirements.

The following options are available:

- Transfers from two alternative options, either the Lower Thukela or the Mvoti Water Project. The functions of these alternative schemes are to supply the far north coast supply area and then transfer the available remaining yield to the north coast metropolitan area. The Lower Thukela Scheme includes the utilisation of the presently unused yield in the Lower Thukela and consists of abstraction works, pump station and transfer infrastructure. The Mvoti Development Scheme consists of a dam on the Mvoti River near IsiThundu; abstraction works, a pump station and associated transfer infrastructure.

- Use of treated effluent. The option includes the re-use from selected Waste Water Treatment Works to augment the water resources of the Mdloti River System (Hazelmere Dam).

9.1.1.3 Use of treated effluent

There are currently significant volumes of treated wastewater processed by municipalities that are either discharged directly or indirectly through the coastal rivers into the ocean. eThekwini Municipality has already successfully implemented re-use for industrial purposes. However, reconnaissance investigations show that by applying sophisticated filtration and treatment processes (addition to current wastewater treatment plants) further re-use seems plausible and economically comparable to other alternatives. A major advantage of the re-use is that it could be implemented over a significantly shorter time period, compared to large surface water augmentation options.

The total return flow volumes generated from the eThekwini and Msunduzi municipal areas in 2006 are 57% of the total water use (195.0 million m^3/annum). Of the total return flows generated, certain Waste Water Treatment Works were identified to be suitable for domestic re-use purposes based on their location, return flow volumes and the industrial portion of the effluent volume. Effluent with an industrial component of 10% or less was regarded as suitable for domestic re-use purposes and effluent with an industrial component of more than 10% as only suitable for industrial purposes.

9.1.2 Desalination and Re-use

Apart from the uMWP-1, the options under further investigation for supplying water to the region include:

- Desalinisation of sea water; and
- Re-use of treated effluent.

A study to investigate the feasibility of desalination of sea water as an option to provide additional domestic water is being undertaken by Umgeni Water. Preliminary indications suggest that desalination of sea water is still more expensive than other alternative options, although it is recognised that at some point in the not too distant future desalination of sea water may become economical. Seawater desalination may be of particular importance to the KZN Coastal Metropolitan Area because of very rapid growth and the high economic and environmental cost of additional surface water development.

There are two wastewater re-use projects under investigation, namely a study by eThekwini Municipality which will feed into the coastal zone and another study by Umgeni Water to feed into the Umlaas Road reservoir.

Both of these alternatives will form part of the overall decision on the most appropriate means of addressing water demands.

9.1.3 Use of Groundwater

Given that most of the ideal locations for surface water dams have been used in South Africa, groundwater resources are increasingly being used for potable water supply. There are however some challenges that accompany the sole use of groundwater in large water supply schemes such as the uMkhomazi Water Project.

Groundwater is the ideal water resource for rural water supply and water supply to small isolated towns and scattered villages, as found in the Eastern Cape. Sustainable groundwater sources such as perennial springs where present are also good sources of potable water supply to small villages at higher elevations and steep slopes in mountainous areas.

The most challenging aspect of using groundwater for the total water supply of the uMkhomazi water supply project is the total requirement of 220 million m^3/a. This equates to ±6 976 ℓ/s. It is unlikely that groundwater can supply such a large volume without having an immense network of successfully sited boreholes at high density across the whole study area. Extensive pipeline networks to the different boreholes are required and this also places a large burden on the maintenance of such schemes.

Aquifers are continually filled/recharged from rainfall as surface water dams are continually filled from direct precipitation and runoff from rainfall. Another challenge in groundwater is the inability to construct an adequately spaced production borehole network to abstract all the groundwater recharged to an aquifer. This is largely due to factors such as the low permeability or transmissivity of some aquifer units, aquifer heterogeneity, inaccessibility of some terrain to drilling rigs as well as unknown aquifer boundary conditions (DWA, 2005).

The total recharge based on a lower 95 % assurance is 316 million m^3/a. A yield of 220 million m^3/a would represent 70% of recharge, which is a very high abstraction ratio. Apart from this, the borehole yields are very low at ±1 ℓ/s, which would require +6 900 boreholes across the uMkhomazi River catchment area. This would be a physically impractical task, taking the piping and electrical reticulation into account. It would require a borehole drilled every 800 m if it would be done on a grid, which given the limits imposed by the topography, would be impossible.

Conjunctive use is recommended where groundwater is developed along surface water infrastructure to supplement surface water and for rural water supply.

9.1.4 Water Conservation & Water Demand Management

This section was extracted from the Umgeni Water Infrastructure Master Plan of 2014.

Water Demand Management (WDM) initiatives are the quickest measure to implement and have the effect of lowering the demand curve and thereby either reducing the deficit or by delaying the need to implement other measures. However, the extent of the success to be achieved through the implementation of WDM initiatives is very difficult to predict accurately beforehand, and once achieved is difficult to maintain unless it is constantly monitored and managed.

9.1.4.1 eThekwini Municipality

eThekwini Municipality has, in the past, implemented a wide range of WDM initiatives and these had a marked impact on the demand requirements from the Mgeni system. This is clearly evident in the current downturn in the demand curve in **Figure 18**.

Notwithstanding these initiatives, it is evident in both **Figure 18** and **Figure 19** that the long-term projection still anticipates a growth in water demand for the region where economic development and improved levels of water service will outweigh any savings achieved through the WDM initiatives.

eThekwini Municipality do not believe that their water demand management initiatives will further reduce sales figures and have predicted an increase in demand from 866 Mℓ/day to 874 Mℓ/day over the 2013/2014 financial year and to 889 Mℓ/day in 2014/2015. The historical sales and future demand projection for eThekwini Municipality are presented in **Figure 20**.

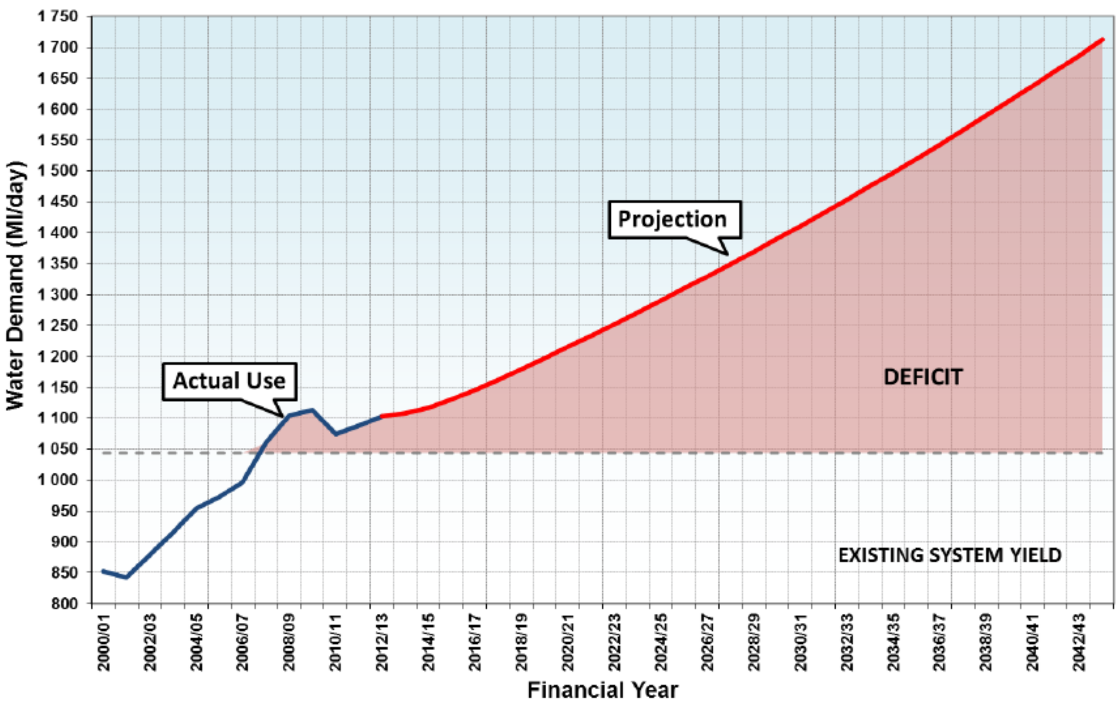


Figure 18: Mgeni System – Existing Water Balance (Umgeni Water, 2014)

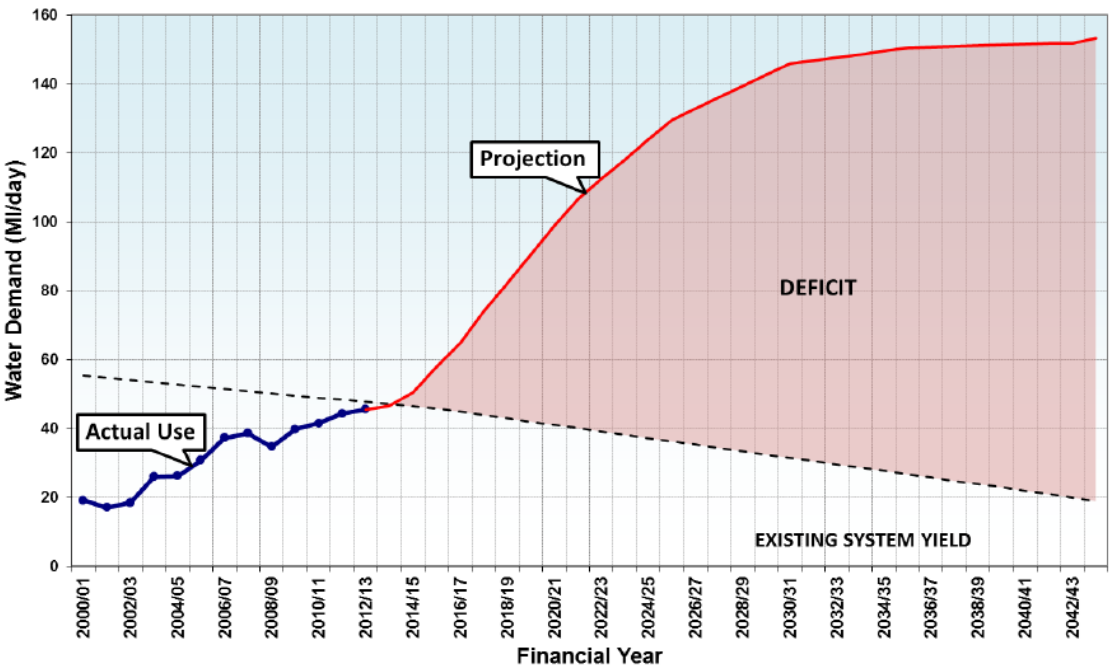


Figure 19: Mdloti System – Existing Water Balance (Umgeni Water, 2014)

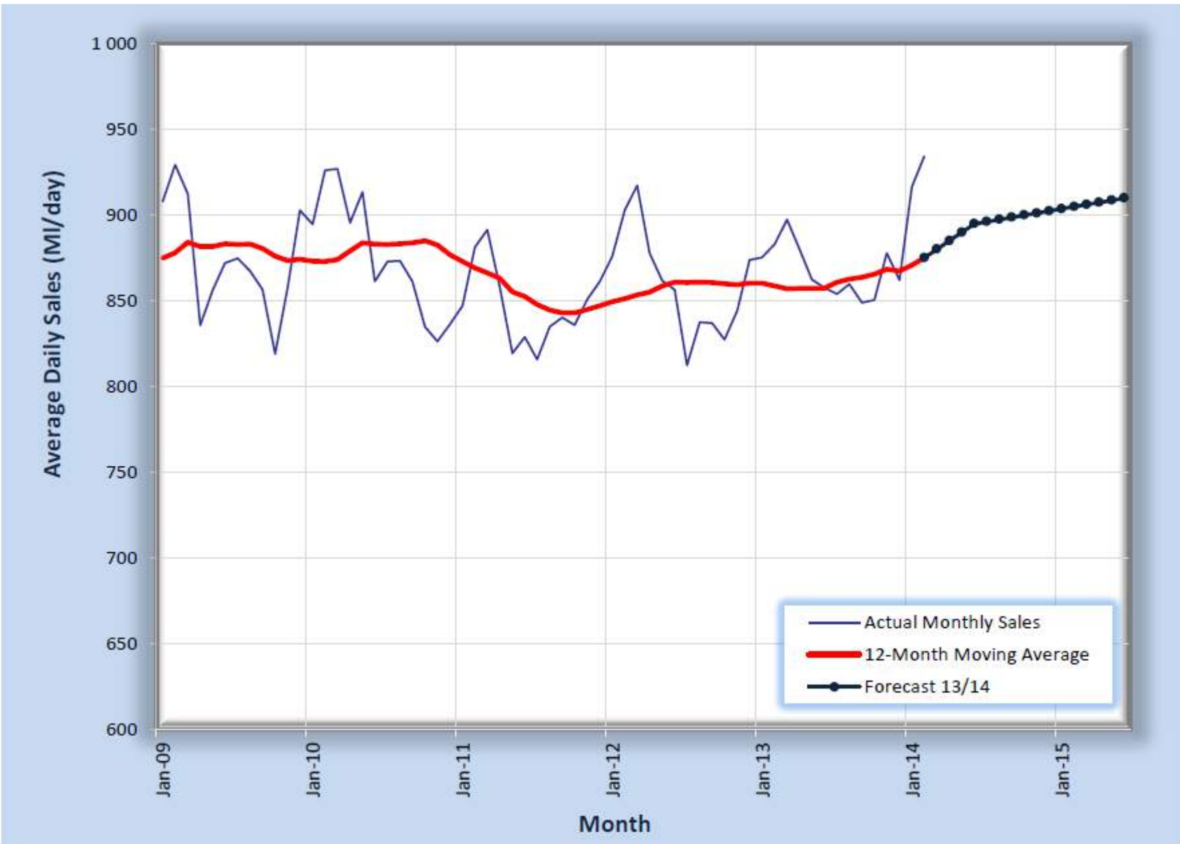


Figure 20: eThekwini Municipality Total Volumes - Annual short-term forecast (Umgeni Water, 2014)

9.1.4.2 Msunduzi Municipality

The water sales to Msunduzi Municipality decreased by 0.6% from 178 Mℓ/day in the 2011/2012 financial year to 177 Mℓ/day in 2012/2013.

The projected demands for 2012/2013 were determined in consultation with the municipality and it was agreed that the demand will decrease at a rate of 0.5% for the short term forecast, due mainly to the intensive water demand reduction programme being implemented by the municipality.

9.1.4.3 iLembe DM

ilembe DM is implementing a number of WDM initiatives within the town of KwaDukuza (Stanger) as well as the Ndwedwe area. It is estimated that savings from these initiatives will offset the growth in sales for the area. However, at the request of iLembe DM, the KwaShangase and KwaChilli areas will be linked to the Ndwedwe Reservoir Supply System off Reservoir 5. This is an interim supply option pending the findings of the Detailed Feasibility Study for a Bulk Water Supply Scheme for the Southern Ndwedwe area.

It is predicted that a 5.5 percent growth rate in the 2013/2014 (38 Mℓ/day) financial year and a -1.6 percent growth rate thereafter in 2014/2015 (37.5 Mℓ/day) will occur. The negative growth rate is attributed to the WDM initiatives and a restricted growth. This restricted growth is due to the limited resource of the Mvoti WTW and an increase in demand will only be experienced when the Lower uThukela Bulk Water Supply Scheme is commissioned during 2016. **Figure 21** shows iLembe’s historical and projected total sales.

After discovering concerning levels of water loss, around 75%, in the Maqumbi area (Maphumulo WTW supply system), iLembe DM started implementing WDM initiatives to this area as well.

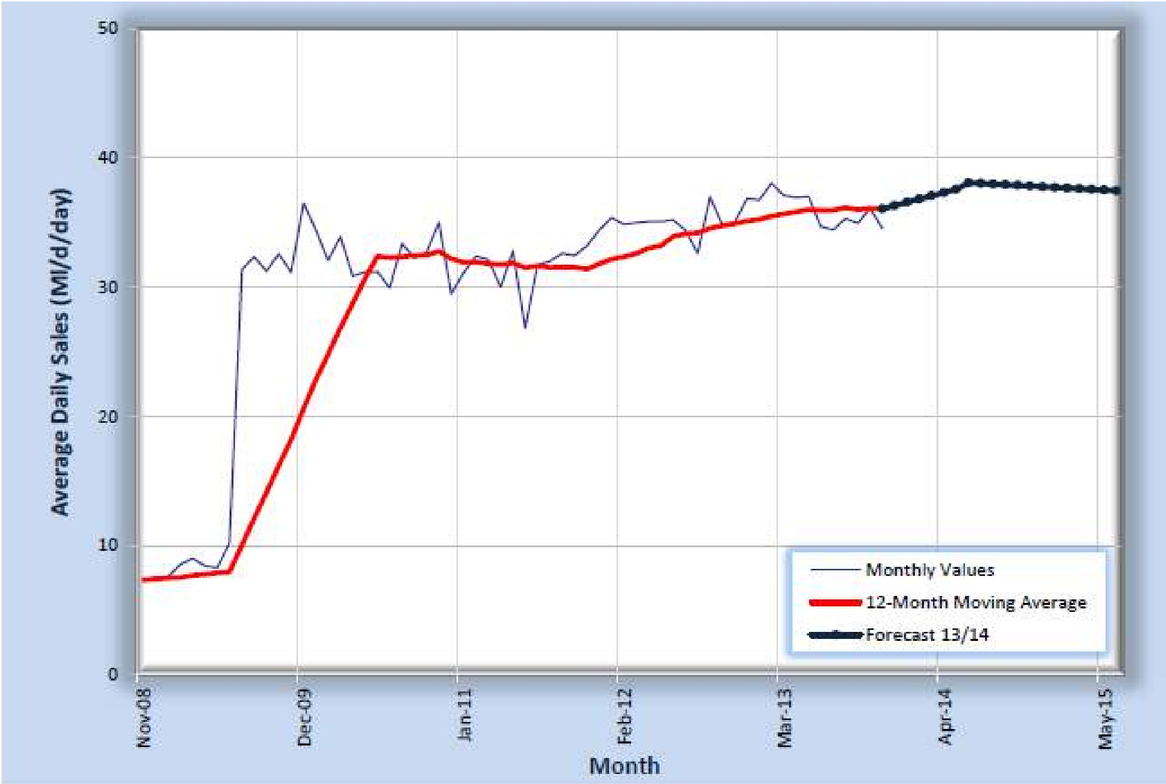


Figure 21: **iLembe DM Total Sales Volumes - Annual short-term forecast (Umgeni Water, 2014)**

9.1.4.4 Ugu DM

Ugu DM has embarked on a number of water demand management initiatives. However, these are mainly in the Lower South Coast region area of supply and hence these are not expected to have a major impact on projected water demand growth rates, which are estimated at 2.2% in the 2013/2014 financial year and 2% in 2014/2015 (**Figure 22**).

Ugu DM highlighted potential growth of sales to the Middle South Coast following the commissioning of the South Coast Pipeline. The full potential will be available once the Phase 2b is commissioned.

This expected growth would be as a result of Ugu DM's proposed initiatives towards the reduction of backlogs. Rapid growth in water sales in the inland rural areas of the municipality, specifically in the Greater Vulamehlo, Ifafa and Mathulini areas are thus expected.

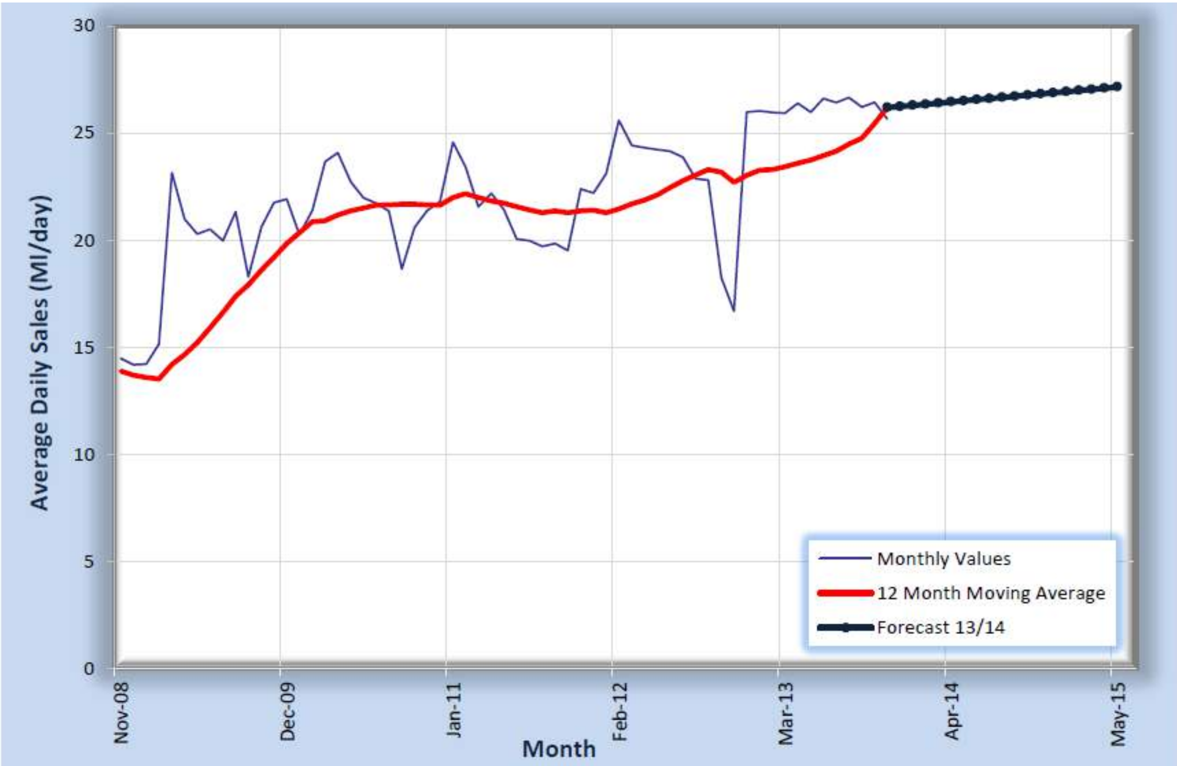


Figure 22: **Ugu DM Total Sales Volumes - Annual short-term forecast (Umgeni Water, 2014)**

9.1.4.5 Harry Gwala DM

The Ixopo WTW supplies the Greater Ixopo area. Average daily sales from the WTW currently amount to approximately 2.4 Mℓ/day. This is a year-on-year decline of 8.93% from 2012, which is attributed to WDM efforts by the municipality that include projects to replace the ageing and leaking potable reticulation infrastructure within Ixopo. Areas with high leaks, like Fairview, are also isolated from the reticulation system during non-peak times.

Following discussions with the municipality and due to the potential development within the town of Ixopo, the projection for Harry Gwala DM has been set at a 1% growth (**Figure 23**).

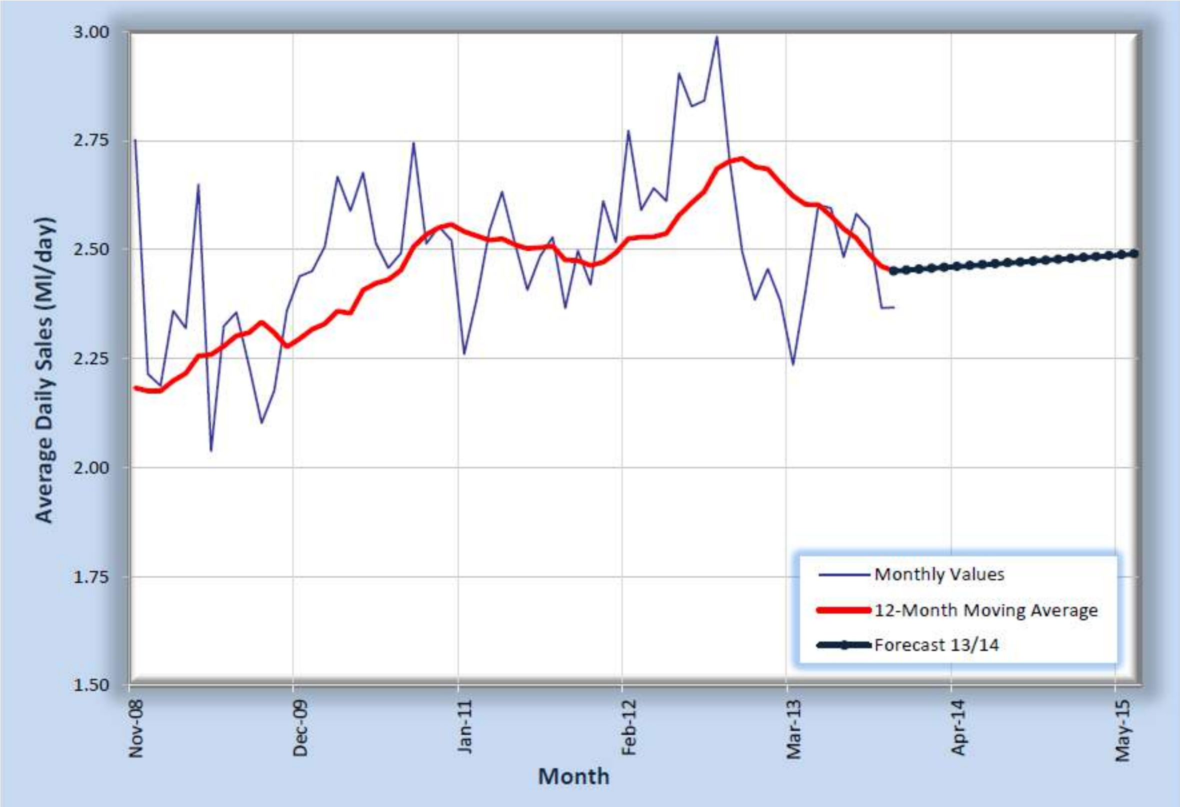


Figure 23: **Harry Gwala DM Total Sales Volumes - Annual short-term forecast (Umgeni Water, 2014)**

9.1.5 uMkhomazi-Mgeni Transfer Scheme

The information contained below was sourced from the uMkhomazi-Mgeni Transfer Scheme Pre-Feasibility Study (DWAF, 1999a).

The Pre-feasibility Study follows on from the Mgeni River System Analysis Study carried out between 1991 and 1994, in which the uMkhomazi 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 included *inter alia* a pre-feasibility investigation of augmentation schemes on the uMkhomazi River preceded by scheme identification and reconnaissance investigations. In the Scheme Identification phase the following eight schemes were identified (as shown in **Figure 24**).

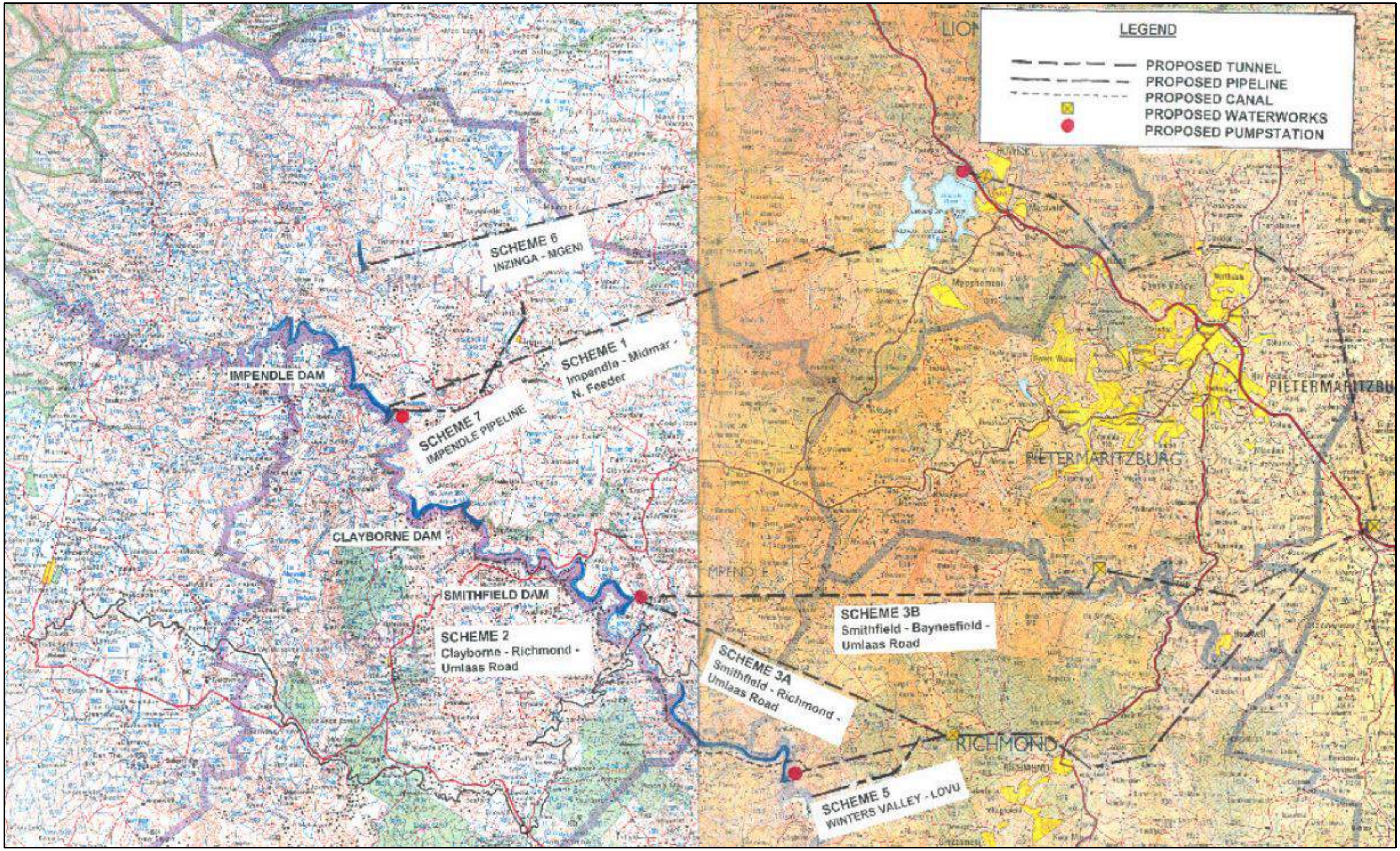


Figure 24: **Layout of Schemes considered during Pre-feasibility Study (DWAF, 1999a)**

1. *Impendle Scheme (Scheme 1)*

This scheme was originally identified by DWA and for the purposes of this study, it was assumed that the scheme would be configured as follows:

- Rockfill dam with side channel spillway and capacity of 200 million m^3, near Inzinga River confluence.
- Gravity tunnel to Midmar Dam.
- Pipeline and low lift pumpstation to extension of Midmar Waterworks.
- Clearwater gravity conveyance (existing and upgraded pipelines and Midmar Tunnel) to Umlaas Road.

2. *Clayborne Scheme (Scheme 2)*

This scheme was identified by Umgeni Water and modified to include limited pumping not allowed for in the original configuration. The selected configuration is as follows:

- Rockfill dam with side channel spillway and capacity of 170 million m^3, approximately 10 km downstream of Impendle.
- 66 km of canals and 8 km of gravity tunnels to Lovu River near Richmond, including a low lift pumpstation and shaft.
- Waterworks and gravity pipeline to Umlaas Road.

3. *Smithfield-Richmond Scheme (Scheme 3A)*

This scheme was identified in the System Analysis Study, but required major modification to deliver water to Umlaas Road. Its revised configuration is as follows:

- Rockfill dam with side channel spillway and capacity of 170 million m^3 at Smithfield.
- Pumpstation and shaft (85 m head) feeding 25 km gravity tunnel to Lovu River near Richmond.
- Waterworks and pipeline as per Clayborne Scheme.

4. *Smithfield-Baynesfield Scheme (Scheme 3B)*

This scheme is a variation of Scheme 3A, as follows:

- Rockfill dam as above.

- Pumpstation and shaft (25 m head) feeding a 32 km gravity tunnel to the uMlaza River at Baynesfield.
- Waterworks and pipeline to Umlaas Road.

5. *Ndonyane Scheme (Scheme 4)*

This scheme was not previously identified. Its configuration is as follows:

- Rockfill dam with side channel spillway and capacity of 160 million m^3 at Ndonyane.
- Pumpstation and shaft (340 m head) feeding 14 km gravity tunnel to Lovu River near Richmond.
- Waterworks and clearwater conveyance as per Scheme 3A.

6. *Winters Valley-Lovu (Scheme 5)*

This scheme was identified by Umgeni Water and is configured as follows:

- Weir on the uMkhomazi at Winters Valley.
- Canal and multiple stage pumping via a pipeline across the divide between the uMkhomazi and Lovu catchments.
- Waterworks and clearwater conveyance as per Scheme 3A.

This scheme was eliminated as it relies on run-of-river, which cannot supply a regional waterworks and related conveyance infrastructure at sufficiently high levels of assurance to be viable.

7. *Inzinga-Mgeni (Scheme 6)*

This scheme was not previously identified and consists of the following:

- Dam on Inzinga River near Brooklyn.
- Gravity tunnel 24 km long to upper reaches of Mgeni River.
- Waterworks and clearwater conveyance system as per Scheme 1.

This scheme was eliminated as its yield would be too small to justify the capital cost of a 24 km tunnel. There would also be environmental problems associated with transfers into the Mgeni Vlei.

8. *Impendle Pipeline (Scheme 7)*

As an alternative to Scheme 1, DWA suggested that a smaller scheme without a tunnel should be considered. The configuration is as follows:

- Small dam at Impendle site.
- Pumpstation and pipeline (head 600 m) across watershed to Mgeni catchment.
- Waterworks and clearwater conveyance as per Scheme 1.

This scheme was eliminated on the basis of the extremely high pumping head. There would also be environmental problems associated with discharging water into sensitive vlei areas

Three of the above schemes were eliminated during an initial screening process on mainly technical grounds (refer to **Table 10**).

Table 10: Pre-feasibility Study - Scheme Comparison: Scheme Identification Phase **(DWAF, 1999a)**

Scheme	Advantages	Disadvantages
1: Impendle	❖ Very limited pumping ❖ Probably least impact on estuary ❖ Least impact of conveyance and waterworks ❖ Centralised system simplifies operation	❖ Highest capital cost and Unit Reference Value ❖ Yield limited by MAR ❖ Centralised system entails greater risks
2: Clayborne	❖ Limited pumping ❖ Scope for supplying irrigation along canal route	❖ Second highest capital cost and third highest Unit Reference Value (URV) ❖ Limited scope for phasing of canal ❖ High social and environmental impacts of canal ❖ High maintenance costs of canal
3A: Smithfield-Richmond	❖ Lowest capital cost and second lowest URV ❖ Greater yield than Impendle	❖ Relatively high pumping head ❖ Maximum size limited by topography ❖ Second dam required for future phases
3B: Smithfield-Baynesfield	❖ Second lowest capital cost and lowest URV ❖ Greater yield than Impendle ❖ Low pumping head	❖ Maximum size limited by topography ❖ Second dam required for future phases
4: Ndonyane	❖ Potentially highest yield of schemes evaluated	❖ Very high pumping head ❖ Relatively high capital cost and second highest URV ❖ Dam basin relatively pristine
5: Winters Valley-Lovu	❖ Low capital cost	❖ Very high pumping head ❖ Inadequate assurance of supply for scheme to be viable

Scheme	Advantages	Disadvantages
6: Inzinga-Mgeni	❖	❖ Inadequate yield vs. capital cost for scheme to be viable
7: Impendle Pipeline	❖ Low capital cost	❖ Unacceptably high pumping head ❖ Unacceptable negative impact on receiving stream ❖ Low yield

Note: Shading indicates schemes which were eliminated from further investigation and points considered critical are underlined.

The remaining five schemes, all sized to generate an historical firm yield of 200 million m^3/a, were subjected to further technical and economic evaluation. This secondary screening identified significant flaws in two of the five remaining schemes, but the results of the economic analysis were inconclusive and it was considered inappropriate to eliminate any of these schemes without further investigation.

The remaining five schemes were then subjected to a pre-reconnaissance assessment, in which the schemes were refined, with particular emphasis on phasing. An environmental scoping exercise was also carried out. These schemes consist of dams, clear and raw water conveyances consisting of tunnels, pipelines and, in one case, canals, pumpstations, and water treatment works. Based on environmental and economic considerations (refer to **Table 11**), one of the schemes was eliminated and a second was identified as probably being environmentally unacceptable, but requiring further investigation to confirm this.

Table 11: Pre-feasibility Study - Scheme Comparison: Pre-Reconnaissance Phase **(DWAF, 1999a)**

Scheme	Advantages	Disadvantages
1: Impendle	❖ Very limited pumping ❖ Probably least impact on estuary ❖ Least environmental impact of conveyance and waterworks ❖ Centralised system simplifies operation	❖ Third highest URV ❖ Yield limited by MAR ❖ Centralised system entails greater risks
2: Clayborne	❖ Limited pumping ❖ Scope for supplying irrigation along canal route	❖ Highest URV ❖ Limited scope for phasing of canal ❖ Unacceptably high social and environmental impacts of canal ❖ High maintenance costs of canal and risk of interruption of supply due to instability ❖ Possible instability on dam site
3A: Smithfield-Richmond	❖ Second lowest URV ❖ Greater yield than Impendle	❖ Relatively high pumping head ❖ Maximum size limited by topography ❖ Second dam required for future phases

Scheme	Advantages	Disadvantages
3B: Smithfield-Baynesfield	❖ Lowest URV ❖ Greater yield than Impendle ❖ Low pumping head	❖ Maximum size limited by topography ❖ Second dam required for future phases
4: Ndonyane	❖ Potentially highest yield of schemes evaluated	❖ Very high pumping head ❖ Highest capital cost and second highest URV ❖ Dam probably has greatest environmental impact

Note: Shading indicates schemes which were eliminated from further investigation and points considered critical are underlined.

Three of the remaining schemes were assessed at reconnaissance level (see **Figure 25**), while a habitat integrity and preliminary geotechnical assessment was carried out on the fourth. The schemes were refined, with allowance made for peak demand factors. Geotechnical assessments of the dam sites and tunnel routes were carried out, as were Initial Environmental Assessments.

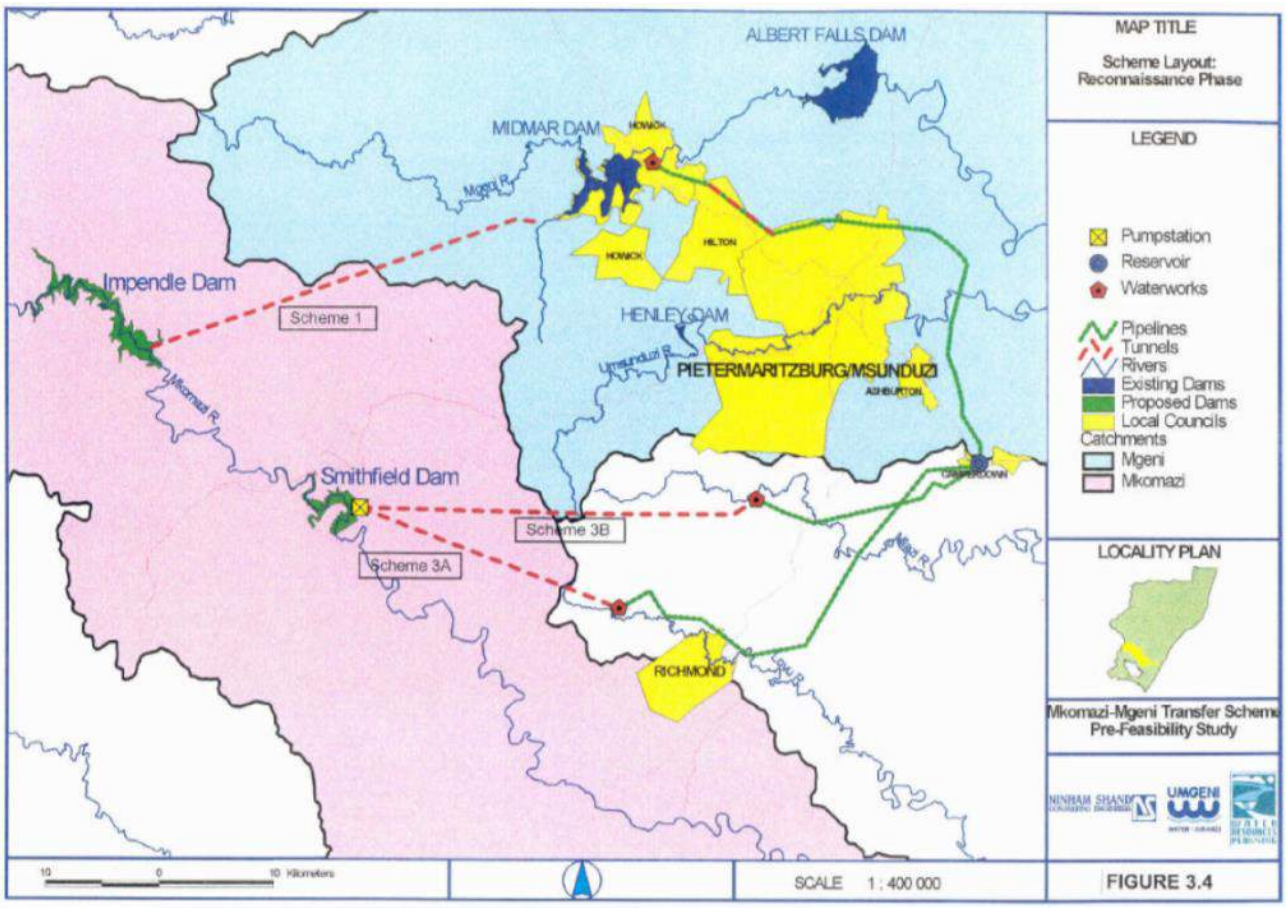


Figure 25: **Layout of Schemes - Reconnaissance Phase (DWAF, 1999a)**

Technically, the three primary schemes were found to be feasible, and economically the schemes lay within a relatively small range. The environmental assessment confirmed that the fourth scheme would be unacceptable. It was therefore decided to eliminate this scheme, along with the least economical of the remaining three schemes (see **Table 12**), from further investigation and to proceed to pre-feasibility phase with two schemes, namely the Impendle Scheme and Smithfield Scheme.

Table 12: Pre-feasibility Study - Scheme Comparison: Reconnaissance Phase (DWAF, 1999a)

Scheme	Advantages	Disadvantages
1: Impendle	❖ Very limited pumping ❖ Low running costs ❖ Impact of waterworks and conveyance system minimised by using Midmar site and northern feeder ❖ Infrastructure is centralised: Ease of operation ❖ More scope for spin-off development of rural areas ❖ Second lowest URV	❖ Yield limited by Mean Annual Runoff ❖ Probable technical difficulties in raising dam ❖ Relatively high initial capital cost ❖ Vulnerability of centralised infrastructure
3A: Smithfield-Richmond	❖ Larger yield than Impendle Scheme ❖ Would create more permanent employment than Impendle Scheme	❖ Requires two dams: Greater environmental impact ❖ Requires major excavation at high point on pipeline route ❖ Waterworks site not ideal topographically ❖ Relatively high pumping head ❖ Highest URV
3B: Smithfield-Baynesfield	❖ Larger yield than Impendle ❖ Relatively low pumping head and running costs ❖ Pipeline route and waterworks site not problematic ❖ Lowest URV ❖ Would create more permanent employment than Impendle Scheme	❖ Requires two dams: Greater environmental impact

Note: Shading indicates schemes which were eliminated from further investigation.

The relative environmental impact ratings of the Smithfield and Impendle Schemes are given in **Table 13** and a comparison of the technical and economic aspects is provided in **Table 14**.

Table 13: Pre-feasibility Study – Environmental Impact Ratings (DWAF, 1999a)

Component	No Development	Impendle Scheme	Smithfield Scheme
Social			
Basins (including Recreation)		Significant impacts on Makhuzeni community as basin relatively densely settled. **3**	Incremental impacts associated with inundation of Smithfield basin relatively low but potential for densification high. However, combined impacts of both basins high. **3,5**
Transfer Infrastructure		Predominantly an upgrade of existing infrastructure i.e. brownfields development. **1,5**	Extensive green-fields development. Predominantly low density agricultural land use. **2**
Waterworks		Upgrade of existing facility. **0,5**	Development of new facility. **1**
Employment	Impact on GGP and employment **4,5**	Minimal	Minimal
Bio-physical			
Basins		Basin extensively modified **1,5**	Basins extensively modified. **2**
IFR's* and EFR's**		Dam designed to meet requirements. Location in upper catchment also reduces impacts. **1,5**	Dams designed to meet requirements. Operation of two dams introduces some complexities and location lower down in catchment reduces ability of mitigation through incremental run-off. **2**
Transfer Infrastructure		Relatively modified landscape - mostly brownfields development. **1,5**	Mostly green-fields development, however, landscape modified through agricultural activities. **2**
Waterworks		Upgrade of existing works. **0,5**	Development of new works. **1**
Overall Rating	**4,5**	**2,0**	**2,5**

* IFR's = Instream Flow Requirements
** EFR's = Estuarine Freshwater Requirements
Impact Rating Scale (incorporates components of magnitude and significance)
1 = low;
2 = moderate;
3 = high;
4 = very high;
5 = fatally flawed

According to DWA (1999a), it is clear from the environmental impact ratings that the Non-augmentation option is not worthy of further consideration. Overall, the Smithfield Scheme has a marginally higher impact rating, but this is still only Moderate-High versus Moderate for the Impendle Scheme. The higher rating can be attributed to the fact that two dams will have to be constructed and that the conveyance and treatment infrastructure involves greenfields development. However, the lower yield of the Impendle

Scheme will require augmentation earlier than the Smithfield Scheme and the potential exists, albeit small, of a future dam on the lower uMkhomazi, which would definitely not be viable in the case of the Smithfield Scheme. The construction of such a dam would reverse the relative ratings.

Table 14: Pre-feasibility Study - Scheme Comparison: Technical & Economic (DWAF, 1999a)

IMPENDLE SCHEME		SMITHFIELD SCHEME	
Issue	**Significance**	**Issue**	**Significance**
20% less ultimate yield than Smithfield	4	Higher pumping head/greater dependence on pumping	2
Potential instability at Midmar/Ferncliffe Tunnel outlet	2	No surcharge capability	1
No redundancy in supply to Pietermaritzburg and Umlaas Road	4	Requires entirely new operational infrastructure	2
Complex ultimate operating system	3	Possible problems with tunnel maintenance downtime due to limited balancing storage	3
Greater risk of failure to supply	3		
10 % greater Unit Reference Value	4		

Note: 1. For each issue, the scheme with the better characteristics for that particular issue is taken as the benchmark and the significance of the difference is rated for the less favourable scheme.
2. The significance of the issues are rated on a scale of 1 to 5.

The technical and economic comparison of the schemes is dominated by the lower yield of the Impendle Scheme, which, in turn results in the Impendle Scheme being less economical than the Smithfield Scheme. The higher URV of the Impendle Scheme and the need to implement the next augmentation scheme earlier result in a total additional Net Present Value of costs of approximately R180 million.

Clearly, very significant ecological and social mitigation measures could be implemented in order to reduce the impacts of the Smithfield Scheme for a fraction of this cost. It should also be noted that the Smithfield Scheme provides greater flexibility with respect to possible future transfers from the Umzimkulu River.

In the light of the above, the Pre-feasibility Study recommended that the Impendle Scheme be eliminated from further investigation and that the Smithfield Scheme be taken forward to the next phase of investigation in a detailed Feasibility Study.

9.2 Overview of uMWP-1 Raw Water Infrastructure and Alternatives

uMWP-1 entails the transfer of water from the undeveloped uMkhomazi River to the existing Integrated Mgeni WSS. As explained in **Section 9.1**, this transfer scheme is deemed to be the most viable option to provide a large volume of water to fulfil the long-term water requirements of this system.

The uMWP-1 consists of both Raw Water and Potable Water components which are being undertaken by DWS and Umgeni Water, respectively. To assist with the overview of the project components, a simplified diagrammatic representation of the overall transfer scheme is provided in **Figure 26**. As mentioned, this report only focuses on the uMWP-1 Raw Water component.

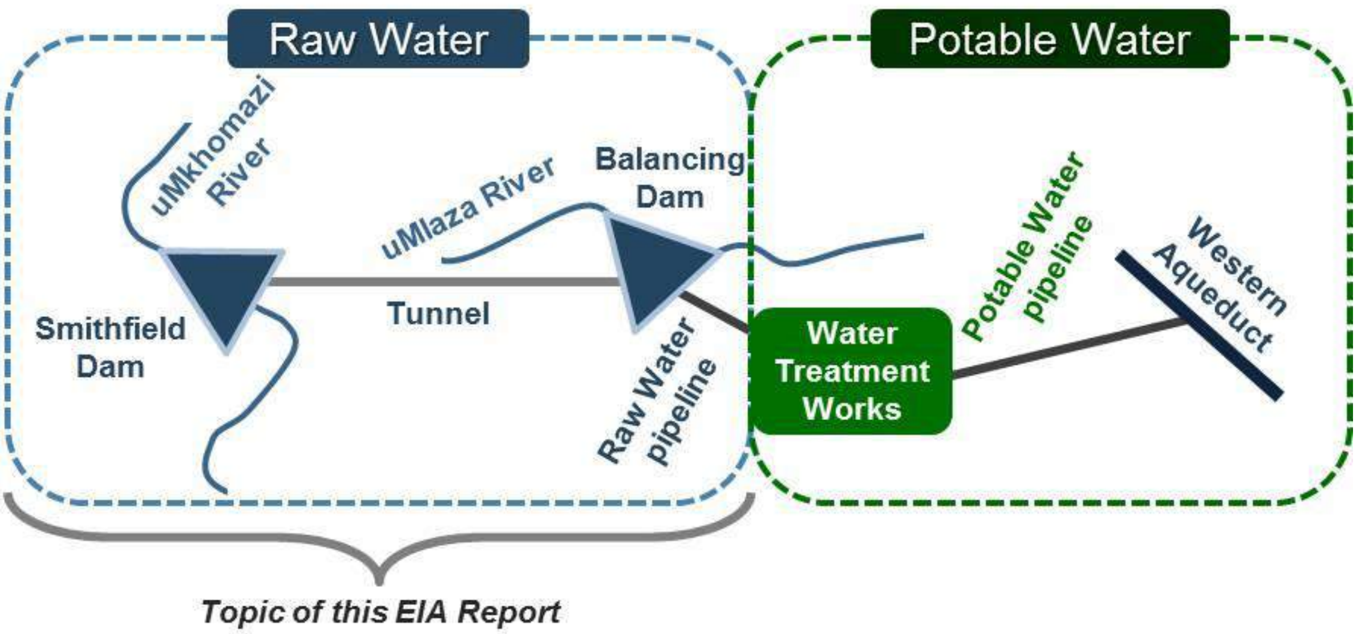


Figure 26: Simplified diagram of uMWP-1 components

The uMWP-1 Raw Water components, including the associated infrastructure and activities, are listed in **Table 15**. The identified alternatives, which are comparatively assessed in **Section 13**, are listed in **Table 16** and shown in **Figures 27 - 28**.

The technical information presented in the sections to follow was primarily sourced from the Technical Feasibility Study.

Table 15: uMWP-1 Raw Water Project Components and Related Activities

Raw Water Component	Associated Infrastructure	Associated Activities (simplified)
Smithfield Dam	22. Dam embankment 23. Saddle dam embankment 24. Spillway (including approach area and plunge pool) 25. Tunnel intake tower 26. Dam outlet works (including dam intake tower, tunnel and outlet valve house) 27. Deviation of the R617 28. Access road to Nonguqa 29. Access road to intake tower 30. Access road to tunnel inlet portal 31. Access road to damwall 32. Construction roads 33. Relocation of power line 34. Relocation of telephone lines 35. Quarries and earthfill borrow areas 36. Substation 37. Operator's offices 38. Gauging weir 39. Access road to gauging weir 40. Hydropower plant 41. Spoil site - inlet 42. Construction and permanent housing	❖ Site clearing and establishment ❖ Construction camp ❖ Construction accommodation ❖ Hauling of material ❖ Storage ❖ Related construction activities ❖ Impoundment of basin ❖ Operation and maintenance
Raw Water Conveyance Infrastructure	13. Tunnel 14. Tunnel intake tower 15. Raw water pipeline 16. Spoil sites (inlet, outlet and central portals) 17. Access road to Shaft 1 18. Access road to Shaft 2 19. Access road to Shaft 3 20. Access road to adit entry 21. Access road to tunnel outlet portal 22. Ventilation shaft 23. Adits 24. Hydropower plant	❖ Site clearing and establishment ❖ Drilling ❖ Hauling and disposal of spoil material ❖ Related construction activities ❖ Operation and maintenance
Balancing Dam	9. Dam embankment 10. Spillway 11. Bottom outlet / intake 12. Relocation of roads 13. Access roads 14. Quarry and earthfill borrow area 15. Construction and permanent housing 16. Spoil site - outlet	❖ Related construction activities ❖ Construction camp ❖ Construction accommodation ❖ Operation and maintenance

The main uMWP-1 Raw Water components and the related alternatives are discussed in the sections to follow. This information was primarily sourced from the uMWP-1: Module 1: Technical Feasibility Study Raw Water. As discussed, the dimensions and layout of the infrastructure may change as the technical study advances through the detailed design stage if Environmental Authorisation is obtained. All dimensions should thus be regarded as approximates.

Table 16: uMWP-1 Raw Water Components and Alternatives

<table>
<tr><th colspan="3">Components</th><th>Alternatives</th></tr>
<tr><td rowspan="10">Smithfield Dam Area</td><td colspan="2">Major storage dam - Smithfield Dam
(Full Supply Level & Purchase Line)</td><td>-</td></tr>
<tr><td colspan="2" rowspan="2">Relocation of Eskom Transmission Line</td><td>1. Option 1 (across the dam)</td></tr>
<tr><td>2. Option 2 (around the SE side of the dam)</td></tr>
<tr><td colspan="2" rowspan="2">Gauging weir
(downstream and close to Smithfield Dam - U10F)</td><td>1. Option 1</td></tr>
<tr><td>2. Option 2</td></tr>
<tr><td>Roads – Smithfield Dam</td><td>• Deviation of the R617
• Road to Nonguqa
• Access road to intake tower
• Access road to tunnel inlet portal
• Access road to dam wall
• Construction roads</td><td>-</td></tr>
<tr><td>Quarries & Borrow Areas – Smithfield Dam</td><td>• Quarries -
o Quarry I
o Quarry II
o Quarry III
o Quarry IV
• Borrow areas -
o Borrow area A
o Borrow Area B
o Borrow Area C</td><td>• Aggregates: Midmar crushers (51.5km from SD; 66.8km from LBD)
• Aggregates: Natal crushers (83.5km from SD; 44.2km from LBD)
• Natural sand: NPC (153km from SD; 87.2km from LBD)</td></tr>
<tr><td colspan="2">Construction camp – Smithfield Dam</td><td>-</td></tr>
<tr><td colspan="2">Hydropower plant – Smithfield Dam</td><td>-</td></tr>
<tr style="display:none"><td></td></tr>
<tr><td rowspan="14">Conveyance Infrastructure</td><td colspan="2">Tunnel</td><td>-</td></tr>
<tr><td colspan="2" rowspan="3">Raw water pipeline</td><td>1. Route to WTW Option 1</td></tr>
<tr><td>2. Route to WTW Option 2</td></tr>
<tr><td>3. Route to WTW Option 3</td></tr>
<tr><td colspan="2">Ventilation shafts</td><td>-</td></tr>
<tr><td colspan="2">Adits</td><td>-</td></tr>
<tr><td colspan="2">Access roads - shafts</td><td>-</td></tr>
<tr><td colspan="2">Access roads - adits</td><td>-</td></tr>
<tr><td colspan="2">Tunnel outlet</td><td>-</td></tr>
<tr><td colspan="2">Hydropower plant – conveyance infrastructure</td><td>-</td></tr>
<tr><td rowspan="3">Spoil / waste disposal sites
(i.e. spoil areas)</td><td>Inlet portal (upstream)</td><td>-</td></tr>
<tr><td rowspan="2">Outlet portal (downstream)</td><td>1. Option 1: Position 1</td></tr>
<tr><td>2. Option 2: Spoil to be used in balancing dam wall</td></tr>
</table>

Components			Alternatives
		Central portal	**-**
Balancing Dam Area	**Balancing dam** (Full Supply Level & Purchase Line)		1. Dam upstream of Mbangweni Dam 2. Langa Balancing Dam
	Approach Area (Langa BD)		-
	Spillway chute (Langa BD)		-
	Road – Balancing Dam		1. Option 1 2. Option 2
	Construction camp – Balancing Dam		-
	Quarries & Borrow Areas – Balancing Dam	Quarry & borrow area 1	• Aggregates • Natural sand

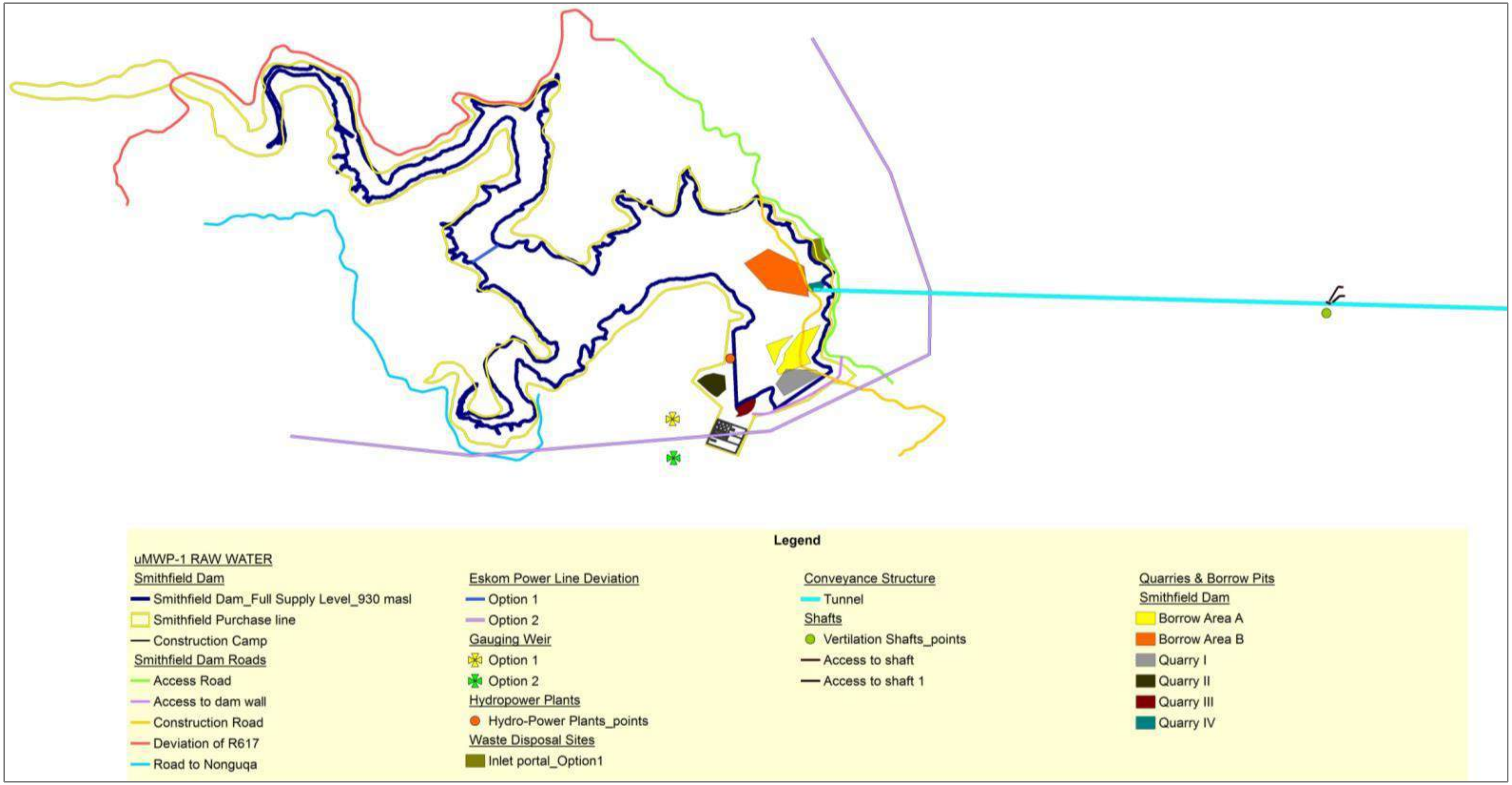


Figure 27: **uMWP-1 Raw Water components and alternatives (western side)**

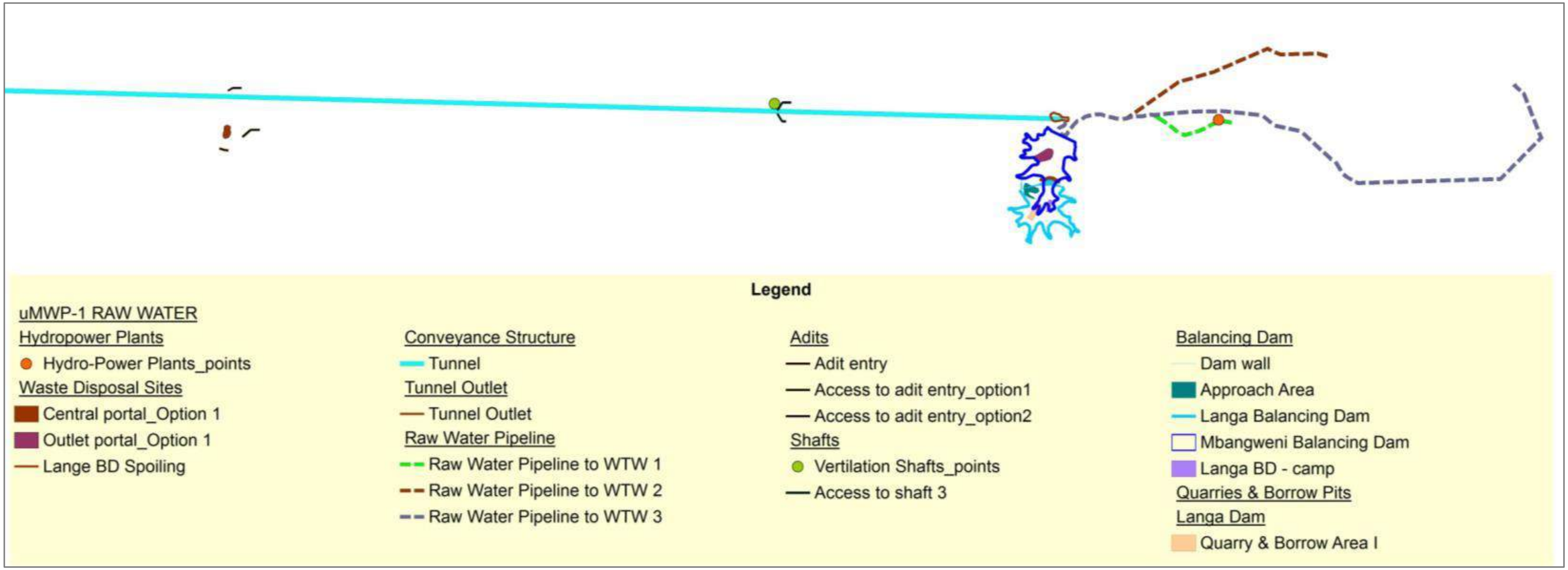


Figure 28: uMWP-1 Raw Water components and alternatives (eastern side)

9.3 Smithfield Dam

9.3.1 General

As part of the scheme, a new dam (called Smithfield Dam) is proposed on the uMkhomazi River, approximately midway between the Lundy's Hill bridge and Deepdale bridge (see **Figure 29**).

Figure 29: Dam site on the uMkhomazi River

The layout and sections of Smithfield Dam and the saddle dam are provided in **Appendix F**.

The proposed dam will most probably include the following (to be confirmed during design):

- An earth core rockfill dam (Main Dam) constructed with residual dolerite earthfill core and dolerite rockfill in the outer zones;

- A primary side channel spillway with a gravity weir structure, chute and ski jump structure;
- A secondary fuse plug spillway;
- A permanent bottom outlet laid out as an intake structure to one of the two 8 m diameter tunnels (used initially for river diversion tunnels) with an access bridge from the main dam crest;
- A zoned earthfill embankment Saddle Dam; and
- An intake tower and access bridge in the Smithfield Dam Reservoir to the transfer tunnel.

The principal data for Smithfield Dam is summarised in **Table 17**.

Table 17: Smithfield Dam and Saddle Dam Principal Data

Parameter	Description	
General		
Name	Smithfield Dam	
Purpose	Bulk water supply	
Estimated date of completion	2022	
River	uMkhomazi River	
Nearest town	Richmond	
District	KwaZulu-Natal	
Location	29°46'33.36" S; 29°56'26.62" E	
Classification: Category	III	
Size class	Large	
Hazard potential	High	
Non-overspill crest level	RL 936 masl	
Full supply level (FSL)	RL 930 m	
Gross storage capacity at FSL	220 million m^3	
Water surface area at FSL	953 Ha	
	Main wall	**Saddle wall**
Wall height above river level (Max. height)	81 m (855 masl to 936 masl)	26 m (910 masl to 936 masl)
Type of dam wall	Earth core rockfill	Zoned earth fill
Crest length	1 200 m	1 090 m
Spillway type	Side channel	Fuse plug
Spillway form	Ogee	Broad crested
Spillway length	150 m	100 m
Freeboard	6 m	2 m
Hydrology and floods		
Catchment area	2 058 km^2	
Safety evaluation flood	5 650 m^3/s	
Regional maximum flood	4 540 m^3/s	
$Q_{1:100}$	2 389 m^3/s	
$Q_{1:200}$	2 620 m^3/s	
Outlet works		
Dam Outlet	Dual pipe system of ND 1.8 m	

Parameter	Description
	6 intakes Butterfly and gate valves
Tunnel Inlet	Tri pipe system of ND 2 m 6 Intakes Butterfly and gate valves
Description of dam wall foundations	The site comprises of shales (mudrocks) with sub-ordinate sandstones and intrusions of dolerite. Three near-horizontal dolerite sills have intruded mainly concordantly into the sedimentary strata and are responsible for the narrow river valley at the dam site and the presence of good quality rock for concrete aggregate and rockfill.

According to DWA (2014e), the feasibility design of the dam included low frequency and high frequency flood estimates, flood attenuation studies, identification of the required freeboard and associated crest height, consideration of the possible flood surges from landslide induced waves from the reservoir and effect on freeboard, summary of the geotechnical investigations for foundation and construction materials, river diversion, embankment dam zoning and slope stability analyses, the design consideration of various spillways including a side channel spillway as well as a fuse plug spillway and the design of a multi-draw-off double pipe system dam outlet. Provision is made at this outlet for the release of water to the second tunnel for when the second phase of the uMkhomazi System is implemented.

Smithfield Dam will be a Category III dam, with an associated large size and high hazard rating. In accordance with SANCOLD's Guidelines on Safety in Relation to Floods (SANCOLD, 1991), the spillway at the dam should be capable of discharging a recommended design flood (RDF) equal to the 200-year flood with adequate "dry" freeboard and without any damage to the dam. It is furthermore required that the spillway and the dam must be able to discharge and accommodate the safety evaluation flood (SEF) with zero "dry" freeboard and accepting damage to the dam, but not with a catastrophic failure. The safety evaluation flood peak for this dam is taken as 6 960 m^3/s.

Three-dimensional illustrations of the proposed Smithfield Dam layout are provided in **Figures 30 - 32**. These illustrations portray what Smithfield dam will look like after construction is finished based on the feasibility design of the project.

Figure 30: Three-dimensional layout of Smithfield Dam (view 1)

Figure 31: Three-dimensional layout of Smithfield Dam (view 2)

Figure 32: Three-dimensional layout of Smithfield Dam (view 3)

9.3.2 Spillway

The spillway is a structure that will allow for controlled release of flows from the dam into the downstream area of the uMkhomazi River.

The main spillway is a side channel spillway type consisting of an excavated approach channel to accommodate smooth flow lines for the improvement of the discharge coefficient, a concrete gravity ogee structure, a side channel and a return chute.

The fuse plug spillway consists of a concrete broad crested weir at FSL (930 masl) covered by non-cohesive material. Pilot channels are provided on the 1:200 year head water level, which will result in the breaching of the fuse plug.

The overspill structure is designed for an ogee shape. The SANCOLD guidelines require that for a Category III dam the ogee must be designed for a RDF of 1:200 year (2 620 m^3/s). The level of the approach channel is at 926 masl, resulting in the pool depth to be equal to the design head.

The chute will be excavated to the rock level with side slope of 1V:1H. The width of the chute is determined using the assumption that 100 m^3/s is required per width of chute. A flow of 3 700 m^3/s will be discharged through the main side channel spillway when an SEF occurs and the fuse plug spillway is breached, resulting in an approximate chute width of 37 m. The width of the chute was taken as 40 m. The chute will be lined with a layer of concrete with a minimum thickness of 500 mm and anchored into the rock with anchor bars drilled and grouted into the rock. The concrete lining will be up to the water level for the partly discharged SEF (3 700 m^3/s) in the chute, from where the ground will be shaped to 1V:1.5H until it reaches the natural ground level.

The concrete lining also needs to be protected by a comprehensive system of drains underneath it with collector drains on each side of the chute. The anchors need to hold down the concrete lining against a possible full static uplift water pressure, and the surface finish of the lining must be of a high standard to minimise the effects of cavitation should high velocity flows occur. The anchors and drainage system should be designed in the detail design phase.

The chute will end with a ski jump discharging into a plunge pool. The ski jump for Impofu Dam was adopted for the feasibility design.

Refer to **Appendix F** for details on the spillway, fuse plug, chute and ski jump.

The plunge pool will also serve as a quarry and the excavated material used to construct the dam.

9.3.3 Dam Outlet Design

9.3.3.1 General arrangement

The outlet works will release water into the uMkhomazi River for environmental requirements, downstream water users and in the case of emergency drawdown conditions.

The outlet works are positioned with a circular intake tower on top of the intake section of the second river diversion tunnel and outlet valves further downstream. This tunnel will serve as a permanent outlet where the released water will be conveyed through the tunnel and exit into the uMkhomazi River.

The pipe work in the intake tower consists of a twin or dual system comprising of multi-level intakes at different levels with butterfly valves for selecting the level at which water is to be drawn off, and sleeve valves in the downstream outlet valve chamber for controlling the release volumes.

The intakes will be protected with precast concrete trash racks and stainless steel fine screens to prevent blockage by floating debris. Emergency gates are required for closure at the bellmouth intakes for maintenance purposes. A superstructure with overhead gantry crane on top of the intake tower enables the operation of the fine screens and emergency gates. A combination of cranes allows for valves to be transported for installation and maintenance purposes.

The outlet works, including the intake tower, can be accessed via a bridge from the main dam embankment.

9.3.3.2 Required outlet capacity

The outlet works is designed to:

- Empty Smithfield Dam during emergency drawdown conditions; and
- Release water for the Ecological Water Requirements (EWR) and downstream water users.

<u>Emergency draw down</u>

Emergency drawdown is required when the water level in the dam must be reduced to ensure the safety of the dam. The outlet works should be capable of lowering the reservoir level from FSL to half depth in 60 days and to the lowest drawdown level (LDL) within 120 days. The half depth of Smithfield Dam is considered to be at the approximate level of 895 masl.

EWR

The EWR downstream of Smithfield Dam was determined from the daily flows as measured at gauging weir U1H005. Flow gauging weir U1H005 latitude 29°44', longitude 29°54' and catchment area 1 744 km² is located approximately 11.4 km upstream of the proposed Smithfield Dam site. These daily flows were patched, naturalised and provision for catchment development to 2050 was modelled in these flows.

The target flows to be released from Smithfield Dam to meet the EWR are provided in **Table 18**. These flows are provided with an exceedance probability.

Table 18: EWR requirement

Exceedance Probability	EWR target (m³/s)
100.00%	0.0
50.00%	3.6
20.00%	9.1
10.00%	15.9
5.00%	25.6
2.00%	43.0
1.00%	59.9
0.50%	83.7
0.10%	143.8
0.05%	152.6
0.00%	235.2

Refer to **Section 10.8.4.2** for further details regarding the Reserve Determination.

9.3.3.3 Minimum operating level (MOL)

The MOL for water to be abstracted through the uMkhomazi – uMlaza Tunnel is set at 887.2 masl. The same level is considered relevant for the EWR releases, however for draw down conditions it is required that the dam be drawn down to at least the LDL at level 880 masl.

9.3.3.4 Layout requirements

Multi-level intakes

To ensure the impact of the dam and its management on the downstream aquatic life is minimised, four intake levels are recommended. The centre-line levels of the intakes as proposed in the Water Quality and Limnological Report (DWA, 2014f) are listed in **Table 19**.

Table 19: Outlet works intake levels

Intake level	Meters above sea level	Intervals (m)
L1	920	10
L2	910	10
L3	895	15
L4	880	15

*FSL at 930 masl

Two outlet systems are provided with the intakes staggered between the two outlet systems. Each intake connects to one of the two vertical collector pipes which are extended to the top of the intake tower for aeration.

Due to temperature and stratification compliance, the first two intake levels will be used for the majority of the time for EWR releases. The bottom level intakes ensure that water can still be released down the river with the MOL at 887.2 masl without vortex formation. Two intakes are required at the bottom intake level to accommodate emergency drawdown conditions.

Intake bays

Two intake bays are provided for the dual system of outlet pipes. The intake bays will extend outward from the circular intake tower. The intake bays have been sized to ensure sufficient approach flow area at the entrance and hence maintain an acceptable flow velocity through the trashracks and fine screens.

Trashracks and fine screens

Trashracks and fines screens prevent floating trash and debris, mostly occurring near the water surface, to be drawn into the intakes and damage equipment.

The upstream end of the intake bays are protected by fixed coarse precast concrete trashracks followed by removable stainless steel fine screens downstream.

The fine screen panels are lowered into guides embedded in concrete piers. These removable fine screen panels are each fitted with a tray at the upstream bottom to collect trash or debris when the screens are hoisted for cleaning purposes.

A grappling beam for handling the screens will be provided with storage in a rack on the deck.

Emergency gates

Emergency gates, one for each intake bay, are required to close off the bellmouth intakes during emergencies and for maintenance purposes. Built-in parts and guides are provided for handling the gate and for sealing around any of the intake bellmouths.

Drywell

A circular shape was proposed for the intake tower as it provides more seismic resistance than a square or rectangular structure. Furthermore, compressive stresses rather than tensile stresses are induced on the structure, resulting in less concrete reinforcing being required.

The drywell houses the intake level selector valves (butterfly valves), provides access to the valves, and is used for installation, removal and replacement of the valves, if necessary.

The drywell can be accessed from the bridge linked between the tower and the embankment. A lift and staircase in the intake tower will be required for inspection and maintenance purposes of the structure and the valves.

Super structure and overhead cranes

An overhead gantry crane is required on the deck of the intake tower to handle the fine screens and emergency gates.

A combination of gantry cranes enables the installation and removal of valves and their equipment for refurbishment. A single beam crane runs along the top of the outlet tunnel for removal of the downstream sleeve valves and equipment. The overhead gantry crane on the deck of the intake tower allows for the valves to be removed and lowered onto a 10 ton truck.

9.3.3.5 Valves

Intake level selector valves

The four intake level selector valves are 2 m diameter butterfly valves, which are only used to select the level at which water is to be drawn off. They will thus be either fully open or fully closed. The butterfly valves can be operated locally but remote operation is recommended.

Outlet control valves

The control valves for releases down the river are situated downstream at the end of the outlet conduit.

Sleeve valves with a 1 m diameter are used to release the EWR and to draw down the dam during emergency conditions. The 1 m pipe will branch into a 300 mm pipe with a 300 mm sleeve valve before the 1 m sleeve valve to release smaller EWRs when required. To contain the spray, hoods are provided with diameters of twice the size of the sleeve valves.

9.3.4 Intake Structure to uMkhomazi – uMlaza Tunnel

9.3.4.1 General arrangement

The purpose of the Smithfield Dam tunnel intake structure is to house the hydro-mechanical equipment required to operate and control the releases from

Smithfield Dam through the uMkhomazi – uMlaza tunnel and raw water pipeline to the proposed WTW and ultimately the Umlaas Road Reservoir.

The intake structure must also provide for the releases associated with the implementation of Phase 2, the construction of the upstream Impendle Dam (refer to **Section 3.4**), and the second tunnel.

The circular tunnel intake structure is positioned within the Smithfield Dam reservoir as indicated in **Figure 33**.

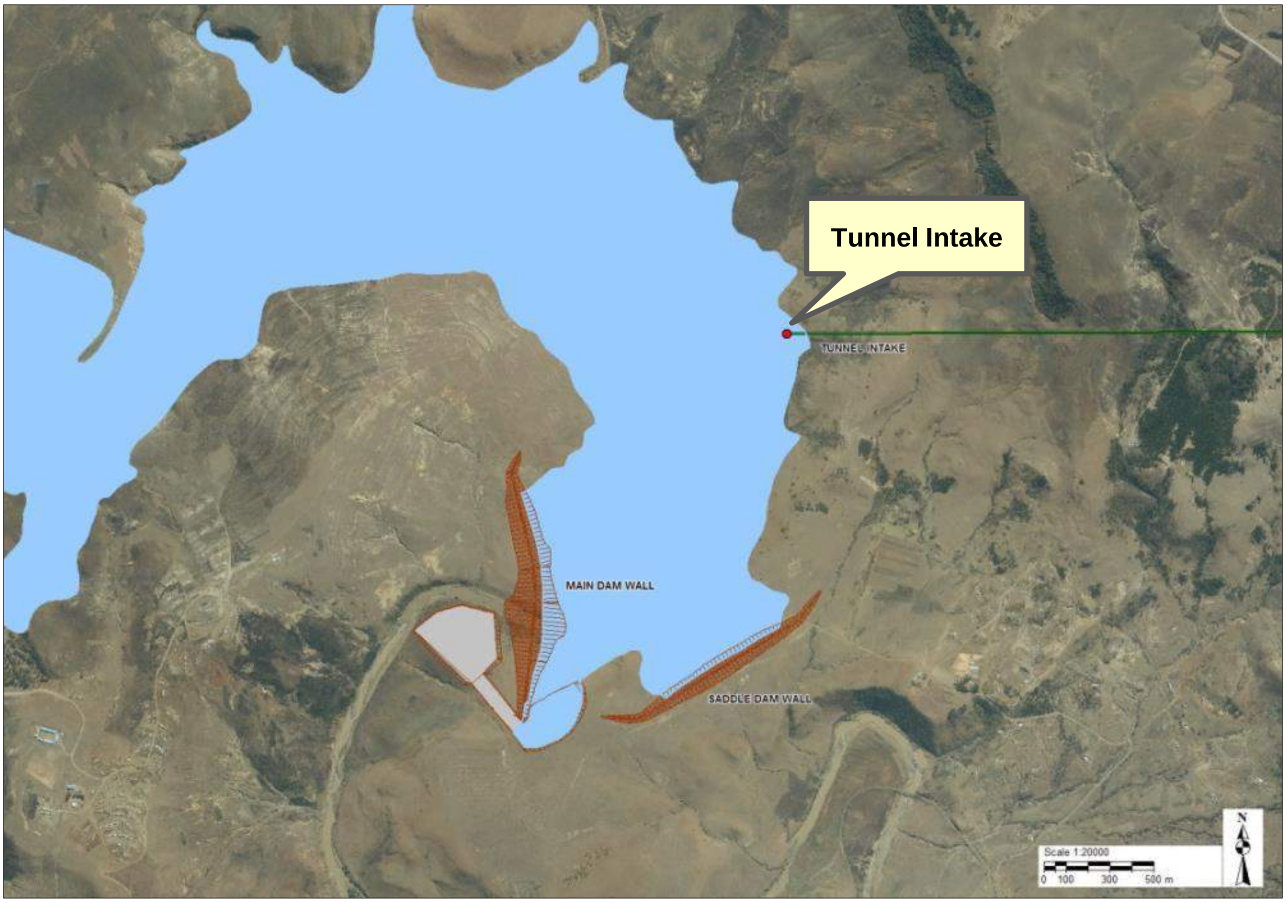


Figure 33: Position of the intake structure

The structure connects to the uMkhomazi – uMlaza tunnel with a series of pipes as shown in the general layout (**Appendix F**).

The circular shaped intake structure consists of three intake systems each comprising of multi-level bellmouthed pipes with butterfly valves for selecting the level at which water is to be drawn off. Control valves are situated downstream of each intake system conduit before connecting to the tunnel collector manifold for controlling the releases to the tunnel(s). Service valves (butterfly valves) are positioned in the tunnel collector manifold on both sides of each intake system connection to allow for maintenance and inspection as well as to close off the intake system(s) not in use.

The three-intake system is proposed to accommodate the increased transfer capacity for when Impendle Dam (uMWP Phase 2) and the second tunnel are implemented as well as to allow for flexible maintenance operation and emergency situations.

Precast concrete trash racks and stainless steel fine screens will be incorporated to prevent floating debris from blocking or damaging the downstream infrastructure. Emergency gates are required for the closure of the bellmouth entrances for maintenance of downstream located valves.

The intake structure also consists of a superstructure which houses the overhead crane required for the operation of the fine screens, butterfly valves and emergency gates. Access to the intake structure will be from the natural embankment via an access bridge.

The intake pipes will connect to the tunnels with bellmouth outlets encased in concrete. Ventilation shafts just downstream of the pipe bellmouth outlets into the tunnels will provide air at the connection to ensure design discharge into the tunnel.

9.3.4.2 Required transfer capacity

The intake structure is designed to meet the following:

- Phase 1 maximum transfer capacity of 8.65 m^3/s to be conveyed through the uMkhomazi – uMlaza Tunnel.
- Phase 2 maximum transfer capacity of 14.86 m^3/s for the case when the upstream Impendle Dam and second transfer tunnel are implemented. The

additional maximum transfer capacity of 6.21 m³/s is to be conveyed through the second tunnel.

The Phase 1 design transfer capacity is associated with a Smithfield Dam with 31% MAR storage volume and a 1.25 supply peak factor. The proposed maximum design transfer capacity of Phase 2 is based on this Smithfield Dam combined with a 1.5 MAR capacity Impendle Dam and a 1.25 supply peak factor.

9.3.4.3 Layout requirements

Three intake system

The intake structure consists of three intake systems of which system 1 and 2 will be operational with the implementation of Phase 1 of the uMkhomazi Project to feed the uMkhomazi – uMlaza tunnel. This dual system is required for maintenance purposes.

System 3 will accommodate the additional release requirement when Phase 2 of the uMkhomazi Project is implemented in approximately 2044. This system will be constructed to a level where this system can be blocked off and linked to the other two systems when it becomes necessary. This includes the bellmouth intakes on the various levels, the section of pipe leading from the intake structure to the second tunnel and the bellmouth outlet at the pipe-tunnel connection. The ventilation shaft leading from the intake structure will be constructed during Phase 1. The remainder of pipes and valves of system 3 will be installed during the construction of Phase 2.

Multi-level intakes

From the Water Quality and Limnological Report (DWA, 2014f), six abstraction levels were proposed to ensure the best possible water quality is abstracted. Each of the three intake systems consist of intakes at these abstraction levels.

Intake bays

Three intake bays are provided, one for each of the three intake systems. The intake bays will extend outward from the main circular structure. The intake bays have been sized to ensure sufficient approach flow area at the entrance of the intake bay and hence an acceptable flow velocity is maintained through the trashracks and fine screens.

Trashracks and fine screens

Trashracks and fine screens are designed to prevent floating trash and debris, mostly occurring near the water surface, to be drawn into the intakes and damage equipment.

The upstream end of the three intake bays are protected by fixed coarse precast concrete trashracks followed by removable downstream stainless steel fine screens.

The fine screen panels are lowered into guides embedded in concrete piers. These removable fine screen panels are each fitted with a tray at the upstream bottom to collect trash or debris when the screens are hoisted for cleaning purposes.

A grappling beam for handling the screens will be provided with storage in a rack on the deck.

Emergency gates

Emergency gates are required to close off the bellmouth intakes to allow for inspection and maintenance thereof. Due to the layout of the intake structure, each of the intake systems should comprise of an emergency gate as interchanging an emergency gate between the three intake systems is not permitted.

Drywell

The dry well will house the following:

- Intake level selector valves (butterfly valves);
- Control valves (knife gate valves) of each intake system;

- Service valves (butterfly valves) for closing off intake systems and regulating the flow direction;
- Elevator shaft as well as stair cases to provide access to the valves on the various intake levels; and
- Inlet of the ventilation shafts at the pipe-tunnel connections.

Super structure and overhead crane

A superstructure is located above the intake structure and houses an overhead crane to handle the fine screens, emergency gates and the various valves during installation, removal or refurbishment.

Access to the superstructure is permitted via an access bridge from the tunnel inlet portal access road. The bridge is supported with columns spaced every 12 m. The superstructure can be reached by a 10 ton truck for the transportation of the valves, emergency gates and fine screens.

Sufficient overhead cranes for the handling of the valves are provided.

Ventilation shafts

A 3.5 m diameter steel pipe ventilation shaft is provided for each of the tunnels downstream of the pipe bellmouth outlets. The ventilation shafts are encased in concrete with the inlets situated within the intake structure. The purpose of the ventilation shafts is to provide a facility for air entrainment to ensure undisturbed water flow conditions.

9.3.5 River Diversion

The purpose of river diversion is to enable construction of the main dam embankment, especially in the river section, while accommodating the river flows and possible floods at an acceptable risk of delays and damages.

9.3.5.1 River Diversion Philosophy

The river diversion period is planned over three years with closure for impoundment in the fourth year. The risk of flooding during the winter months (low flow season) is appreciably lower than during the summer months (high flow season). Therefore, to a great extent, the construction programme dictates the sizing of the different river diversion stages.

To ensure that the risk is within acceptable limits, the hydraulic sizing of the various river diversion stages must be seen as the minimum requirements.

The phases, seasons, description of the construction of associated structures and the risk of damages are given in **Table 20**. **Figures 34 - 40** graphically illustrate the content of **Table 20**.

Table 20: River diversion phases

River diversion phase	Season	Description of construction of structures	Risks associated with cofferdams and figures illustrating phase
Phase 1: Water in river	Summer of Year 1	Construct Cofferdam 1 and Cofferdam 2 and excavate the diversion tunnel inlet and outlet portals. Excavate and provide rock support to the two 8 m diameter diversion tunnels and line Tunnel 1. Construct the foundation of intake tower to dam bottom outlet. This includes for an access connection tunnel between the tunnels and a plug on the one side. Commence with provision of grout curtain of the main dam.	*Earthfill Cofferdam 1* and *Earthfill Cofferdam 2* are to accommodate the *1:10 year flood event* without overtopping. See **Figure 34**.
Phase 2: Water diverted through tunnels	Winter of Year 1	Remove Cofferdams 1 and 2 and construct earthfill Cofferdam 3 in the river downstream of Cofferdam 1 to allow for the construction of Cofferdam 5. Construct Cofferdam 4 to prevent water exiting the tunnels to enter the main dam embankment area upstream in the river. Construct upstream concrete gravity Cofferdam 5. Proceed with lower parts of intake structure as well as parts of the main dam outside the river section.	*Earthfill Cofferdam 3* is to accommodate the *1:10 year winter flood event* without overtopping. *Cofferdam 4* to accommodate the *1:50 year flood event* without overtopping. *Concrete gravity Cofferdam 5* to accommodate the *1:20 year winter flood event* without overtopping. See **Figure 35**.
Phase 3: Water diverted through tunnels and	Summer of Year 2	Proceed with construction of Intake Tower. Provision of grout curtain in river section	See **Figure 36**

River diversion phase	Season	Description of construction of structures	Risks associated with cofferdams and figures illustrating phase
over Cofferdam 4		may commence.	
Phase 4: Water diverted through tunnels	Winter of Year 2	Construct rockfill Cofferdam 6. Cofferdam 5 is abutting the rockfill of Cofferdam 6. Construct the upstream part of the main dam embankment in the uMkhomazi River on the downstream side of the gravity wall (Cofferdam 6). Proceed with the construction of the intake tower.	*Rockfill Cofferdam 6* to accommodate the *1:50 year summer flood event* without overtopping. See **Figure 37**
Phase 5: Water diverted through tunnels	Summer of Year 3	Remove Cofferdam 3 and continue with the construction of main dam embankment in the uMkhomazi River section on the downstream side of the gravity wall. Complete intake tower to NOC level and complete access bridge.	See **Figure 38**
Phase 6: Divert water through one tunnel	Winter of Year 3	Complete the remainder of the main dam embankment in the river section. Plug Tunnel 1 and insert the bottom part of the outlet pipes of the intake tower as well as the sleeve valves. Insert all butterfly valves. Complete control house on top of the intake tower.	See **Figure 39**
Phase 7: Impoundment commencement	Summer of Year 4	Plug Tunnel 2. Reinstate access connection tunnel between Tunnel 1 and 2.	See **Figure 40**

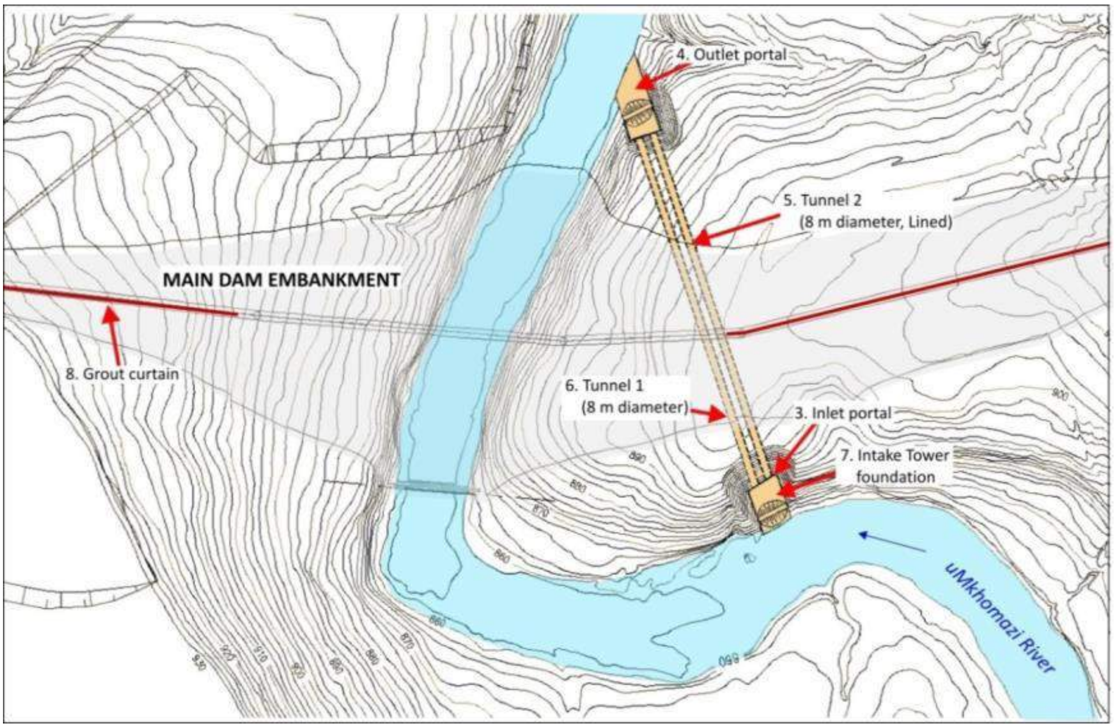


Figure 34: River diversion phase 1 – summer of year 1

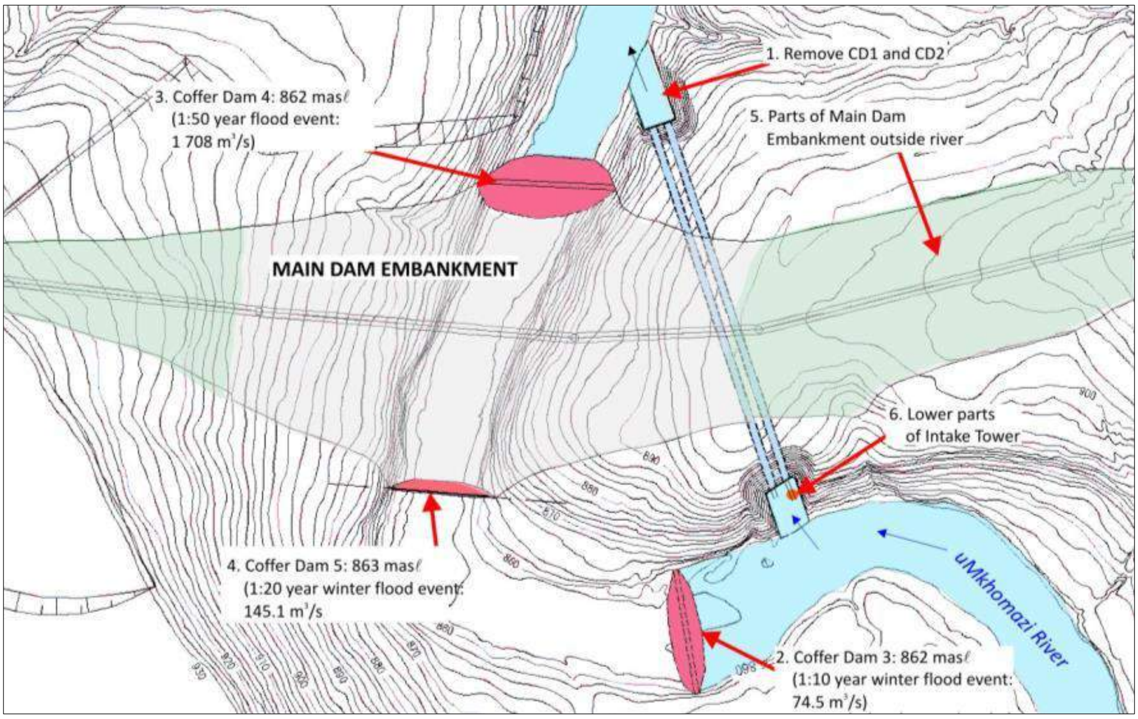


Figure 35: **River diversion phase 2 – winter of year 1**

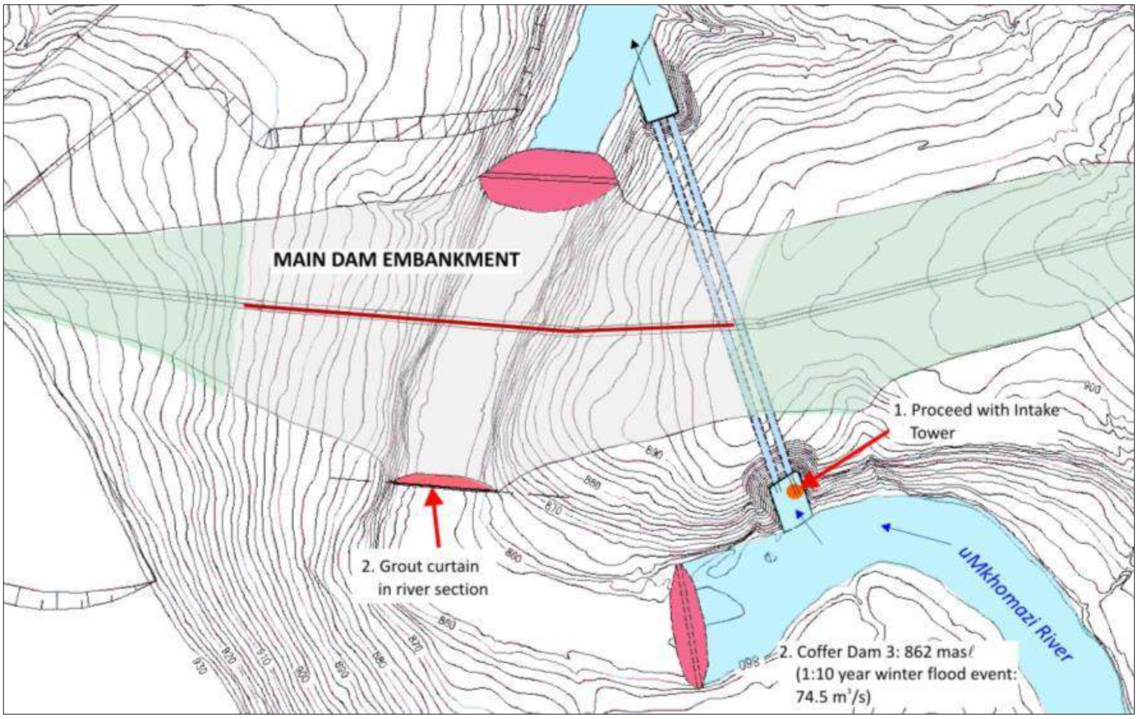


Figure 36: **River diversion phase 3 – summer of year 2**

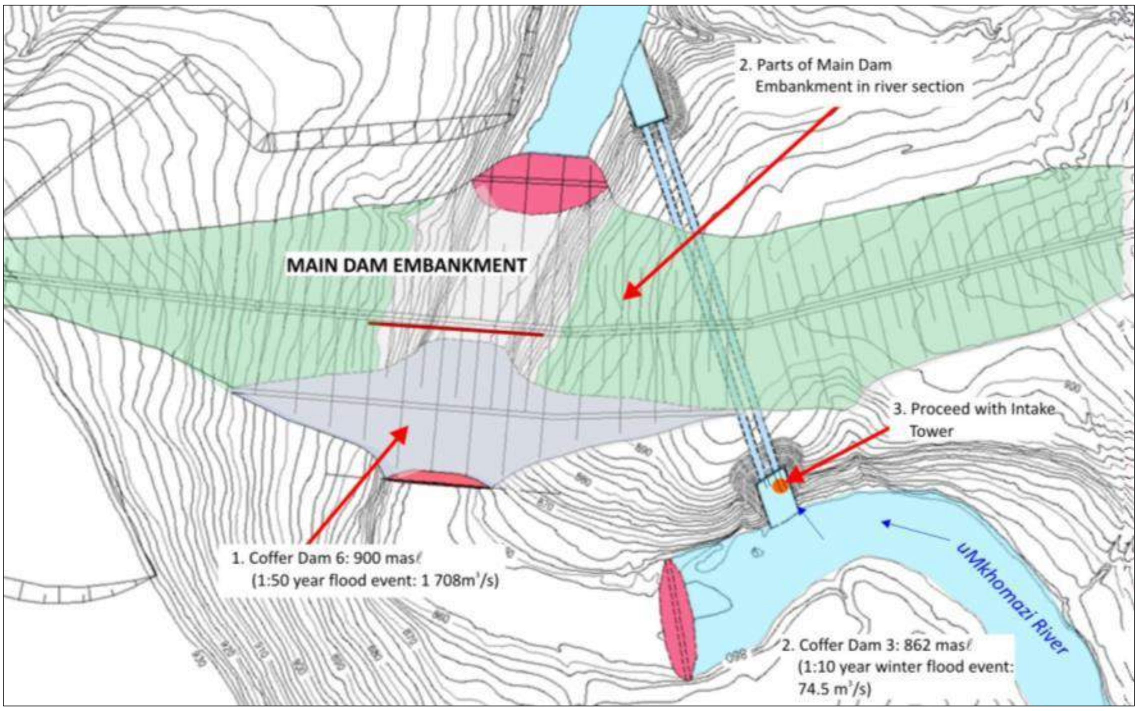


Figure 37: **River diversion phase 4 – winter of year 2**

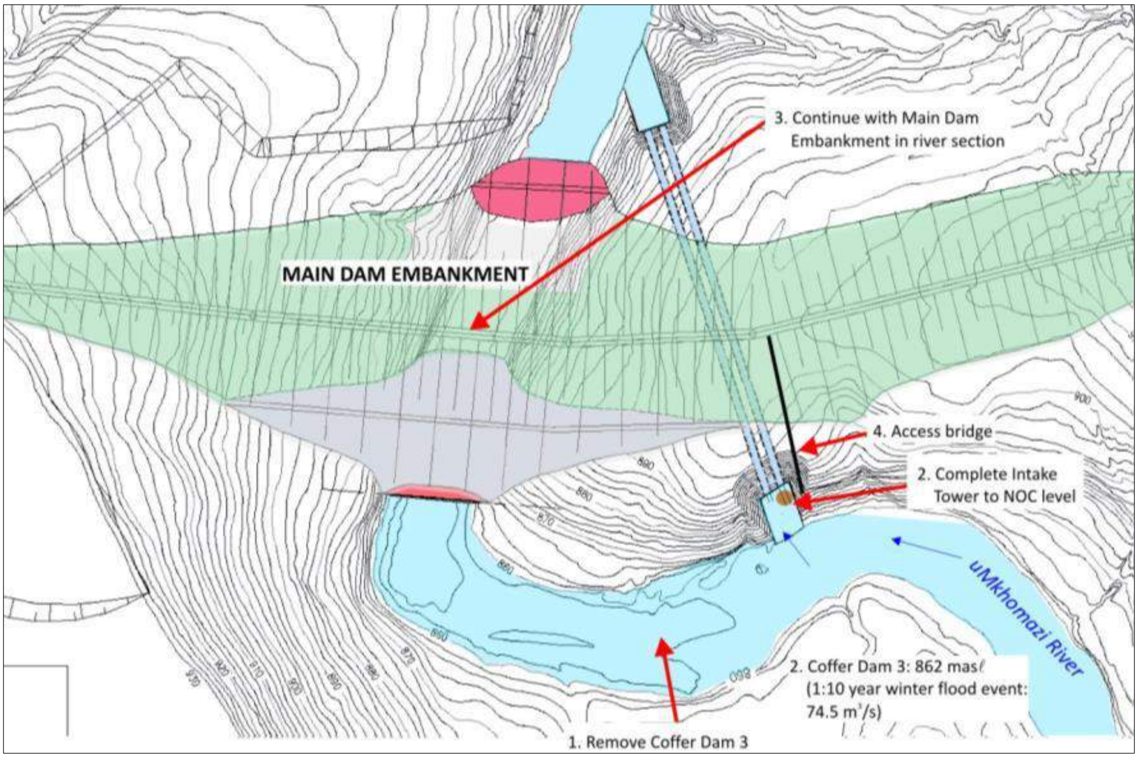


Figure 38: **River diversion phase 5 – summer of year 3**

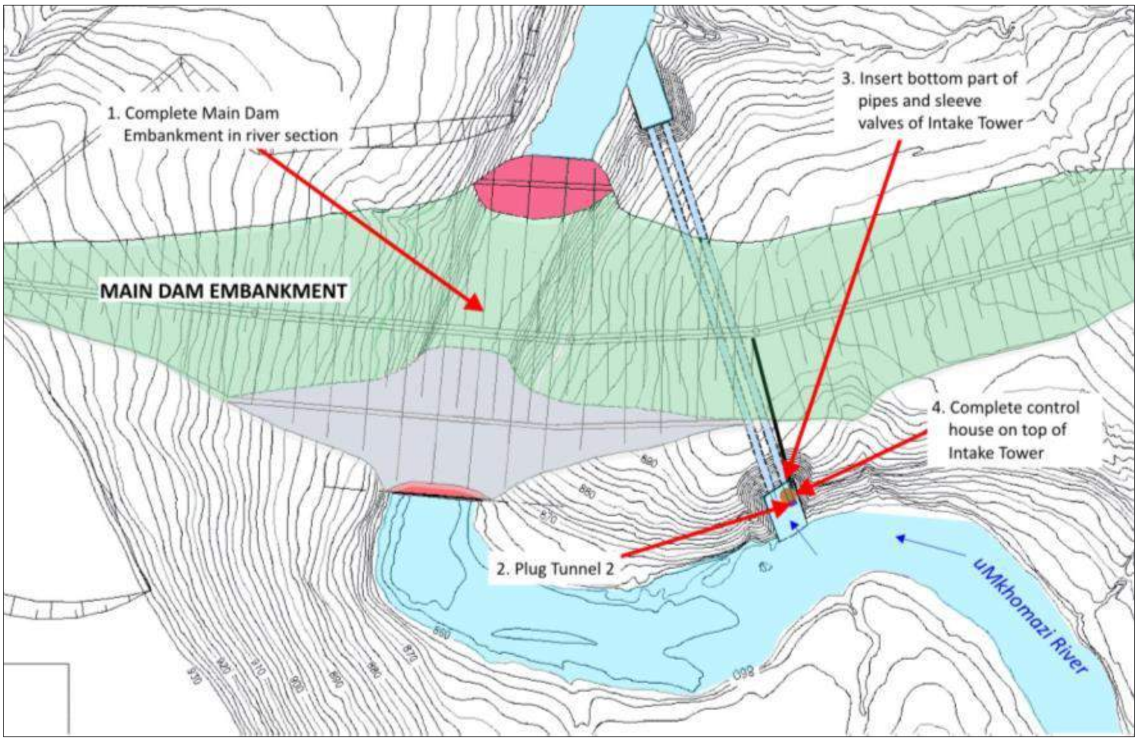


Figure 39: River diversion phase 6 – winter of year 3

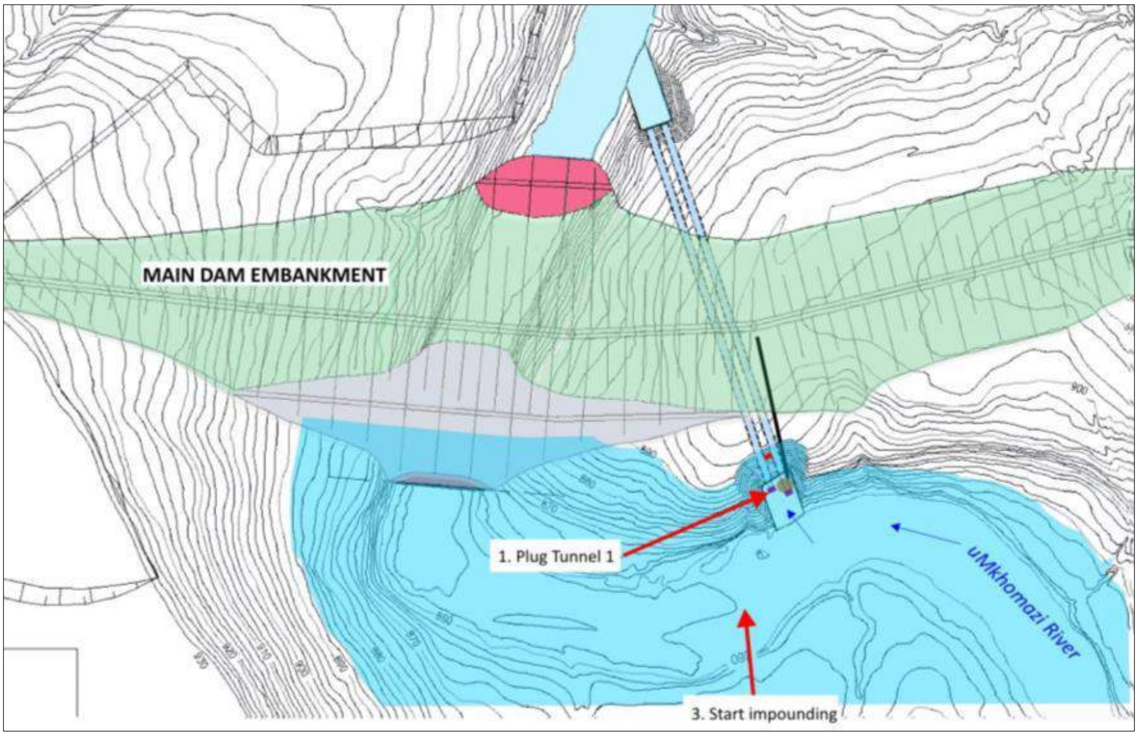


Figure 40: River diversion phase 7 – summer of year 4

9.3.5.2 Diversion tunnels

The purpose of the two diversion tunnels is to divert river flows and possible floods away from the construction area of the main dam embankment. After construction is completed, Tunnel 2 will serve as a permanent outlet to the uMkhomazi River, accommodating the outlet pipes from the outlet works on top of the tunnel.

Figure 41 shows the general layout of the Tunnel 1 and Tunnel 2 bellmouth intake sections. The upstream view of the tunnel intakes is shown in **Figure 42**.

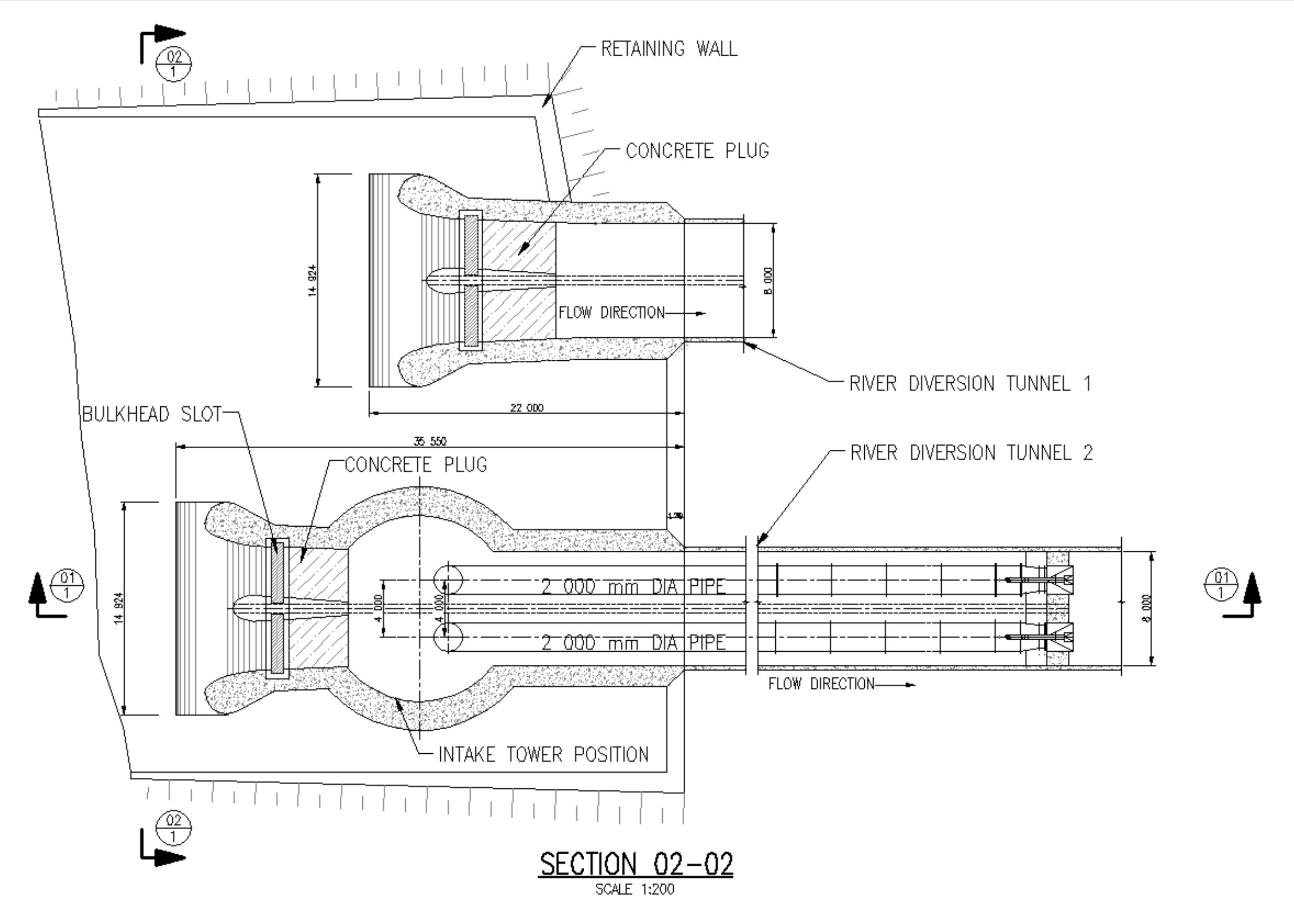


Figure 41: Plan layout of intake tunnels

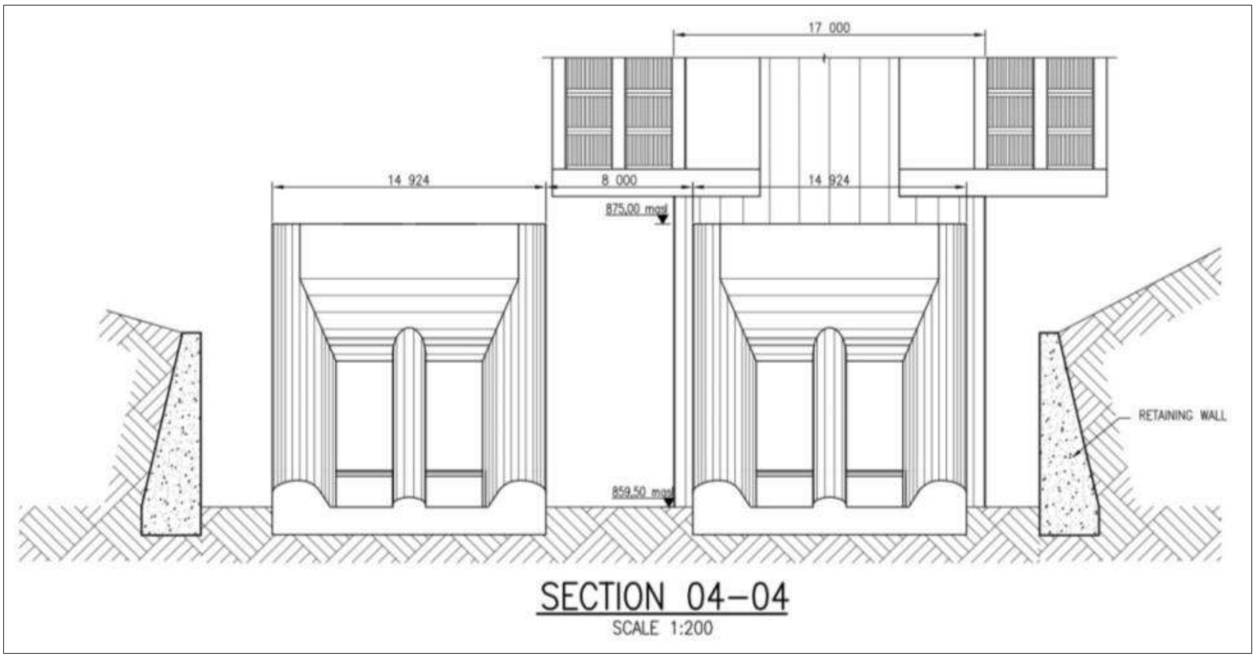


Figure 42: Upstream view of tunnel outlet

a) Tunnel 1

Tunnel 1 is a concrete lined tunnel with internal dimensions as shown in **Figure 43** and a slope of 1V:100H to convey water during river diversion. The length of the tunnel is about 390 m. The invert level of the tunnel inlet is at 859.5 masl and the invert level for the outlet at 855.5 masl. The inlet of the tunnel is bell mouthed with concrete to smooth flow lines and hence to reduce hydraulic losses at the entrance.

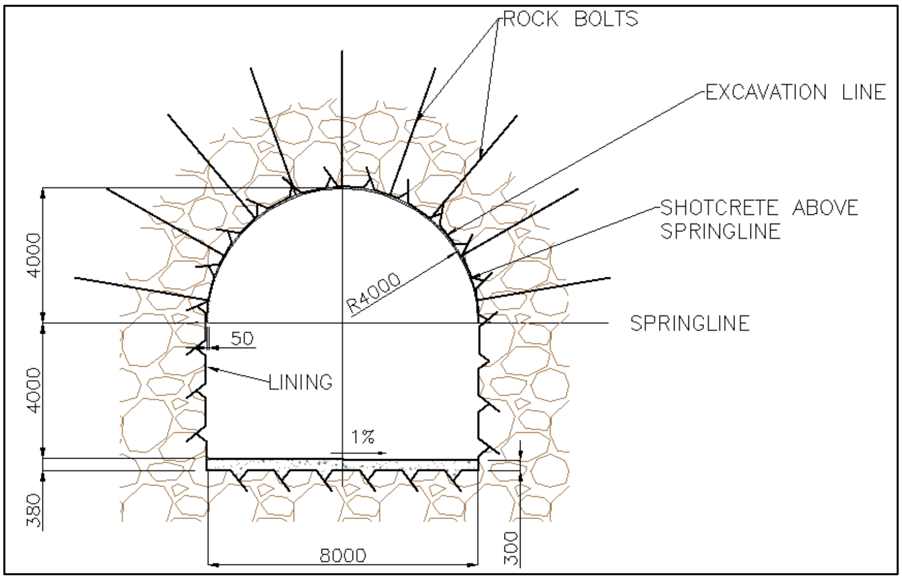


Figure 43: Tunnel 1 cross-section

Tunnel 1 has the same geometrical properties as Tunnel 2. However, the intake section of Tunnel 1 will be shorter and will not be lined over its entire length. Tunnel 1 will be plugged during Phase 7 of the river diversion to allow impoundment to commence.

b) Tunnel 2

Tunnel 2 is a concrete lined tunnel with an internal diameter of 8 m and a slope of 1V:100H to convey water during river diversion. The length of the tunnel is about 390 m. The invert level of the tunnel inlet is at 859.5 masl and the invert level for the outlet at 855.5 masl. The inlet of the tunnel is bell mouthed with concrete to smooth flow lines and hence to reduce hydraulic losses at the entrance.

Tunnel 2 will serve as a permanent outlet accommodating the outlet pipes leading from the outlet works on top of the tunnel to a position in the tunnel. The access to the valves will be from the intake tower.

The tunnel will be plugged during Phase 6 of the diversion works to allow for the installation of the bottom part of the outlet pipes of the intake tower and the sleeve valves. Bulkhead slots downstream of the bellmouth intake allow for the tunnel to be closed off prior to plugging. The cross-section of Tunnel 2 is illustrated in **Figure 44**.

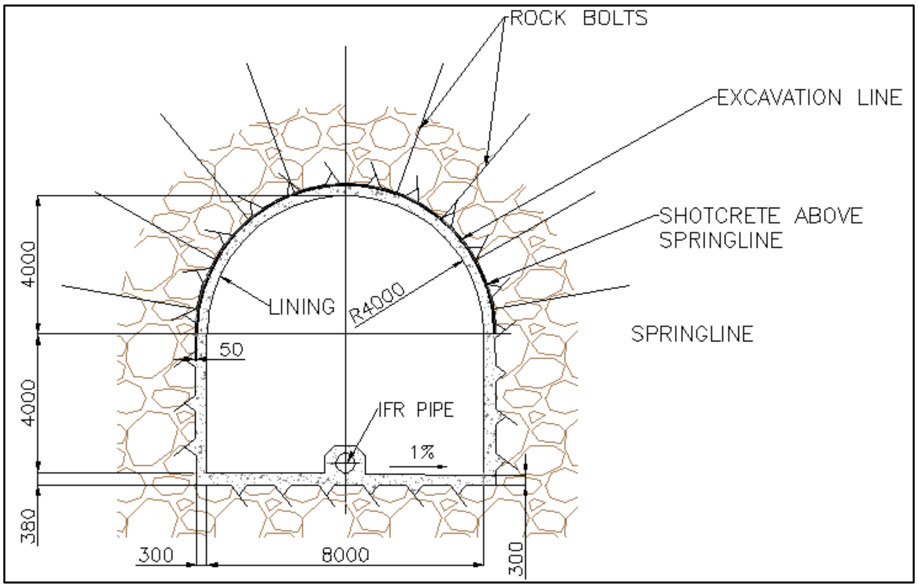


Figure 44: Tunnel 2 cross-section

A longitudinal section of the intake section of Tunnel 2 and the valve chamber is depicted in **Figure 45**, which also shows a section through the intake tower at a higher elevation.

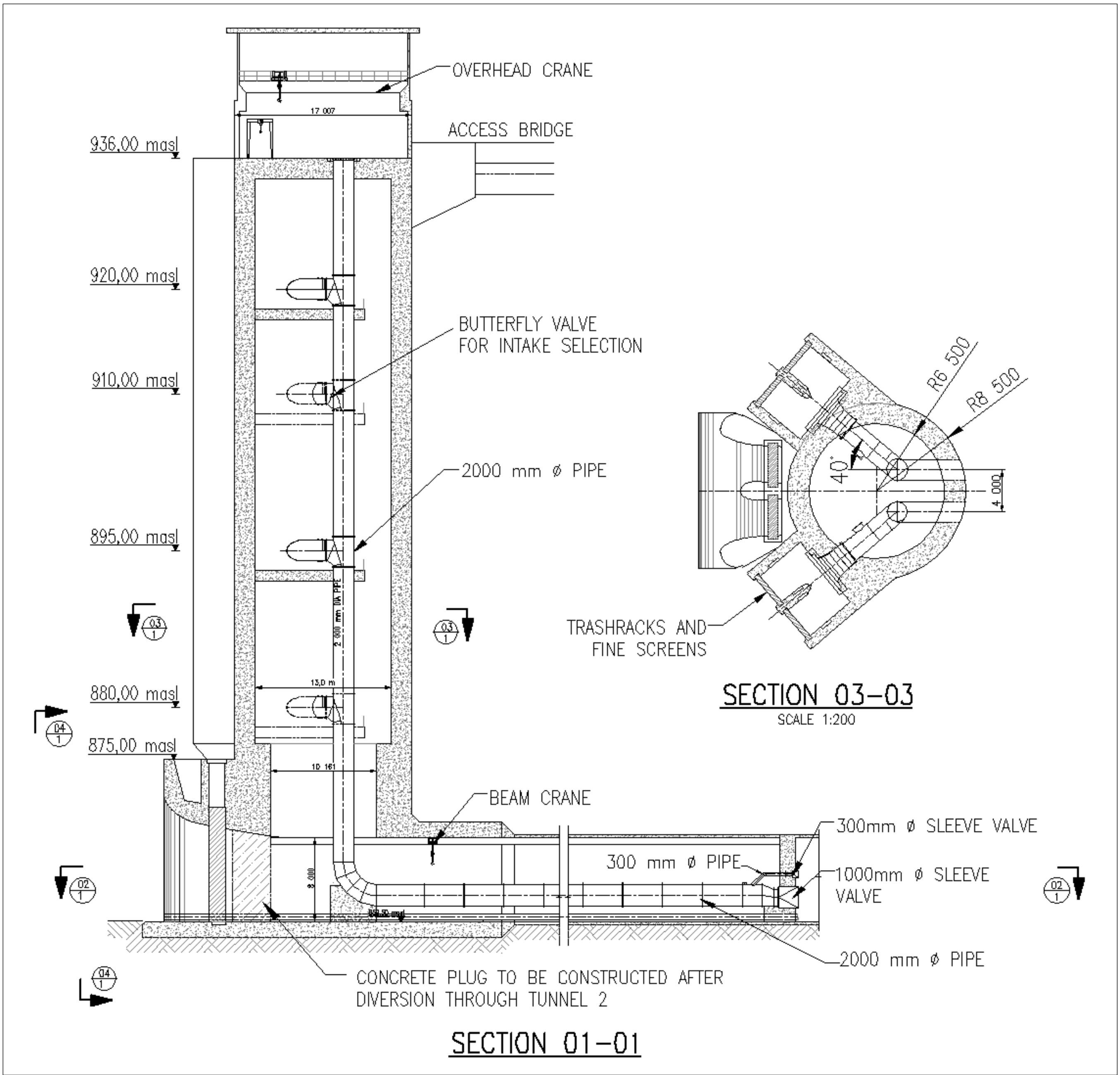


Figure 45: Section through intake structure

9.3.5.3 Cofferdam characteristics

Table 21 provides a summary of the crest levels of the various cofferdams and the flood event which they can accommodate. The cofferdams are shown in **Figure 46 – 49**.

Table 21: Cofferdam characteristics

Coffer dam	NGL (masl)	Accommodated flood event	Flood volume (m^3/s)	Crest elevation (masl)	Height from NGL (m)
1	859.5	1:10	937.0	862.4	2.9
2	855.5	1:10	937.0	860.1	4.6
3	858.0	1:10 winter	74.5	862.0	4.0
4	856.0	1:50	1 708.0	862.3	6.3
5	856.0	1:20 winter	145.1	863.0	7.0
6	856.0	1:50	1 708.0	888.0	32.0

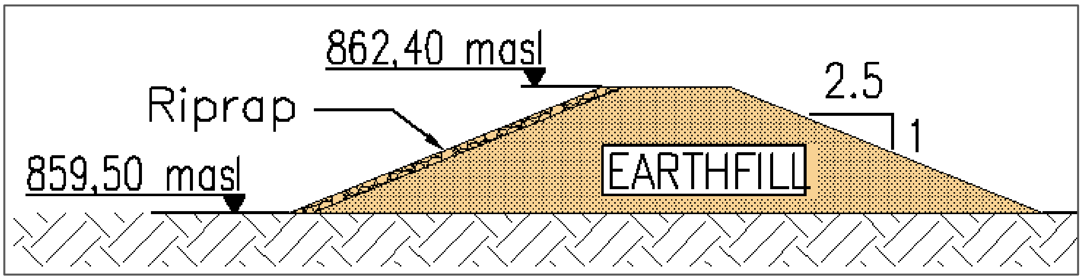


Figure 46: Cofferdam 1

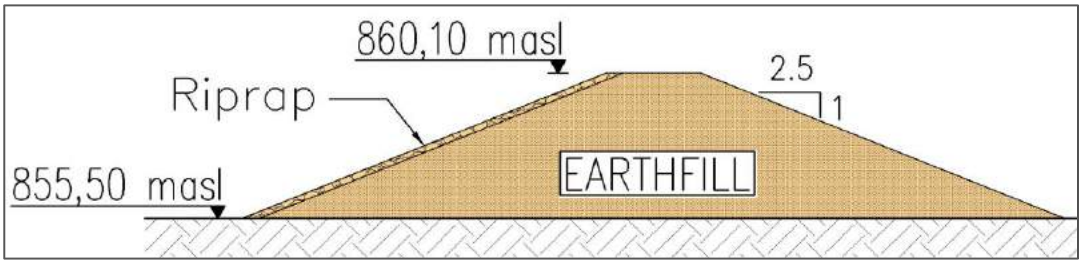


Figure 47: Cofferdam 2

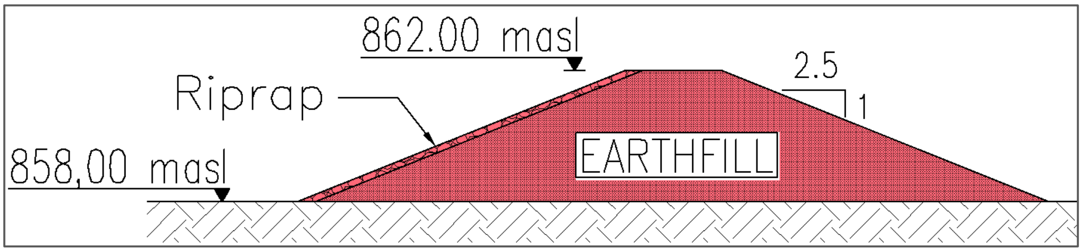


Figure 48: Cofferdam 3

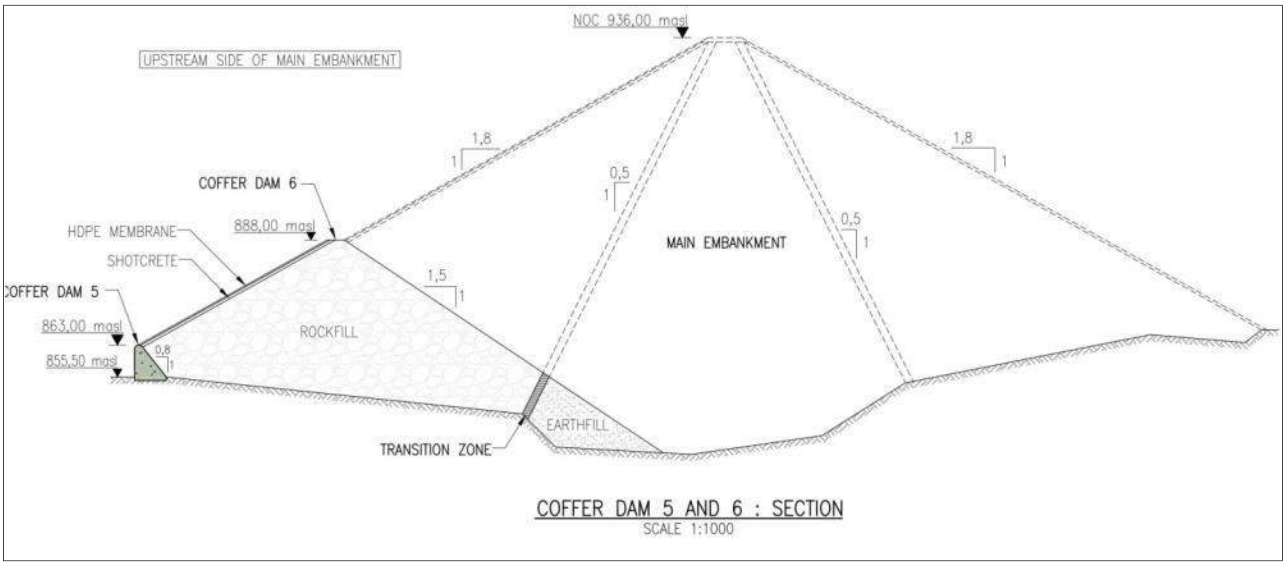


Figure 49: Cofferdams 5 and 6

9.3.6 *Alternatives*

Initially the following possible sites were identified for Smithfield Dam (shown in **Figure 50**):

- Site A; and
- Site B – includes a saddle dam on the left side close to the main dam.

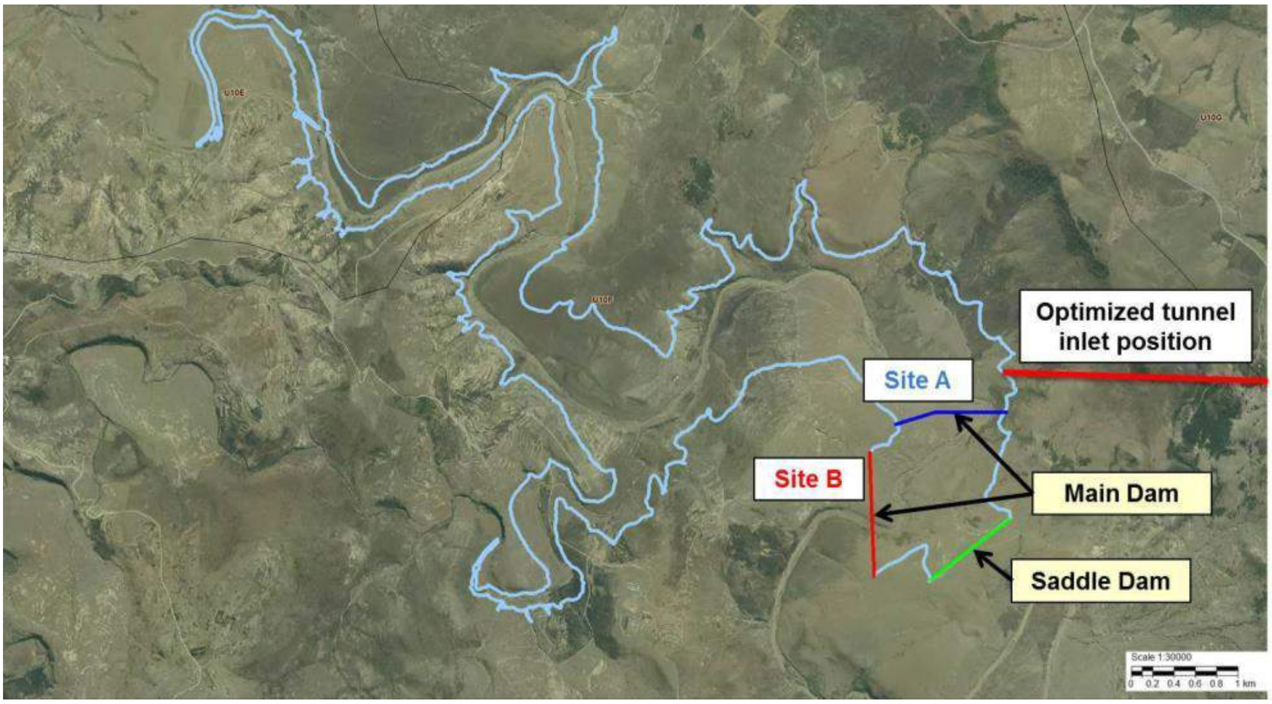


Figure 50: Alternatives - Major Storage Dam

For both dam options a portion of the dam wall is located on the Farm Smithfield 14796. Following further optimisation, Site A was eliminated.

For the purpose of selecting the best dam type for Smithfield Dam many possible dam type options had to be considered. However, depending on the availability of materials on site some of the dam type options had to be eliminated or adjusted to include zones of alternative obtainable material.

9.4 Gauging Weir

9.4.1 Description

A gauging station is a site on a river which has been selected, equipped and operated to provide the basic data from which systematic records of water level (stage) and discharge may be derived. Essentially it consists of a natural or artificial river cross-section where a continuous record of stage can be obtained and where a relation between stage and discharge can be determined (Lambie, 1978).

Overall, the project requires the following three weirs to be constructed to measure the flow of the river (DWA, 2014b):

1. One of these will be below the proposed Impendle Dam to determine the inflow to the proposed Smithfield Dam for operational purposes - i.e. timing and magnitude of EWR releases and accounting for incremental flows when making releases from Impendle Dam;
2. The second is to be constructed in the area below Smithfield Dam to determine the discharges (i.e. spills and releases) from Smithfield Dam for application in the dam balance; and
3. The third will be located further downstream, with the intent being to determine the runoff from the incremental catchment downstream of Smithfield Dam to account for this in determining the magnitude of EWR releases from Smithfield Dam. **Figure 51** shows an example of a weir downstream of a dam, which was built for the same purpose.

This EIA is only assessing the gauging weir located immediately below Smithfield Dam (no. 2 above). **Separate applications will be required for the other two weirs**.

The proposed weir has been designed as a crump weir which accommodates site specific flows.

The drawings associated with the gauging weir are contained in **Appendix F**.

Figure 51: Example of a gauging weir downstream of Spring Grove Dam

9.4.2 *Alternatives*

When selecting a site for a gauging weir the most important aspects to consider are as follows (DWA, 2014b):

- Good foundation conditions;
- Steep slope downstream from the site and a gradual to flat slope upstream;
- A bend in the river, upstream and downstream, must be avoided to facilitate straight flowlines over the weir;
- The river banks must be stable; and
- Easy access to the site is advisable.

The coordinates of the alternative sites for the gauging weir below Smithfield Dam are as follows (refer to **Figure 52**):

- Option 1 - 29°46'53.09"S; 29°55'52.70"E; and
- Option 2 - 29°47'11.91"S; 29°55'53.11"E.

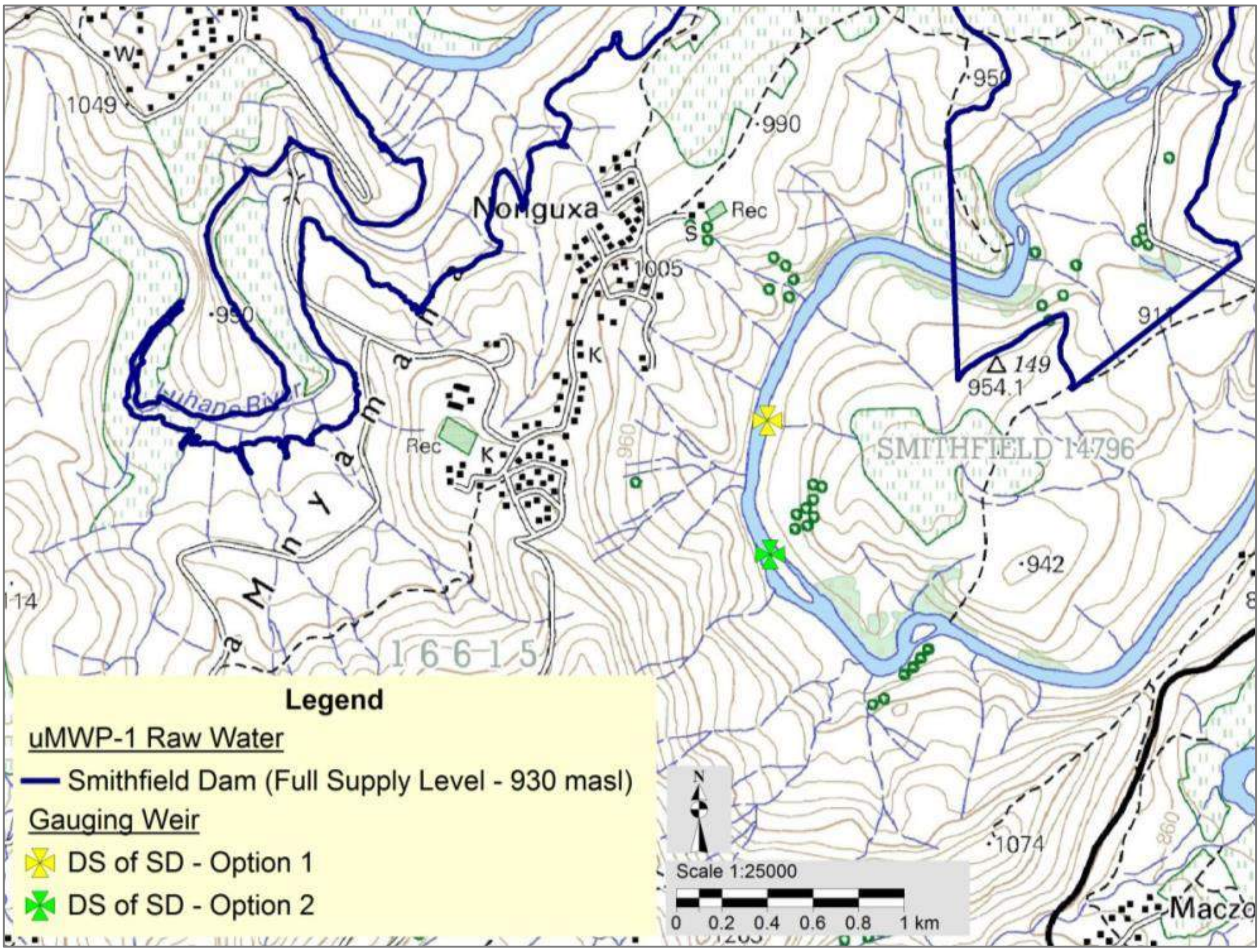


Figure 52: Alternative Gauging Weir Sites

The alternative sites for the gauging weir are compared from a technical perspective in **Table 22**.

Table 22: Weir downstream of Smithfield Dam – technical comparison of optional sites

Factor	Site 1	Site 2
Access	There are roads close to the left hand side, but these would need to be extended by approximately 600 m and upgraded. Closest road on the right hand side is 900 m away and on top of a high bank.	Existing roads run near the site but would need to be extended by approximately 1.1 km. This extension would result in some destruction of virgin land.
Exposed Rock in	Some unweathered surface rock	There is an exposed rock face on

Factor	Site 1	Site 2
River	boulders daylight on the banks; however, these are quite small (roughly 150 mm in diameter).	the right hand side banks upstream of the site. Aside from this there is limited rock exposure at the site.
Length of Straight Pool Upstream of Weir	250 m	150 m
Downstream Inundation potential During Low Flows	The flow velocity increases after the site, indicating an increase in the bed slope. This would assist in avoiding inundation at the site.	There is a section of aerated water downstream of the site which shows indications that there is also an increase in the bed slope.
Influence by Upstream Stream/Rivers	There is a small stream running into the river upstream of site 1. However, this stream is unavoidable as the site (at 1.3 km downstream of the proposed dam wall) could not be positioned above this stream.	There is an additional stream entering the river between site 1 and site 2. This stream has a slightly larger catchment than the one entering upstream of site 1. This may affect the accuracy of measuring discharge from Smithfield Dam.

Due to the stream that enters the river in between the two sites and the length of the straight pool leading up to site 2, site 1 is preferred from a technical perspective.

9.5 Raw Water Conveyance Infrastructure

9.5.1 Tunnel

9.5.1.1 Description

Raw Water Conveyance Infrastructure is required to convey the raw water from Smithfield Dam to the proposed WTW. This includes a transfer tunnel which extends from the intake tower at Smithfield Dam to the Baynesfield area. The shortest route through the mountain range between the two valleys was identified based on a comparison analysis between pumping schemes and the selected gravity conveyance system. This pressure tunnel has to be driven through hard quality shales and dolerites (last mentioned about 40% of the distance) and is connected with a pressure pipeline from the tunnel end to the site of the proposed WTW. This system is sized to accommodate design flows with Smithfield Dam at the minimum operating level.

The characteristics of the tunnel are provided in **Table 23**.

Table 23: Characteristics of Tunnel

Parameter	Description	
Type	Pressure tunnel	
Diameter (m)	3.5	
Length (km)	Option A - 32km	Option B - 31km
Maximum tunnel cover depth (m below NGL)	636.4	
Transfer capacity (m^3/s)	8.65	

A cross section of the tunnel is provided in **Figure 53**. The selected horizontal and vertical layout of the tunnel is shown in **Figure 54**. A long section and chainages is provided in **Appendix G**.

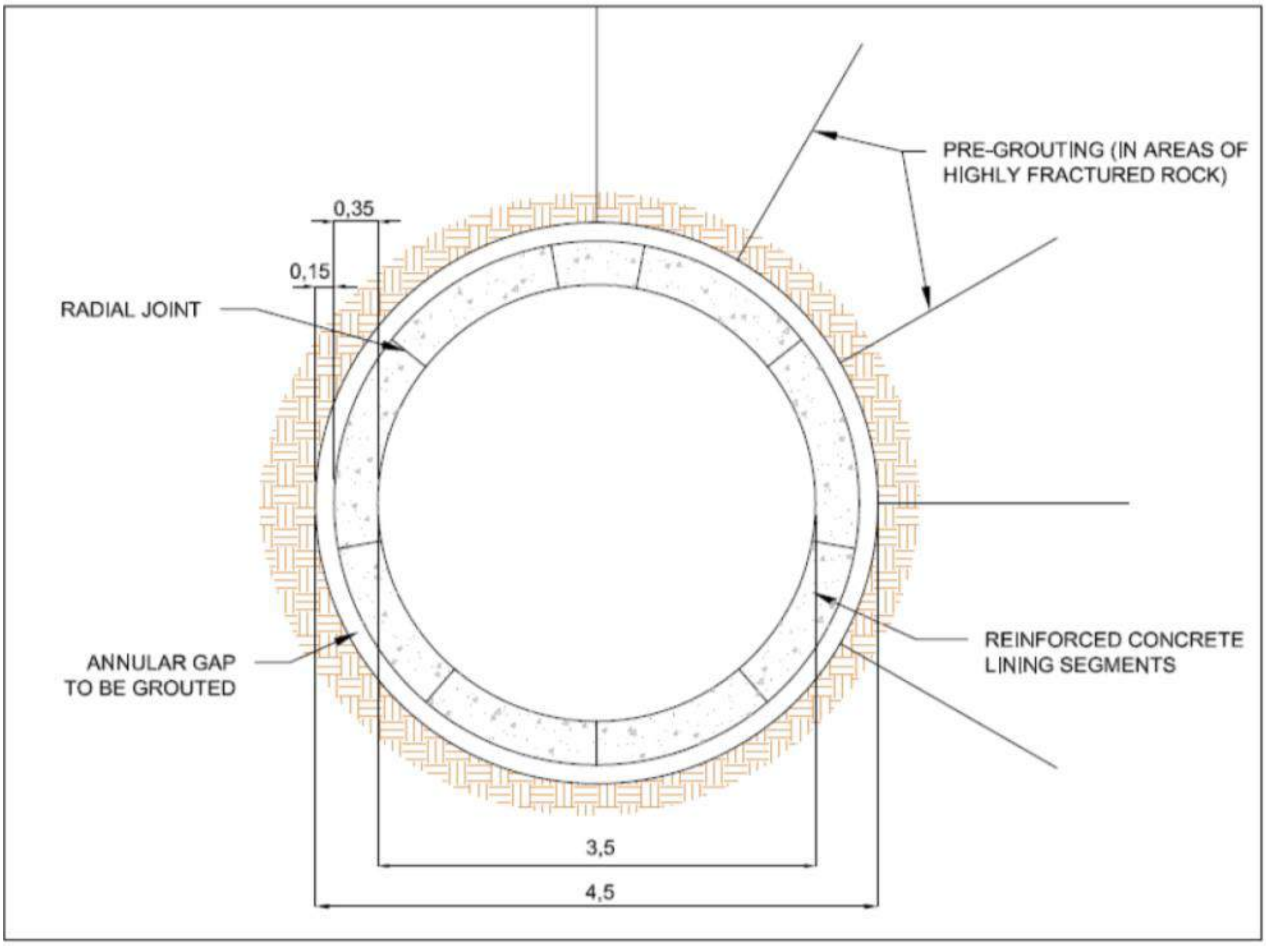


Figure 53: Cross section of tunnel

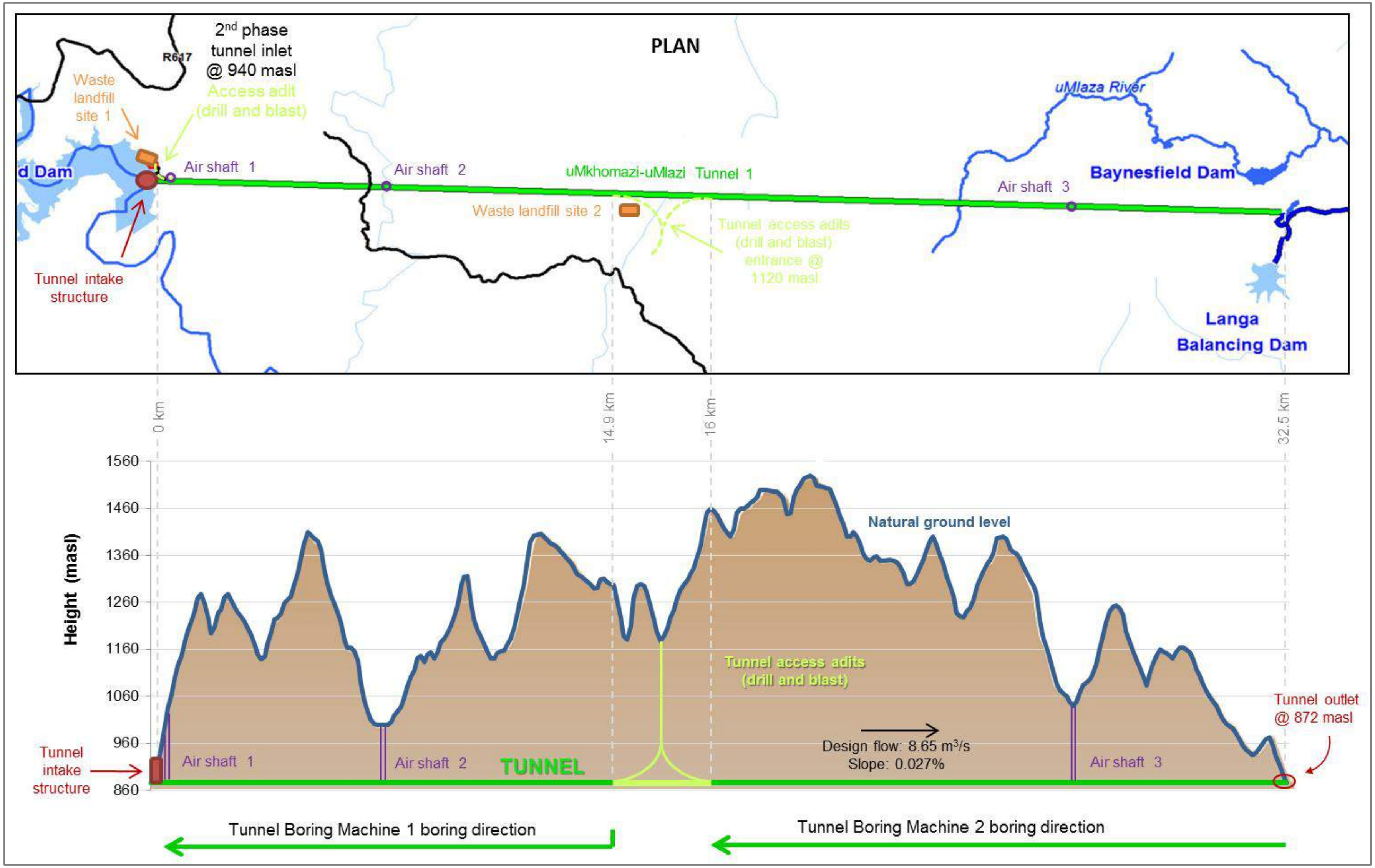


Figure 54: Long section of uMkhomazi – uMlaza Tunnel

9.5.1.2 Tunnel and shaft design philosophy

General considerations

Design and construction of tunnels and shafts in rock requires processes and procedures that are in many ways different from other design and construction projects, because the principal construction material is the rock mass itself rather than an engineered material. Uncertainties persist in the properties of the rock materials and in the way the rock mass and groundwater will behave. These uncertainties must be overcome by flexible design and safeguards during construction.

More than for any other type of structure, the design of tunnels must involve the selection of an anticipated method of construction. The selection of a tunnel boring machine (TBM) construction arrangement in comparison with a drill and blast techniques (DBT) construction methodology is based on a lower construction cost and a significantly shorter time required for excavation of the tunnel. More information is provided in **Appendix F**. Examples of a TBM are shown in **Figures 55 - 56**.

Figure 55: Example of a TBM
(http://www.tunnelforum.com/projects/?mode=type&id=3274)

Figure 56: **Example of a TBM**

Geology and hydrogeological considerations

The site geology provides the scene for any underground structure. The mechanical properties of the rock mass determine how the geologic materials deform and fail under the forces introduced by the excavation. The hydrogeological conditions establish the quantity and pressure of the water to be controlled.

The materials and geotechnical investigation carried out for the feasibility design indicated that the tunnel will traverse sub-horizontally bedded shale rock of the Karoo Sequence which has been extensively intruded by dolerite. The 1:250 000 geological survey maps indicate a number of faults, generally striking NW to SE at roughly 45° to the tunnel alignment. The shale rock at tunnel level is unweathered and very hard to extremely hard, whilst the dolerite is extremely hard and unweathered. Both rock types are described as slightly to highly fractured.

The hydrogeological conditions along the tunnel route vary considerably. During investigations the groundwater was generally located at depths between 20 and 30 m; however, artesian conditions were encountered in two of the exploratory rotary core boreholes – one borehole was dry and two had relatively shallow ground water tables. The high groundwater flows were encountered where the rock mass was highly fractured.

Although no specific testing was carried out to determine the presence of gas, this cannot be precluded as some carbonaceous shale rock was encountered in some boreholes.

Construction of the tunnels

Methods and sequences of tunnel excavation affect the loads and displacements exerted by the rock mass that have to be resisted by the rock support. Although it is good practice to leave many details of construction for the contractor to decide, it is often necessary for the designer to specify methods of construction when these affect the quality, cost, programming or safety of the work. The basic components of underground construction include, inter alia, the following:

- Excavation, by means of blasting or by mechanical means;
- Ground support;
- Survey;
- Site and portal preparation;
- Ventilation and lighting of the underground works; and
- Drainage and water control.

The central access adits of the tunnel, required for access to the main tunnel during excavation and for maintenance under operation, span 5 m to provide sufficient space for machines to access the tunnel and transporting components of the TBMs. These adits will not be lined; however, they will be covered with a layer of shotcrete where necessary. A section through the access adits is shown in **Figure 57** as well as in a drawing in **Appendix F**.

Reasons for the large size of the access adits:

- Sufficient room for transporting components of the TBM;
- Sufficient space provisions for vehicles moving in and out during operation, with some enlarged areas to facilitate passing of construction vehicles; and
- Sufficient space for mucking conveyors, ventilation ducts, lighting and services.

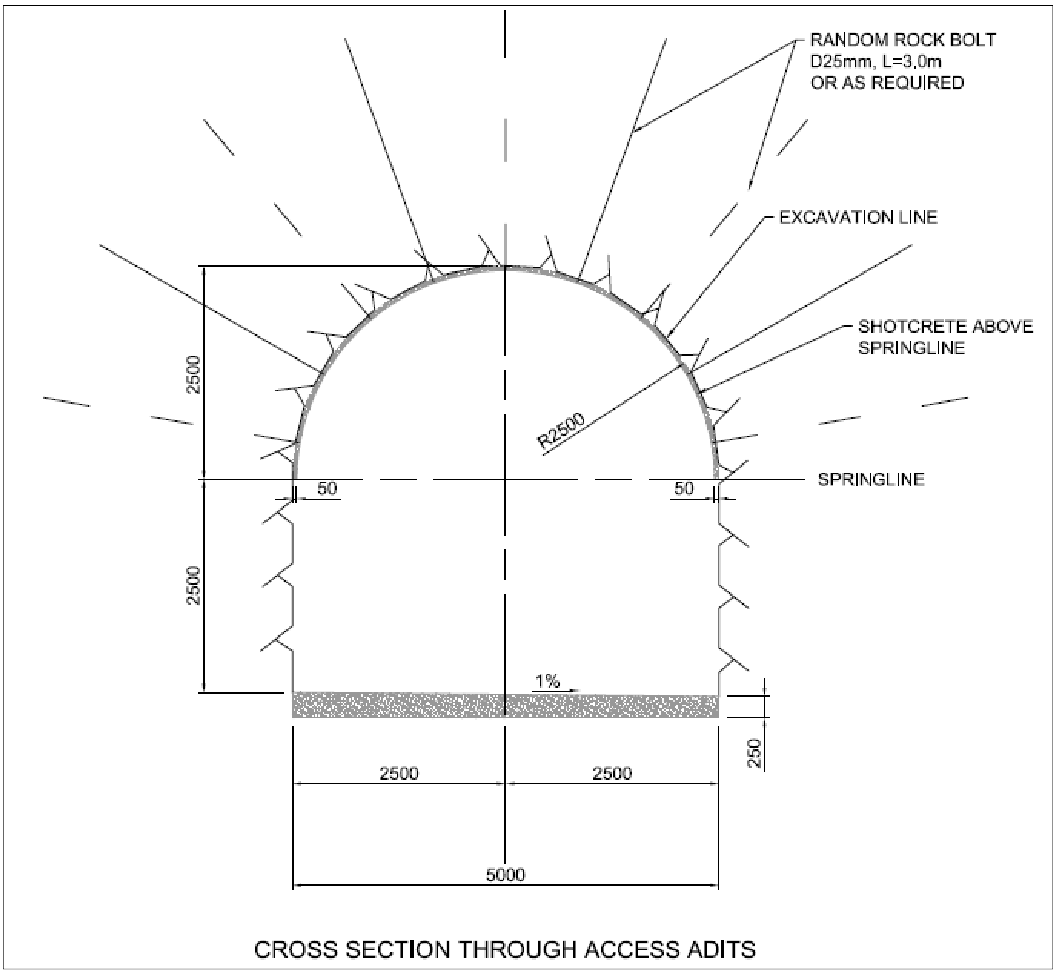


Figure 57: Section through an access adit

A portion of the main tunnel in the vicinity of the central access adit will be enlarged to a 7.5 m span to facilitate the assembly and dismantling of the TBM. This enlargement will be required over a length of 40 to 50 m. This area will also be utilised for the storage of conveyor belting, pre-cast lining segments, ventilation ducts and services.

Due to the length of the water transfer tunnel and the fairly uniform strength of the rock mass, this tunnel will be excavated by two double shield TBMs. These machines consist of two main components, a front shield with the cutterhead, main bearing and drive, and a rear shield with gripping unit, auxiliary thrust cylinders and tailskin. The main thrust cylinders connect the two parts of the shield.

In stable rock, the machine is braced radially against the tunnel with the gripper shoes in the rear shield while the front shield is advanced independently of the gripper shield using the main thrust cylinders. Simultaneously while tunnelling, the precast liner segments are installed in the tailskin section. When the advancing stroke is completed, the gripper shoes are released and the rear shield is pushed towards the front shield utilising the auxiliary thrust cylinders. Regripping lasts only a few minutes, which means that tunnelling is almost continuous.

Double shield TBMs can also operate in fault zones or areas of weak rock. In these sections radial bracing is not possible and the front and rear shields are retracted to form a rigid unit. The thrust force to advance the TBM is applied using the auxiliary thrust cylinders which push against the last segment ring installed. As a result, tunnelling and ring building can no longer take place simultaneously. However, this method provides for higher tunnelling safety in difficult sections of the alignment.

It is envisaged that no primary support will be installed as the final lining will be installed fairly close to the excavation face. The final tunnel support will consist of precast lining segments that will be assembled to form watertight rings. The annulus between the assembled rings and the excavated rock face will be backfilled with cementitious grout. The assembled rings will have a reasonably low Manning's number which will assist with water flow and velocity criteria.

Two TBMs will be utilised on this project, the first advancing from the outlet portal to a central access adit and the second from the central access adit towards the inlet portal. Both drives will be undertaken up-grade to ensure drainage of the tunnels.

Advantages of using a TBM include the following:

- Higher advance rates;
- Continuous operations;
- Less damage to the rock mass;

- Fewer support requirements;
- Uniform muck characteristics; and
- Greater work safety.

Disadvantages of a TBM are the fixed circular tunnel geometry, limited flexibility in response to extremes in geological conditions, longer mobilisation time and higher capital cost.

Due to the proposed layout of the tunnel and to accommodate access for the TBMs, it is proposed to excavate some of the tunnels by means of DBT, i.e. the access tunnels (adits) and the central portion of the water transfer tunnel. The DBT is suited to the excavation of these tunnels as it is versatile in being able to excavate tunnels of varying dimensions and more adept at handling varying ground conditions. The tunnels will be advanced full face and vibrations from blasting are not considered to be problematic due to the rural location of the project.

Primary rock support for the DBT sections of the tunnel will incorporate either tensioned or untensioned rock bolts with varying thicknesses of either fibre or mesh reinforced sprayed concrete, i.e. shotcrete. The use of steel arches or lattice girders is not foreseen. The final tunnel support will consist of a cast in-situ concrete lining which will be reinforced where it has to cater for high internal or external water pressures. As mentioned above, the access adits will not be lined; however, they will be covered with a layer of shotcrete where necessary.

Access during construction

The radius of the access tunnels should be at least 250 m with a vertical gradient of 12% to facilitate the transport of TBM equipment.

As it is envisaged that a second tunnel will be excavated around 2044, it is prudent to excavate the inlet stub tunnel during the initial contract to facilitate access to the second main tunnel as this inlet will be inundated in 2044 by the Smithfield reservoir. The inlet from the intake tower and shaft of this stub tunnel should be provided with stoplogs or an equivalent sealing system, as this will be necessary for the excavation of the second tunnel without interfering with the operation of the initial tunnel.

Portal construction

Tunnels usually require a minimum of one or two tunnel diameters of rock cover before tunnelling can safely commence. To start with, an open excavation is made which when finished will provide the necessary cover to begin tunnelling. Rock reinforcement systems are often used to stabilise the rock above the tunnel. Tunnel excavation from the portal should be done carefully and judiciously with controlled blasting and short rounds being used initially. After the tunnel has been advanced to two to three diameters from the portal face, or as geology dictates, the blasting rounds may be increased progressively to standard length rounds for normal tunnelling.

When constructing portals, the following will be taken into account:

- The rock in the portal area is likely to be more weathered and fractured than that in the tunnel.
- The portal must be designed with proper regard to slope stability conditions, since the portal excavation will unload the toe of the slope, and saturated/drawdown conditions will exist at the inlet portal.
- The portal will be developed at the beginning of mining, as the excavation crew gain experience and go through their learning curve.
- The portal will be a heavily utilised area and a conservative design approach should be taken because of the potential negative effects any instability would have on the tunnelling operations.
- Where TBMs are to be assembled, the portal area should allow for a level area of 40 to 50 m length with a minimum width of 7.5 m.

The design of the portal reinforcement will depend on geological conditions and both rock and soil stability analyses will be required as both types of material are present.

Shaft construction

Most underground works include at least one deep excavation or shaft for temporary access and ventilation or as part of the permanent facility. In this scheme, a minimum of two access shafts will be required, initially for ventilation purposes and in the permanent case for venting during de-watering, air entrainment during streamflow and to act as surge chambers if necessary.

As shafts are excavated from ground surface, they typically go through a variety of ground conditions which include overburden excavation, weathered rock and unweathered rock of various types, with increasing groundwater pressure. Shafts serving permanent functions (personnel access, ventilation or utilities, drop shaft, de-airing, surge chamber, etc.) are sized for their ultimate purpose.

Shallow shafts through overburden are often large and rectangular in shape. Deep shafts servicing tunnel construction are most often circular in shape with a diameter as small as possible. Considering the services required for the tunnel work (hoisting, mucking, utilities, etc.) typical diameters are between 5 and 10 m. If a TBM is used, the shaft is usually sized to accommodate the largest single component of the TBM, usually the main bearing, which is approximately two-thirds of the TBM diameter.

Shaft excavation through soil overburden may be carried out utilising conventional soil excavation methods such as backhoes and dozers, supported by cranes for muck removal.

Many options are available for initial ground support, including, inter-alia, the following:

- Soldier piles and lagging in soils where groundwater is not a problem or is controlled by dewatering;
- Ring beams and lagging;
- Cast in-situ concrete lining utilising a tapered sliding shutter;
- Precast segmental shaft lining;

- Steel sheet pile walls, often used in wet ground that is not too hard for driving the sheet piles;
- Diaphragm walls cast in slurry trenches; generally more expensive but used where they can form part of the permanent structure or where settlements and groundwater must be controlled;
- Secant pile walls or soil-mixing walls as substitutes for diaphragm walls, which are generally less expensive where they can be used; and
- In good ground above the water table, soil nailing with sprayed concrete (i.e. shotcrete) is often a viable ground support alternative.

Circular shafts constructed with diaphragm, secant pile or cast in-situ concrete walls usually do not require internal bracing or anchor support, provided circularity and continuity of the wall is well controlled.

Conventional shaft sinking methods are generally utilised for excavation in rock. Blasting techniques can be used to construct a shaft of virtually any depth, size, and shape. A circular shaft is usually preferred, because the circular shape is most favourable for opening stability and lining design. Shallow shaft construction can be serviced with cranes, but deeper shaft construction requires more elaborate equipment.

The typical arrangement includes a headgear at the top, suspending a two- or three-story stage with working platforms for drilling and blasting, equipment for mucking, initial ground support installation, and final shaft lining placement. The typical shaft lining is a cast-in-situ concrete lining, placed 10 to 15 meters above the advancing face.

Most shaft construction requires the initial construction of a shaft collar structure that supports overburden and weathered rock near the surface. It also serves as a foundation for the temporary headgear used for construction as well as for permanent installations at the top of the shaft.

Ground improvement

When difficult tunnel or shaft construction conditions are foreseen, ground improvement is often advisable and sometimes necessary. There are, generally, three types of ground improvement that can be feasibly employed for underground works in rock formations:

- Dewatering;
- Grouting; and
- Freezing (which is not seen as an option on this project).

In overburden or weathered material, ground improvement must be considered when shaft sinking involves unstable ground associated with significant groundwater inflow. If sufficiently shallow, the best solution is to extend the shaft collar, consisting of a nominally watertight wall, into the top of the rock. Shallow groundwater can also often be controlled by dewatering.

Deep groundwater cannot be controlled by dewatering. This is usually done by cementitious grouting from the ground surface to full depth before shaft sinking commences, because it is very costly when carried out from within the shaft. The detailed grouting design for deep shafts is often left to a specialist contractor to perform and implement. Grout penetration into rock fractures is limited by the aperture width of the fractures relative to the cement particle size. As a rule, if the rock formation is too tight to grout, it is also usually tight enough that groundwater flow is not a problem.

Shaft grouting usually starts with the drilling of two or three rows of primary grout holes around the shaft perimeter, spaced 2.0 m to 2.5 m apart. Grout injection is performed in the required zones usually from the bottom up, using packers. The effectiveness of the grouting can be verified by drilling secondary grout holes, which if they display little or no grout take, is a sign of the effectiveness of the grouting. Where required, additional grout holes can be drilled and grouted until results are satisfactory. A limit of 1.0 Lugeon (obtained from packer testing in the grout hole) is usually considered satisfactory to ensure adequate water tightness.

Rock tunnels generally do not require ground improvement as frequently as shafts. Where it is known that the tunnel will traverse weak ground with high water pressure, the ground can be grouted ahead of time. It is preferable to grout from the ground surface, if possible, to avoid delaying tunnelling operations. The primary purpose of grouting is to reduce the ground permeability; strengthening of the ground is sometimes an additional benefit.

When grouting cannot be carried out from the ground surface, it can be carried out from the face of the tunnel before the tunnel reaches the region with adverse conditions. Where adverse conditions are anticipated but their location is unknown, probe hole drilling will help determine their location and characteristics. Where required, an arrangement of grout holes is drilled in a fan shape some 20 to 40 m ahead of the face. Quality control is achieved by drilling probe holes and testing the reduction in permeability. Grouting is continued until a satisfactory reduction is achieved.

If it is found that water inflow into the excavated tunnel is too large for convenient placement of the final lining, radial post-grouting can be performed to reduce the inflow. Generally, the grout is first injected some distance from the tunnel, where water flow velocities are likely to be smaller than at closer distances. Where it is necessary to perform radial grouting after the completion of the tunnel lining, the finished lining helps to confine the grout, but the lining must be designed to resist the grout pressure.

Drainage and control of groundwater

Prior to construction, estimates of the expected sources of groundwater and the expected inflow rates and volumes must be identified in order for the contractor to provide adequate facilities for handling inflow volumes. Water occurring in the tunnel during construction must be disposed of because it is a nuisance to workers and machinery. When encountered, water should be channelled to minimise its effect on the remaining works. Where possible, all tunnels should be excavated up-slope to ensure that they are free draining. Where necessary, water will have to be pumped out of tunnels that are excavated down-slope.

The water transfer tunnel on this project has a slope of 0.027% and when completed will be free draining. The channels, however, must be cleared from silt during construction, only the lower section where the one TBM enters from the outlet portal will be free draining. The upper section where the TBM enters from an access tunnel will be free draining down to the access tunnel, from where it will have to be pumped to the surface. Due to the length and pumping height of the access tunnel, this may entail the excavation of a series of side adits with sumps to facilitate continuous pumping.

If excavation of a tunnel is carried out with free drainage away from the excavation head and no pumping of the water is required, the cost of excavation is approximately 10% less.

Construction of permanent tunnel lining

When the initial rock support components do not fulfil the long-term functional requirements for the tunnel, a final lining is installed. In the DBT sections, the final lining will typically be constructed of cast-in-situ concrete, reinforced or unreinforced, or a steel lining surrounded by concrete or grout. For the TBM section, the initial ground support consisting of precast segments will also serve as the final lining. This scheme is fully lined as both the shale and dolerite are generally slightly to highly fractured. **It can be reconsidered during construction that the lining of the tunnel be left out for portions of the tunnel that are not significantly fractured**.

Ventilation of tunnels and shafts

Shaft and tunnel construction generally occurs in closed, dead-end spaces, and forced ventilation is essential to the safety of the works. Contractors are responsible for the safety of the work, including temporary installations such as ventilation equipment and their operation and are obliged to follow the law as enforced by the Occupational Health and Safety Act. The purpose of underground ventilation during construction serves at least the following purposes:

- Supply of adequate quality air for workers;
- Dilution or removal of construction-generated fumes;
- Cooling of air – heat sources include equipment and high temperature of rock/groundwater; and
- Smoke exhaust in the event of underground fire-dust control.

In the permanent structure, ventilation provisions may be required for at least the following purposes:

- To bleed off air at high points in the alignment;
- To purge air entrained in the water, resulting, for example, from aeration in a drop shaft; and
- To provide ventilation for personnel during inspection of empty tunnels.

These ventilation requirements often result in the use of permanent ventilation shafts with appropriate covers and valves.

A drawing showing the cross-sectional view through a ventilation shaft has been included in **Appendix F**, alongside a section of an access adit.

Spoil management

The spoil material removed from tunnels and shafts is to be placed in the provided waste landfill site areas as discussed in **Section 9.10**.

All construction water must be treated before being discharged into a natural watercourse.

In addition to the water generated by construction, it is expected that existing ground water will be encountered during the tunnelling process. This water is required to be removed from the construction area and discharged back into a natural resource, assuming it is not contaminated. If the encountered groundwater is contaminated, then provision for a waste disposal lagoon should be made to ensure the contaminated water does not enter the existing water supply systems in the area.

Economic tunnel drive lengths

A study conducted on the Mohale Tunnel of the Lesotho Highlands Project has shown that 15 km is the most economical length of drive achievable by a 4.5 m outside diameter TBM. Thus, it is envisaged that at least two TBMs would be utilized on this project. Aspects such as access and ventilation can become problematic with longer drives.

As the tunnel(s) will operate under pressure it is assumed that they will be fully concrete lined along the entire length (to be confirmed). Waterproof membrane and steel liners have not been considered necessary at this stage. The assumptions will be refined at conceptual design stage once more data is available.

Effect of tunnel on groundwater regime

The tunnel would first be constructed and later be operated after construction. The construction of the tunnel would entail:

- Drilling or blasting of rock, and opening of possible aquifers especially at weathered rock or rock contacts where water is expected to be encountered;
- Immediate sealing of areas where excessive groundwater is expected by grouting of rock or providing mass concrete plugs where necessary;
- Concrete lining of the full length of the tunnel (to be confirmed); and
- Conveyance of excessive seepage water during construction and discharging this water into the stream.

During operation the tunnel will be lined (to be confirmed) and water will be conveyed under pressure. No groundwater is expected to be added to the water conveyed from Smithfield Dam. It may, however, be necessary to pipe groundwater behind the liners from high fractured and leaking zones through a separate pipe system for discharge into the stream.

As the geotechnical investigations (boreholes) carried out during the feasibility design stage are still limited to 4 to 6 holes to the tunnel alignment area of a

32.5 km long stretch, it is not possible to project the quantity of expected seepage into the tunnel area. Normally this rate is very small and compared to the total mass of rock and groundwater on top of a 32.5 km long and approximately 400 m deep mountain area the expected seepage of say 5 l/s is small and insignificant and is not expected to impact significantly on the water head. It is also not expected to impact the quantity of boreholes which may only be 60 to 100 m deep at some locations in this rock mass.

Furthermore, the shales are horizontally layered which could cause water to flow vertically only at fractured zones. The dolerites, expected to be up to 40% of the tunnel line, are normally water tight except at contact zones with shales and/or vertical joints or fractures.

It is therefore concluded that:

- Minimum and insignificant effects on the groundwater and yields of boreholes can be expected.
- The highest risk of encountering insignificant effects is during construction in times when the boring machine has completed drilling. The grouting is done from the second “train truck” behind the bore and a liner is put in place from the “third truck” – a small time span.
- High fluoride water was encountered in one borehole at 60 m depth during investigations. This location is more than 400 m away from the tunnel. The quality of water encountered in the tunnel will only be known during construction. For this reason it is planned to provide for some treatment facility to treat the water into acceptable qualities before discharging into the stream. This will need to be determined through appropriate analysis as part of the design phase, and the relevant approvals will need to be sought.

9.5.1.3 Tunnel Inlet an Outlet

The location of the tunnel inlet is shown in **Figures 58 – 59**.

Figure 58: **Eastern view of approximate position of tunnel inlet (indicative only; not according to scale)**

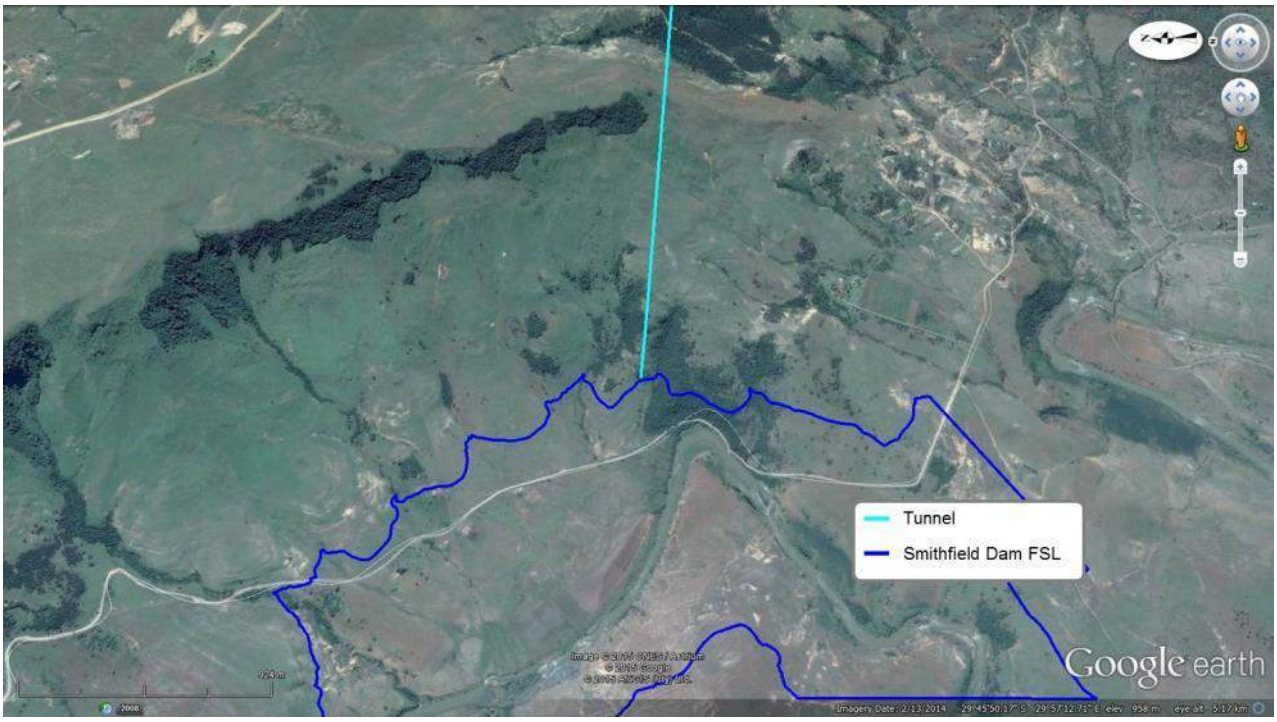


Figure 59: **Tunnel inlet (Google Earth image)**

Figure 60 shows the position of the tunnel outlet at Baynesfield Estate. A photograph of the area and three-dimensional illustrations are provided in **Figures 61** and **62**, respectively.

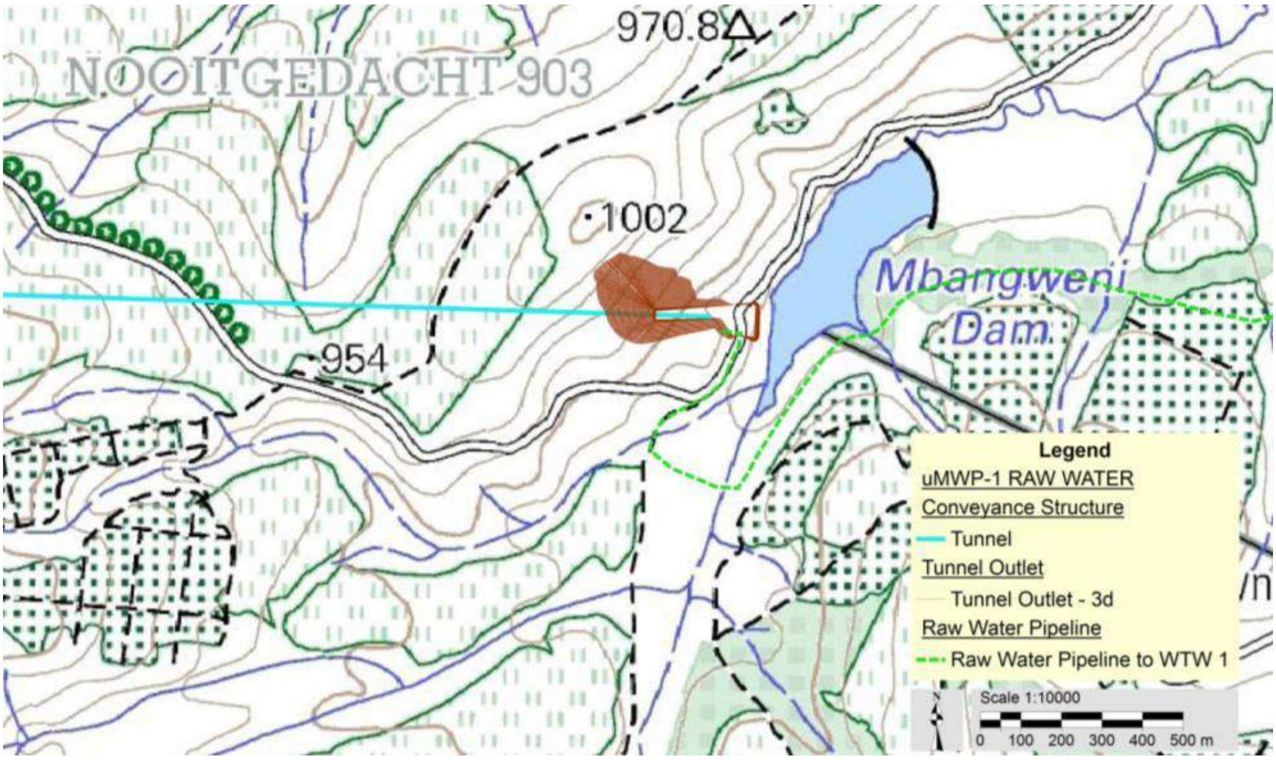


Figure 60: **Outlet for Tunnel Option A**

Figure 61: **South-western view of tunnel outlet (indicative only; not according to scale)**

Figure 62: South-western (top) and eastern view (bottom) of tunnel outlet – three-dimensional illustrations

9.5.1.4 Alternatives

The tunnel options considered cover pumping at the Smithfield Dam into a free flow tunnel or a pressure tunnel. Originally, it was envisaged that a single tunnel for each option be provided, capable of transferring the total yield associated with uMWP Phase 2 when the Impendle Dam comes on line. Based on the expected growth in water requirements, Impendle Dam (Phase 2) will be required some 18 years after the Smithfield Dam (Phase 1). Therefore, it may be beneficial to provide twin tunnels to suit the phasing of the Impendle Dam, particularly for the pressure tunnel option requiring a large size tunnel to transfer the ultimate yield of both the Smithfield and Impendle Dams.

The following options were initially evaluated:

- Pumping via a free flow tunnel –
  - Single tunnel (14,89 m^3/s); or
  - Twin tunnels (7,445 m^3/s each);
- Pressure tunnel –
  - Single tunnel (14,89 m^3/s); or
  - Twin tunnels (7,445 m^3/s each).

Due to a higher URV and the need for pumping, the option for pumping via a free flow tunnel was not investigated further.

In addition, the following two options were identified for the alignment of the tunnel (as shown in **Figure 63**):

- Option A: Tunnel to Langa Balancing Dam (± 34km in length); or
- Option B: Tunnel to Baynesfield Balancing Dam (± 33km in length).

Following optimisation of the scheme as part of the Technical Feasibility Study, Option B was eliminated.

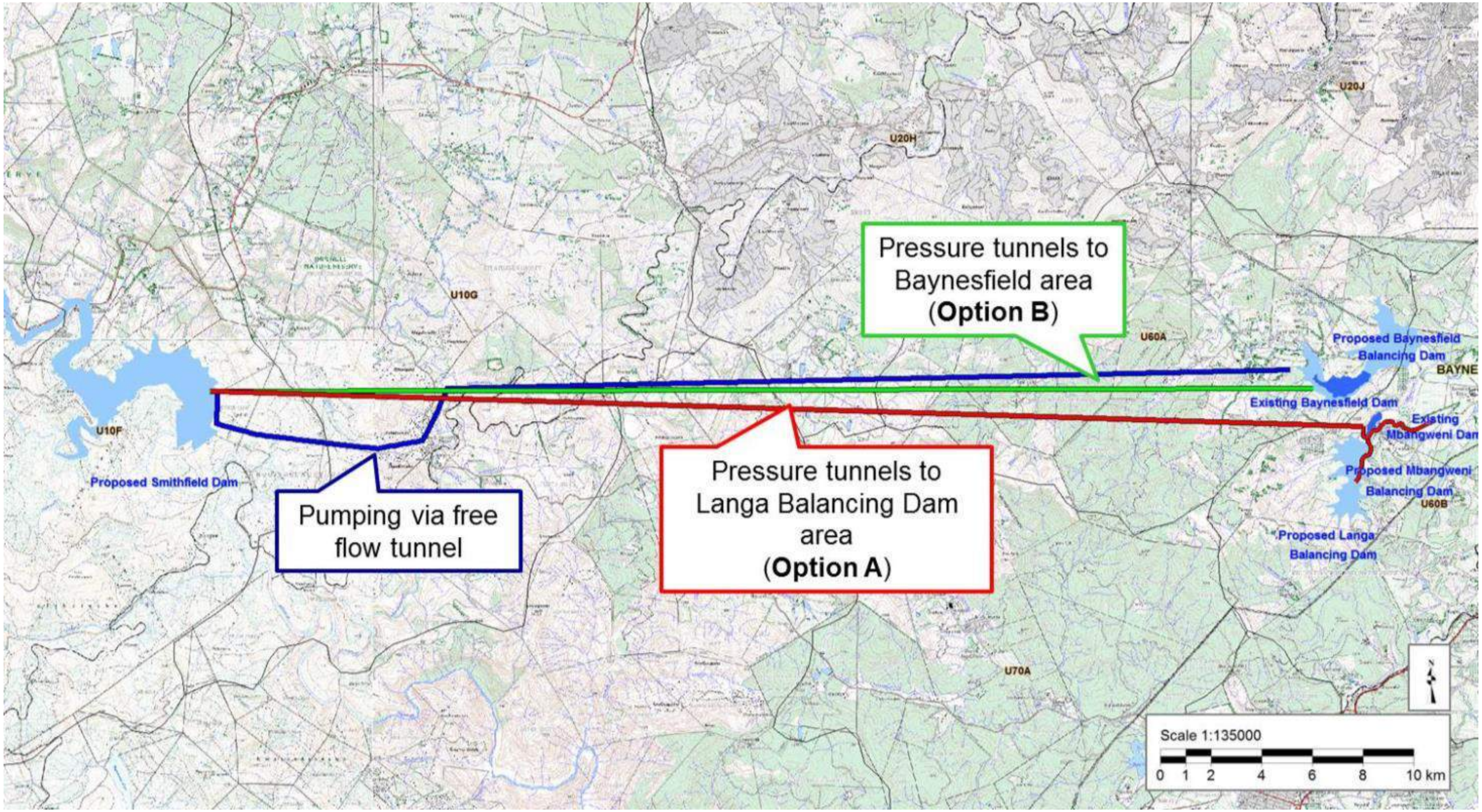


Figure 63: Alternatives – Tunnel (disregard eliminated options for balancing dam)

9.5.2 *Raw Water Pipeline*

9.5.2.1 Description

Raw water pipelines will supply raw water from Smithfield Dam to the WTW as well as the balancing dam for storage whenever raw water needs to be supplied from Langa Balancing Dam to the WTW via the same pipelines. A stilling basin will be provided at the end of the pipeline for dissipating the energy of the water before it is routed through the WTW.

An overview of the raw water pipeline specifications are provided in **Table 24**. The drawings associated with the raw water pipeline are contained in **Appendix F**.

Table 24: Raw Water Pipeline Specification

Parameter		Description
Pipe diameter	:	• To WTW - 2600 mm diameter • Link to balancing dam - 1600 mm diameter
Pipe material	:	Steel pipes with welded joints. Pipes will be protected internally with a liner and external with an external coated to safeguard against corrosion (and associated impacts on water quality) and lengthen their lifespan. Pipe should also be provided with necessary AC mitigation protection where required.
Peak throughput	:	8,65m³/s or 747Mega Litre per day
Installation	:	• Underground, with a minimum cover above the pipe of 1,2m with additional cover in wet areas as required. • Access/air valve and scour chambers will be located at approximately 500 m intervals along the route. It will be concrete structures protruding above natural ground level.
Servitude Width	:	Typically up to 40 m.
Servitude Conditions	:	• Permanent access to the pipeline servitude will be required after construction for maintenance of the pipeline and equipment. • Pipeline markers (concrete posts) will be installed at changes in direction and at regular intervals along the route • Farming activities (stock and crop farming) can continue within the servitude area after construction, taking cognisance of the need for permanent access to the pipeline servitude. • No encroachment of infrastructure (buildings) or the establishment of trees, large bushes or deep-rooted plants will be allowed as roots compromise the stability of the pipeline.

The negotiations with the landowners for the registration of the servitude or acquisition of land will be undertaken by DWS, which will include the appointment of a land valuer. This process, which does not form part of the EIA, will adhere to all statutory requirements.

9.5.2.2 Design layout philosophy

The end of the tunnel from Smithfield Dam will be located about 1 500 m downstream of Langa Balancing Dam and the raw water pipeline to the WTW will start at this point. The 2.6 m diameter raw water pipeline will convey raw water from the end of the tunnel to the WTW at a peak flow rate of 8.65 m^3/s. A take-off along the raw water pipeline is proposed to convey raw water to Langa Balancing Dam for storage. This take-off will be located approximately 1 500 m upstream of the Langa Balancing Dam and the diameter of this take-off pipeline will be 1.6 m. The design layout philosophy is as follows for the following two supply scenarios:

Scenario 1: Direct supply from Smithfield Dam to the WTW

- Raw water will be released from Smithfield Dam into the proposed 3.5 m diameter tunnel at a flow rate of 8.65 m^3/s.
- At the end of the tunnel, raw water will be discharged into the proposed 2.6 m diameter gravity steel pipeline to supply the WTW, also at a flow rate of 8.65 m^3/s.
- During off-peak periods, and when Smithfield Dam reservoir is at high levels, the pipeline will be closed and raw water will be diverted to the take-off from where it will be conveyed to balancing dam for storage.

Scenario 2: Supply from Langa Balancing Dam to the WTW

- During maintenance periods of the tunnel, when raw water cannot be conveyed from Smithfield Dam via the tunnel, the stored water in Langa Balancing Dam will then be supplied via the pipeline under gravity to the WTW, at a flow rate of 8.65 m^3/s, for the duration of the maintenance of the tunnel.

9.5.2.3 Alternatives

The raw water pipeline forms part of the raw water conveyance infrastructure. As shown in **Figure 64**, the alternative alignments of the raw water pipeline are dependent on the final location of the WTW, which forms part of the Potable Water component. For detailed maps on the raw water pipeline routes, please refer to **Appendix D**.

The following aspects were considered in defining the raw water pipeline routes:

- Topography and associated elevation;
- Impacts to the social, biophysical, economic and built environment;
- Existing servitudes;
- Existing structures and infrastructure;
- Existing roads, as well as boundaries between landowners along the routes;
- Site constraints, potential watercourse crossings, road and railway crossings; and
- Geotechnical overview.

The table to follow lists the properties (based on 2006 cadastral information) traversed by the alternative alignments of the raw water pipeline, from west to east (starting at the tunnel outlet – Coordinates: 29°46'26.05"S; 30°18'10.91"E). All distances provided should be regarded as approximates, as they are based on a desktop estimate from GIS.

Table 25: Raw Water Pipeline Routes (NE = north-east; SW = south-west; SE = south-east)

Option	Property			Distance (approximate)	Dominant Direction
	Farm	No.	Ptn		
Route to WTW Option 1	Nooitgedacht	903	3	441 m	SW
	The Mynde	15363	0	634 m	SE & NE
	Nooitgedacht	903	8	2 157 m	NE & East
	Nels Rust	849	0	1 709 m	SE & NE
Route to WTW Option 2	Nooitgedacht	903	3	441 m	SW
	The Mynde	15363	0	634 m	SE & NE
	Nooitgedacht	903	8	2 495 m	SE & NE
	Nels Rust	849	3	1 972 m	NE

Option	Property			Distance (approximate)	Dominant Direction
	Farm	No.	Ptn		
	Nels Rust	849	85	1 759 m	SE & NE
	Nels Rust	849	65	95 m	SE
Route to WTW Option 3	Nooitgedacht	903	3	441 m	SW
	The Mynde	15363	0	634 m	SE & NE
	Nooitgedacht	903	8	2 121 m	SE & NE
	Nels Rust	849	0	2 559 m	SE, NE & East
	Brasfort Park	1295	22	462 m	SE
	Brasfort Park	1295	26	373 m	SE
	Brasfort Park	1295	24	800 m	SE
	Brasfort Park	1295	20	389 m	SE
	Brasfort Park	1295	47	432 m	SE
	Brasfort Park	1295	6	1 873 m	NE
	Hopewell	881	9	79 m	NE
	Hopewell	881	5	746 m	NE
	Hopewell	881	6	482 m	NE
	Hopewell	881	43	1 425 m	NE
	New Leeds	17536	1	1 042 m	NW
	Morning Sun	17790	0	163 m	NW
	New Leeds	17871	0	342 m	NW & NE
Link to Balancing Dam	The Mynde	15363	0	1 102 m	SW
	Nooitgedacht	903	8	145 m	SW

A brief overview of the routes for each of the alignment options for the raw water pipeline follows (refer to **Figure 64**) (note that all three alternative routes follow the same alignment for the first section).

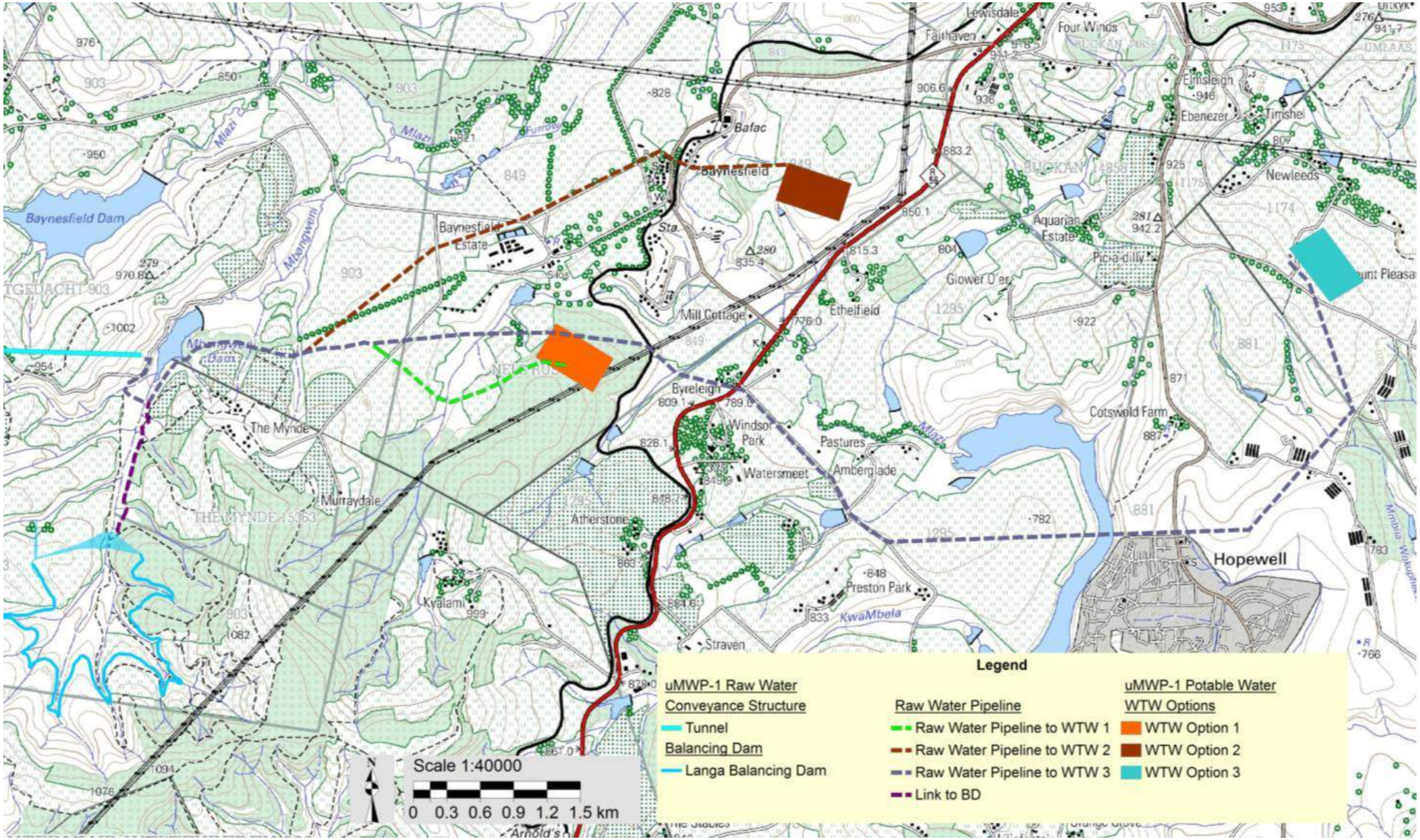


Figure 64: **Raw water pipeline routes**

- **<u>Raw water pipeline to WTW Option 1</u>** –
  From the tunnel outlet the pipeline crosses a private dirt road and turns south-westerly to follow this road for approximately 200m. From there the route continues in a south-western direction and crosses a watercourse before turning to the south-east and traversing a wetland system. The pipeline then turns north-eastwards and runs to the immediate west of cultivated land. It then passes to the east of Mbangweni Dam before turning in a more easterly direction to cross two timber plantations and two watercourses.

  From there the route continues north-easterly through cultivated land before turning in a south-easterly direction and crossing the D41 road. It then crosses more cultivated land and another watercourse and ends at the proposed WTW Option 1 site that is situated within a timber plantation on the Remainder of the Farm Nels Rust 849. The entire route is located on the Baynesfield Estate.

- **<u>Raw water pipeline to WTW Option 2</u>** –
  From the tunnel outlet the pipeline crosses a private dirt road and turns south-westerly to follow this road for approximately 200m. From there the route continues in a south-western direction and crosses a watercourse before turning to the south-east and traversing a wetland system. The pipeline then turns north-eastwards and runs to the immediate west of cultivated land. It then passes to the east of Mbangweni Dam before turning in a more easterly direction to cross two timber plantations and two watercourses.

  From there the route turns in a more northerly direction and crosses cultivated land and the D41 road. It then continues through cultivated land and passes more than 100m to the north of the Baynesfield Estate piggery. The route follows a private road for approximately 1.2km before crossing a road and passing to the immediate north of the Baynesfield Club sports ground. The route then turns in a south-eastern direction and passes a residential dwelling before traversing the P334, a railway line and a private road. The route then travels to the south of residential dwellings and turns north-eastwards to traverse a watercourse and cultivated land before ending at the WTW Option 2 site on Portion 85 of the Farm Nels Rust 849. Apart from public roads and the railway line, the entire route is located on the Baynesfield Estate.

Refer to selected views along the pipeline route shown in **Figures 65 – 66**.

Figure 65: **South-westerly view - raw water pipeline to WTW Option 2 (along P334)**

Figure 66: **South-easterly view - raw water pipeline to WTW Option 2 (P334 crossing)**

- **<u>Raw water pipeline to WTW Option 3</u>** –

  From the tunnel outlet the pipeline crosses a private dirt road and turns south-westerly to follow this road for approximately 200m. From there the route continues in a south-western direction and crosses a watercourse before turning to the south-east and traversing a wetland system. The pipeline then turns north-eastwards and runs to the immediate west of cultivated land. It then passes to the east of Mbangweni Dam before turning in a more easterly direction to cross two timber plantations and two watercourses.

  It then crosses more cultivated land, the D41 road, another two watercourses and a timber plantation more than 500m to the south of the Baynesfield Estate offices and piggery. Thereafter the route crosses a railway line and power line servitude, before traversing another watercourse followed by cultivated land (Byreleigh Farm). After crossing the R56 the pipeline runs alongside the D360 gravel road, past cultivated land.

  On Portion 6 of the Farm Brasfort Park 1295 the route turns easterly and traverses cultivated land before crossing the Mapstone Dam. It then traverses vacant land and the R624. Thereafter in enters land owned by Rainbow Farms and after approximately 490m it turns in a north-eastern direction and travels for another 1.4km passing chicken houses, a private road and a watercourse along the way.

  The route then turns north-westerly and traverses a sugarcane plantation for approximately 1.5km before terminating at the WTW Option 3 site on the Remainder of the Farm New Leeds17871.

  Refer to selected views along the pipeline route shown in **Figures 67 – 69**.

Figure 67: North-westerly view - raw water pipeline to WTW Option 3 (west of R56 crossing point)

Figure 68: South-easterly view - raw water pipeline to WTW Option 3 (along D360)

Figure 69: Western view - raw water pipeline to WTW Option 3 (Mapstone Dam crossing)

❖ **Link to Balancing Dam** –

From the raw water pipeline to the WTW the link to the balancing dam runs in a predominantly south-western direction and follows an existing farm road on the Baynesfield Estate.

The initial section passes to the west of cultivated land followed by a timber plantation until it reaches its destination at the Langa Balancing Dam.

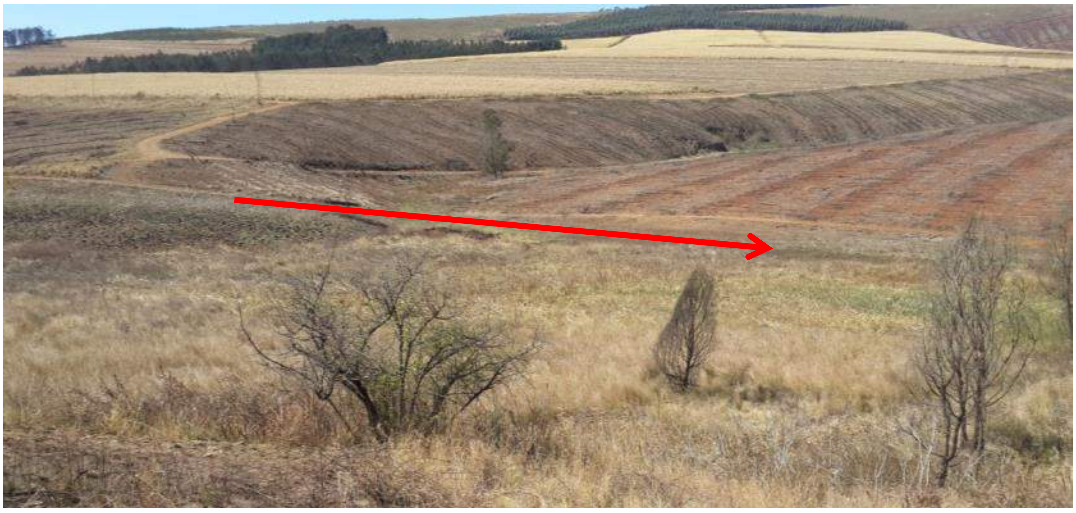


Figure 70: Eastern view - raw water pipeline to balancing dam

Figure 71: Southern view - raw water pipeline to balancing dam

9.6 Balancing Dam

9.6.1 *Description*

Operational requirements for inspection and maintenance of long transfer tunnels, like the Lesotho Highlands Transfer scheme, include the provision of balancing dams on the downstream side. These dams store water for the supply during down time periods required for inspection and maintenance periods of the tunnels, also if they are concrete lined.

The criteria applied for the sizing of Langa Balancing Dam are the following:

- Two months of supply should be available. If the storage that can be provided is not sufficient, the maximum possible storage should be provided and the rest can be provided from other sources through the Umgeni System.
- The FSL of Langa Balancing Dam cannot be higher than the FSL of Smithfield Dam (930 masl), since Langa Balancing Dam has to be filled under gravity from Smithfield Dam.
- The hydraulic requirements of supplying water through the tunnel to the proposed WTW and for filling Langa Balancing Dam, and thereby accommodating friction and secondary losses, must be met. During off-peak periods, and when Smithfield Dam reservoir is at high levels, raw water will be supplied to both the WTW and Langa Balancing Dam for storage.

9.6.2 *River Diversion*

The following two river diversion phases are proposed for the balancing dam during construction:

- **Phase 1:** A 250 m long cofferdam (Cofferdam 1) that is designed for the recommended peak discharge of 76 m^3/s for the 1:20 year recurrence interval. This cofferdam is required to ensure that river flow remains within the river channel during construction of the two proposed 1.6 m diameter outlet pipes for Langa Dam.
- **Phase 2:** A short and low cofferdam (Cofferdam 2) that is designed for the recommended winter peak discharge, for the 1:20 year recurrence interval of 8.20 m^3/s. This cofferdam is required to ensure that river flow is diverted through the two

proposed 1.6 m diameter outlet pipes during the construction of the last section of the rockfill embankment for during the winter season.

9.6.3 Operation Rule

In accordance with the water yield analysis carried out, the following operation rule was developed for the operation of Langa Balancing Dam:

- Langa Balancing Dam is to be filled and topped up from Smithfield Dam when Smithfield Dam is spilling.
- Evaporation losses in Langa Balancing Dam are to be supplemented from runoff from the catchment area.
- Langa Balancing Dam is to release water for EWR between the dam and the new Mbangweni Dam.
- Langa Balancing Dam is to provide water to the proposed WTW during maintenance and repair periods of the tunnel.

9.6.4 Alternatives

9.6.4.1 Location

The following options were initially considered for the balancing dam as part of the Technical Feasibility Study, as discussed in the Scoping Report (refer to **Figure 72**):

- Baynesfield Balancing Dam –
  - Enlarge the existing Baynesfield Dam to provide the necessary storage capacity required;
- Upper Mbangweni Balancing Dam –
  - Construct a new dam on the Mbangweni River approximately 250m upstream from the existing Mbangweni Dam;
- Langa Balancing Dam –
  - Construct a new dam on the Mbangweni River, where the impoundment will be located on Portion 8 of the Farm Nooitgedacht 903.

Unfavourable geotechnical and topographical conditions, as well as higher costs, lead to the elimination of the Baynesfield Balancing Dam option.

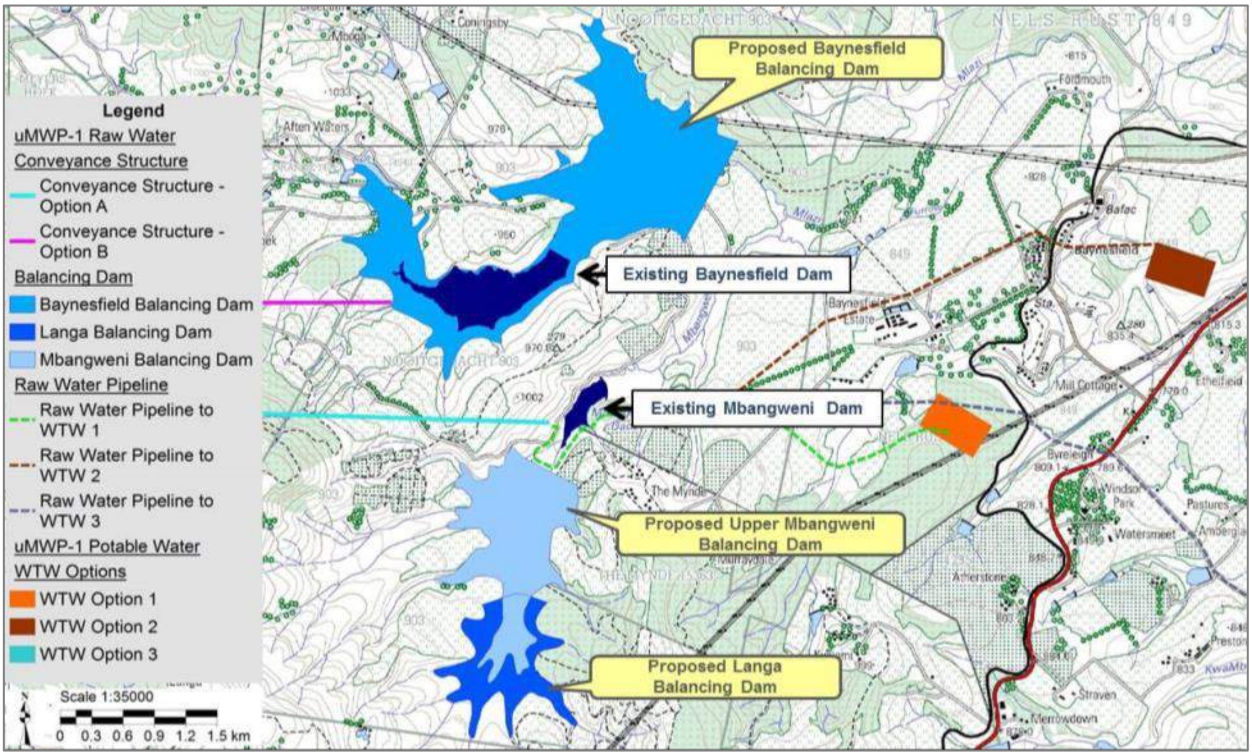


Figure 72: Alternatives – Balancing Dam

9.6.4.2 Dam type

The dam types indicated in **Table 26** have been considered. Reasons for not considering the dam type are also indicated.

Table 26: Dam type options considered

Dam type	Reason for not selecting the dam type as indicated
Roller compacted concrete (RCC) gravity dam	Selected
Concrete faced rockfill dam (incl. various options of zoning depending on availability of material)	Selected
Composite dam (various options of gravity dam with any of the above-mentioned embankment dams)	Selected
Earth core rockfill dam (incl. various options of zoning depending on availability of material)	Insufficient impervious material and semi-pervious material
Zoned earthfill embankment dam	Insufficient impervious material and semi-pervious material
Conventional vibrated concrete (CVC) gravity dam	More expensive (with a higher cement content) than RCC gravity dam
Conventional vibrated concrete (CVC) buttress dam	More expensive than both RCC and CVC gravity dams Time-consuming
Concrete arch dam	More expensive than both RCC and CVC gravity dams Valley shape not favourable
Hardfill concrete gravity dam	More expensive than both RCC and CVC gravity dams Would need too much aggregate that is not necessarily available on site

Dam type	Reason for not selecting the dam type as indicated
Asphalt concrete gravity dam	Too expensive Earthfill materials for the core (more favourable than asphalt) are available on site
Masonry/hand labour intensive methods	This dam type does not meet the time requirement

As can be seen from **Table 26**, based on the available materials and making maximum use thereof, the following types were considered:

- CFRD;
- RCC gravity; and
- Composite dam: central RCC gravity type with CFRD on left and right flank.

Due to the lack of sufficient earthfill materials and relatively deep foundations encountered, the best dam type identified was a CFRD (to be confirmed as part of final design). This dam type also provided the least amount of material that would need to be spoiled.

For the proposed Non-overspill crest (NOC) of 926.60 masl, the maximum wall height and width will be 46.60 m and 202.72 m respectively. The proposed embankment crest width is 7 m and the proposed upstream and downstream slopes of the rockfill embankment are 1V:2H and 1V:2.2H. The estimated total length of the dam wall is 573 m. The dam will inundate an area of about 95.48 ha at the proposed FSL of 923 masl, which is about 17.91% of the dam's catchment area.

A 10 m long ogee spillway on the left flank of the dam, with an approach channel with an ogee weir of 1.5 m depth, is proposed together with a 177 m long chute and stilling basin at the end. An inlet/outlet structure comprising one tower with a dual pipe system is proposed to serve the following purposes:

- An inlet structure for water that will be supplied to Langa Balancing Dam from Smithfield Dam;
- An outlet structure which will serve as the outlet for raw water supply to the WTW; and
- An outlet structure for water releases from Langa Balancing Dam for environmental purposes from time to time.

The principal data for Langa Balancing Dam is summarised in **Table 27**. The layout of Langa Balancing Dam is included in **Appendix F** and a 3 dimensional view is provided in **Figure 73**.

Table 27: Langa Balancing Dam Principal Data

Parameter	Description
Type of dam	CFRD
Catchment area	5.34 km²
Recommended design flood (RDF)	1:200 year
Peak inflow of the 1:200 year flood	204 m^3/s
Regional maximum flood (RMF)	283 m^3/s
Safety evaluation flood (SEF)	313 m^3/s
Full supply level (FSL)	923.00 masl
Minimum operating level (MOL)	898.24 masl
Non overspill crest level (NOC)	926.60 masl
Gross storage volume at FSL, including additional storage created by the quarry	15.67 million m^3
Live storage volume at FSL, including additional storage created by the quarry	14.82 million m^3
Area at full supply level	95.48 Ha
Estimated sediment volume after 50 years	0.21 million m^3
Mean annual runoff (MAR)	2.03 million m^3 per annum
Maximum wall height of the embankment	46.60 m
Maximum wall width of the embankment	202.72 m
Time of supply at 7.10 m^3/s	24 days

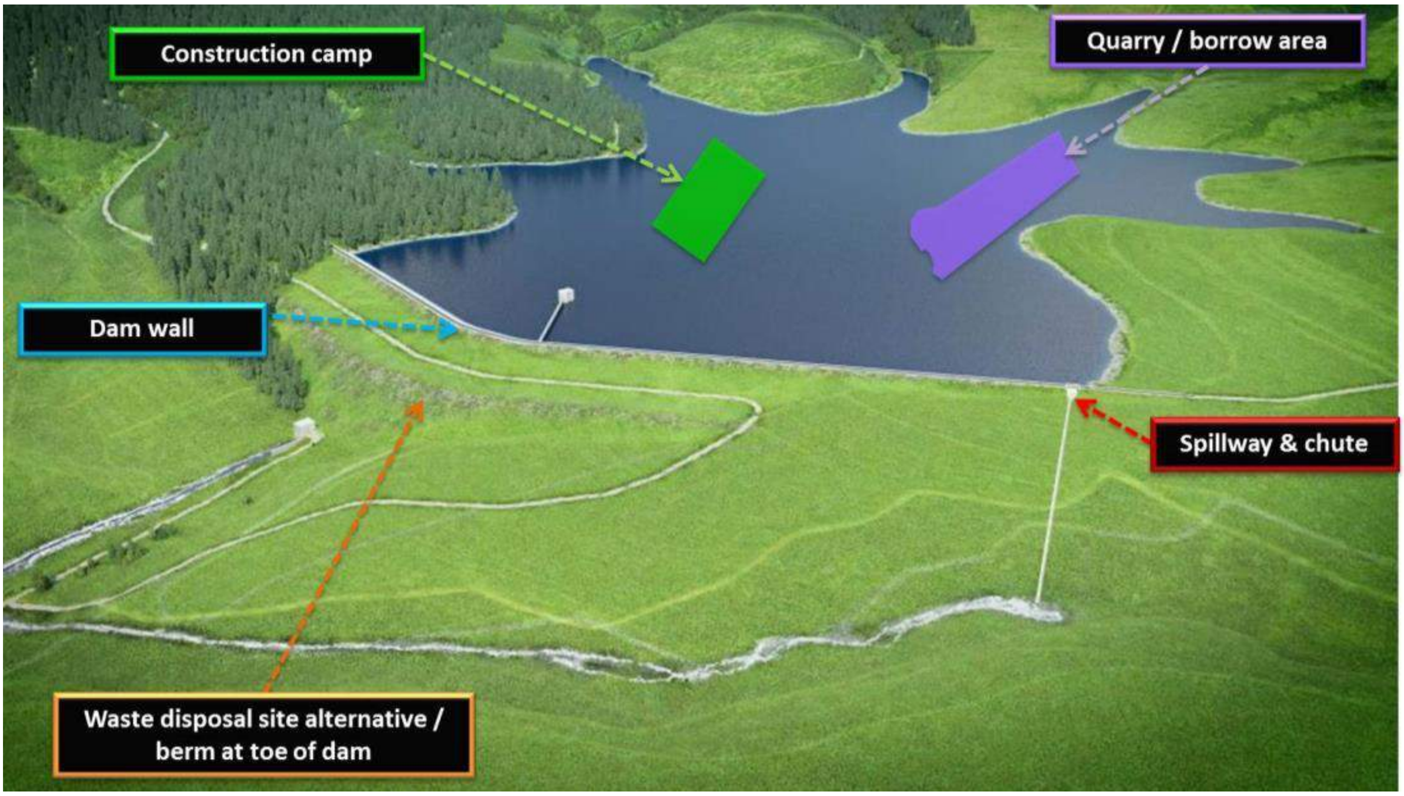


Figure 73: 3 Dimensional view of the proposed Langa Balancing Dam

9.7 Hydropower Plants

9.7.1 Introduction

As part of the uMkhomazi Water Project Technical Feasibility Design, an assessment of the feasibility of hydropower generation as a secondary benefit to the uMWP was undertaken (DWA, 2014a).

9.7.2 Possible sites

Two potential sites were identified; the first being at the proposed WTW as part of the conveyance structure from Smithfield Dam to the plant, and the second just below Smithfield Dam on the outlet works (shown schematically in **Figure 74**). At the first site, known as Baynesfield Hydropower Plant (HPP), power would be generated by water transfers through the conveyance structure. At the second site, known as Smithfield Dam HPP, power would be generated by spills and releases from the dam.

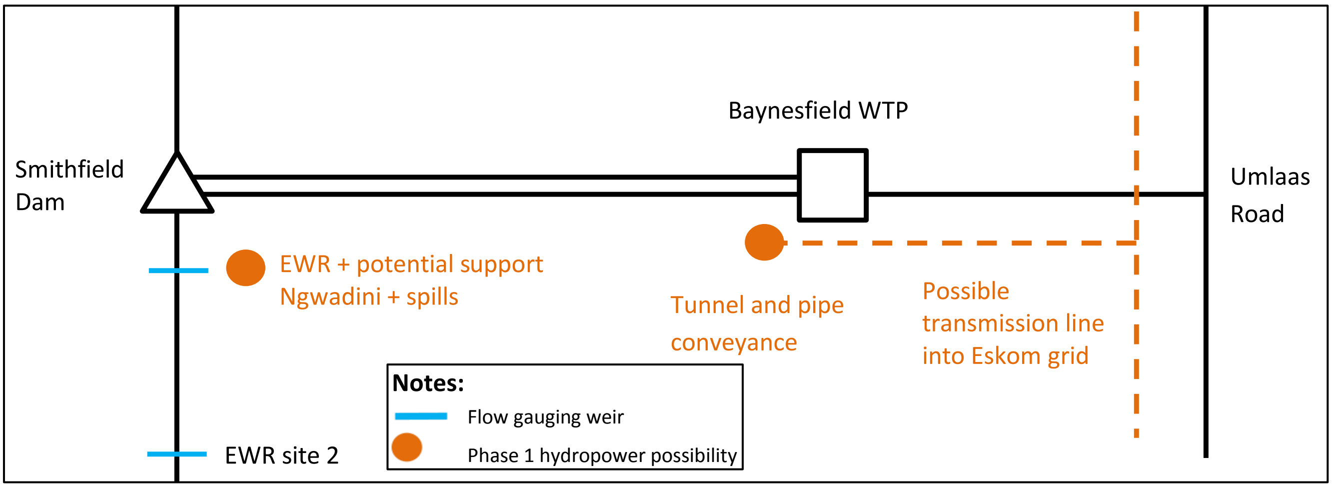


Figure 74: Layout schematic of hydropower plants

9.7.3 Energy yield

The Water Resource Planning Model (WRPM) was used to simulate the future dam levels and flow volumes over the project period, which were used to determine the hydropower potential at each site for key probabilities. **Figure 75** shows the time series of hydropower potential over the project period for Baynesfield HPP. **Figure 76** shows the probability distribution curve of hydropower potential for Smithfield Dam HPP.

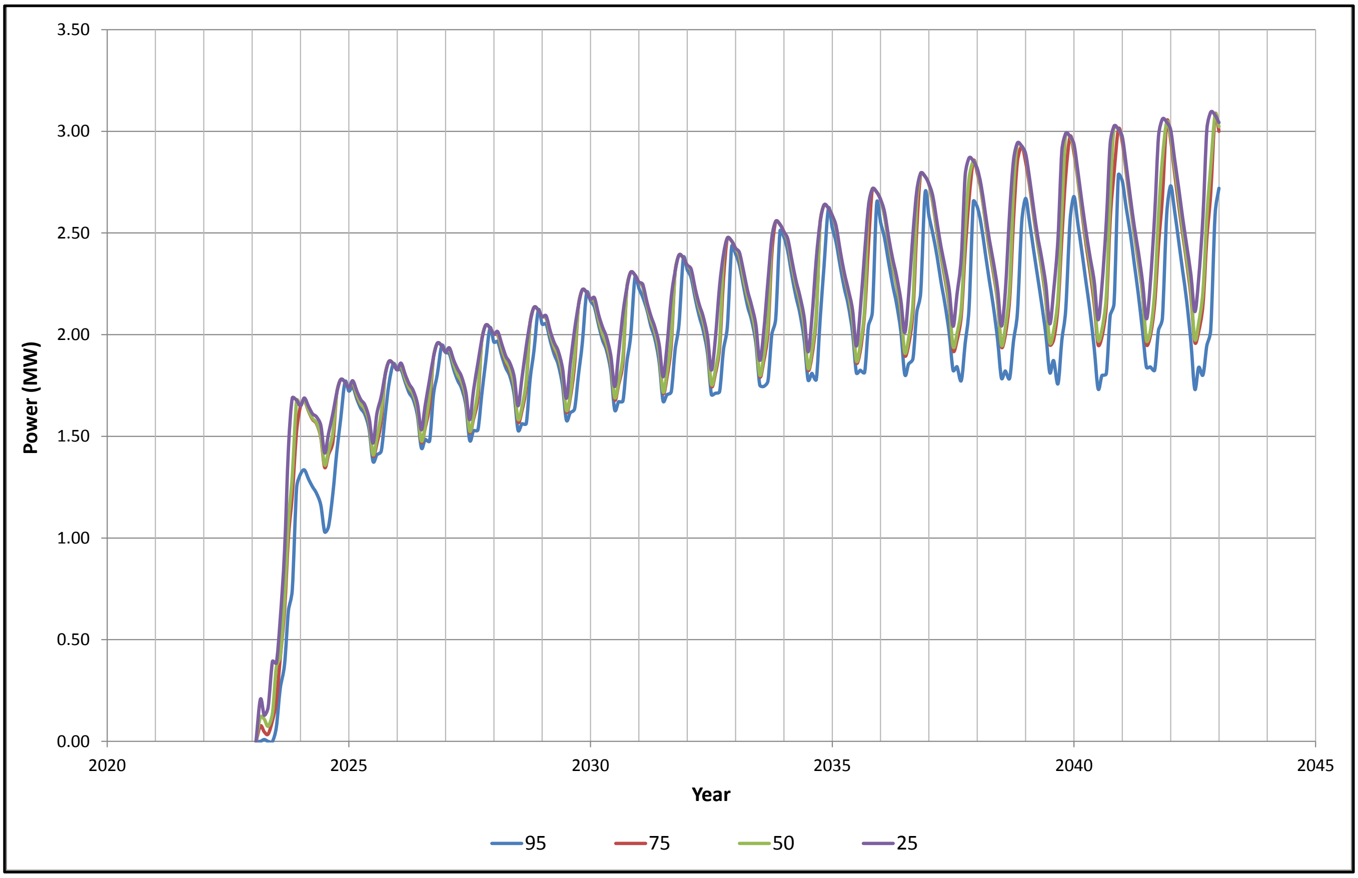


Figure 75: **Hydropower potential at Baynesfield HPP**

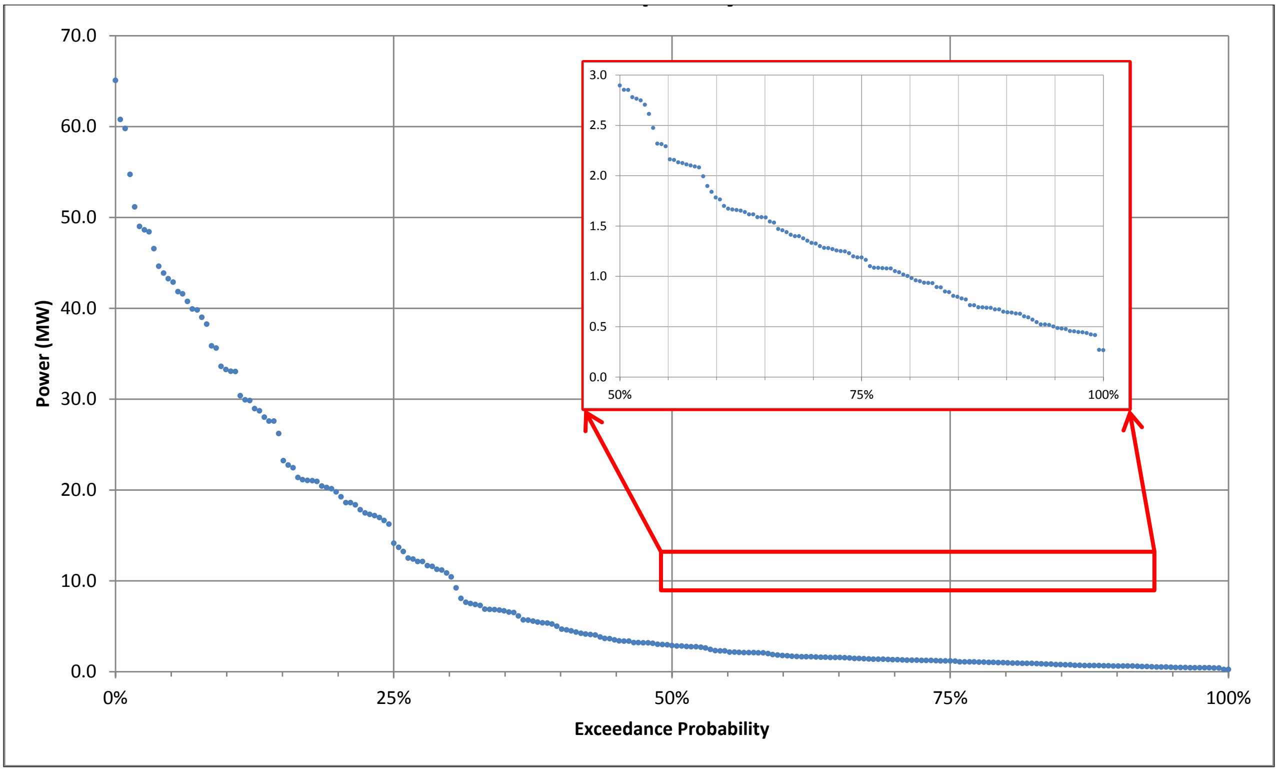


Figure 76: **Hydropower potential at Smithfield Dam HPP**

9.7.4 Conceptual design of hydropower plants

Having calculated the hydropower potential at each of the sites, the conceptual design of the HPPs was done. This entailed the design of turbines, including design for water hammer effects; the layout of the HPPs; and the design of the power transmission.

9.7.4.1 Baynesfield HPP

At Baynesfield HPP, the rated point was calculated as 8.65 m^3/s flow and 41.7 m net head, with 3 MW power potential. In order to accommodate the effects of water hammer, and because of the long penstock leading up to the turbine, a bypass to the turbine would be needed, in addition to a slow closure of the turbine. A flywheel would also be needed to limit the speed rise. The layout of the powerhouse is given in **Appendix F**.

The design of power transmission infrastructure is dependent on the usage of the power. Due to the existence of infrastructure for providing power to the site for operation of the proposed WTW, as well as during its construction, the main additional requirement would be nominal infrastructure to “clean” the generated power for wheeling into the grid or for direct use by the WTW. In addition, short underground or overhead cables would be needed, for about 50 m.

The alternatives for the HPP at this site were as follows (preferred options to be confirmed as part of final design):

- Baynesfield HPP alternative 1: Power wheeled into national grid for use at the proposed WTW; and
- Baynesfield HPP alternative 2: Power supplied directly into the proposed WTW with supply from the national grid as backup.

9.7.4.2 Smithfield Dam HPP

At Smithfield Dam HPP, two power generation alternatives were considered, with turbines rated 0.5 and 2.6 MW. The rated point for 0.5 MW was calculated as 1.1 m^3/s flow and 55.5 m net head; and for 2.6 MW was 5.0 m^3/s flow and 64.0 m net head. Because of the short penstock length, no bypass pipe would be needed to limit water hammer, and the turbine could have a short closure time with acceptable pressure rise. A flywheel would be required to limit speed rise.

Modifications will need to be made to the dam's outlet works in order to accommodate the potential powerhouse. This would involve the following:

- A bypass pipe to accommodate the turbine, which will allow the turbine to not interfere with the operation of the outlet works during emergency releases;
- A connection between the two pipes, so that hydropower can be generated when maintenance is done on either of the pipes;
- Five additional butterfly valves, in order to control flow in the abovementioned connection and to the turbine; and
- Larger sleeve valves to accommodate additional losses incurred.

The layout of the potential powerhouse incorporated into the dam's outlet works is illustrated in **Figure 77**.

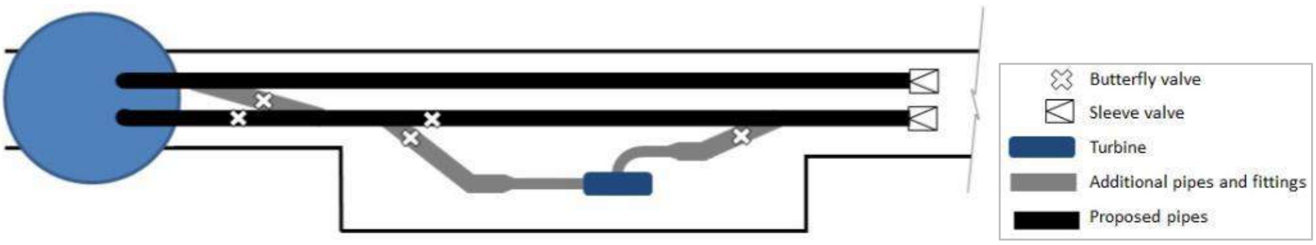


Figure 77: Schematic of modifications to outlet works for Smithfield Dam HPP

Should the powerhouse be considered feasible, the details of these modifications must be confirmed during detail design as it will also depend on the selected turbine configuration. The superstructure of the powerhouse would be similar to that for Baynesfield HPP. Power transmission infrastructure will be the same as with Baynesfield HPP, with 500 m of transmission lines.

The alternatives for the HPP at this site are as follows (preferred options to be confirmed as part of final design):

- Smithfield Dam HPP alternative 1: Power wheeled into national grid for operation and maintenance of Smithfield Dam (0.5 MW turbine);

- Smithfield Dam HPP alternative 2: Power wheeled into national grid for operation and maintenance of Smithfield Dam (2.6 MW turbine); and
- Smithfield Dam HPP alternative 3: Power supplied directly to Smithfield Dam operation and maintenance facilities.

9.8 Relocation of Eskom Transmission Line

9.8.1 *Description*

A section (approximately 700m) of an existing high voltage Eskom transmission line, known as the Bulwer/Elandskop 88kV line (shown in **Figures 78** and **79**), will become inundated by the Smithfield Dam. This line is due to be upgraded in approximately 10 years' time to a 132 kVA line.

Figure 78: Transmission line at Smithfield Dam site to be deviated

9.8.2 *Alternatives*

The initial options for the relocation of the power line, as discussed in the Scoping Report, included the following (see **Figure 79**):

1. Option 1 – power line maintains existing alignment and provision is made for the line to cross the new dam;
2. Option 2 – deviation of the power line around the north-western side of the dam; and
3. Option 3 – deviation of the power line around the south-eastern side of the dam.

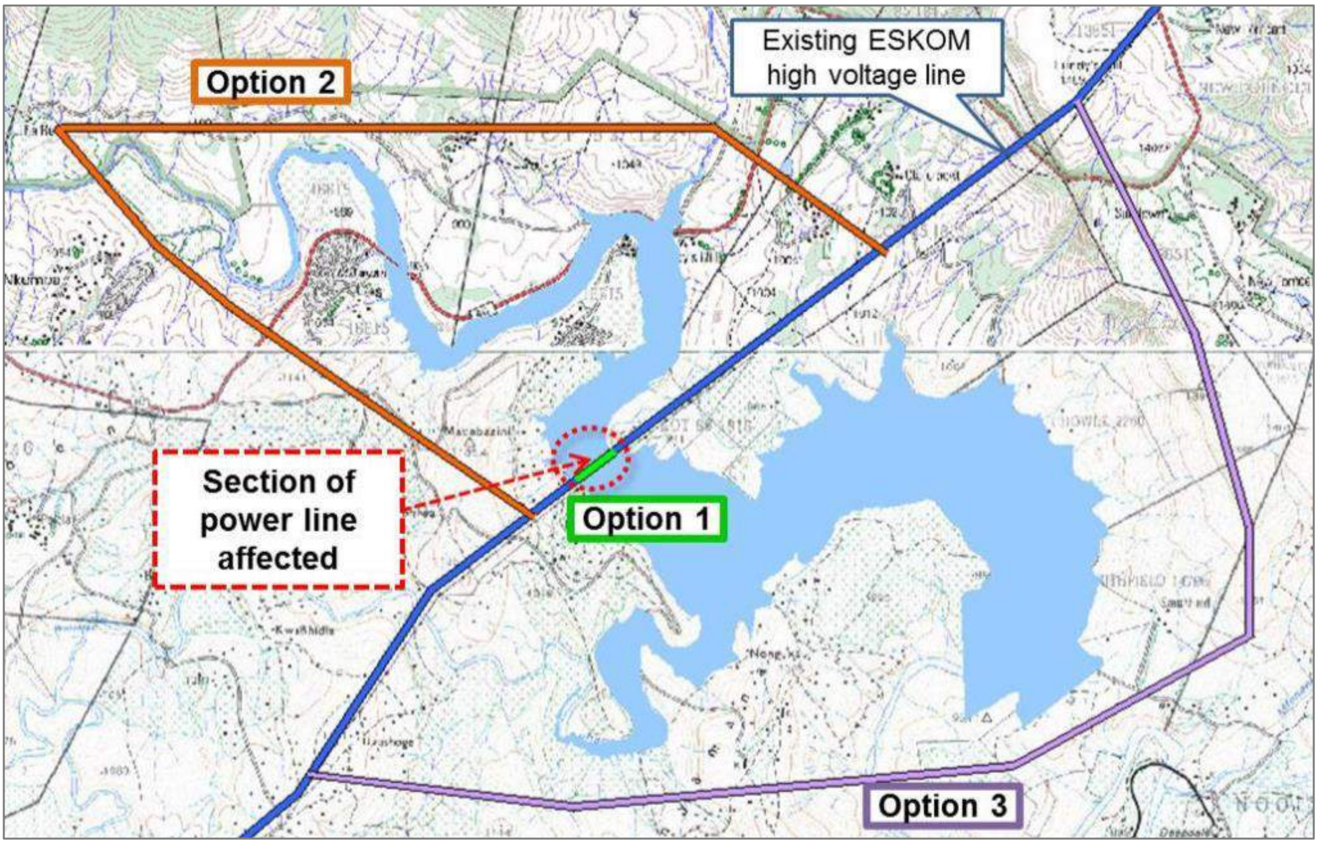


Figure 79: Alternatives – Relocation of Transmission Line at Smithfield Dam

Option 2 was subsequently abandoned, as a section of the proposed route traverses the Impendle Nature Reserve.

Option 1 is preferred from a technical perspective. During discussions with Eskom this option was also found to be preferable. For Option 1 the conceptual design of the proposed upgrade will probably consist of new towers at the sides of reservoir designed for 220 kV or 400kV. The design will include obtaining towers with sufficient attachment height that will result in the towers having sufficient clearance

9.9 Roads

9.9.1 General

The roads that have particular bearing on the proposed project and that were investigated as part of the Technical Feasibility Study and EIA are listed in **Table 28**.

Table 28: Road associated with uMWP-1

Relevant Project Component	Related Roads	Reason for Assessment
Smithfield Dam	Deviation of the R617	Inundation by Smithfield Dam
	Access road to Nonguqa	Inundation by Smithfield Dam
	Access road to tunnel inlet portal	Use during construction and operation
	Access road to dam wall	Use during construction and operation
	Construction road	Use during construction
	Access road	Use during construction and operation Section inundated by Smithfield Dam
Tunnel	Access road to Ventilation Shaft 1	Use during construction and operation
	Access road to Ventilation Shaft 3	Use during construction and operation
	Access road to centre adit entry	Use during construction and operation
Langa Balancing Dam	Access road to tunnel outlet portal and Langa Balancing Dam	Use during construction and operation
	Private road	Inundation by Langa BD
Gauging weir	Access road to gauging weir below Smithfield Dam	Use during construction and operation

The layouts of the abovementioned roads are shown in **Appendix F**.

The deviation of road R617 was designed as a paved road with a 3.5 m lane in each direction and a 1.0 m shoulder on either side, therefore a 9 m formation. For the gravel roads, a width of 8 m is proposed.

The following factors were taken into consideration during the alignment of the roads:

- Geometric design standards;
- The 1:100 year floodline;
- Areas of steep natural cross-fall; and
- The alignment of existing Provincial Road R617 in the Smithfield Dam area (where relevant).

9.9.2 Stormwater drainage

All of the access roads under discussion are situated in the catchment of the uMkhomazi River, characterised by steep, rocky terrain and mountain grassland with scattered bush.

The soils are easily eroded so great care needed to be taken in the design of drainage structures. The average annual precipitation for this area is 810 mm.

The following stormwater design standards were used:

- Minor catchments -
  - Pipe and box culverts: 1:2 year flood return period;
  - Side drains: 1:2 year flood return period;
- Major catchments -
  - Low water bridges: 1:5 year flood return period; and
  - Major bridges: 1:50 year flood return period.

9.9.3 *Description*

9.9.3.1 Roads - Smithfield Dam

Existing roads that will be affected by the proposed Smithfield Dam, as well as the initial options that were identified to deviate these roads, are shown in **Table 29** and **Figure 80**.

Table 29: Roads to be affected by Smithfield Dam and Initial Deviation Options

Affected Roads	Initial Deviation Options
Two sections of road R617 (from east to west – approx. 1200m and 330m), which is administered by the KZN Department of Transport	North deviation: ❖ Option 1 ❖ Option 2
Access dirt roads to traditional areas	West deviation ❖ Option 1 ❖ Option 2
	East deviation ❖ Option 1 ❖ Option 2

Following a refinement of the road layout, new options were identified for the roads associated with Smithfield Dam (shown in **Figure 81**). These new options were assessed further during the EIA.

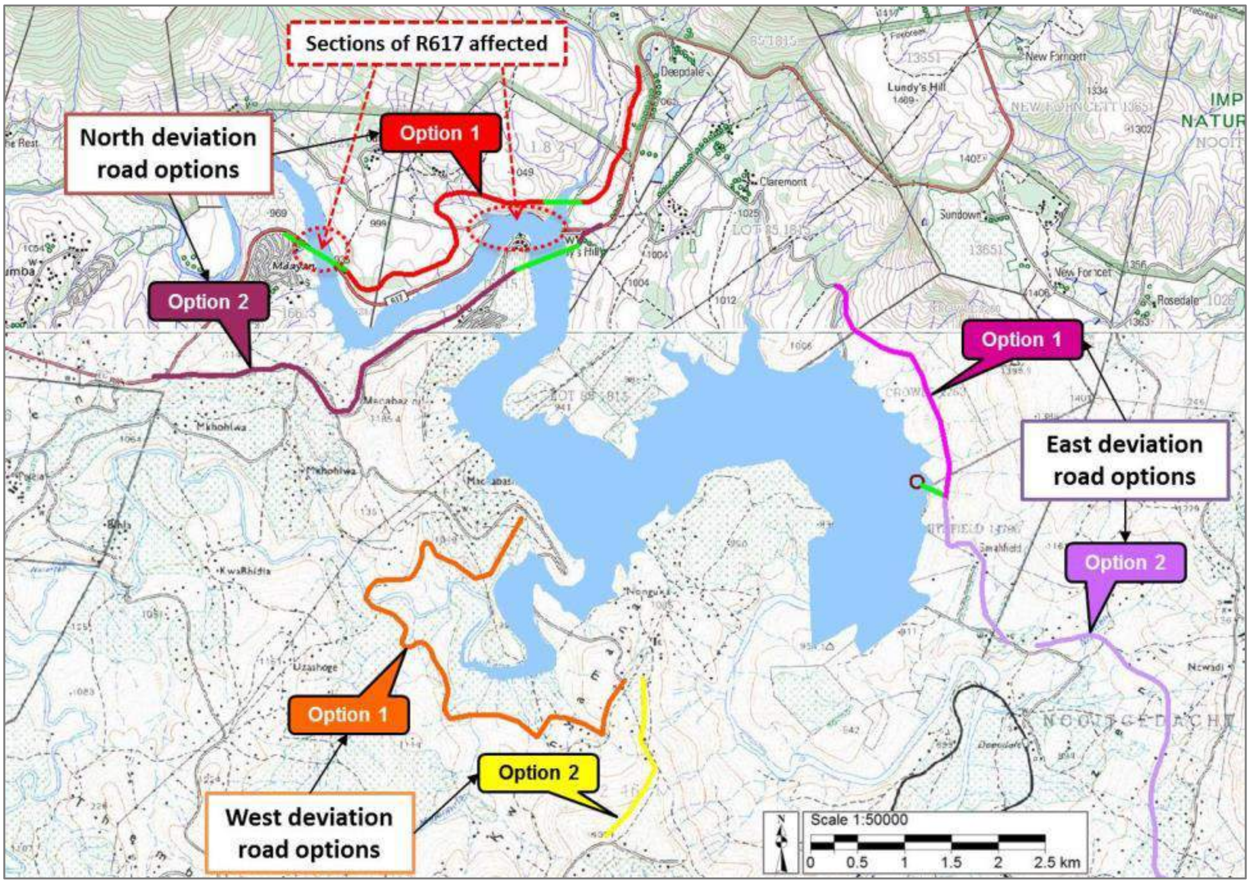


Figure 80: Road Layout at Smithfield Dam - Initial Alternatives

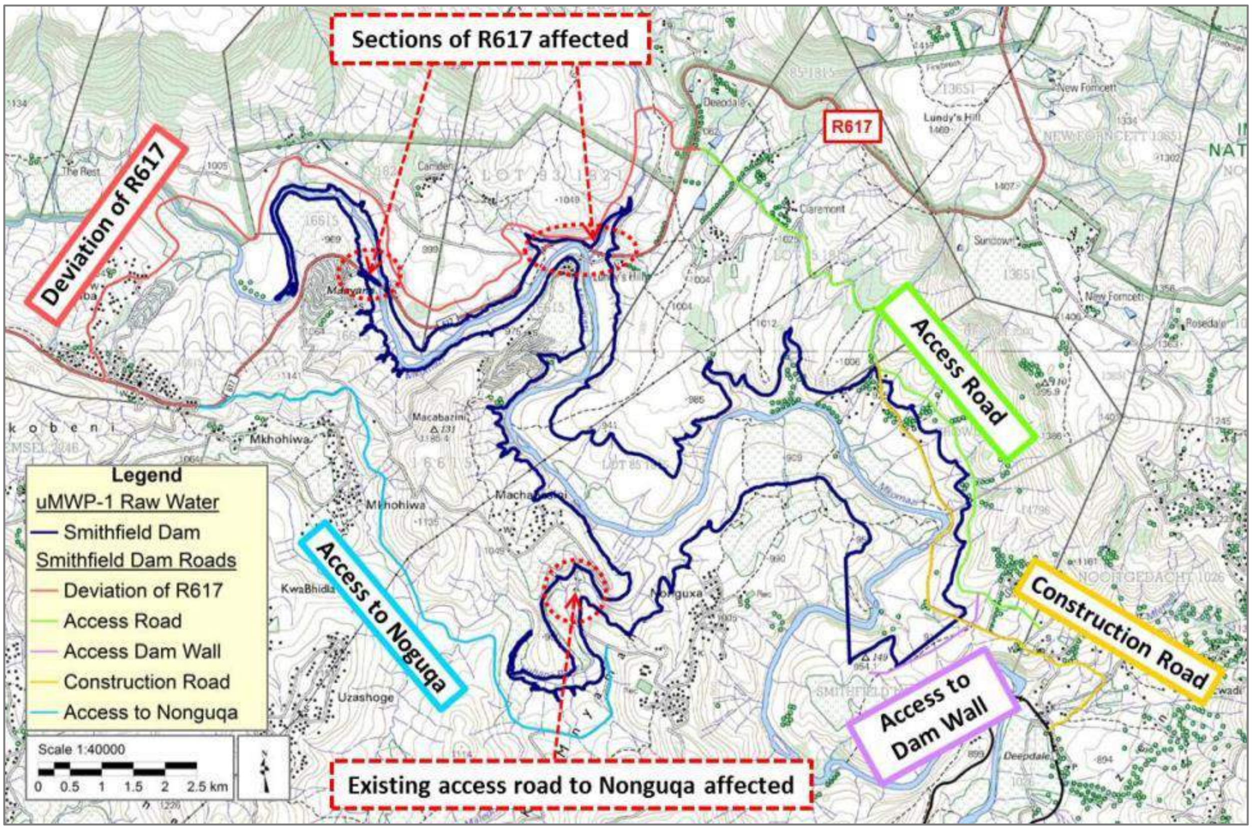


Figure 81: Road Layout at Smithfield Dam - Revised Alternatives

An overview of the roads in the Smithfield Dam area follows.

- Deviation of the R617 -

Two alternative route options were investigated to deviate road R617 around the expected FSL water line of the dam, to ensure continuity of the road. However, the one option required a long bridge over the uMkhomazi River and was discarded. The viable option will deviate road R617, to ensure continuity of the surfaced route on the northern side of the dam, from a position at a village west of the dam wall to where it joins the surfaced section of this road on the northern side of the dam.

The preferred road for the deviation of road R617 will match the existing road which is a *7 m* wide surfaced road with a *3.5 m* lane in each direction including a 1 m shoulder on each side. The length of the deviation is *12.06 km* and has a maximum slope of *13.9%*.

- Access road to Nonguqa -

The proposed road will ensure access to Nonguqa, a village on the southern side of the dam, which is currently served by an unsurfaced road, joining road R617 west of the dam. Option 2 runs along the southern end of the dam, first in an easterly direction when it leaves the R617, turning south after a distance of 2 km, and then east again until it reaches Nonguqa, which is situated in close proximity to the proposed dam wall. The length of the deviation is *8.13 km* and it has a maximum slope of *12.8%*. The new route will have a gravel surface and a width of *8 m*, with a 2% camber from the centre line.

- Access road to tunnel inlet portal -

As with the access road to the intake tower to the dam, the same route applies to the tunnel inlet portal. This road has a length of *0.23 km*, and turns off Option 3 access road 5.21 km from the R617. The maximum slope on this proposed alignment is *13.9%.*

❖ Access road to dam wall -

Access to the dam wall can be taken off the route of the overall access road, at a position 6.68 km from road R617. This road has a length of *1.56 km*, and the maximum slope on this proposed alignment is *13.8%.*

❖ Construction road -

The access road and construction road are located on the eastern side of the dam basin, mostly on the alignment of an existing route, except for a section which will be above the FSL of the dam. The construction road, which is the existing alignment of the road, is an alternative that can be used as an access road during the construction of the dam.

The two routes investigated have a common alignment up to 7.0 km. Route 1 then continues in a southerly direction to link up with Road D874 while Route 2 turns eastward to link up with Road D874. This road has a length of *5.82 km*. The maximum slope on this proposed alignment is *10.6%.*

❖ Access road -

The access road is on the eastern side of the dam basin, mostly on the alignment of an existing route, except for a section, almost parallel to the construction road, which will be above the FSL of the dam. The access road will give permanent access to the dam wall, intake tower and tunnel inlet portal. This road has a length of *7.50 km*. The maximum slope on this proposed alignment is *11.16%.*

9.9.3.2 Roads - Tunnel

❖ Access road to Ventilation Shaft 1 -

This road has a length of *70 m*. The maximum slope on this proposed alignment is *6.79%.*

❖ Access road to Ventilation Shaft 3 -

This road has a length of *68 m*. The maximum slope on this proposed alignment is *13.64%.*

❖ <u>Access road to centre adit entry</u> -

This road has a length of *2.10 km*. The maximum slope on this proposed alignment is *13.88%.*

9.9.3.3 Roads - Balancing Dam

The initial options for the access roads to the construction areas in the Baynesfield area are shown in **Figure 82** (referred to as 'outdated'). In order to address concerns that had been raised by the local community, additional options were identified for the access roads in the Baynesfield area, which are also shown in **Figure 82** (referred to as 'new').

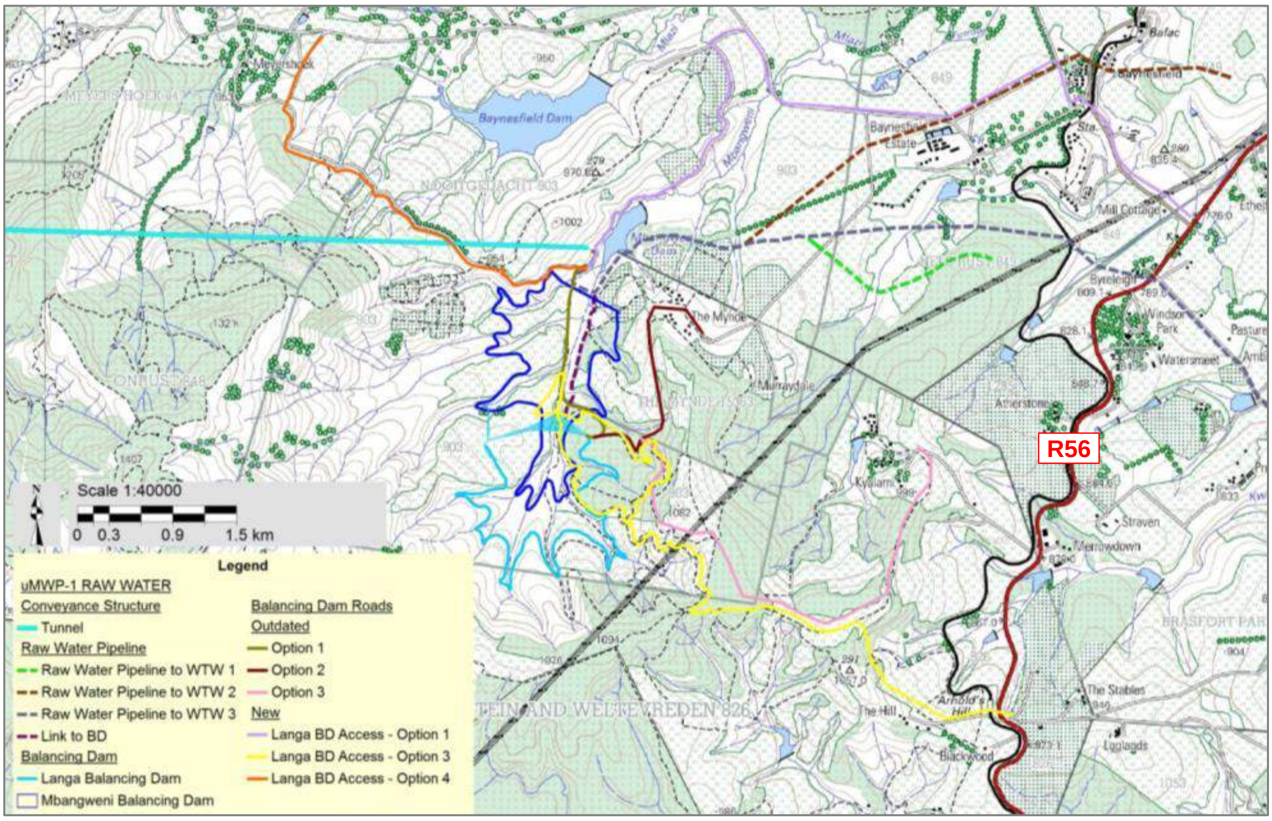


Figure 82: Road Access in Baynesfield Area - Initial Alternatives

Following a meeting with the local community in the Baynesfield area on 31 January 2014 to discuss the abovementioned new road alternatives (amongst others), the access road options were again updated to those reflected in **Figure 83**. These last mentioned alternatives were assessed further as part of the EIA.

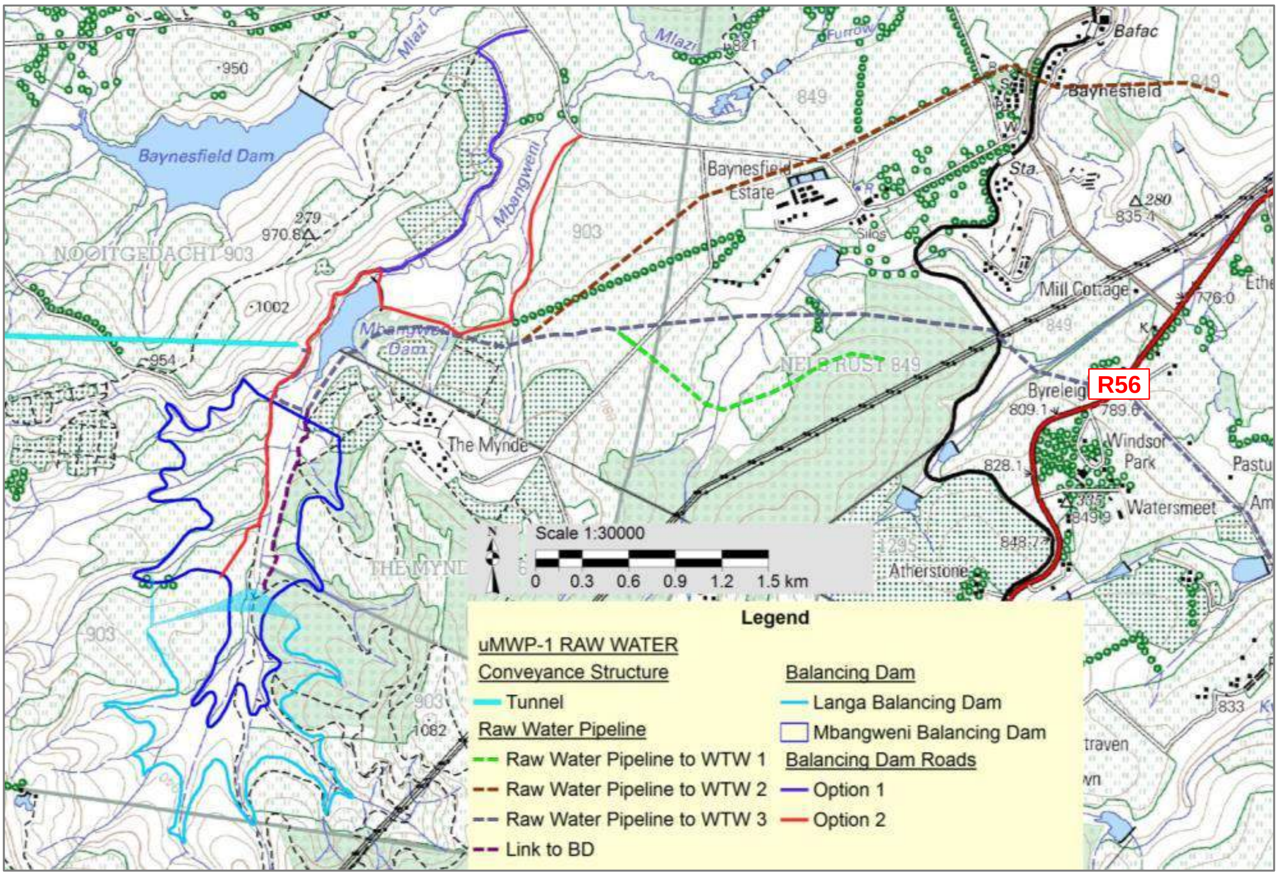


Figure 83: Road Access in Baynesfield Area - Revised Alternatives

9.10 Managing Spoil Material

9.10.1 Description

Excess spoil material (soil and rock) will be generated as part of the bulk earthworks associated with the construction phase of the project. In particular, large volumes of excavated material will be produced during the tunnel boring exercise, which will be removed from the inlet, central and outlet portals. Rock will consist of shale and dolerite and when covered these materials do not deteriorate.

This spoil material will be hauled and dumped at new disposal sites that will be created at the inlet and central portals of the tunnel, or will be used in the construction of the dam wall of the balancing dam (see **Figure 84**). The spoil from road construction will be spoiled at the closest fill position and not the designated waste disposal sites. Spoil may also be disposed of within the basin (e.g. filling of borrow areas and quarries)

The spoil volumes to be disposed of at the waste disposal sites and the sources thereof are summarised in **Table 30**.

Table 30: Spoil volumes, sources and disposal sites (BCM = Bank Cubic Meters; LCM = Loose Cubic Meters)

Source	Excavated material, in-situ volume (BCM)	Excavated material (LCM(1))	Waste disposal site
Tunnel 1 inlet portal	365 000	584 000	Site 1
Tunnel 1 outlet portal	401 000	641 600	Langa Balancing Dam
Tunnel 1 (portion from central adit to inlet portal)	233 014	372 822	Site 2
Tunnel 1 (central tunnel section between adits)	32 558	52 093	Site 2
Tunnel 1 (portion from outlet portal to central adit)	285 117	456 187	Langa Balancing Dam
Tunnel 1 central access adit	79 334	126 934	Site 2
Tunnel 2 (first portion of tunnel)	1 590	2 544	Site 1
Tunnel 2 access adit	12 959	20 734	Site 1
Ventilation Shaft 1	216	346	Site 1
Ventilation Shaft 2	2 598	4 157	Site 2
Ventilation Shaft 3	3 593	5 749	Langa Balancing Dam
Roads	Approx. 137 791	-	Closest fill position

(1) Loose cubic metre based on a 1.6 swell factor

Initially, a spoil site was identified at the tunnel outlet. However, an additional option for the disposal of the spoil material at the tunnel outlet was identified, based on the constraints posed at the initial disposal site (including prime agricultural land, proximity to watercourses and objection from landowner). This entailed the current option of using the spoil material in the construction of the dam wall of the balancing dam

A summary of the volume of waste to be disposed of at each of the spoil sites and the capacity thereof is included in **Table 31**.

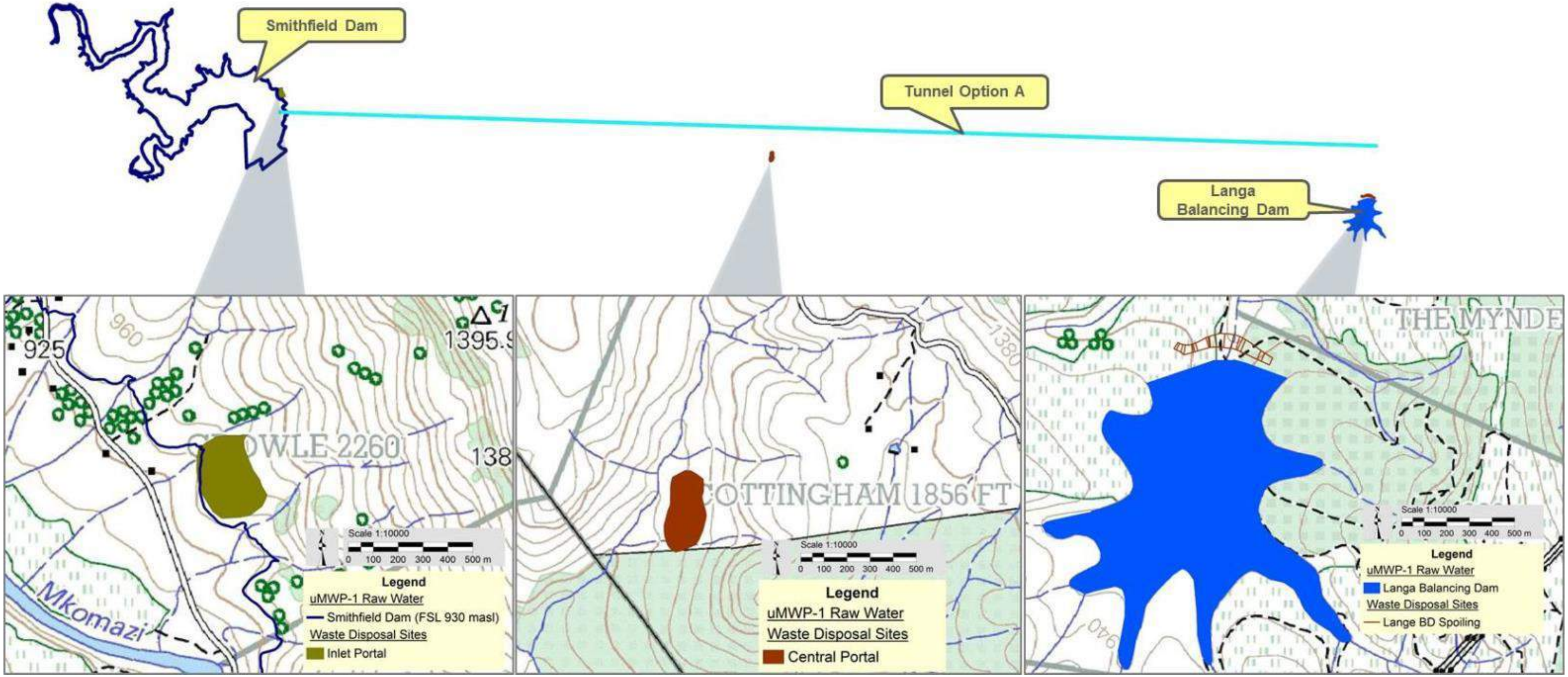


Figure 84: Spoil Sites (inlet portal – left; central portal – middle; Langa Balancing Dam spoil site – right)

Table 31: Summary of spoil site volumes

Spoil site	Total excavated material to spoil (LCM)	Available volume at spoil site (LCM)
Site 1 (inlet portal)	607 624	615 000
Site 2 (central portal)	556 006	560 000
Langa Balancing Dam	1 103 536	*Used in dam wall of balancing dam*

The dimensions of the disposal sites are shown in **Table 32**.

Table 32: Dimensions of the disposal sites after rehabilitation

	Site 1 (inlet portal)	Site 2 (central portal)
Height/Depth	39	32
Length	300	320
Breadth	200	150

Any additional spoil material generated during the construction period may also be disposed of at these sites. Where possible, suitable excess material that will be generated by earthworks may be re-used in the construction process (e.g. building of the embankment, coffer dams, roads, etc.). Dolerite material excavated from the river diversion infrastructure such as from the inlet portal, outlet portal and tunnels, will be used as construction material for the Smithfield Dam main embankment, where possible.

The spoil sites will only be operational for the construction period of uMWP1 and will be rehabilitated afterwards through shaping, application of topsoil and planting of indigenous vegetation.

The drawings associated with the spoil sites are contained in **Appendix F**.

9.10.2 Classification

Disposed material will mainly be spoil from the uMkhomazi – uMlaza Tunnel and portal excavations which comprises of weathered and unweathered shale and dolerite. Other construction material such as concrete and earthfill will also be disposed of at the two spoil sites but to a lesser extent. The disposed material is considered to be categorised as (i) building and demolition waste not containing hazardous waste or hazardous chemicals and (ii) excavated earth material not containing hazardous waste or hazardous chemicals.

Waste will be disposed of at a maximum rate of approximately 600 ton per day, classifying the spoil site as a large landfill. The rate of disposal was calculated assuming the TBM is able to bore 0.492 km per month.

The potential for significant polluted leachate generation and the need for leachate management are considered negligible due to the nature of the disposed material.

With reference to the National Norms and Standards for the Disposal of Waste to Landfill (published in GN No. R. 636, 23 August 2013), the two spoil sites are classified as Class D landfills with Type 4 waste.

In order to adhere to the classification requirements, no unpermitted waste (e.g. domestic waste) may be disposed of at these sites. It is recommended that such waste be transported to and disposed of at commercial permitted landfills in Pietermaritzburg or as arranged by the contractor.

9.10.3 Lining and Cover

Class D landfills do not require a liner but a base preparation layer of reworked in-situ soil with a minimum thickness of 150 mm. The surface of the base preparation layer must be graded at a slope of 2% towards a central channel on the down gradient side of the spoil site from which sporadic leachate can be collected if it occurs. The central channel must contain a 150 mm layer of single-sized gravel or crushed stone to act as a finger drain.

The final cover of the spoil sites must be a minimum of 200 mm thick layer of topsoil lightly compacted after spreading and planted with local grasses and shrubs. Topsoil obtained from the reservoirs may be used in this regard.

Cross-sections of spoil site 1 and 2, as well as more detailed site layouts, are shown in **Appendix F**.

9.11 Disposal of Possible Waste Water from Tunneling

Geotechnical investigation results indicated that water from one of the boreholes has high fluoride content. This necessitates that groundwater encountered during the construction of the uMkhomazi – uMlaza Tunnel must be evaluated for contaminates. Should the quality of the groundwater be inadequate for direct discharge into natural watercourses, it must be treated prior to discharge.

The expected sources of groundwater and inflow rates must be identified prior to construction to provide adequate facilities for the removal of these waters from the construction area. If required, waste water lagoons or channels must be constructed to convey contaminated water to a treatment plant. The method and location of groundwater treatment, if necessary, will have to be confirmed during the detail design phase.

9.12 Quarries and Borrow Areas

9.12.1 Smithfield Dam

9.12.1.1 Description

Based on the findings of the preliminary geotechnical investigation undertaken as part of the Technical Feasibility Study, the required materials for Smithfield Dam can be sourced on site from (see **Figure 85**) –

- Borrow area A;
- Borrow area B;
- Quarry I (left flank);
- Quarry II (plunge pool);
- Quarry III (spillway approach);
- Quarry IV (tunnel inlet);
- Main dam excavation; or
- Saddle dam excavation.

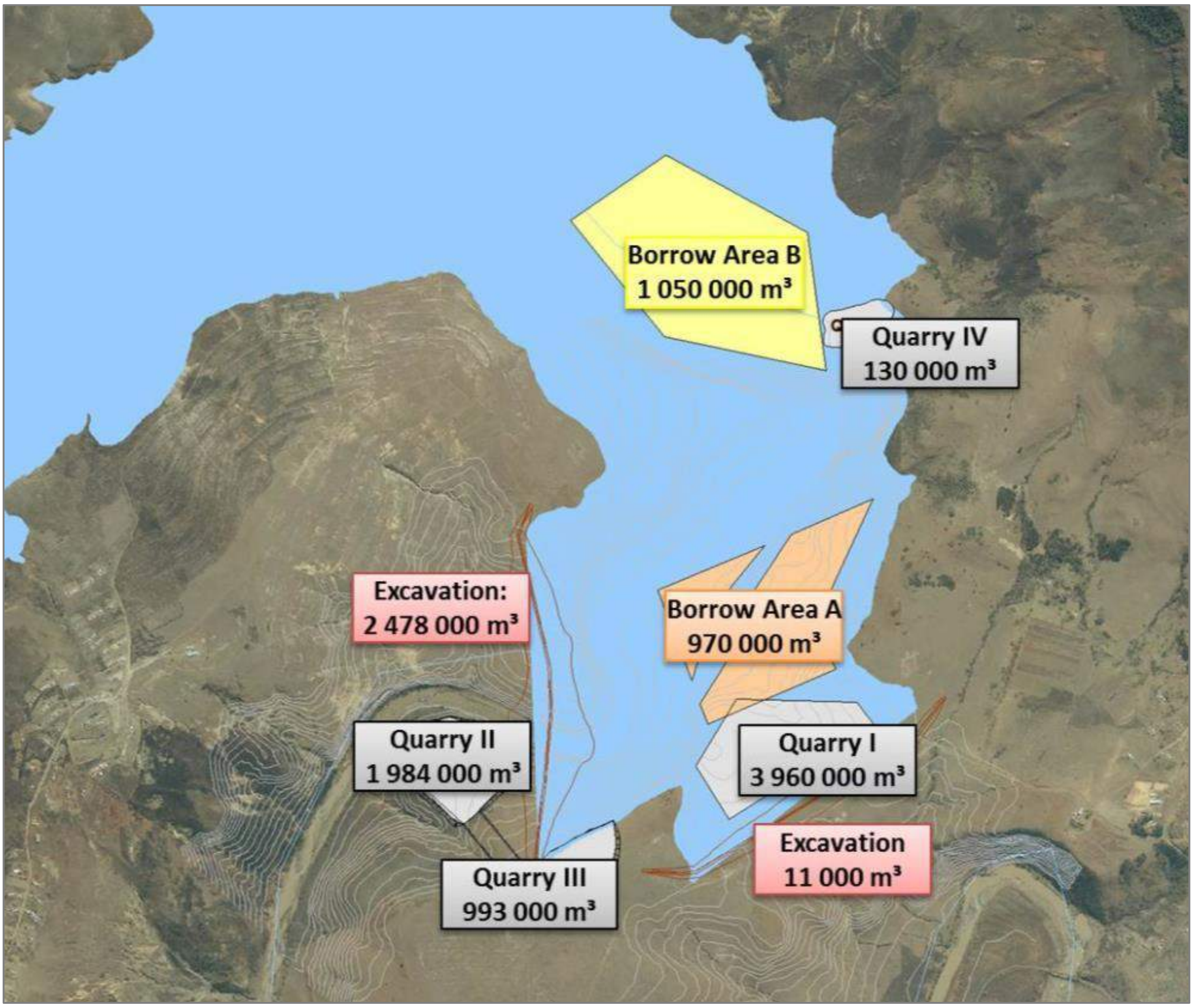


Figure 85: Alternatives - Quarries and Borrow Areas at Smithfield Dam

The type of materials, quality of the materials and their uses are described in **Table 33**.

Table 33: Type, quality and uses of soil and rock materials

Type of material / location	Quality	Use application
Overburden	Soil mixed with topsoil	Rehabilitation of disturbed areas
Impervious earthfill material in Borrow Areas A and B	Classify as CI and few CH in Casagrande Classification*. Two samples have a plasticity index of 30 to 40 and a liquid limit of 60 to 70. These materials must be mixed with materials with lower values for quicker construction.	Core zones of Smithfield Main and Saddle Dam Embankments
Semi-pervious earthfill materials – all over the site expect for Borrow Areas A and B	Classify as CL or CI in Casagrande Classification	To be used in zones of embankment
Soft shale rockfill	Moderately weathered shales	To be used in zones of

Type of material / location	Quality	Use application
		embankment
Coarse shale rockfill below dolerites in Quarry I not shown in table.	Good coarse rockfill	To be used in zones of embankment dam if dolerite quantity is not sufficient
Weathered dolerites	Soil to be used as earthfill	May be usable in outer zones of embankment dams
Rockfill, aggregates, filters, transition zones, rip-rap	Moderately weathered dolerite	Rockfill in main dam embankment Rip-rap and transition zones in saddle dam embankment Transition zones in main dam embankment

9.12.1.2 Alternatives

Alternatively, if no sufficient material of a specific type is available on site, it can be imported from nearby commercial sources. For this purpose three commercial sources have been identified close to the Smithfield Dam site, which are listed in the table to follow.

Table 34: Commercial sources close to the Smithfield Dam site (DWAF, 2013e)

Name	Material source	Distance from Smithfield Dam site (km)
Midmar Crushers	Aggregates	51.5
Natal Crushers	Aggregates	83.5
NPC	Natural sand	153

9.12.2 Langa Balancing Dam

9.12.2.1 Description

Required materials for Langa Balancing Dam can be sourced on site (based on the geotechnical study) from the following sources:

- Spoil from the conveyance tunnel excavation;
- Excavated material from the tunnel outlet portal;
- Excavated material from the spillway approach area on the upper left flank;
- Material from a borrow area/quarry located below FSL in the dam basin (see **Figure 86**).

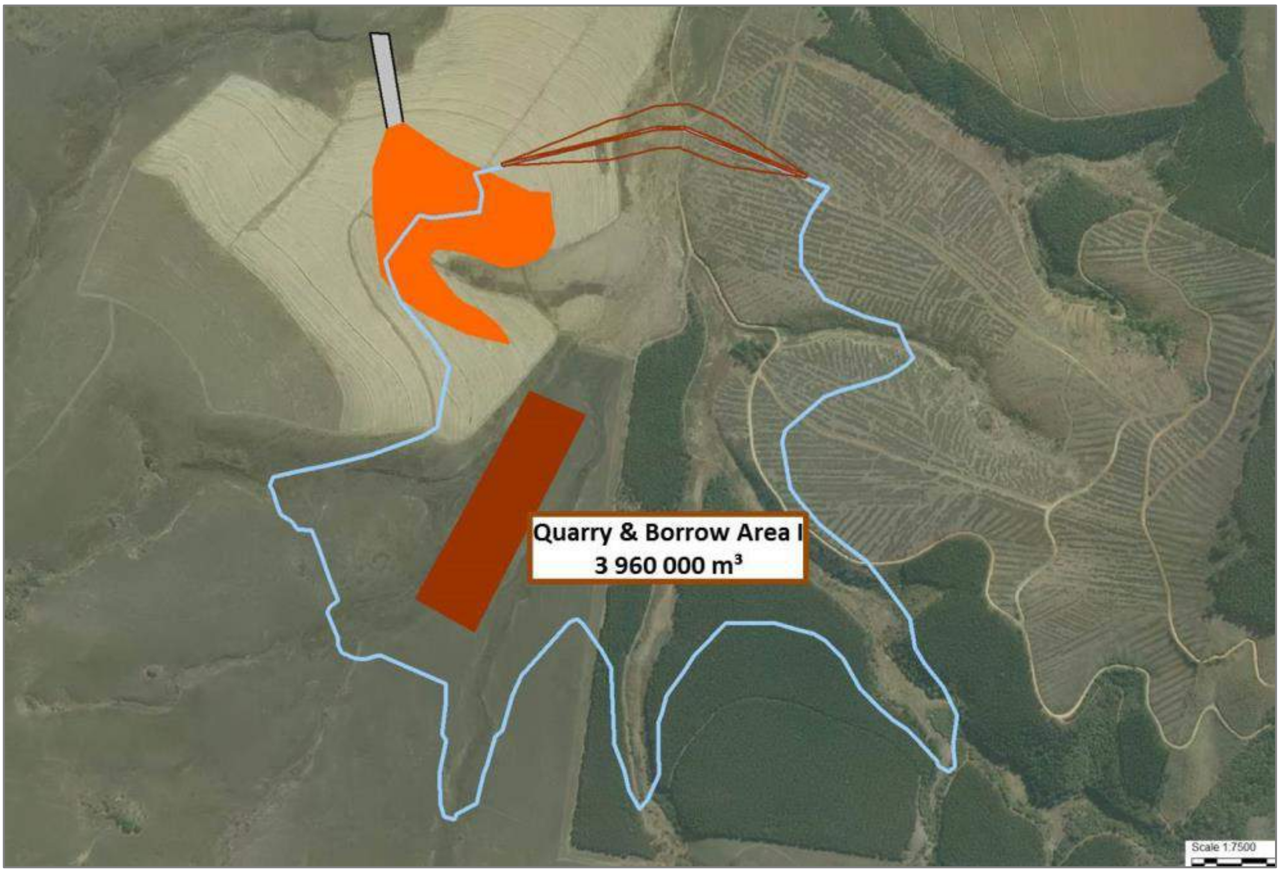


Figure 86: Quarry and Borrow Area at Langa Balancing Dam

9.12.2.1 Alternatives

Alternatively, if no sufficient material of a specific type is available on site, it can be imported from the commercial sources shown in **Table 35**.

Table 35: Commercial sources close to the Langa Balancing Dam site (DWAF, 2013e)

Name	Material source	Distance from Langa Balancing Dam (km)
Midmar Crushers	Aggregates	66.8
Natal Crushers	Aggregates	44.2
NPC	Natural sand	87.2

9.13 Power Requirements

9.13.1 Introduction

Power supply to the scheme would be required during two phases:

1. During the construction phase - power at the construction site; and

2. After construction of the works is completed - permanent power supply to the site for operational purposes.

Figure 87 shows the general layout of the scheme and the location of the connection points for construction and permanent power supply.

Discussions were held with Eskom during the Scoping phase and the availability of power supply was confirmed. A separate EIA will be conducted to seek approval for a new high voltage power line to supply electricity to the site.

9.13.2 Construction power requirements and location

To perform all various construction works, temporary power is required at the construction areas. These requirements are needed for the operation of the various construction activities such as:

- Quarry operations;
- Main and saddle dam embankment;
- Spillway;
- Outlet works;
- Batch plants;
- Aggregate crushing plant;
- Concrete mixing plant;
- Laboratory;
- Contractor's and Engineer's offices;
- Operation village;
- Crane operations;
- Compressors;
- Conveyors;
- Lighting;
- Workshops;
- Precast yard for TBM segments; and
- Miscellaneous.

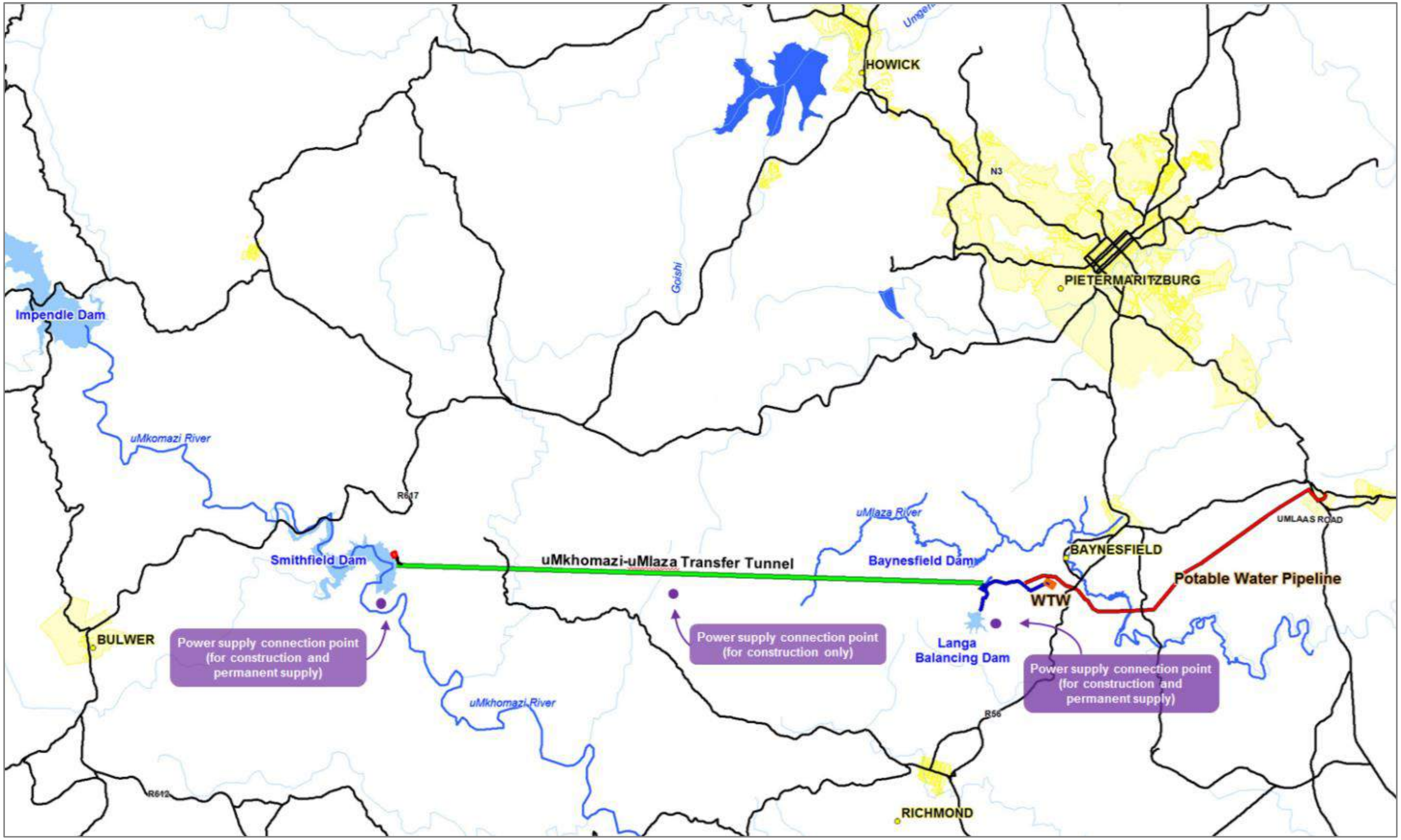


Figure 87: **Scheme layout showing required locations for connection points for power**

Table 36 shows the recommended power supply connection points during the construction phase of the project.

Table 36: Recommended locations for power supply connection points

Component	Power requirement (kVA)	Location of connection points: Coordinates
Smithfield Dam: Main and Saddle embankments	2 000	29°46'47.82''S; 29°56'9.46''E
Adit at centre of tunnel	1 500	29°46'49.92''S; 30°6'21.29''E
Langa dam	3 500	29°47'14.49''S; 30°18'26.4''E
TOTAL	**7 000**	

Once the construction of the dam is complete, the electricity supply to the site will be utilised for operation of the dam and the operator's housing requirements.

9.13.3 Permanent power requirements

For operational purposes, power will be required permanently at both Smithfield and Langa Dam sites. Power at these sites is needed for sufficient operations and maintenance of the components of the project.

The operational power requirements at Smithfield and Langa Dam include the following components:

- Intake tower of the raw water tunnel (only at Smithfield Dam);
- Intake tower to the dam;
- Lights;
- Actuators for valves;
- Cranes for gates;
- A hydraulic power pack for operation of sleeve valves;
- Lifts inside intake towers;
- Permanent housing on site at Smithfield and Langa Balancing Dam;
- A site office and work shop; and
- Submersible pumps/de-watering pumps inside the dam.

Table 37 and **Table 38** show the permanent power requirements for Smithfield Dam and Langa Balancing Dam, respectively.

Table 37: Permanent power requirements at Smithfield Dam

Item no.	Component	Formula	Power requirement (kW)
1	Lights		
	Intake tower to outlet at dam	8 levels x 2 lights x 50 W	0.8
	Flood lights on crane	2 x 50 W lights	0.1
	Terrain	6 x 50 W lights	0.3
	Tunnel	2 lights x 400/10 m x 30 W	2.4
	Site houses		(Incl. in site houses)
	Site office and work shop		(Incl. in site office)
2	Crane	1 x 20 000 W crane	20.0
3	Actuators	4 x 1 000 W actuators	4.0
4	Hydraulic power pack	1 x 1 000 W power pack	1.0
5	Lift	1 x 20 000 W lift	20.0
6	Site houses	6 x 8 000 W	48.0
7	Site office	1 x 4 000 W	4.0
8	Intake tower at raw water tunnel inlet portal	0.8 + 0.1 + 20 + 19 + 20 + 3	62.9
9	Submersible pumps	3 000 W for pumps	3.0
Sub-total			**166.5**
Contingencies (20%)			**33.3**
Total			**199.8**
Recommendation			**250.0**

Table 38: Permanent power requirements at Langa Balancing Dam

Item no.	Component	Formula	Power requirement (kW)
1	Lights		
	Intake tower to outlet at dam	8 levels x 2 lights x 50 W	0.8
	Flood lights on crane	2 x 50 W lights	0.1
	Terrain	6 x 50 W lights	0.3
	Site houses		(Incl. in site houses)

Item no.	Component	Formula	Power requirement (kW)
	Site office and work shop		(Incl. in site office)
2	Crane	1 x 20 000 W crane	20.0
3	Actuators	1 x 1 000 W actuators	1.0
4	Hydraulic power pack	1 x 1 000 W power pack	1.0
5	Lift	1 x 20 000 W lift	20.0
6	Site houses	6 x 8 000 W	48.0
7	Site office	1 x 4 000 W	4.0
8	Submersible pumps	3 000 W for pumps	3.0
Sub-total			**98.2**
Contingencies (20%)			**19.6**
Total			**117.8**
Recommendation			**250.0**

The power requirements during the construction phase of the project are higher than the requirements during the permanent phase. This is calculated using a power factor of 0.8. This means that a transformer with a capacity of 1 500 kVA (lowest transformer required for construction phase of project) is able to handle power requirements of up to 1 200 kW (1 500 kVA x 0.8). This is much higher than the required 250 kW recommended for permanent supply to each of the dam sites.

The same transformers, installed at Smithfield and Langa Dam, for the construction phase, will therefore be used to supply power permanently.

9.14 Land Acquisition

Land is required for constructing the selected scheme. Both title deed and tribal land will need to be acquired for the project. Section 64 of the NWS enables the Minister of Water and Sanitation, or a Water Management Institution authorised by the Minister in writing, to expropriate any property for any purposes contemplated by this Act if the purchase is for public purposes or in public interest. Servitudes with specific purposes can also be registered.

The following approach is recommended for this project:

- Land inside purchase lines as well as areas at the dam walls must be expropriated for Smithfield Dam and the balancing dam;
- Servitudes are required for protecting the tunnel from non-project related rights for the uMkhomazi – uMlaza Tunnel;
- Servitudes are required for maintenance and the right to provide water for the raw water pipeline, including the section to the balancing dam; and
- Land required for housing and other infrastructure required for the operation of the scheme is to be expropriated.

The areas to be acquired, as well as the methodology for calculating these areas, are discussed in the sub-sections to follow.

9.14.1 Smithfield Dam and Langa Balancing Dam

The purchase lines for dams in the Republic of South Africa are based on the 1:100 year recurrence interval backwater profile, up to the upstream point of no influence as per DWA policy. It is long standing DWA policy to add a buffer strip to the backwater profile for the 1:100 year recurrence interval. This buffer strip is the greater of the horizontal distance for a height of 1.5 m above the 1:100 year recurrence interval backwater level or 15 m horizontally from the 1:100 year recurrence interval backwater level.

The backwater levels for Smithfield Dam and Langa Balancing Dam were calculated with the HEC-RAS model for their respective inflow hydrographs for the 1:100 year recurrence intervals. This was based on their respective FSLs of 930 masl and 923 masl, as well as spillway discharge rates at the 1:100 year flood. The purchase lines for Smithfield Dam and Langa Balancing Dam are shown in **Figure 88** and **Figure 89**, respectively.

The estimated areas of land that will be required for Smithfield Dam and Langa Balancing Dam are 1 487.0 ha and 117.2 ha, respectively.

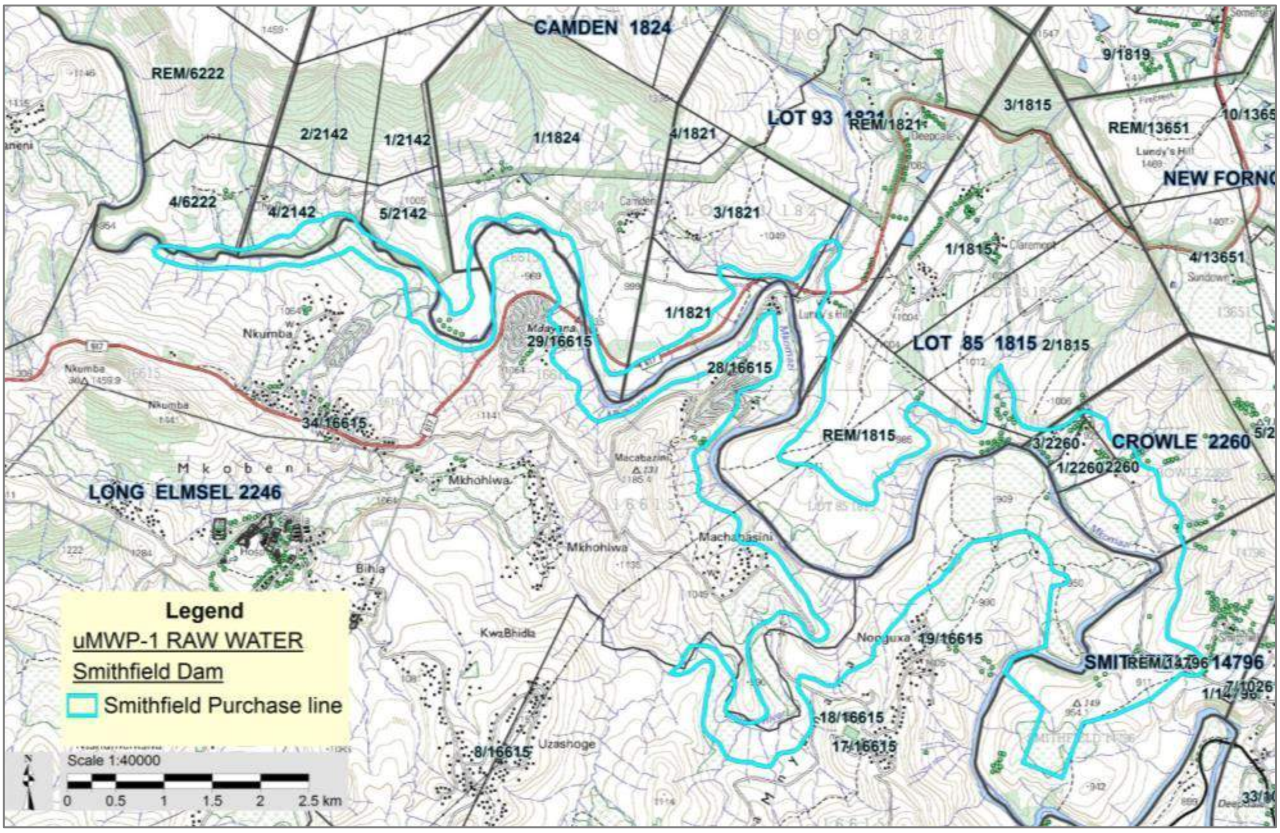


Figure 88: Smithfield Dam purchase line

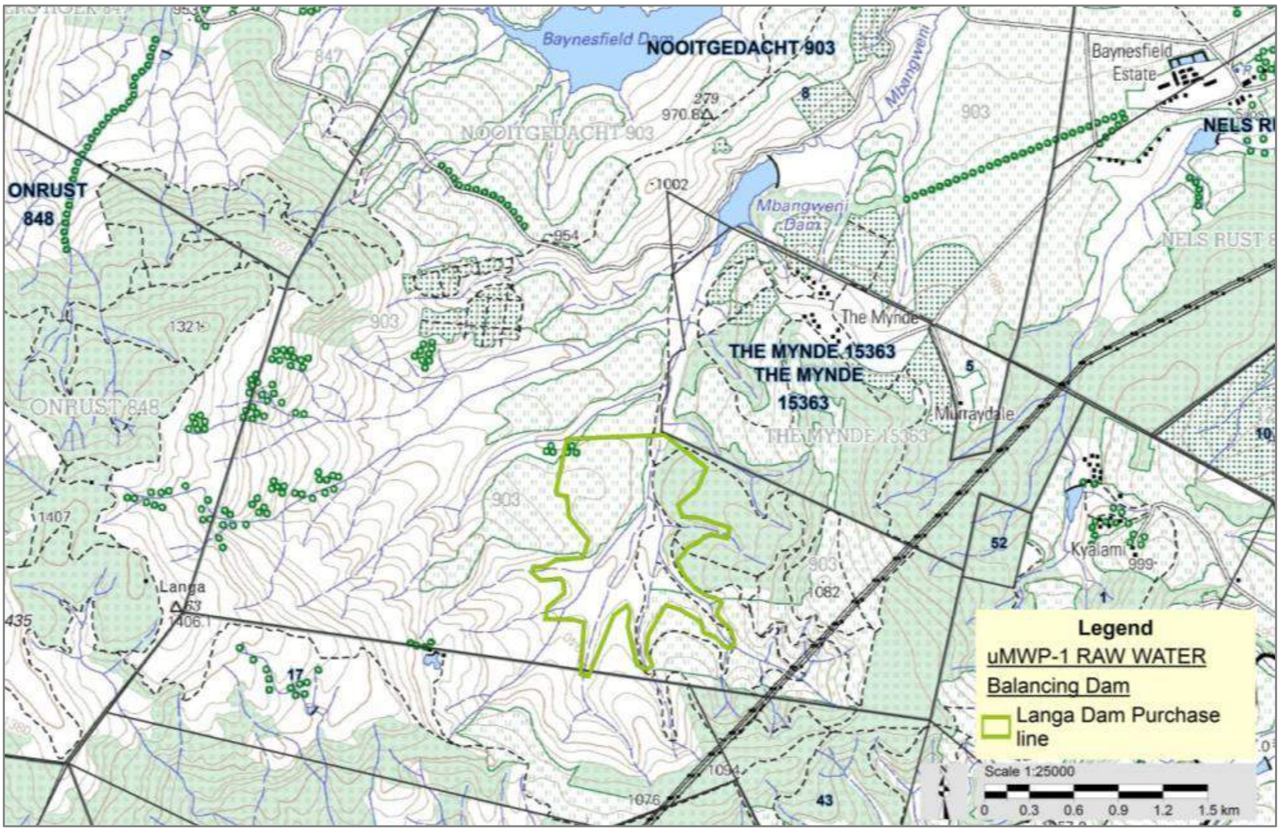


Figure 89: Langa Balancing Dam purchase line

9.14.2 uMkhomazi – uMlaza Tunnel

The proposed servitude width for the tunnel for the purposes of this study is based on the following plan areas:

- The tunnel diameter plus 0.6 m on each side of the tunnel;
- Provision of a 5 m wide strip on one side of the tunnel for a service road; and
- Provision of a 2 m wide strip on the other side of the pipeline for additional working space.

A summary of the proposed servitude for the tunnel is given in **Table 39**, which is 24 m wide. The estimated area of the servitude that will be required for the tunnel, which is 32.5 km long, is 78 ha. An additional area of 10 ha was included for the inlet and outlet portal areas.

Table 39: Estimate of proposed servitude width for tunnel

Description	Servitude width (m)
Tunnel diameter	4.5
Provision for 0.6 m on sides of tunnel	1.2
Provision for service road	5.0
Provision for additional working space	1.5
Estimated servitude width	12.2
Rounded-off	12
Additional width	12
Final proposed servitude width	**24**

9.14.3 Tunnel – Langa Balancing Dam – Baynesfield Pipeline

The proposed servitude widths for the pipelines for the purposes of this study are also based on the following:

- Recommended excavation widths by Vaal Augmentation Planning Study (VAPS) for pipelines (see **Table 40**) for planning purposes;
- Provision of a 5 m wide strip on one side of the pipeline for a service road; and
- Provision of a 1 m wide strip on the other side of the pipeline for additional working space.

Table 40: VAPS recommended excavation widths for planning purposes

Pipe diameters (m)		Recommended excavation widths (m)	
From	**Up to**	**From**	**Up to**
-	0.6	-	0.9
> 0.6	1	1.4	1.8
> 1	2	2	3
> 2	-	3.2	-

9.14.3.1 Pipeline 1 – Tunnel outlet to proposed WTW

The recommended trench width for this 2.6 m diameter pipeline is 3.8 m, in terms of VAPS recommendations for planning purposes. A summary of the proposed 10 m wide servitude for pipeline 1 is given in **Table 41**. The estimated area of the servitude that will be required for pipeline 1, which is approximately 6 km long, is 6 ha.

9.14.3.2 Pipeline 2 – Langa Balancing Dam to pipeline 1

The recommended trench width for this 1.6 m diameter pipeline is 2.6 m, in terms of VAPS recommendations for planning purposes. A summary of the proposed 9 m wide servitude for pipeline 2 is also given in **Table 41**. The estimated area of the servitude that will be required for pipeline 2, which is approximately 1.52 km long, is 1.37 ha.

9.14.3.3 Servitude widths estimates for pipelines 1 and 2

The estimates of the proposed servitude widths for pipelines 1 and 2 are summarised in **Table 41** below.

Table 41: Estimates of Proposed Servitude Widths for Pipelines 1 and 2

Description	Servitude width (m)	
	Pipeline 1	**Pipeline 2**
Pipe diameter	2.6	1.6
Trench width	3.8	2.6
Provision for service road	5.0	5.0

Description	Servitude width (m)	
	Pipeline 1	**Pipeline 2**
Provision for additional working space	1.0	1.0
Estimated servitude width	9.8	8.6
Proposed servitude width	10.0	9.0

9.14.4 Flow gauging weirs

The gauging weir downstream of Smithfield Dam is about 1 km downstream of the dam, and can therefore not be included in the area to be expropriated for the construction of Smithfield Dam. This needs to be confirmed as part of the final design.

The proposed purchase line for the gauging weir is based on the backwater level for the design floods for each one of the weirs, plus a 15 m buffer zone. The estimated area of land that will be required is 18.2 ha.

9.14.5 Access and deviation of roads

The proposed width of the servitudes for the access roads is 12 m. A summary of the proposed 12 m wide servitudes for the roads is given in **Table 42**. **Table 43** summarises all the roads and their respective servitude areas. The total estimated area of the servitudes that will be required for the roads, with a total length of approximately 49.4 km, is 59.3 ha.

Table 42: Estimate of proposed servitude width for access roads

Description	Servitude width (m)
Road width	7
Provision for 2.5 m wide shoulders	5
Final proposed servitude width	**12**

Table 43: Estimate of proposed servitude areas for access roads

Road	Length (km)	Servitude area (ha)
Smithfield		
Deviation of R617	12.06	14.5
Nonguqa	8.13	9.8

Road	Length (km)	Servitude area (ha)
Tunnel inlet portal	0.23	0.3
To dam wall	1.56	1.9
Construction	5.82	7.0
Access road	7.50	9.0
Tunnel		
Ventilation Shaft 1	0.07	0.1
Ventilation Shaft 3	0.07	0.1
Central adit entry	2.10	2.5
Langa BD		
Tunnel outlet portal and Langa Balancing Dam	7.06	8.5
Flow gauging weir		
Downstream of Smithfield Dam	2.17	2.6
Total	**46.71**	**56.1**

9.15 Alternatives Suggested by Interested and Affected Parties

This section provides an overview of certain alternatives that were identified by I&APs that have specific bearing on the uMWP-1 Raw Water component. Refer to the Comments and Response Report (**Appendix L**) for further discussions on alternatives identified during the Public Participation process.

9.15.1 Overall Scheme

Various concerns have bene raised with regards to the proposed transfer scheme as the preferred option to fulfil the long-term water requirements of the Mgeni system. These concerns included the potentially significant impacts of dams on rivers, which is compounded by the fact that the uMkhomazi River is one of the last free flowing rivers in KZN. In addition, other options such as investing in improving catchments and ecosystems to address water security were also advocated, rather that the transfer scheme.

Various options to meeting the project's objectives were considered during previous studies, which eventually lead to the identification of alternatives to be investigated as part of the Feasibility Study. Pertinent studies that lead to the identification of the current project proposal (uMWP-1) are contained on the following website: http://www.dwaf.gov.za/Projects/uMkhomazi/documents.aspx.

The Mgeni River System Analysis Study carried out between 1991 and 1994 identified the uMkhomazi River as a potentially viable source of water for augmentation of the Mgeni System. The subsequent uMkhomazi-Mgeni Transfer Scheme Pre-Feasibility Study included an investigation of augmentation schemes on the uMkhomazi River preceded by scheme identification and reconnaissance investigations. The initial eight schemes that were identified were refined based on technical, environmental and economic factors. The Pre-feasibility Study recommended that the Smithfield Scheme be taken forward to the next phase of investigation in a detailed Feasibility Study.

In terms of project alternatives, **Section 9.1** includes a discussion that is dedicated to explaining the various screened options that were considered to increase the water resource (apart from a transfer scheme), which is referenced to the Water Reconciliation Strategy for the KZN Coastal Metropolitan Areas. This includes desalinisation, use of treated effluent, use of groundwater, etc.

It was also suggested by I&APs that off-stream storage be investigated as an option. As part of the technical response it was indicated that an off-channel storage (OCS) dam typically yields about 15 million m^3/annum in KZN and costs about R800 million. The Smithfield Dam will yield approximately 200 million m^3/annum and cost R2.5 billion. In addition to this, OCS is a solution that works for a specific requirement. It often needs to be close to the demand centre. The Mgeni River is currently fully developed, this implies that even if an OCS dam is constructed in that river it will not fill up or the cost of water will be very expensive per m^3. To fill OCS Dams one needs long expensive canals or huge amount of pumping to fill them. Suitable dam sites are not regularly available.

9.15.2 <u>Baynesfield Estate</u>

Various meetings and discussions have been held with representatives from the Baynesfield Estate. Some of the key outcomes of these engagements with regards to alternatives to the project infrastructure include:

- Identification of alternative WTW sites (covered in separate EIA for the uMWP-1 Potable Water component);
- Identification of an alternative to creating a spoil / waste disposal site for spoil material on the estate, which lead to the option of using the spoil material in the construction of the balancing dam wall; and
- Identification of alternative access roads.

9.15.3 Baynesfield Community

Feedback received from the community in the Baynesfield area resulted in the identification of alternatives to the following project elements:

- Access roads to balancing dam; and
- WTW site (covered in separate EIA for the uMWP-1 Potable Water component).

9.16 uMWP-1 Potable Water

Although the uMWP-1 Potable Water component is **covered under a separate EIA**, an overview of this project is provided for the sake of completeness.

The Potable Water component consists of the following (as shown in **Figure 90**):

- WTW and water reservoir in the uMlaza River valley –
  - Three alternative sites, with Options 1 and 2 located in the Baynesfield area and Option 3 situated north-east of Hopewell;
  - Phasing of plant –
    - Stage 1: 2023 to 2037 – 375 Mℓ/day capacity;
    - Stage 2: 2037 to 2053 – 625 Mℓ/day capacity;
  - Reservoir dimensions = 200 m x 350 m x 10 m deep;
  - WTW footprint = maximum area of 600 m x 350 m;
- Gravity pipeline –
  - Length – Route option 1 = 21 283 m; Route option 2 = 24 482 m;
  - Internal diameter = 2.3 m steel pipeline; and
  - Peak throughput = 518 Mℓ/day.

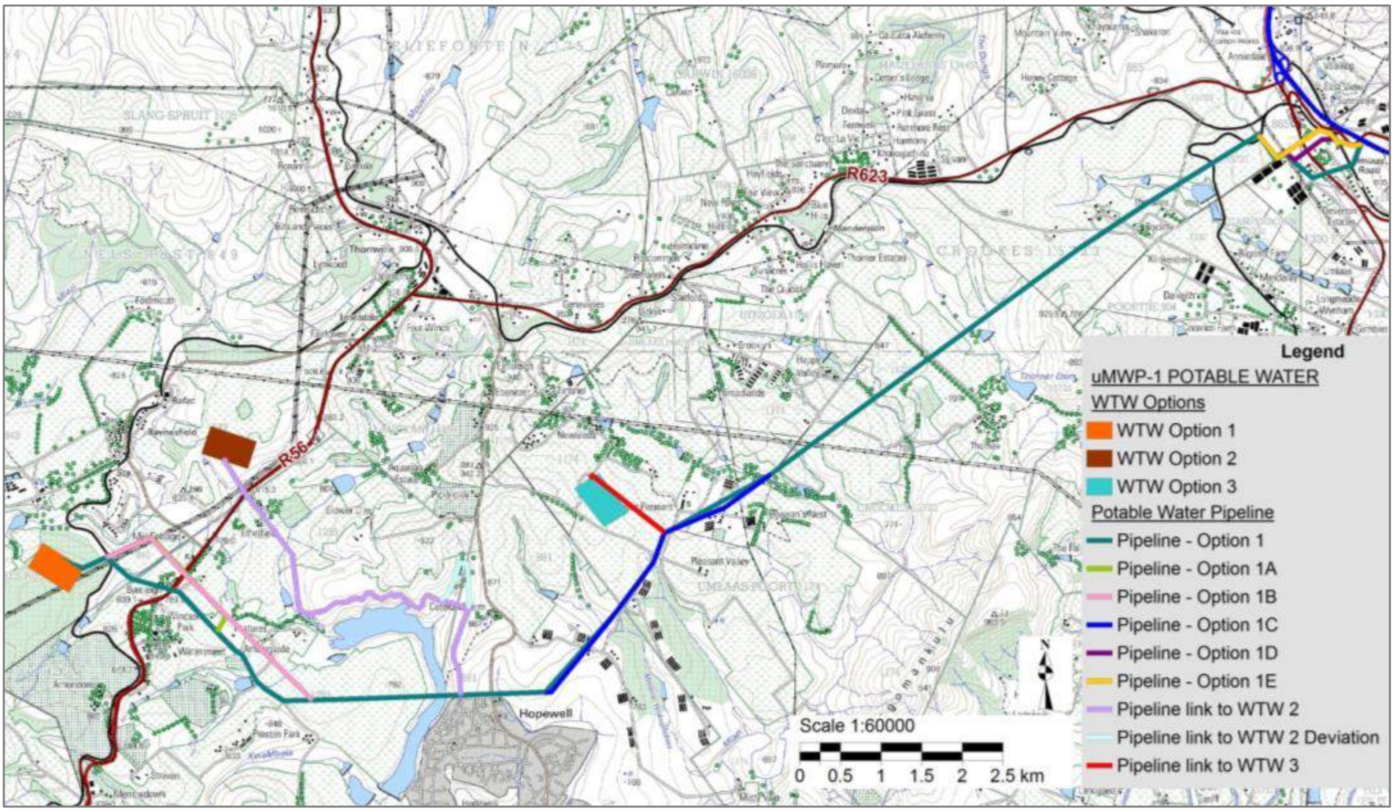


Figure 90: uMWP-1 Potable Water component

9.17 Operation of the Scheme

Water for transfer will be abstracted via the tunnel intake structure (see drawings in **Appendix F**) within the Smithfield Dam basin. Abstraction rates will be demand-driven. Water would be transferred virtually continuously.

River releases from Smithfield Dam will be via a multi-level intake tower and conduit, enabling water to be drawn off near the surface of the reservoir. The outlets will be controlled with sleeve valves, enabling a wide range of flows to be released.

Provision will be made in the design to accommodate maximum releases, however, daily release requirements will be determined during the detail design phase. The in-stream flow requirements at environmental control sites will be adhered to.

9.18 uMWP-1 Project Life-cycle

To adequately consider the impacts associated with the development of the uMWP-1 Raw Water component, the major activities during each phase of the project life-cycle are listed below:

1. Pre-feasibility and Feasibility phases –
    a) Streamflow and yield modelling;
    b) Assessment of base conditions (including geology, construction material investigation, assessing the seismic hazard, topographical survey, analysing sediment yields, etc.);
    c) Technical, economic and environmental screening of alternatives;
    d) Geotechnical investigations to confirm borrow areas and quarries; and
    e) Sizing and costing of dam and infrastructure.

2. Design and Pre-construction phases –
    a) Negotiations and agreements with the affected landowners, stakeholders and authorities;
    b) Detailed engineering design;
    c) Detailed geotechnical investigations, including geophysical investigations;
    d) Survey and mark construction servitude;
    e) Survey and map topography for determination of post-construction landscape, rehabilitation and shaping (where necessary);
    f) Possible removal of trees within construction servitude;
    g) Procurement process for Contractors;
    h) Selective improvements of access roads to facilitate the delivery of construction plant and materials;
    i) Arrangements for accommodation of construction workers;
    j) The building of a site office and ablution facilities;
    k) Development of resettlement plan (Smithfield Dam basin);
    l) The harvesting of timber that will be inundated (if deemed necessary);
    m) Permits if protected trees are to be cut, disturbed, damaged, destroyed or removed;

n) Permits if heritage resources are to be impacted on and for the relocation of graves;
o) Confirmation of arrangements with individual landowners and/or land users for managing and mitigating issues such as fencing and gate dimensions for traversing servitude, traversing patterns of livestock over servitude, access to livestock drinking points, security, opening and closing of gates and access to private property;
p) Confirmation of the location and condition of all buildings, assets and structures within the servitude; and
q) Determining and documenting the road conditions for all identified haul roads.

3. Construction phase –
   a) Site establishment;
   b) Relocation of infrastructure;
   c) Prepare access roads;
   d) Establish construction camps;
   e) Bulk fuel storage;
   f) Storage and handling of material;
   g) Construction employment;
   h) Site and basin clearing;
   i) Excavation;
   j) Blasting;
   k) Tunnel excavation including TBM activities and shaft sinking operations;
   l) River diversion for building of major storage dam and balancing dam;
   m) Establishment and operation of crusher;
   n) Establishment and operation of batching plant;
   o) Establishment and operation of materials testing laboratory;
   p) Create haul roads;
   q) Create quarry and borrow areas;
   r) Construction of embankments, bottom outlets, tunnel outlets, spillways;
   s) Concrete Works;
   t) Steel works;
   u) Mechanical and Electrical Works;

v) Temporary river diversion for gauging weir and pipeline crossings;
w) Electrical supply;
x) Construction of spoil disposal sites;
y) Construction of pipeline;
z) Cut and cover activities;
aa) Stockpiling (sand, crushed stone, aggregate, etc.);
bb) Waste and wastewater management;
cc) Relocation of dwellings, graves, protected species; and
dd) Reinstatement and rehabilitation of construction domain (outside of inundation area, as necessary).

The methodology for the installation of the raw water pipeline is as follows:

- Site clearing;
- Remove topsoil in the area where construction will take place and stockpile separately for later re-instatement;
- Excavate pipe trench;
- Install and compact pipe bedding;
- Install pipe sections by means of side booms (special cranes) and weld joints;

Figure 91: Typical trench excavation and pipe installation activities

- Repair field joints and backfill and compact pipe trench in layers;
- Construct air and scour valves. Air valves, which are generally positioned at high points along the route, release air from the pipeline as it fills, allow air into the pipeline when it is draining and ‘bleed’ off air during normal operations. The scour valves serve to drain water from the pipeline (typically during maintenance), and are located a low points along the route for drainage purposes. A detailed

hydraulic analysis for the positioning of the valves will be performed as part of the detail design;

- Construct access chambers;

Figure 92: **Typical examples of chambers (left - during construction; right – completed)**

- Re-shape the impacted area to its original topography and replace stripped topsoil.

Figure 93: **Typical views of reinstated (left) and rehabilitated (right) pipeline routes**

- Install final Cathodic Protection;
- Install AC mitigation measures;
- Install pipeline markers at changes in direction and at regular intervals along the route; and
- Rehabilitation.

Watercourse crossings will generally consist of pipe sections encased in concrete in accordance with the relevant DWS criteria. The typical construction methodology for a river crossing is as follows:

- An earthen berm (coffer dam) and temporary bypass canal is constructed to divert the water around the construction site.
- The trench is excavated across the dry river channel
- A concrete bedding is constructed first, followed by the installation and restraining of the pipe to prevent flotation. Encasement is completed by the construction of further concrete lifts.
- Once the concrete has set, the temporary coffer dam is removed and the bypass canal backfilled to re-instate the flow.
- The impacted area is re-shaped to its original topography.
- The disturbed area is rehabilitated.
- If erosion of the disturbed river banks is a concern, suitable measures will be implemented to ensure the stabilisation of the river structure.
- It may be necessary to construct permanent roads through wetlands to minimise impacts related to future access for operation and maintenance. In these instances normal water flow needs to be maintained through the road material.

Figure 94: Examples of typical river crossings

4. Operational phase –
   a) Maintenance of infrastructure;
   b) Operation of dam;
   c) Raw Water Pipeline –
      - Create access track along pipeline servitude;
      - Conduct routine maintenance inspections of the project infrastructure;
      - Scouring of pipeline, where the water conveyed and stored within this system will be released into the receiving watercourses along the alignment from

scour valves. A detail hydraulic analysis will be conducted to determine the optimum positioning of the scour valves;

- Undertake maintenance and repair works, where necessary; and

d) On-going consultation with directly affected parties.

5. Decommissioning phase –
Under suitable maintenance the lifespan of the dam is estimated to be more than 50 years. Depending on water supply requirements, the dam could possibly be upgraded or at least maintained to cater for projected needs. Decommissioning is thus not considered applicable to the scheme. However, should decommissioning be required the activity will need to comply with the appropriate environmental legislation and best practices at that time.

9.19 Preliminary Implementation Programme

The preliminary programme for the implementation the uMWP-1 project components is shown in **Figure 95**. Note that the finalisation of the programme will be affected by various factors, and must thus only be regarded as indicative.

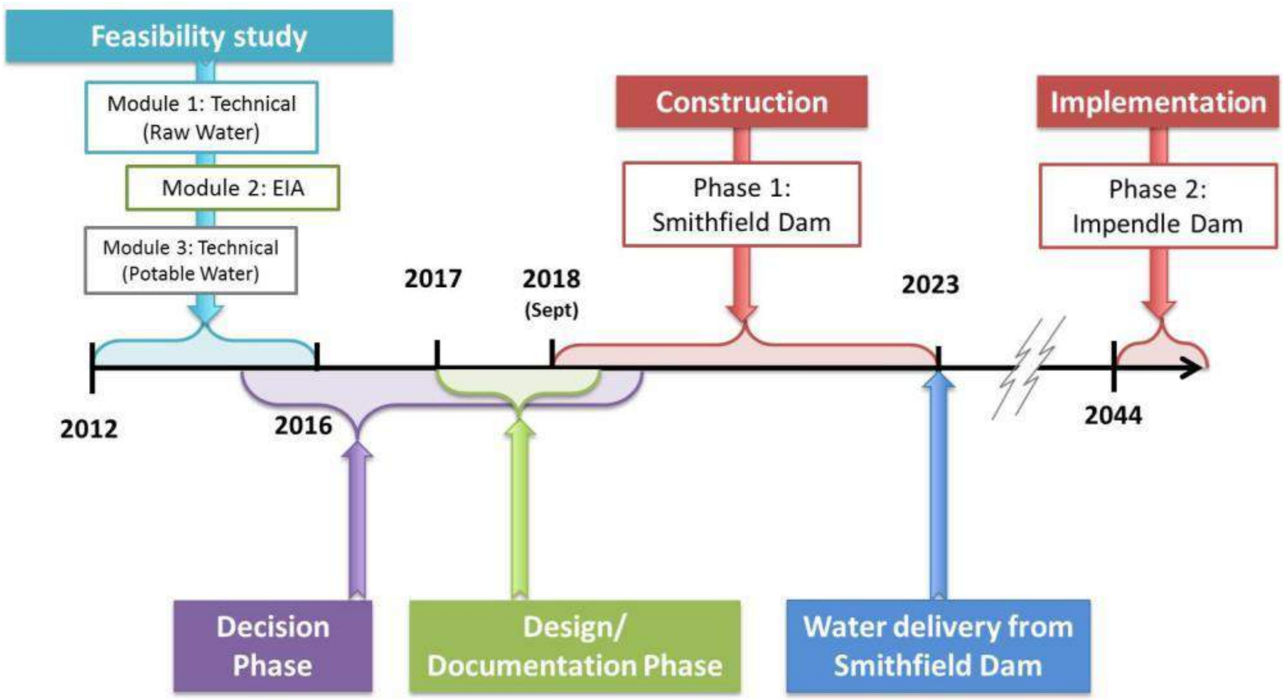


Figure 95: Preliminary Implementation Timeframes

Note that the finalisation of the programme will be affected by various factors, which include the securing of finance, institutional arrangements, statutory approvals (e.g. EIA), environmental and social baseline studies, etc.

9.20 Resources Required for Construction and Operation

This section briefly outlines the resources that will be required to execute the project.

9.20.1 Water

During the construction stage, water will be required for various purposes, such as concrete batching, washing of plant and equipment in dedicated areas, dust suppression, potable use by construction workers, etc. Water for construction purposes will be sourced directly from watercourses on site and groundwater (boreholes) will also be utilised. Water tankers will also supply water to the site.

All water uses triggered in terms of Section 21 of the NWA must comply with DWS' requirements.

Water for operational purposes will include domestic supply to the offices and accommodation facilities.

9.20.2 Sanitation

Sanitation services will be required for construction workers in the form of chemical toilets, which will be serviced at regular intervals by the supplier. Conservancy tanks will be provided at the residential labour camps and site offices.

Ablution facilities will also be provided as part of the permanent infrastructure for the operational phase at the offices and accommodation facilities for the dam operators, which will include septic tanks. The locations of the tanks will be selected to minimise environmental impacts. The tanks will be property maintained by the dam operator.

9.20.3 Roads

Permanent access roads will be required for the operational phase, whereas temporary access and haul roads will need to be created for construction purposes. Refer to **Section 9.9** for a discussion on access roads.

9.20.4 Waste

Solid waste generated during the construction phase will be temporarily stored at suitable locations (e.g. at construction camps) and will be removed at regular intervals and disposed of at approved waste disposal sites within each of the local municipalities that are affected by the project. Landfills in the greater area include the New England Road landfill (G:L:B+) and the Richmond Landfill Site (G:S:B+). All the waste disposed of will be recorded.

All storage of general or hazardous waste in a waste storage facility (e.g. onsite waste transfer station) will comply with the national norms and standards (GN R. 926 of 29 November 2013). The waste storage facility will be established at the camp where waste from site will be collected, sorted, weighed and placed in skips and recycling containers for removal to service providers and appropriate registered landfill sites (hazardous and general sites, as required).

Wastewater, which refers to any water adversely affected in quality through construction-related activities and human influence, will include the following:

- Sewage;
- Water used for washing purposes (e.g. equipment, staff); and
- Drainage over contaminated areas (e.g. cement batching / mixing areas, workshop, equipment storage areas).

All wastewater discharges will comply with legal requirements associated with the NWA, including the General Authorisation that specifically deals with S21(g) water use (i.e. disposing of waste in a manner which may detrimentally impact on a water resource). Suitable measures will be implemented to manage all wastewater generated during the construction period.

The management of spoil material and wastewater generated during tunnelling is discussed in **Section 9.10** and **Section 9.11**, respectively.

9.20.5 Construction Camp

9.20.5.1 Smithfield Dam

The construction camp for Smithfield Dam is located to the south of the dam wall, within the purchase line (refer to **Figure 96**). Provision is made for construction accommodation at the camp.

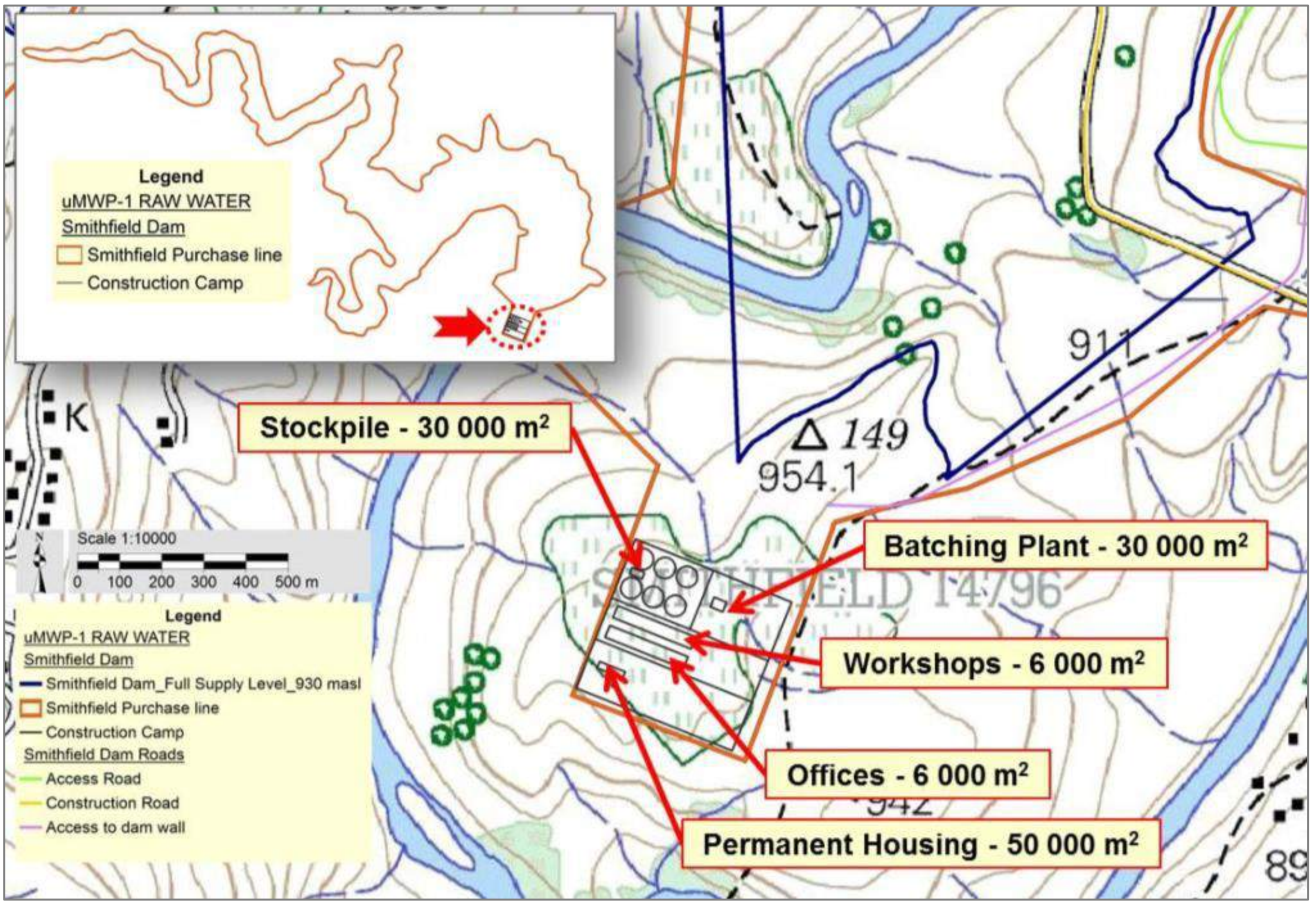


Figure 96: Smithfield Dam Construction Camp

9.20.5.2 Langa Balancing Dam

The construction camp for Langa Balancing Dam is located within the proposed basin and is shown in **Figure 97**.

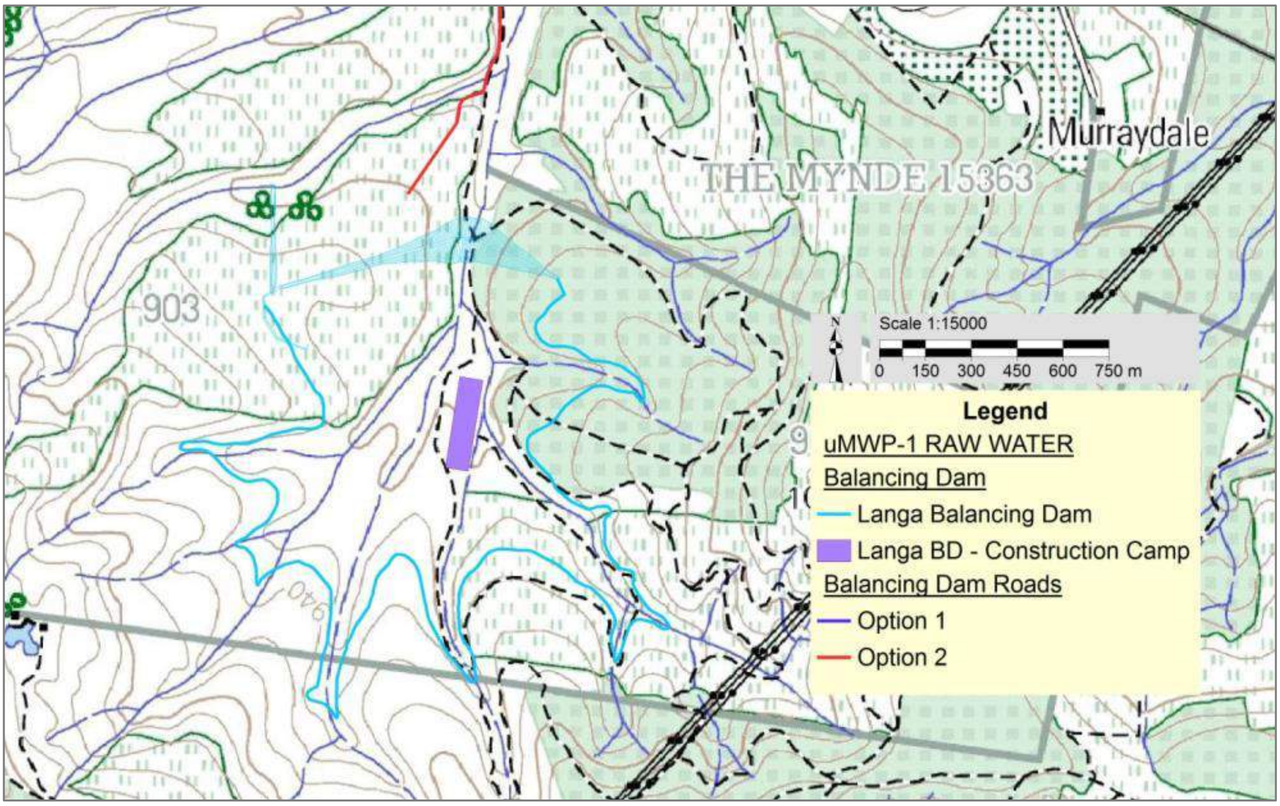


Figure 97: **Langa Balancing Dam Construction Camp**

9.20.6 Electricity

The power requirements during the construction and operational phases of the project are discussed in **Section 9.13**.

A separate EIA will be conducted to seek approval for supplying electricity to the project. Based on discussions held with Eskom during the Scoping phase, there is sufficient capacity to cater for the project's electrical requirements.

9.20.7 Construction Workers

The appointed Contractor will make use of skilled labour where necessary. In those instances where casual labour is required, DWS will request that such persons are sourced from local communities as far as possible.

9.20.8 *Operator's Facilities*

9.20.8.1 Smithfield Dam

The structures required at Smithfield Dam for the operational phase include:

- An office complex with two offices and amenities with a size of 50 m²;
- An operator's house consisting of a three bedroom unit with a floor space of 220 m²;
- Three workers' houses consisting of two bedrooms each with a floor space of 92 m²;
- A boat store of 40 m²;
- A workshop of 100 m²; and
- A covered parking area for 5 cars.

The operational phase structures will be constructed in a similar position as used for the construction phase.

9.20.8.2 Langa Balancing Dam

The accommodation and related structures at the WTW will be used to service Langa Balancing Dam.

9.21 Resource Management Plan for Smithfield Dam and Balancing Dam

A Government Waterworks refers to a waterworks (e.g. water storage dams, water transfer schemes and flood attenuation works) owned or controlled by the Minister of Water and Sanitation and includes the land on which it is situated. The future use of the Smithfield Dam and the balancing dam, as Government Waterworks, will be detailed in a Resource Management Plan (RMP) which will be compiled by the relevant unit within DWS prior to impoundment.

The RMP will take into consideration aspects highlighted to date in the EIA process, such as the access to and utilisation of Smithfield Dam by the surrounding rural community (e.g. stock watering) and the possible use of the impoundment for recreational purposes, as well as the exclusive use of the balancing dam by Baynesfield Estate.

According to the Guidelines for the Compilation of Resource Management Plans (RMPs) (DWAF, 2006), the main aim of an RMP is to *"…compile workable, functional sustainable access and utilisation plans for water resources and in particular State Dams through a process based on the attainment of harmony within the natural and cultural environment while addressing the needs and expectations of both the community, users and visitors ….*". Broadly, an RMP comprises an Integrated Environmental Management Plan (including a zonation plan), a proposal for institutionalising the implementation of the plan and a Business Plan that informs decision-makers of the required actions and resources associated with the RMP. The RMP development approach is presented in the figure to follow.

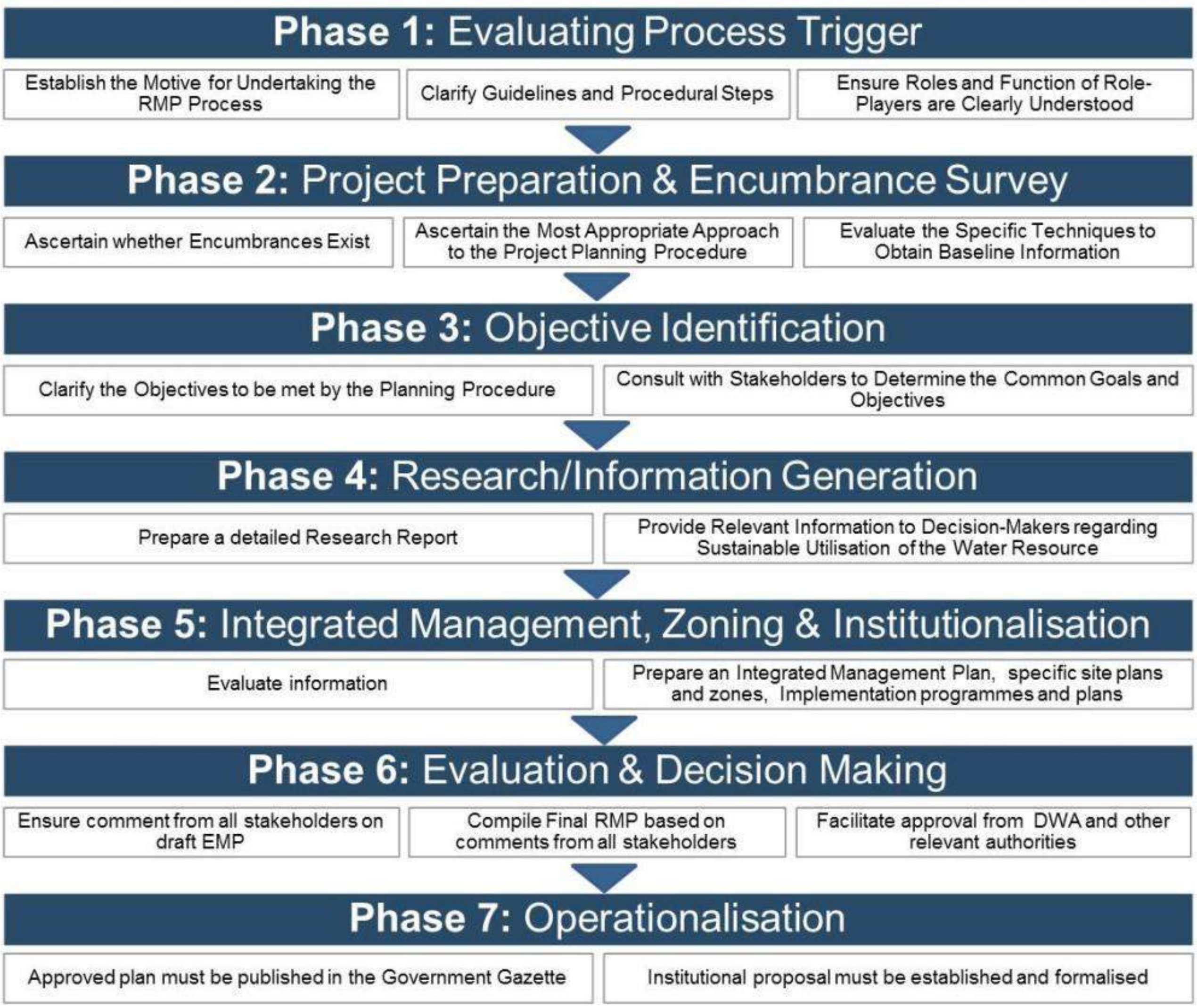


Figure 98: RMP Development Process

10 PROFILE OF THE RECEIVING ENVIRONMENT

10.1 General

This section provides a general description of the status quo of the receiving environment in the project area. This serves to provide the context within which the EIA was conducted.

The study area includes the entire footprint of the project components and related activities. Where necessary, the regional context of the environmental features is also explained, with an ensuing focus on the local surrounding environment. The reader is referred to **Section 11** for more elaborate explanations of the specialist studies and their findings for specific environmental features.

This section allows for an appreciation of sensitive environmental features and possible receptors of the effects of the proposed project. The potential impacts to the receiving environment are discussed further in **Section 12**.

Where relevant, the sub-sections to follow were divided into the primary project components, namely:

- Smithfield Dam (including associated road layout, borrow pits and quarries, transmission line deviations, spoil site at inlet portal, hydropower plant);
- Raw water conveyance infrastructure (tunnel, raw water pipeline, spoil site at central portal, hydropower plant);
- Balancing dam (including associated access roads, borrow pit and quarry, hydropower plant, spoil site at inlet portal); and
- Gauging Weir.

10.2 Land Use & Land Cover

10.2.1 General

The land cover in the study area is shown in **Figure 99**. The land use and cover for each of the major project components are explained further below.

Figure 990: Land Cover

(Note: disregard reference to Gauging Weirs : “US of SD” and “Near IFR Site” in legend – these sites will be assessed in a separate EIA)

10.2.2 Smithfield Dam

The proposed dam site is situated in a rural area, with scattered traditional settlements. In general, the traditional homesteads are mostly clustered along the mid slopes of the uMkhomazi River valley (see **Figure 100**). The pattern of settlement has been influenced by geographical, biophysical and land tenure features.

Figure 100: Typical settlement pattern near Smithfield Dam

The Smithfield Dam basin is shown in **Figure 101**.

Figure 101: Southern view of Smithfield Dam basin

The land cover in the Smithfield Dam catchment is provided in **Table 44**.

Table 44: Land cover in the proposed Smithfield Dam catchment

Land Cover	Smithfield Dam	
	km^2	%
Unimproved (natural) Grassland	1498.33	73.10
Degraded Unimproved (natural) Grassland	174.04	8.49
Thicket, Bushland, Bush Clumps	137.03	6.69
Forestry: Plantations	101.33	4.94
Cultivated, temporary, subsistence, dryland	86.00	4.20
Indigenous Forest	19.46	0.95
Waterbodies and wetlands	14.61	0.71
Urban / Built-up (rural cluster)	8.49	0.41
Shrubland	6.96	0.34
Improved Grassland	1.76	0.09
Bare Rock and Soil	1.55	0.08
Total	**2049.57**	**100**

The land cover is mostly unimproved and degraded unimproved grassland. Surrounding land uses include small-scale and subsistence farming and grazing on Traditional Authority and state land. Agricultural activities are encountered along the left bank within the basin, with more formal cultivated fields occurring on Portions 1 and 3 as well as the Remainder of the Farm Crowle 2260, which is managed by the Department of Rural Development and Land Reform (DRD&LR). A number of dwellings are also located within the proposed area to be inundated by the basin (see **Figure 102**).

Figure 102: Dwellings in proposed Smithfield Dam basin

As part of the Agricultural Impact Assessment (Index, 2015), the present land use was determined by interpretation of high resolution satellite images and a site visit. Spot checks were made on land uses and general soil types noted during site visit. The land uses at Smithfield Dam, as established as part of the Agricultural Impact Assessment, are listed in **Table 45** and shown in **Figure 103**.

Table 45: Land use - Smithfield Dam (Index, 2015)

	Crops	Erosion	Grazing	River	Total
Land use	227.5	197.7	432.2	112.2	969.6

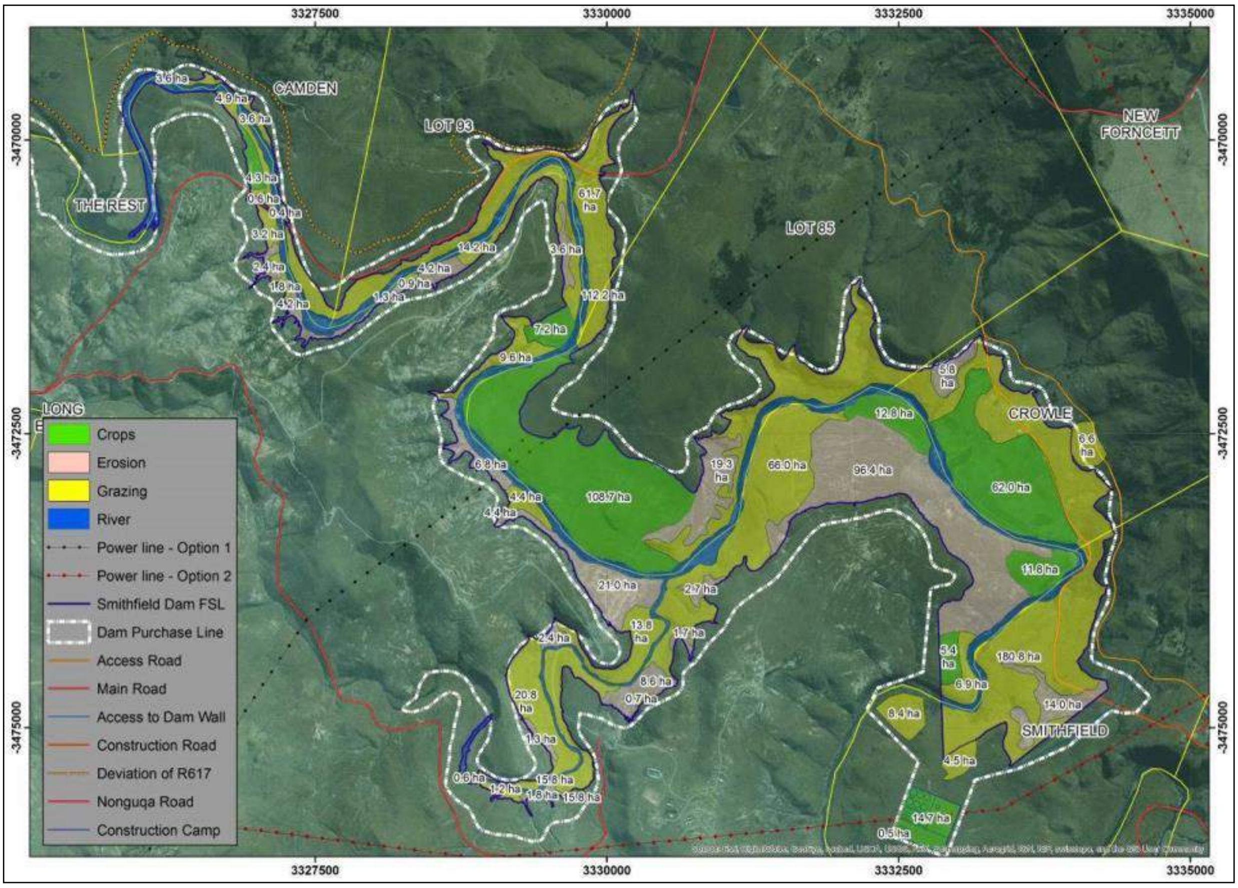


Figure 103: Land use - Smithfield Dam (Index, 2015)

10.2.2.1 Transmission Line Deviations

The land affected by the proposed options for the relocation of the existing high voltage power line includes the following:

- Option 1 – no new land affected, as it only entails crossing the basin along its existing alignment; and

- Option 2 – vacant land, grazing area, conservation (Impendle Nature Reserve) and settlements.

10.2.3 Road Layout

The road deviations necessitated by the Smithfield Dam basin affects the following land:

- R617 deviation (see **Figure 104**) – conservation (Impendle Nature Reserve), vacant land, grazing area, subsistence agriculture and settlements; and
- Deviation of existing access road to Noguqa (see **Figure 105**) – vacant land, grazing area, subsistence agriculture and settlements.

The other roads that form part of Smithfield Dam affect the following land (see **Figure 106**):

- Access road and construction road - vacant land, grazing area, subsistence agriculture and settlements; and
- Access road to dam wall - vacant land and grazing area.

Figure 104: R617 deviation

Figure 105: **Deviation of existing access road to Noguqa**

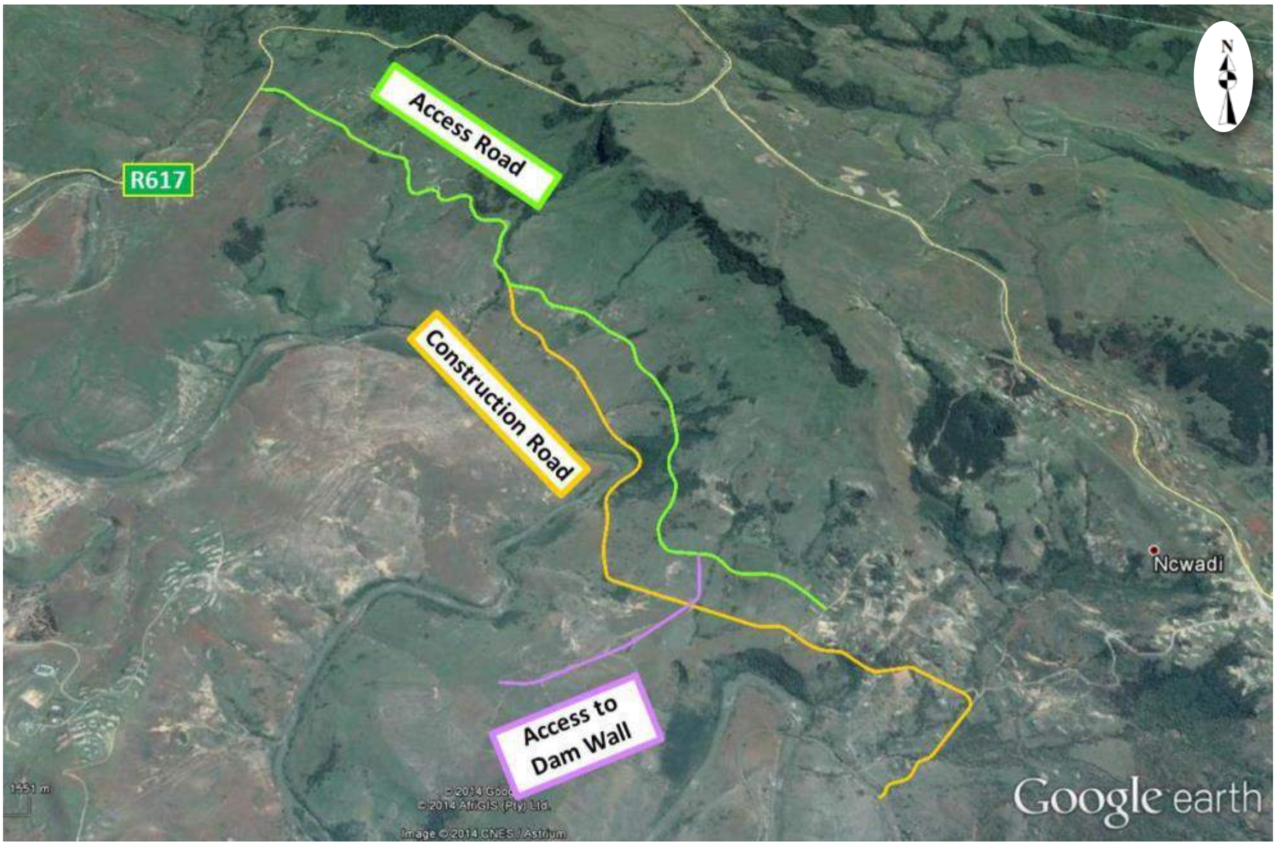


Figure 106: **Smithfield Dam – access road, construction road and access to dam wall**

10.2.4 Tunnel

Approximately the first 21 km of the tunnel from Smithfield Dam (west to east) falls under Traditional Authority and state land. The area is characterised by traditional homestead settlements and rural subsistence agriculture. Land cover includes unimproved and degraded unimproved grassland, thicket, bushland, forest plantations and subsistence agriculture.

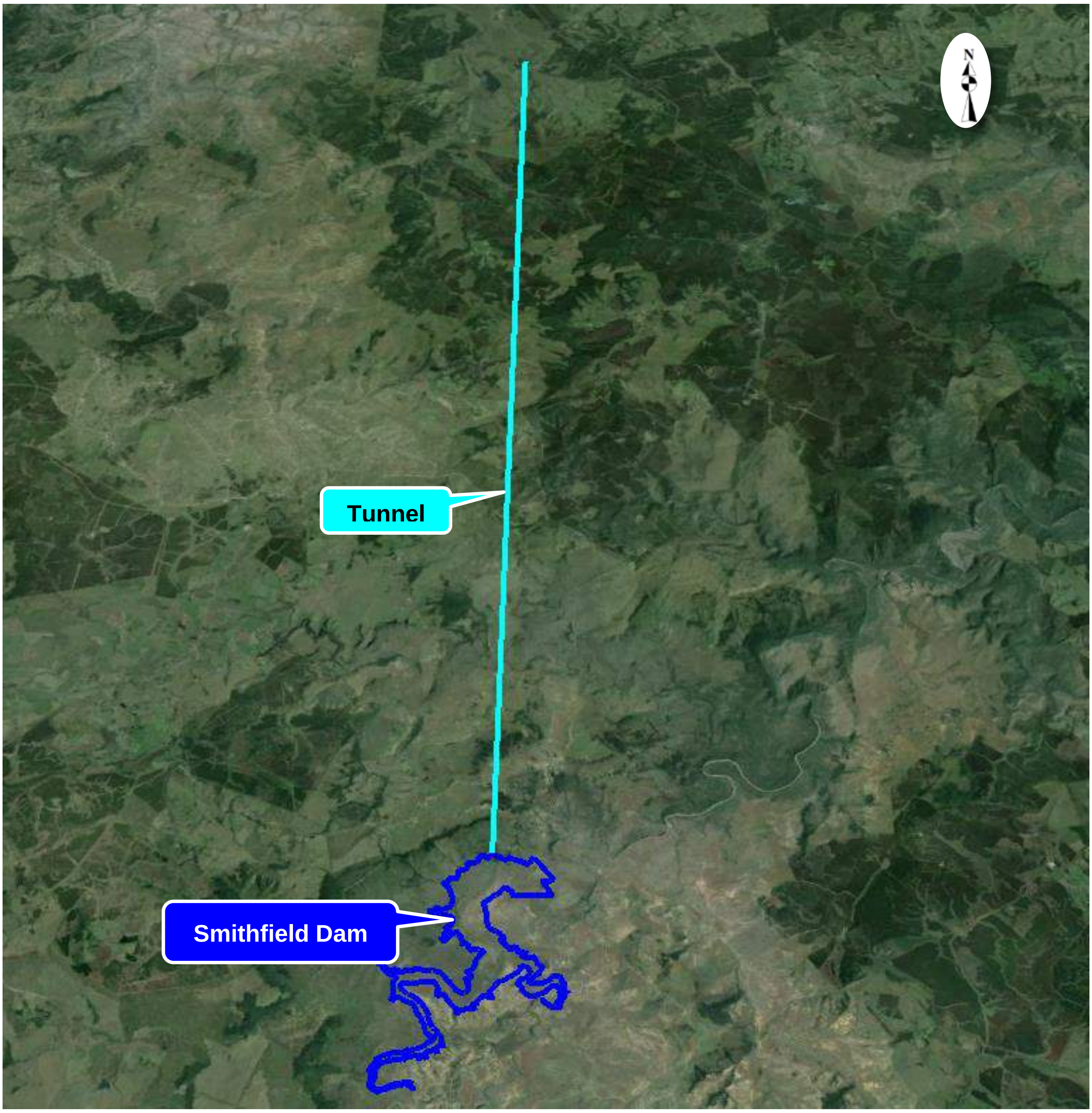


Figure 107: Tunnel route

The remaining part of the tunnel (± 13 km) traverses privately owned land that is predominantly used for commercial farming and forestry, with patched of indigenous forests and improved grassland.

10.2.5 Raw Water Pipeline

The raw water pipeline's final alignment will be dependent on the location of the WTW, which forms part of the EIA for the uMWP-1 Potable Water component. The raw water pipeline routes are shown in **Figure 108**.

The raw water pipeline to WTW Option 1 is located on Baynesfield Estate, and it mostly crosses cultivated land, timber plantation, vacant areas and watercourses.

The raw water pipeline to WTW Option 2 is also located on Baynesfield Estate, and predominantly passes through cultivated land and small areas of timber plantation and vacant land, as well as watercourses). It also travels past some residential dwellings and the Baynesfield Club sports grounds.

The raw water pipeline to WTW Option 3 crosses Baynesfield Estate and other private land, with the land cover mostly constituting cultivated land followed by timber plantation, vacant areas, grassland and watercourses (including Mapstone Dam). The route travels to the north of Hopewell and also traverses Rainbow Farms property where the route passes chicken houses.

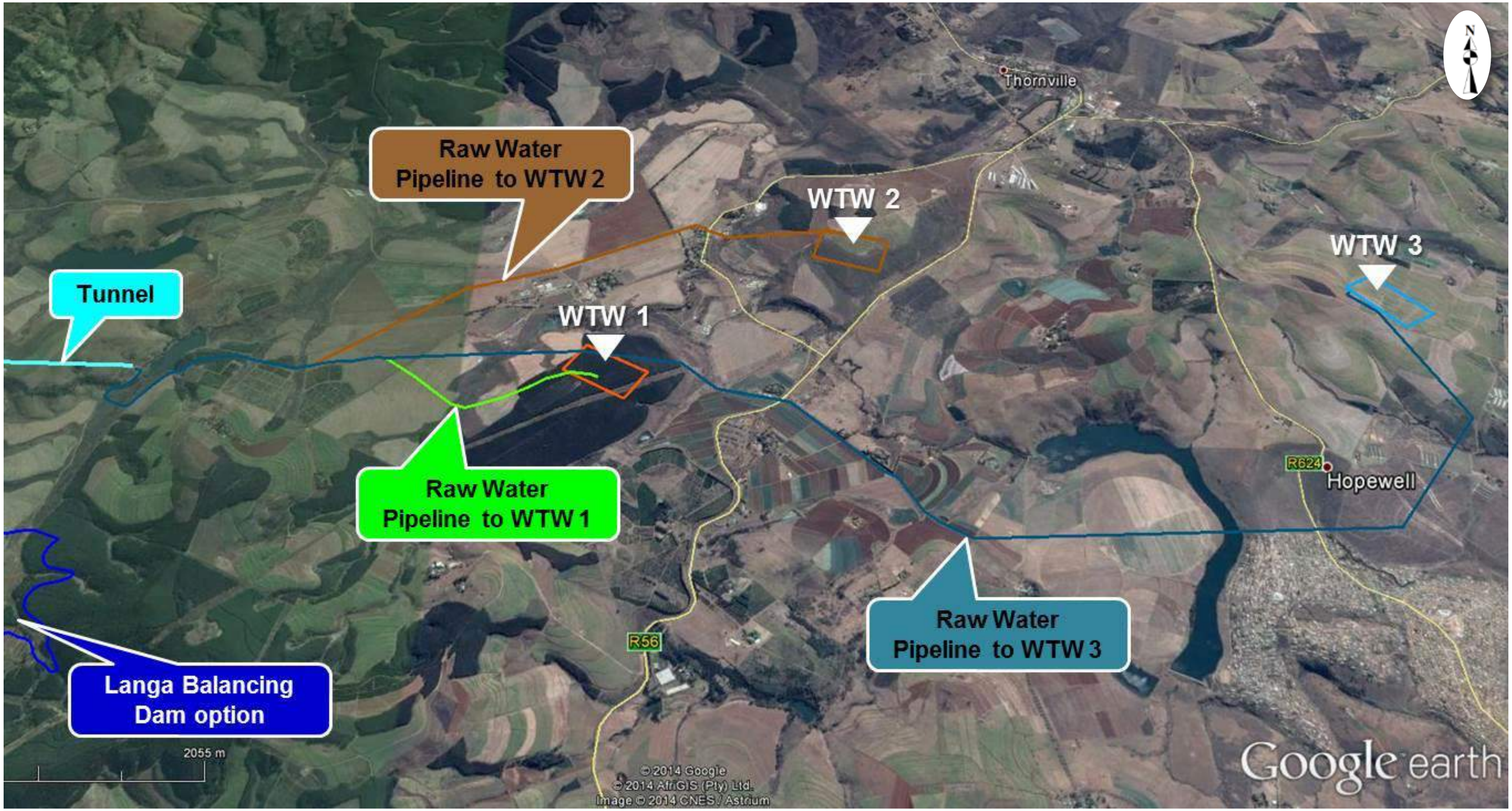


Figure 108: Raw water pipeline routes for WTW Options 1 -3

10.2.6 Balancing Dam

The balancing dam options are situated on Baynesfield Estate. Parts of the basins for the various dam options will inundate cultivated land and a forest plantation (see **Figure 109**).

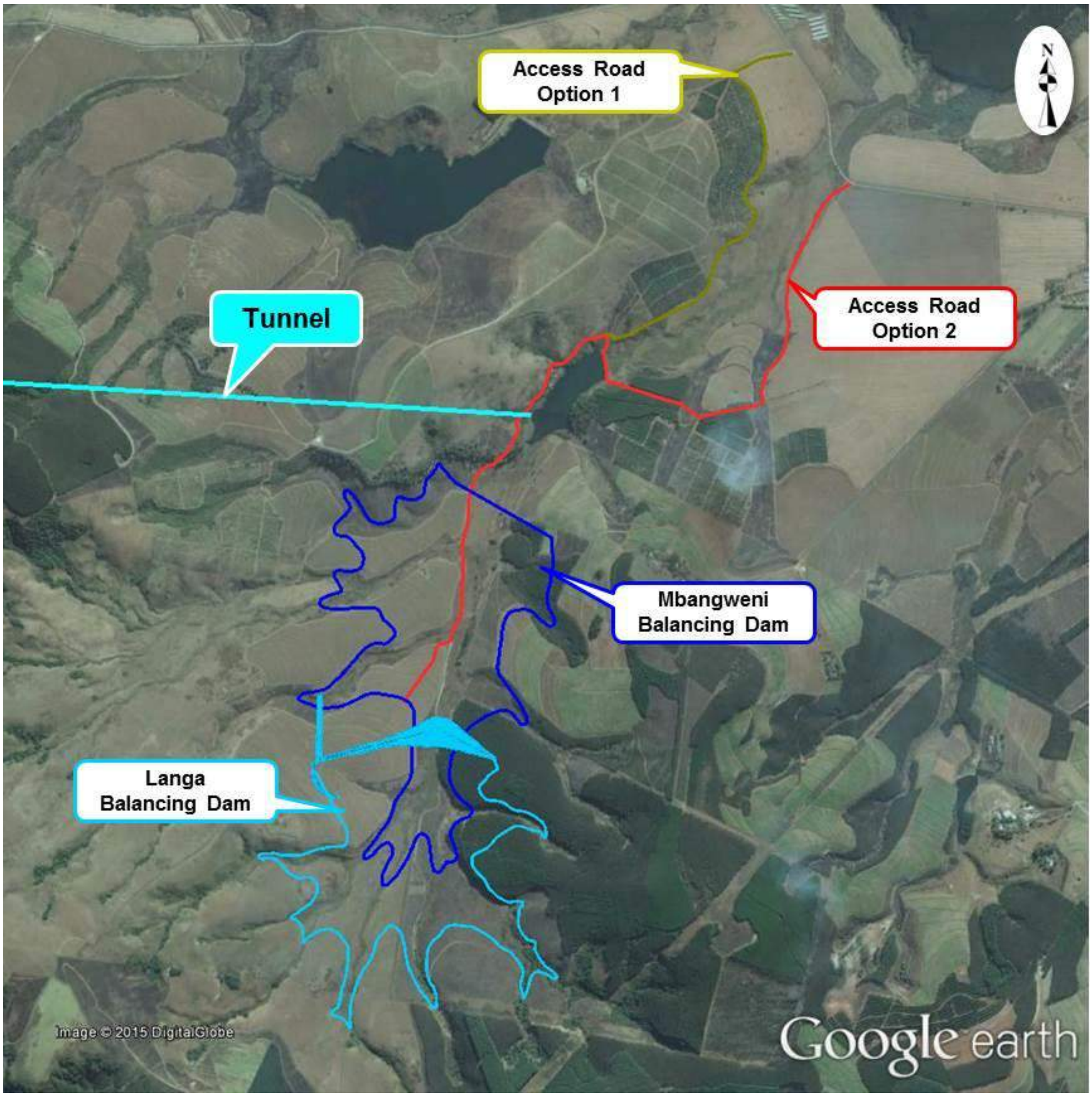


Figure 109: Balancing Dam Sites

The dominant land cover in the Langa Balancing Dam catchment, as shown in **Table 46**, is natural thicket and bushland, followed by improved grassland, forestry plantation and cultivated land.

Table 46: Land cover in the proposed Langa Balancing Dam catchment

Land Cover	Langa	
	km^2	%
Unimproved (natural) Grassland	0.10	1.93
Degraded Unimproved (natural) Grassland	0.03	0.59
Thicket, Bushland, Bush Clumps	2.36	46.92
Forestry: Plantations	0.93	18.50
Improved Grassland	1.38	27.52
Cultivated, temporary, commercial, irrigated	0.23	4.56
Total	**5.02**	**100**

The land uses at the balancing dam options, as established following a more detailed site appraisal as part of the Agricultural Impact Assessment, are listed in **Table 47** and shown in **Figure 110**.

Table 47: Land use – Balancing Dam (Index, 2015)

	Mbangweni	Langa
Cane	1.54	-
Crops	48.60	27.64
Forests	50.59	53.02
Grazing	84.19	63.81
River	21.50	18.13
Total	206.43	162.61

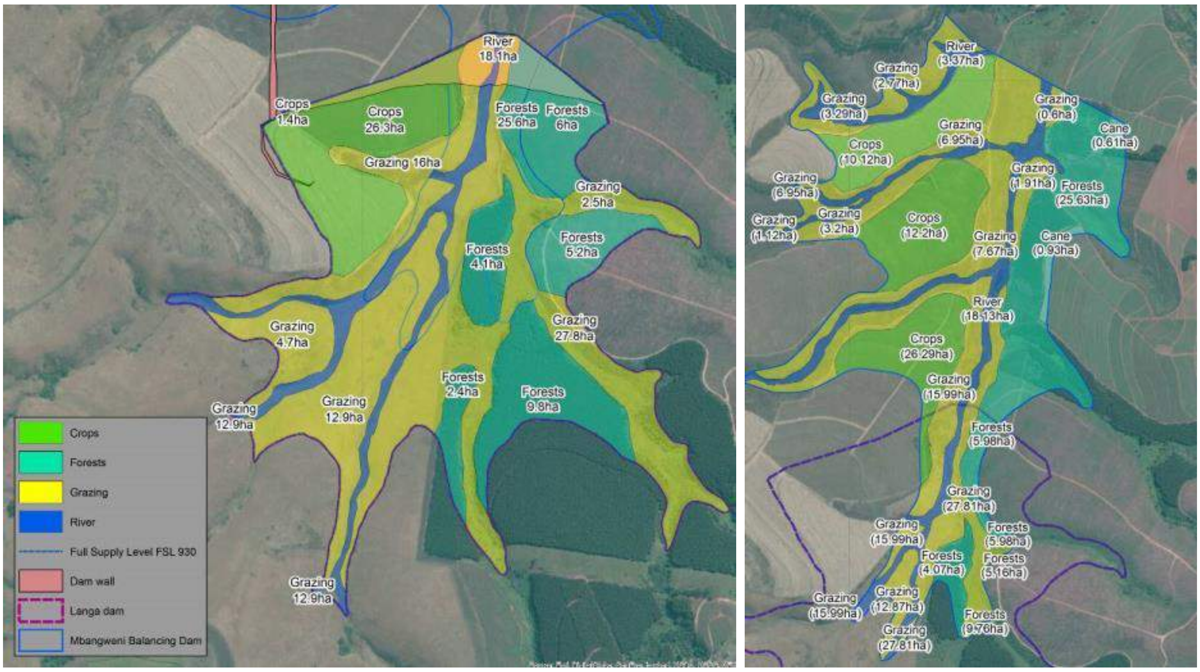


Figure 110: Land use - Balancing Dam (Langa left and Mbangweni right) (Index, 2015)

10.2.7 Spoil Sites

The land affected by the proposed spoil / waste disposal sites is as follows (refer to **Figure 111**):

- Inlet portal – vacant land used primarily for grazing purposes;
- Central portal – vacant land;
- Outlet portal –
    - Option 1 - cultivated land on Baynesfield Estate; or
    - Option 2 - disposal within the dam wall of the balancing dam, which will affect cultivated land, improved grassland and a forestry plantation.

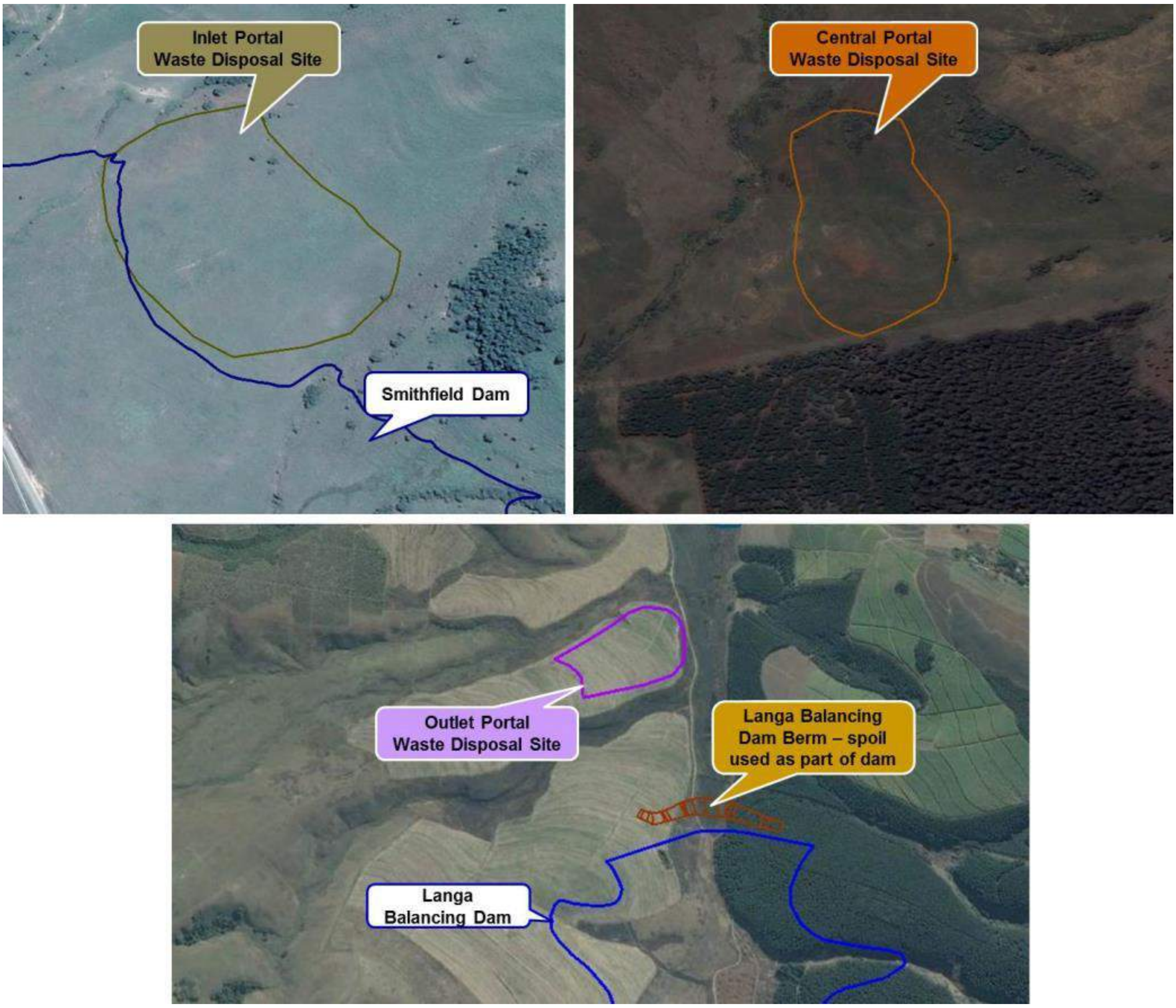


Figure 111: Spoil / Waste Disposal Sites

10.2.8 Gauging Weir

The land cover and land use on either side of the alternative gauging weir sites are as follows (refer to **Figure 112**):

- Downstream and close to Smithfield Dam (U10F) –
  - Options 1 and 2 -
    - Left bank – grassland, vacant land and subsistence grazing; and
    - Right bank – unimproved grassland and vacant land.

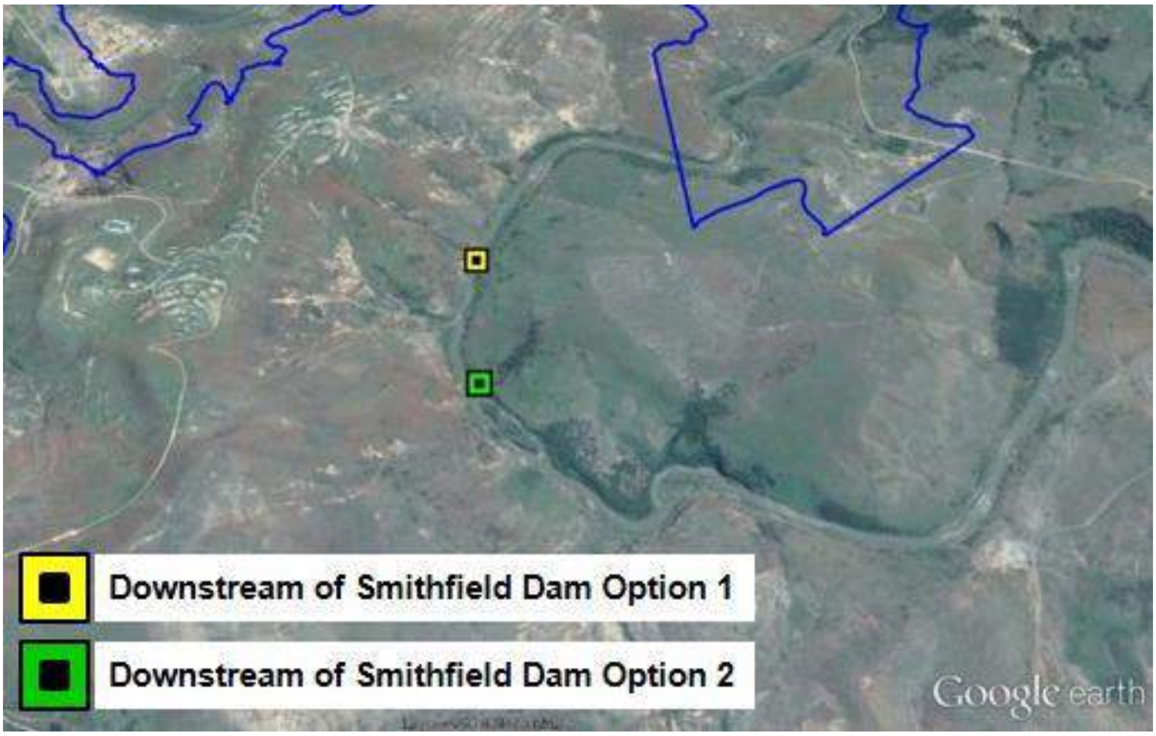


Figure 112: Views of alternative gauging weir sites

10.2.9 Hydropower Plant

The hydropower plant at Smithfield Dam will be located just below the dam wall where the land cover constitutes unimproved and degraded unimproved grassland.

The position of the second hydropower plant will be dependent on the final location of the WTW, which may be as follows:

- WTW Option 1 – Baynesfield Estate, with potential encroachment into timber land or cultivated land;
- WTW Option 2 – Baynesfield Estate, with potential encroachment into fallow land; or

- WTW Option 3 – encroachment into private sugarcane plantation.

10.3 Climate

10.3.1 General

Based on feedback from the South African Weather Services (SAWS) the closest meteorological station is located in Pietermaritzburg, KZN. The information to follow was obtained for this station.

It is noted that as part of the uMWP-1 Feasibility Study, the climatology at the proposed Smithfield Dam and Langa Balancing Dam construction sites was assessed. The variables considered included rainfall, evaporation and temperature.

10.3.2 Temperature

Mild to warm temperatures are experienced during the summer, whilst winters are characterised as being cold with frost occurring regularly.

Average daily maximum and minimum temperatures for the last ten years are shown in **Tables 48** and **49**, respectively.

Table 48: Average Daily Maximum Temperature (°C) - Pietermaritzburg

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2003	29.9	31.2	30	26.8	23.2	20.8	22.7	23.5	23.7	27	27.5	28.7
2004	28.4	28.3	27.2	27.5	26.7	23.2	21	25.1	23.7	26.7	29.3	28.7
2005	27.7	29.3	26.7	26.2	26.1	24.1	24.2	25.8	26.9	26.9	26.6	27
2006	28.4	28.3	26	25.2	21.3	21.6	24.4	22.7	24.8	25.6	25.6	27.1
2007	29.1	30.7	27.5	26.1	26.6	22.6	23.7	25.2	26.4	23.4	24.6	26.7
2008	28.8	29.6	28.4	25.5	26.2	22.6	24.3	26.1	26.3	25.2	26.6	28.3
2009	27	28	27.4	26.7	24.9	22.7	23	24.8	25.5	24.6	24.8	26.4
2010	28.2	30.3	29.4	27.4	27.6	23.4	24.4	26	28.5	26.3	26.7	25.9
2011	27.5	29.8	32	24.5	23.6	21.9	19.8	22.9	25.9	25.4	25.1	26.6
2012	28.5	29.7	27.9	25	24.8	22.3	22.2	23.8	21.9	22.6	23.3	26.9
2013	27.5	28.1	26.2	25.7	23.6	23	21.7	23.7	25.5	24.8	25.8=	*
AVG	**28.37**	**29.49**	**28.1**	**26.1**	**25.0**	**22.6**	**22.9**	**24.5**	**25.4**	**25.3**	**26.0**	**27.2**

Legend: *= indicates that the average is unreliable due to missing daily values*
** indicates that data is unavailable*

Table 49: Average Daily Minimum Temperature (°C) - Pietermaritzburg

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2003	19.3	20	16.9	15.5	9.7	6.2	5.7	7.5	12.4	13.9	15.7	16.5
2004	18.3	18.4	16.9	14	10	5.7	5.6	10.1	10.3	13.8	17.6	18
2005	18.5	18.9	16.6	13.8	9.4	6.9	6.3	11.1	12.2	14.4	16.1	15.4
2006	18.8	19.4	14.9	13.5	7.3	4.8	6.3	7.9	11.4	14.8	15.1	16.5
2007	17.6	18.5	16.7	14.5	8.1	6.4	5.3	7.8	13.5	13.7	14.5	17
2008	18.6	19	16.9	13	11.4	8	6.4	9.9	10.4	14.2	16.4	18.2
2009	18.3	18.3	17.1	13.7	10.6	7.6	5	9	11.7	14.7	15	17
2010	18.5	19.2	17.9	15.1	11.4	6.6	7.2	8.2	13	14.5	16	16.9
2011	18.7	18.9	18.7	13.7	10.7	6	5.2	7.9	12.8	13.4	14.3	16.6
2012	18.2	18.4	16.3	11.5	10.3	6	6	9.4	11.1	13.6	14.1	17.3
2013	17.5	17.2	16.4	12	8.7	5.6	7.9	7.5	10	12.3	14.6=	*
AVG	**18.4**	**18.7**	**16.8**	**13.7**	**9.8**	**6.3**	**6.1**	**8.8**	**11.7**	**13.9**	**15.5**	**16.9**

Legend: *= indicates that the average is unreliable due to missing daily values*
** indicates that data is unavailable*

10.3.3 Precipitation

Rainfall occurs predominantly during summer, but isolated winter rainfalls may occur. The Mean Annual Precipitation (MAP) of the uMkhomazi River catchment can reach a maximum of 1 500 mm in the upper reaches of the Drakensberg. The central regions experience a lower average MAP of 1 200 mm. In general, the project area has a moderate climate, with summer rainfall characterised by afternoon thunder showers. The monthly daily rainfall for the last ten years is shown in **Table 50**.

Table 50: Monthly Daily Rain (mm) - Pietermaritzburg

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2003	76.4	53.8	130.2	83.6	45	8.2	0	23.6	35.8	17.6	83	49.4
2004	54.2	191	59.6	11.8	0.2	22.6	38.2	15.2	70	70	183.4	189.8
2005	180.4	84	121.2	8.2	0.8	3.2	1	10.7	24.4	67	71.4	102.2
2006	185.6	54.8	98.6	109.2	68	1.4	0.4	52.2	54.2	81.6	101	177.2
2007	69.8	38	192.8	24.6	7.4	60.6	0	14	33	171.2	159	58.2
2008	178.2	78.6	77.4	86.2	0	17	0	4	53.6	37	78.6	169.8
2009	174.6	126	73.2	15	26.4	0.8	0.2	46.4	14.8	114.4	51.6	149.4
2010	162	83.4	30	79.8	4.6	9.2	0.8	2.4	2.8	97.2	93.6	140
2011	103.8	33.4	41	93.8	35.8	34.4	49.6	18.2	36.4	48.6	105.2	134.6
2012	86.6	28.8	146.6	31.6	6.6	0.6	0	1	58.2	129.4	77.8	50.6
2013	114.6	144.6	26.2	85.6	27	21.6	4.2	12.4	18	122	16.0=	*
AVG	**126.0**	**83.3**	**90.6**	**57.2**	**20.2**	**16.3**	**8.6**	**18.2**	**36.5**	**86.9**	**100.7**	**122.1**

Legend: *= indicates that the average is unreliable due to missing daily values*
** indicates that data is unavailable*

10.3.4 Wind

The wind rose shown in **Figures 113** for a 10-year period (2003 – 2013) is interpreted as follows:

- Prevailing wind direction is south-east;
- Highest percentage of winds blow with speeds of 0.5 – 2.5 m/s;
- 43.4% of all winds are calm.

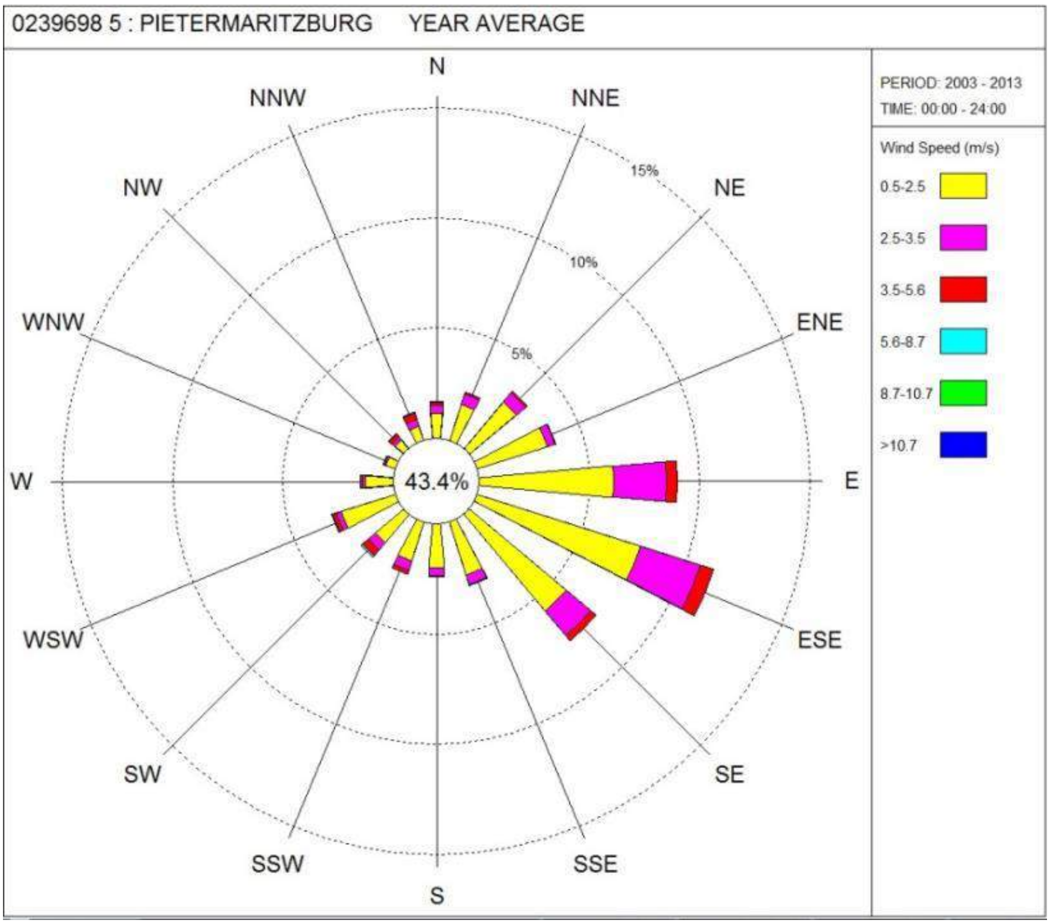


Figure 113: Wind rose for the Pietermaritzburg weather station

The potential impacts of the project on the climate are discussed in **Section 12.3**.

10.4 Geology

10.4.1 Basic Geology

The basic geology of the uMkhomazi River Catchment is shown in **Figure 114**.

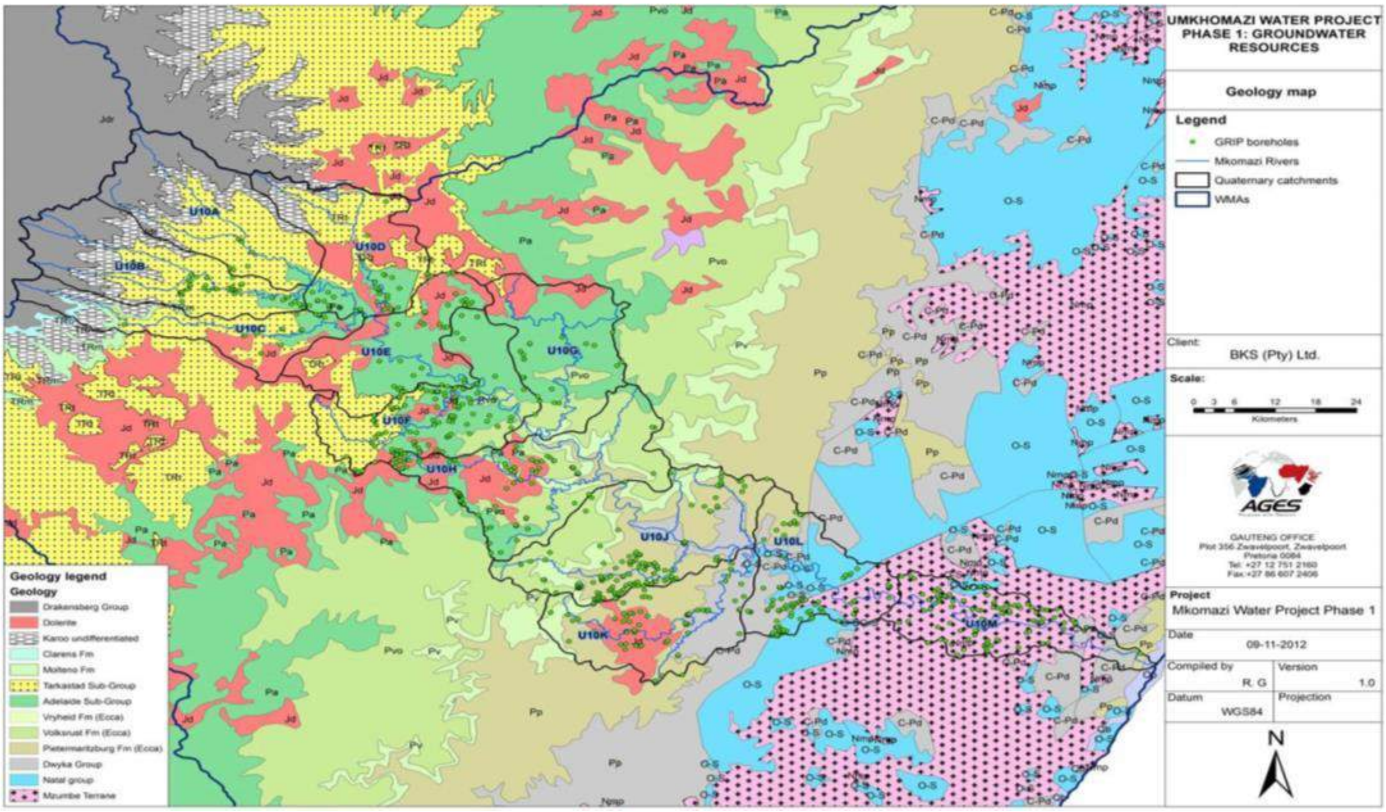


Figure 114: Basic geology map for the uMkhomazi River catchment

10.4.2 General

A reconnaissance level geotechnical investigation was carried out as part of the Pre-feasibility Study. The findings are summarised below. Findings from the geotechnical investigations as part of the Feasibility Study will be presented in the EIA Report.

10.4.2.1 Smithfield Dam

The area at Smithfield Dam is underlain by sedimentary strata of the Karoo Supergroup which have been intruded by younger dolerite sills and dykes. At the dam site a relatively thick dolerite sill has been eroded through by the uMkhomazi River to expose indurated mudstones in the river bed. The dolerite sill extends up each flank for about 25 m in height from 5 m above the river to about 30 m above the river. This hard rock forms the steep sides to the river valley. Above the dolerite sill the valley slopes are flatter where they are underlain by siltstones and thin interbedded sandstones. The sedimentary rocks are generally sub-horizontally bedded and relatively undisturbed.

Four boreholes were drilled at this site. On the upper right flank the siltstones are deeply weathered and overlain by recent unconsolidated sediments (possibly colluvium) consisting of sandy clay and gravel to a depth of 12 m that could form pervious horizons that may have to be sealed by the proposed embankment cut off.

No boreholes were drilled at the site of the saddle dam but examination of the surface exposures in this area indicate that relatively undisturbed weathered siltstones and thin sandstone beds occur in this area. The saddle ridge is wide and is not expected to present a problem with respect to seepage or instability

A Probabilistic Seismic Hazard Analysis was performed for the Smithfield Dam site as part of the Feasibility Study. All earthquakes located within a radius of 320 km from the dam site were used in the assessment. The analysis consisted of two phases, namely (1) spatial delineation of seismogenic sources within 320 km from the site and (2) integration of all possible earthquake scenarios from each source to obtain probabilities of exceedance of specified ground motion parameters. According to the applied guidelines, the site of the future dam is rated as low risk (DWA, 2014d). All results of calculations are based on the assumption that the dam structures are founded on rock.

10.4.2.2 Raw Water Conveyance Infrastructure

According to the published 1:250 000 scale geological maps of the project area the tunnel traverses areas underlain by rocks of the Karoo Sequence and possibly the upper Natal Group, while the raw water pipelines traverse areas underlain by rocks of the Karoo Sequence, Pietermaritzburg Formation.

The transfer tunnel is expected to mainly be driven within rocks of the Volksrust Formation (69%), which almost exclusively comprises mudrocks (predominantly siltstone), but will also intersect strata of the older Vryheid Formation (14%) which comprises sandstone with interbedded siltstone, and the Pietermaritzburg Formation (17%), a relatively homogeneous unit comprising siltstone with interbedded mica-rich horizons. These sedimentary strata have all been intruded by dolerites, in the form of dykes and sills.

10.4.2.3 Balancing Dam

The area around the Langa Balancing Dam site is underlain by rocks of the Pietermaritzburg Formation of the Ecca Group, comprising shales (mudrocks) with sub-ordinate sandstones. The sedimentary strata are essentially horizontal, and largely undisturbed. Regional dips of 3 – 5 degrees are recorded. A near-horizontal dolerite sill had intruded into the sedimentary strata and occurs below a cover of shale at the dam centre line and the quarry. A fault with a throw of about 8 m intersects the dam centre line.

The Probabilistic Seismic Hazard Analysis for the Langa Balancing Dam revealed that the site has a low seismic risk (DWA, 2014d).

10.4.2.4 Gauging Weir

Site investigations for the positioning of the gauging weir at Smithfield Dam made the following observations with regards to the local materials and foundations (DWA, 2014b):

- Option 1 - Some surface rock boulders are present at the site, however, these are generally quite small (±150 mm in diameter). The presence of erosion on the western bank may indicate that there may be considerable excavation required in order to find suitable rock foundation material.
- Option 2 - At option 2 the river is slightly wider (±60 m) than at option 1, although the steeper banks would suggest that there may be less excavation required in order to find good founding rock on which to construct. Exposed rock face was found on the western bank of the river approximately 60 m upstream of the proposed option 2 site indicating that excavation may be easier at this site.

10.4.3 Foundation Materials

10.4.3.1 General

The site comprises shales (mudrocks) with subordinate sandstones and intrusions of dolerite. Three near-horizontal dolerite sills have intruded mainly concordantly into the sedimentary strata and are responsible for the narrow river valley at the dam site and the presence of good quality rock for concrete aggregate and rockfill. The site has a low seismic risk.

10.4.3.2 Foundation

a) Main embankment

The founding level for the shells of the rockfill embankment is summarised as follows:

- At the upper left and right flanks a 6 to 10 m layer of colluvium and residual soil/completely weathered shale has to be removed;
- In the central river section 1.5 to 5 m of residual soil/completely weathered shale/dolerite and medium dense river alluvium has to be removed; and
- A large part of the right flank has 11.2 to 14.4 m of transported sandy clay with boulders which has to be removed.

The excavation for the founding level will yield a large volume of material, which might be suitable as impervious and semi-pervious earthfill for the saddle embankment. Laboratory testing of this material will have to be conducted to confirm the suitability.

The clay core of an earthfill or rockfill dam is normally founded on material that is either sufficiently impervious or can be rendered impervious by means of grouting.

It will be necessary to make provision for a *grout curtain* to a depth of about 66% of the water head along the centre line. Although grout penetration might be small except in local zones, the drilling, water test and grout records from a grouting operation are very important and can be considered the final stage of a geotechnical investigation when sub-surface information is obtained at close intervals below the footprint of the dam.

b) Saddle embankment

The founding level for the shells of an earth embankment is typically founded on material with low organic content, low compressibility and with shear strength similar to the dam wall material. This means that a 0.1 to 0.5 m thick layer of organic topsoil has to be removed along the centre line and that founding will take place on highly weathered shale.

The *clay core* of an earthfill or rockfill dam is normally founded on material that is either sufficiently impervious or can be rendered impervious by means of grouting. The clay core of an earthfill dam across the saddle embankment can be founded on moderately weathered shale that occurs at depths of between 2 and 4 m. This excavation depth will also be adequate for the concrete structure of the fuse plug.

If *Quarry I* is developed just upstream of the saddle embankment, the flow path underneath the embankment will be considerably shortened and it is recommended that provision be made for a grout curtain to a level at least 20 m below the quarry floor (approximately 845 masl).

c) Spillway

The position of the main spillway structure was not drilled for foundation levels and needs to be investigated during the tender and detail design phase.

The control structure for a side spillway on the upper left flank can be founded on slightly weathered shale at depths ranging between 15 and 20 m below ground surface and the concrete lined channel can be founded on moderately weathered shale at depths of between 10 and 12 m.

This excavation depth for the clay core or the saddle embankment will be adequate for the concrete structure of the fuse plug spillway.

10.4.4 Availability and quality of construction soil and rock materials

The geotechnical investigation identified three borrow and four quarry areas (refer to **Section 9.12**). The type of materials, quality of the materials and their uses are described in **Table 51**.

Table 51: Type, quality and uses of soil and rock materials

Type of material / location	Quality	Use application
Overburden	Soil mixed with topsoil	Rehabilitation of disturbed areas
Impervious earthfill material in Borrow Areas A and B	Classify as CI and few CH in Casagrande Classification*. Two samples have a plasticity index (PI) of 30 to 40 and a liquid limit (LL) of 60 to 70. These materials must be mixed with materials with lower values for quicker construction.	Core zones of Smithfield Main and Saddle Dam Embankments
Semi-pervious earthfill materials – all over the site expect for Borrow Areas A and B	Classify as CL or CI in Casagrande Classification	To be used in zones of embankment
Soft shale rockfill	Moderately weathered shales	To be used in zones of embankment
Coarse shale rockfill below dolerites in Quarry I not shown in table.	Good coarse rockfill	To be used in zones of embankment dam if dolerite quantity is not sufficient
Weathered dolerites	Soil to be used as earthfill	May be usable in outer zones of embankment dams
Rockfill, aggregates, filters, transition zones, rip-rap	Moderately weathered dolerite	Rockfill in main dam embankment Rip-rap and transition zones in saddle dam embankment Transition zones in main dam embankment

Sufficient materials are available. If the dolerites are insufficient, the unweathered shale below the dolerites can be used in inner zones of the rockfill embankment, thereby saving on dolerite. Material to the eastern side of the displacement could be utilised if at all required. It is therefore clear that final design of the layout of the Earth Core Rockfill Dam (ECRD) should be done during the tender design phase, and if necessary further drilling investigations should also be done during this phase.

10.4.5 Stability of Dam Embankment

Slope stability analyses were conducted with the tested parameters for the different soil types from the geotechnical investigations to determine the optimal slopes of each of the various dam types.

10.4.6 Seepage control

Seepage through the foundation will be controlled with a cement grout curtain drilled at the clay core position. The small amount of seepage passing through the core will be contained with filters immediately downstream of the core and prevents the seepage from carrying core material away.

10.5 Soils

According to DWAF (2004), soil cover throughout the Mvoti to Mzimkulu Water Management Area (WMA) is generally shallow and is strongly parent-material related due mainly to the prevailing topographic conditions. Soils are mainly of sandy types developed on quartzose rocks, or clayey soils developed on argillaceous and basic igneous and metamorphic rocks. Deeper transported soils are present as colluvium on lower slopes, with alluvium occurring in valley bottoms and estuaries at the coast.

At Smithfield Dam and along the initial section of the tunnel route, pressure on this resource is evident from the high levels of soil erosion, arising from over-grazing, intensive cultivation, informal farming and settlements, timber plantations, and sand winning (see **Figure 115**).

Good soil cover is encountered in the Baynesfield area where the balancing dam is proposed, with commercial agriculture, forestry plantations, grassland and wetlands dominating (see **Figure 116**).

Figure 115: Surface conditions in the Smithfield Dam area

Figure 116: Surface conditions in the Baynesfield area along the Mbangweni stream

As shown in **Figure 117**, the study area consists of red and yellow plinthic soils. Soil forms associated with these units are, among others, Hutton, Clovelly, Shortlands and Bainsvlei. In addition, the reconnaissance survey as part of the Agricultural Impact Assessment also identified Cartref, Glenrosa, Mispah and duplex soils like Escourt (Index, 2015).

As part of the reconnaissance survey for the Agricultural Impact Assessment and following an appraisal of satellite imagery, more detailed soil maps were identified which are shown in **Figure 118** (Smithfield Dam) and **Figure 119** (balancing dam options).

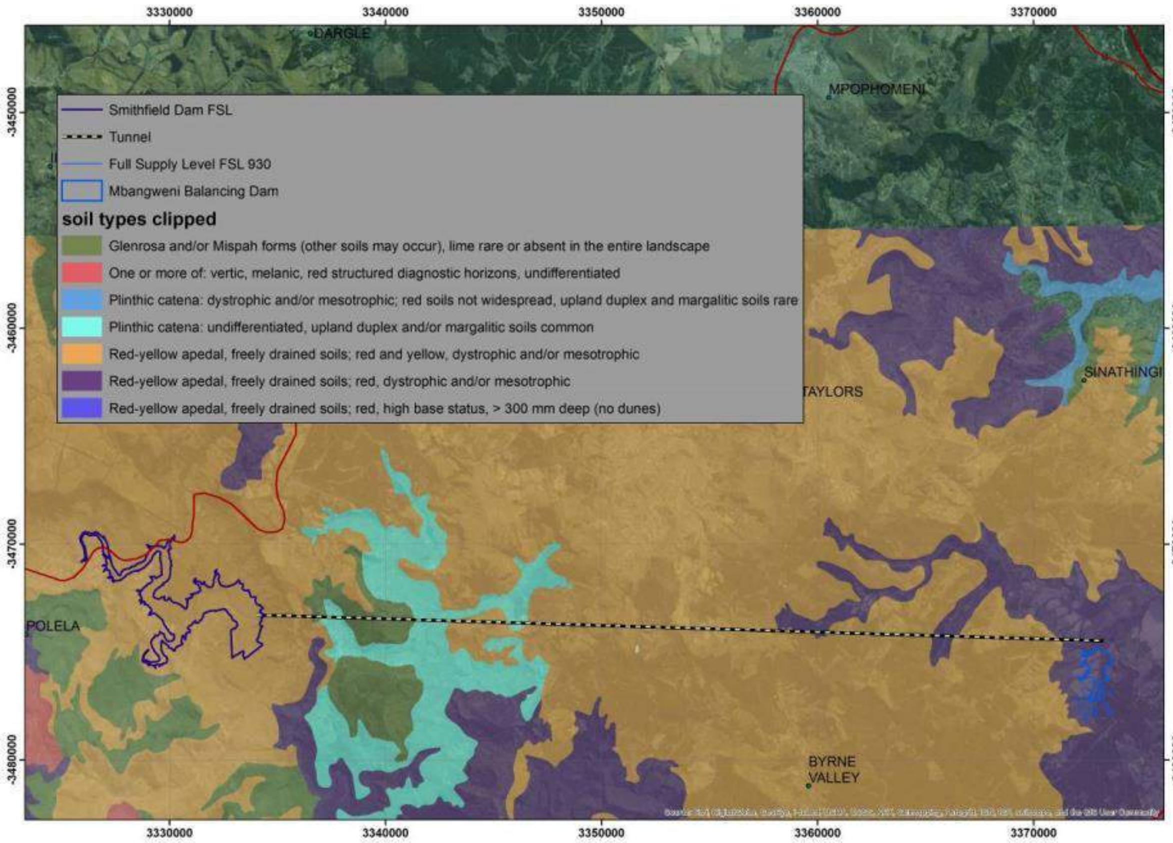


Figure 117: Soil Map (Index, 2015)

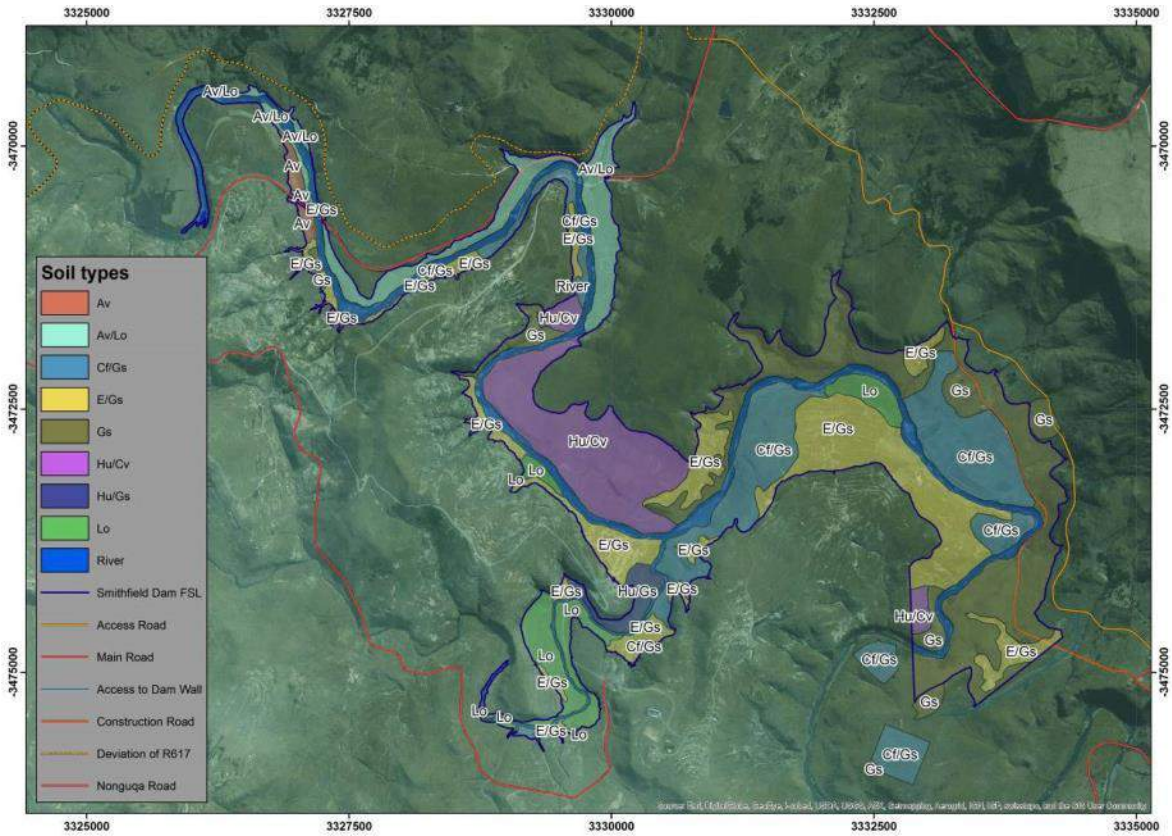


Figure 118: Soil map of Smithfield Dam (Index, 2015)

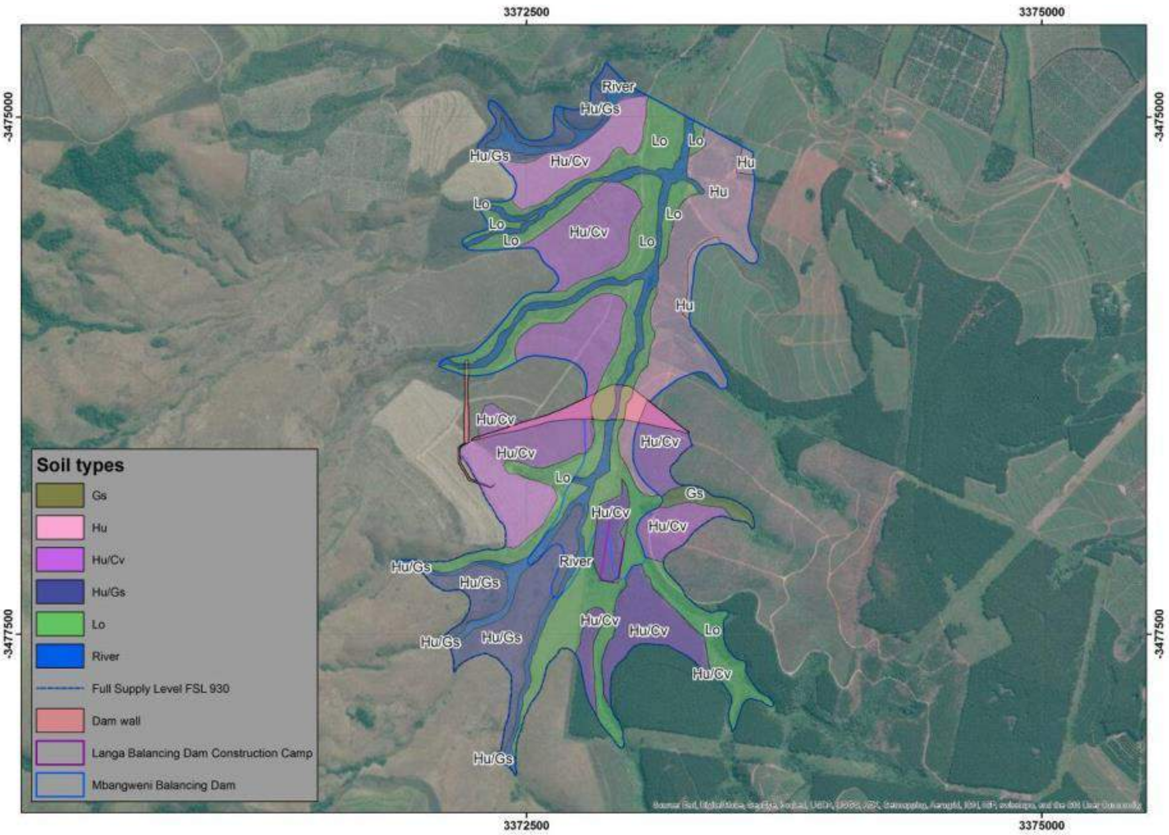


Figure 119: Soil map of Balancing Dam Options (Index, 2015)

10.6 Geohydrology

According to DWAF (2004), groundwater aquifer types present in the Mvoti to Mzimkulu WMA are almost entirely of the ‘hard rock’ secondary porosity, ‘weathered and fractured’, and ‘fractured’ classes. ‘Inter-granular’ primary porosity class aquifers are present to a very limited extent in riverbeds in close proximity to the coast. In the ‘fractured’ class, zones of preferential groundwater presence include faults, major joints, bedding planes, and the contacts of intrusive Karoo dolerite sheets and dykes with the host rock.

The hydrogeological aquifer units encountered in the quaternary catchment, within the EIA study area, are the Beaufort and Ecca shales and sandstones with intrusive Karoo dolerite.

By far the most common method of groundwater abstraction in the region is the normal ‘hard rock’ borehole of 165 mm diameter, with its uppermost portion (10-15 m) cased, and of depth 60 to 120 m. Numerous natural low-flow springs and seepages of groundwater are utilised as water supply sources in the rural portions of the region (DWAF, 2004).

As part of the uMWP-1 Feasibility Study, an exercise was undertaken to determine the groundwater resources of the uMkhomazi River secondary catchment and to assess the groundwater-surface water interaction (DWA, 2013d). It was found that the quaternary catchments U10A – U10G are the most suited catchments for groundwater development. Quaternary catchments U10H – U10M show lower potential for groundwater development. U10H – U10L have groundwater utilisation indices that range between 61% and 98% and are thus moderately stressed to critical. **Section 9.1.3** further explains the constraints associated with considering groundwater as a viable resource to meet the demands of the uMWP-1.

Groundwater Resource Quality Objectives (RQOs) were determined as part of the Comprehensive Reserve and RQOs in the Mvoti to Umzimkulu WMA (DWS, 2015). Groundwater RQOs are developed to maintain the required groundwater contribution (groundwater baseflow) to the Ecological Reserve, which is assumed to equal the required maintenance low flow. The relevance off the groundwater RQOs to protect groundwater is twofold; 1) to maintain and support the ecological requirements of the receiving surface water bodies; 2) to protect groundwater resources for the direct and indirect users of the groundwater (DWS, 2015). The study area was subdivided into Groundwater Response Units (GRUs) by catchment areas, topography and geology. Key findings in terms of the EIA study area follows:

- **Smithfield Dam** –
  - Smithfield Dam falls within the U10E and U10F quaternary catchments, which are located in GRU 11 of the Integrated Unit of Analysis (IUA) U1-1 MKOMAZI MOUNTAIN ZONE.
  - Groundwater use in the IUA is minimal. The stress index (use/ aquifer recharge) is low and groundwater resources are under-utilised.
  - Borehole yields in the IUA are low.
  - The IUA is of moderate aquifer vulnerability.
  - In general there are few impacts or threats to the water resources and the water quality can be regarded as good.

- Each quaternary was assigned a present status based on the volume of groundwater abstracted compared to the volume recharged. The present status for U10E is A (Unmodified) and for U10F is B (Largely Natural).
- The groundwater RQOs are presented in **Table 52**.

❖ **Balancing dam** –

- The balancing dam options fall within the U60B quaternary catchment, which is located in GRU 28 of the IUA U6-1 UPPER MLAZI.
- Groundwater use in the IUA is minimal. The stress index (use/ aquifer recharge) is low and groundwater resources are under-utilised.
- The present status is A (Unmodified).
- Borehole yields are moderate.
- Groundwater quality is generally good.
- Groundwater abstraction has a minimal impact on groundwater baseflow.
- Baseflow reduction due to afforestation and alien invasive plants is significant.
- GRU 28 is of moderate aquifer vulnerability.
- The groundwater RQOs are presented in **Table 52**.

Table 52: Narrative and Numerical RQOs (DWS, 2015)

GRU	Quat	Groundwater narrative RQO				Groundwater numerical RQO
		Abstraction	Baseflow	Water Level	Water Quality	
11	*U10E-F*	*Significant ground water abstraction within 200m of a perennial channel should be restricted. All users to comply with existing allocation schedules and individual licence conditions within the confirmed Harvest Potential*	*Due to the low groundwater use, monitoring not required*	*Due to the low groundwater use, low yields and low aquifer contribution to baseflow, monitoring not required*	*No regional groundwater quality issues exist*	*The sustainable volume of groundwater abstraction is 5.03 Mm^3/a evenly distributed in both time and space.*
28	*U60B*	*Significant ground water abstraction within 200m of a perennial channel should be restricted. All users to comply with existing allocation schedules and individual licence conditions within the Harvest Potential*	*Due to the impacts of afforestation, and AIPs, monitoring of baseflow is required.*	*Due to the low groundwater use and low aquifer contribution to baseflow, monitoring not required*	*No regional groundwater quality issues exist*	*The sustainable volume of groundwater abstraction is 3.06 Mm^3/a evenly distributed in both time and space. Low flows at U6H003 should be maintained at a minimum of 5.92 Mm^3/a*

10.7 Topography

The uMkhomazi River catchment originates within the Drakensberg, with the upper reaches of the river catchment at an altitude of 2 500 m. The remainder of the river catchment comprises incised river valleys and mountains.

The rugged landscape in the study area is largely a result of river and/or water erosion. It should be noted that the overall gradient of the rivers in KZN is generally steep and this increases the erosion potential of the rivers. Areas of moderate slopes do occur within the catchment and these flatter areas are mainly subjected to intensive agricultural activities.

As shown in **Figure 120**, the terrain morphology of the project area is classified as follows:

- Smithfield Dam, majority of tunnel options and gauging weir – low mountains; and
- Last portions of tunnel route options, balancing dam options and raw water pipeline options – undulating hills and lowlands.

The 20m contour intervals are shown in **Figure 121**. The highest point in the project area is approximately after 20 km along the tunnel (from west to east), where the elevation is approximately 1500 masl (metres above sea level).

The Smithfield Dam site is roughly symmetrical. The river bed is at elevation 857 meter above sea level (masl) and approximately 60 m wide. The flanks rise steeply on both sides for about 25 to 30 m above the river level. Above this level the flanks flatten out along two ridges which are followed by the embankment sections of the dam.

For a dam having a full supply level at 930 masl, the highest dam that could be cost effectively constructed at Smithfield, a saddle dam will be required to prevent spillage over the saddle situated about 1 km to the north east of the site (see **Figure 122**).

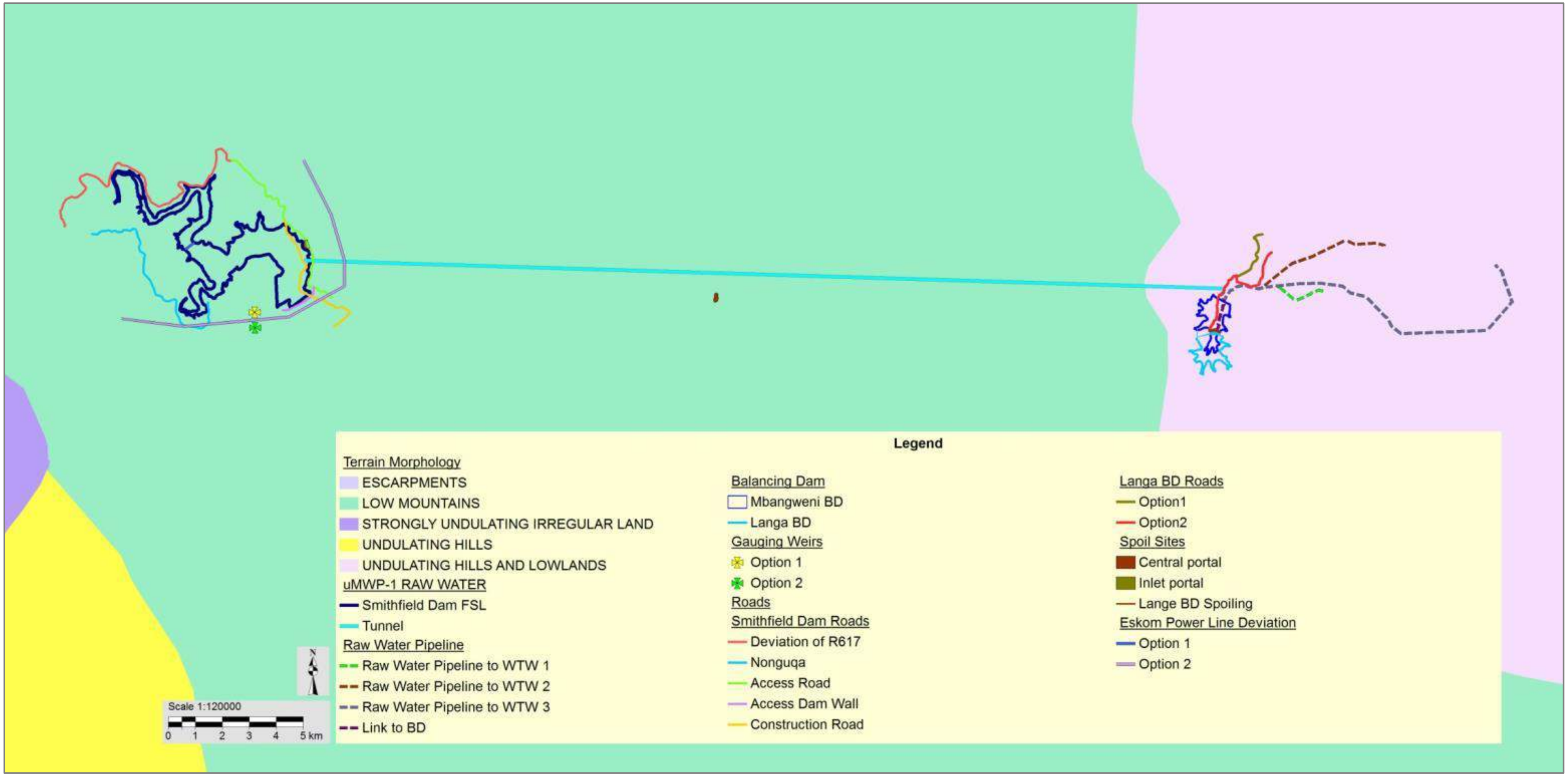


Figure 120: Terrain morphology

Figure 121: **20m Contours**

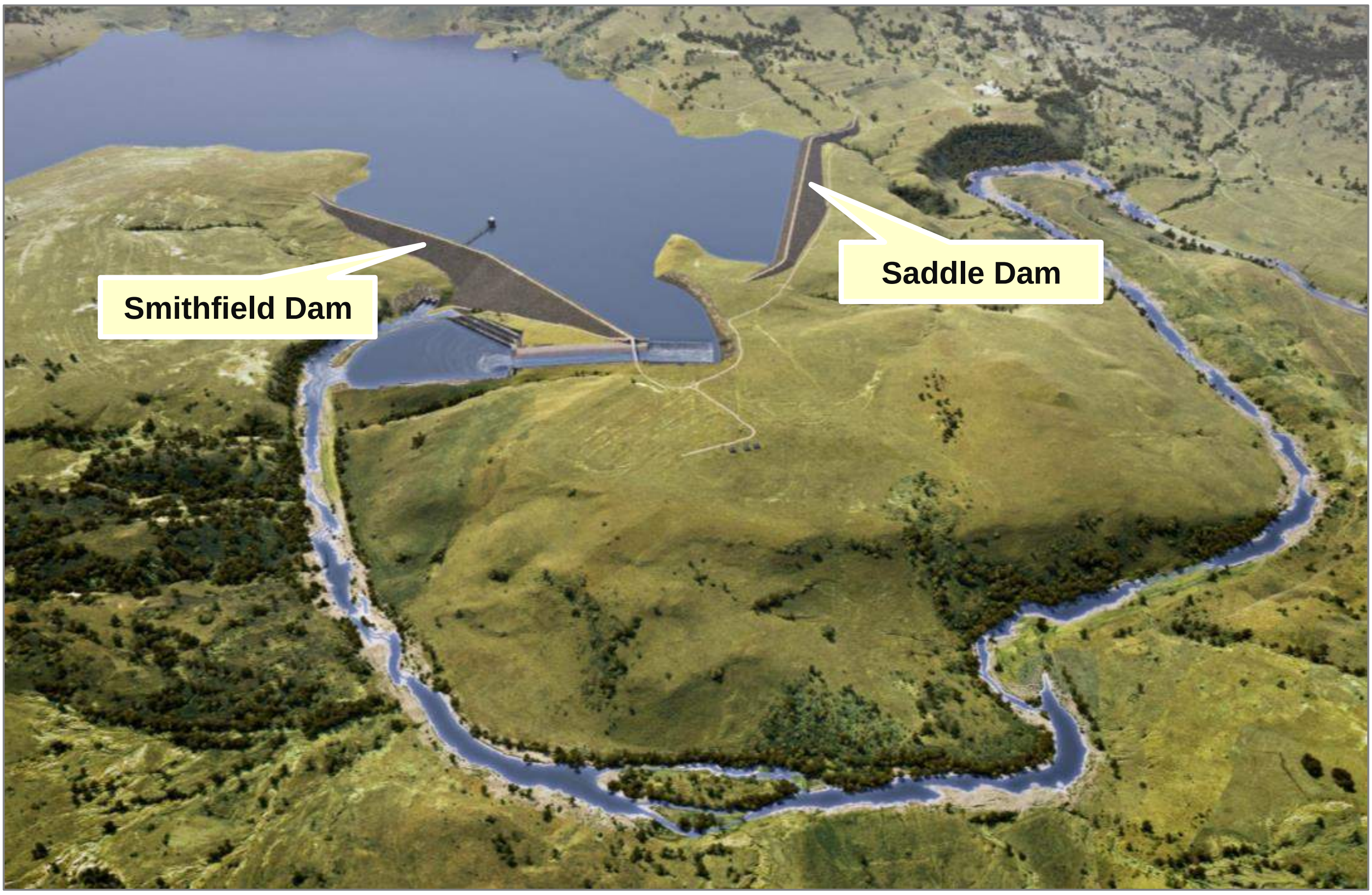


Figure 122: 3 Dimensional view of the proposed Smithfield Dam

Most of the tunnel traverses low mountainous areas. A longitudinal section of tunnel Option A is contained in **Appendix G**. At its deepest point, the tunnel reaches a depth of in excess of 630 m.

10.8 Surface Water

10.8.1 Affected Rivers and Streams

The following rivers and streams are directly affected by the uMWP-1 Raw Water infrastructure (refer to **Figures 123 - 125**):

- Smithfield Dam will be located on the uMkhomazi River. Smithfield Dam will inundate a section of approximately 16 km of the uMkhomazi River and approximately 4 km of the Luhane River (tributary of the uMkhomazi River).
- The balancing dam will be located on the Mbangweni River (Mbangweni and Langa Balancing Dam options), which is a tributary of the uMlaza River.

- Options 2 and 3 for the power line deviation traverse non-perennial watercourses / drainage lines, and Option 1 crosses Smithfield Dam.
- All the proposed roads at Smithfield Dam traverse watercourses, and the deviation of the R617 also crosses the mainstem of the uMkhomazi River.
- Borrow areas A and B as well as quarries I and IV affect non-perennial watercourses / drainage lines. Although these sites are located within the basin of Smithfield Dam and will eventually be inundated, during the construction phase appropriate measures will need to be put into place to divert flows and manage impacts to these watercourses and the downstream aquatic environment. The same applies to the quarry and borrow area at the Langa Balancing Dam.
- Waste Disposal Sites (tunnel inlet and central portals) encroach on drainage lines.
- All three the alternative raw water pipeline routes traverse watercourses.
- The access road options for the balancing dam traverse various watercourses.
- The alternative gauging weir sites are instream structures in the uMkhomazi River. The access road to the gauging weir may also cross watercourses.

10.8.2 Hydrology

The uMkhomazi River is one of the nine major rivers in KZN, and its catchment drains an area of 4 387 km^2. The Great Escarpment around Sani Pass forms the headwaters of the uMkhomazi, and it exits into the Indian Ocean at Umkomaas.

The uMkhomazi River catchment is defined as the secondary catchment U1 that falls within the Mvoti to Umzimkulu WMA. Within the secondary catchment U1, there are 12 quaternary catchments, namely U10A – U10M (see **Figure 126**). The Smithfield Dam basin falls within U10E and U10F quaternary catchments.

The physical characteristics of the defined catchment for the proposed Smithfield Dam are summarised in **Table 53**.

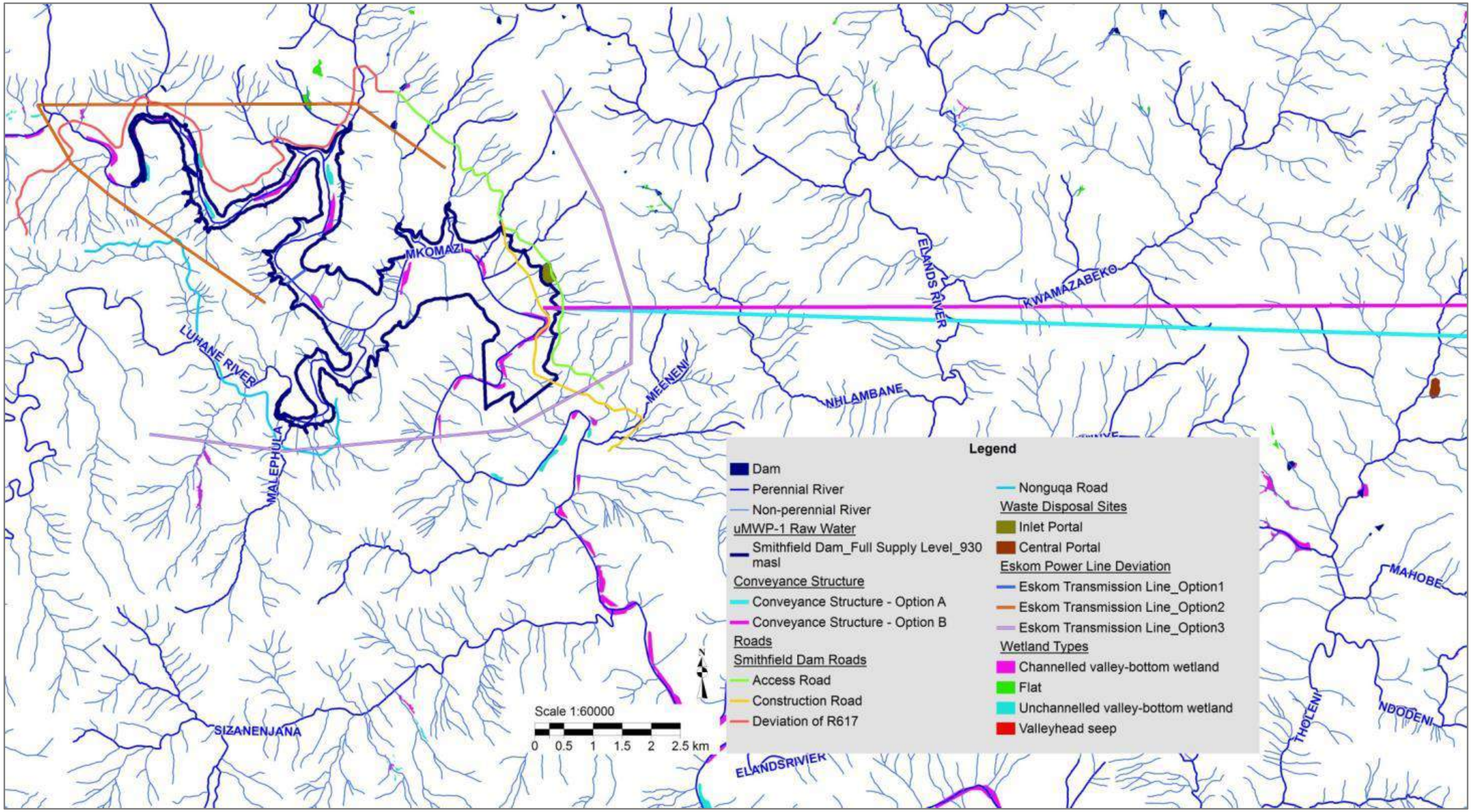


Figure 123: Watercourses - western part of study area

(Note: disregard reference to “Conveyance Structure Option B” and “Eskom Transmission Line Option 2” in legend – these options were discarded after Scoping)

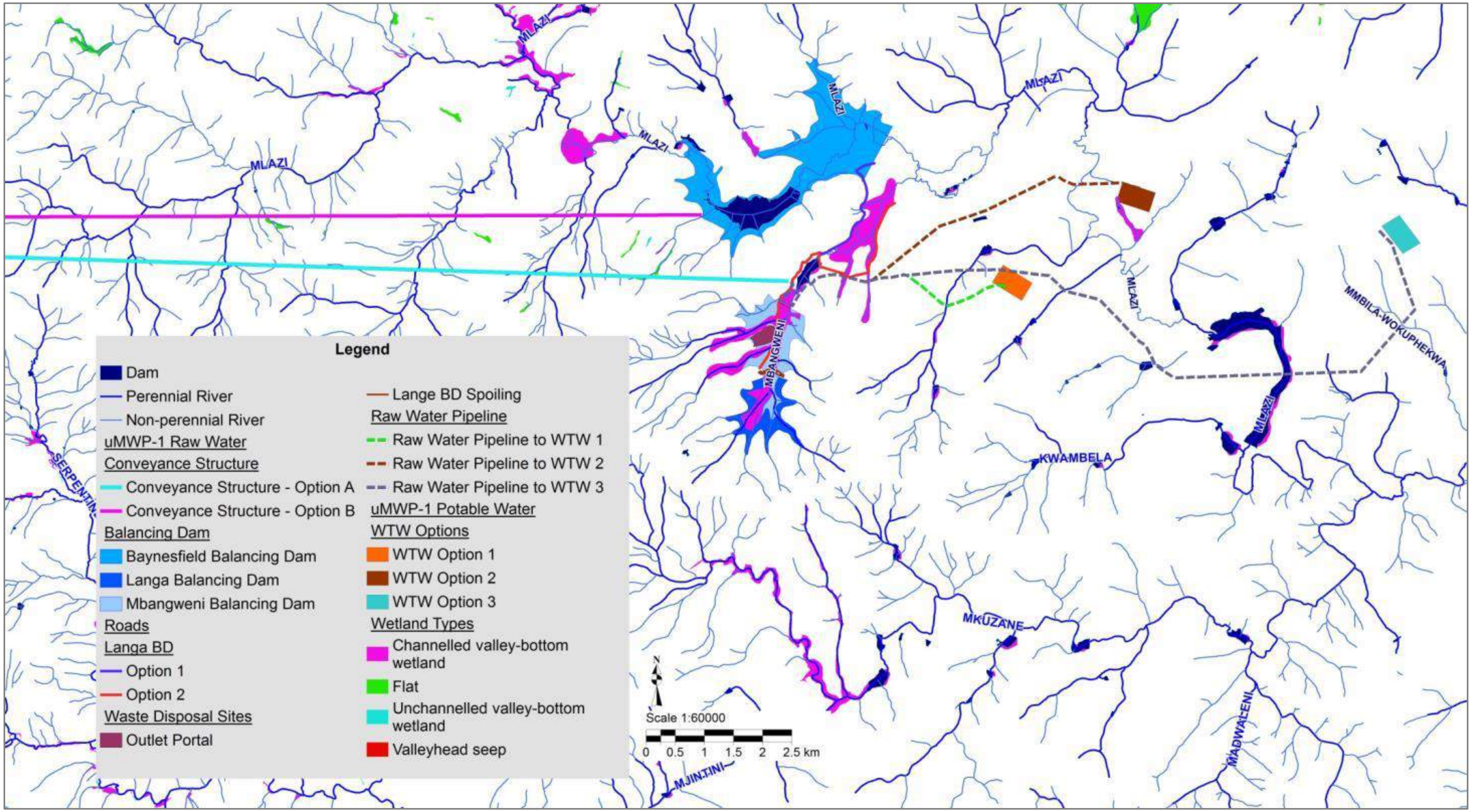


Figure 124: Watercourses - eastern part of study area

(Note: disregard reference to "Conveyance Structure Option B" and "Baynesfield Balancing Dam" in legend – these options were discarded after Scoping)

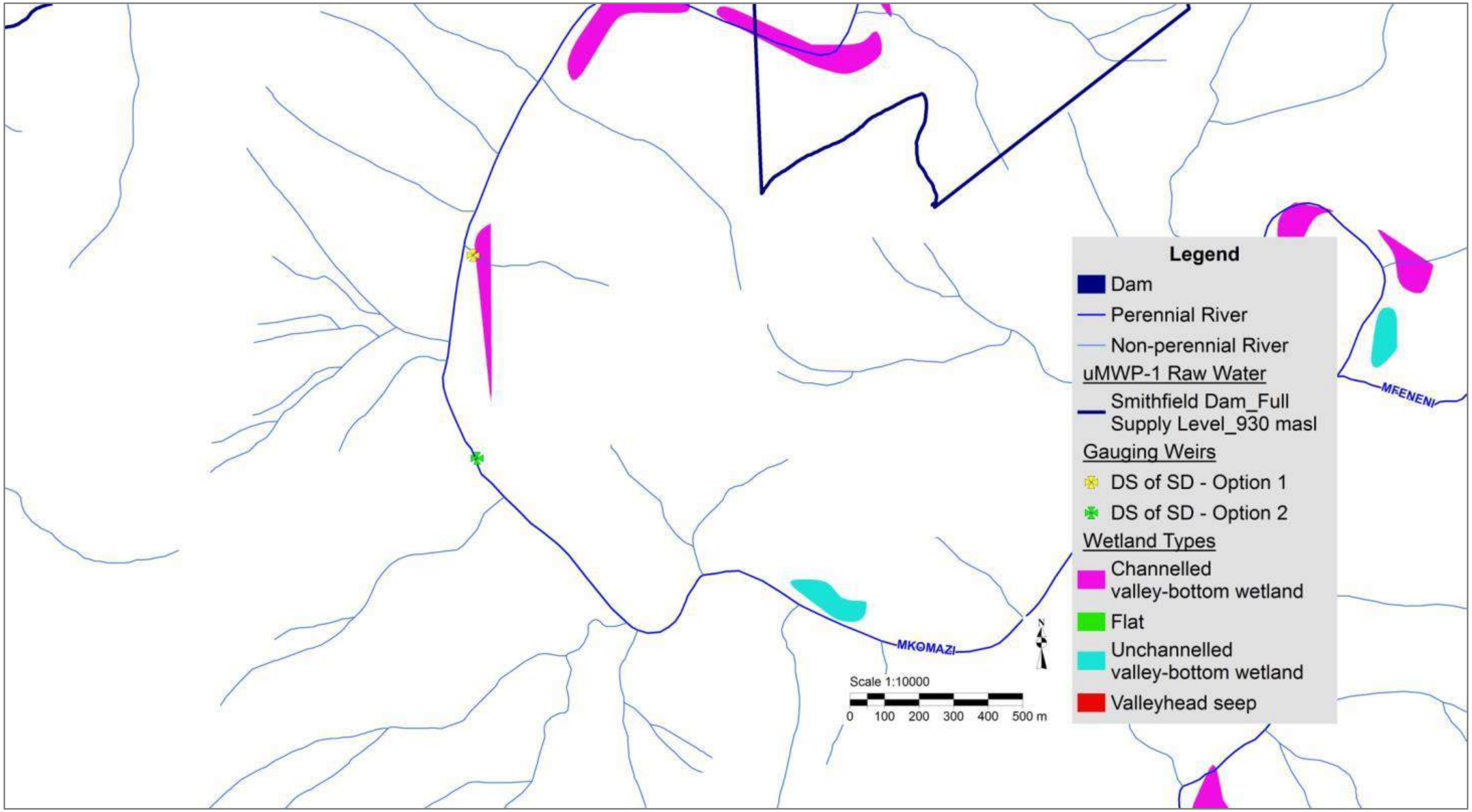


Figure 125: Watercourses – Gauging Weir Downstream of Smithfield Dam

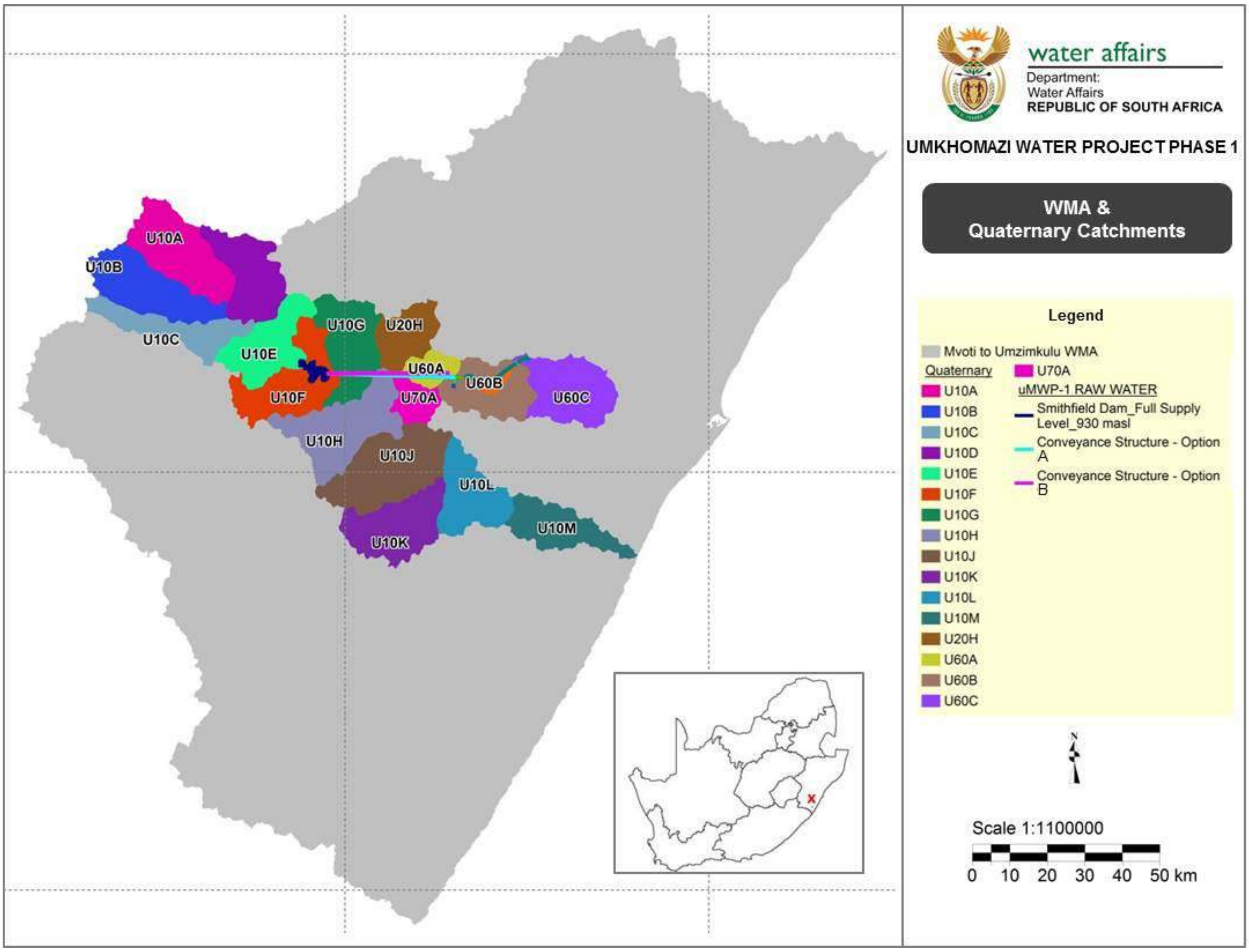


Figure 126: WMA & Quaternary Catchments

(Note: disregard reference to "Conveyance Structure Option B" – this option was discarded after Scoping)

Table 53: Catchment characteristics (DWA, 2013b)

Item	Smithfield Dam catchment
Size of catchment (km^2)	2 058
Longest watercourse (km)	120,3
Average watercourse slope (%)[1]	0,61
Average catchment slope (%)	29
Mean annual precipitation (mm)	1,050
Total stream length (m)	379 528
River density (m/km^2)	184,42

No major existing dams are located in the uMkhomazi River catchment. The closest large dams are the Midmar, Albert Falls, Nagle and Inanda Dams on the uMgeni

River, Wagendrift Dam on the Bushmans River, Craigie Burn Dam on the Mnyamvubu River, Henley Dam on the uMzunduze River, Shongweni Dam on the uMlaza River, Spring Grove Dam on the Mooi River, and Kilburn, Woodstock and Spioenkop Dams on the Tugela River System.

The uMlaza River (also known as the Mlazi or uMlaza River) is also situated in the Mvoti to Umzimkulu WMA. The study area relevant to the Feasibility Study's hydrological analyses for the uMlaza River is quaternary catchments U60A and U60B.

A hydrological assessment was undertaken of the uMkhomazi and upper uMlaza River catchments as part of the uMWP-1 Feasibility Study (DWA, 2013c). There are three important stream flow gauging stations on the uMkhomazi River, namely U1H005 at Camden, U1H006 at Delos Estate (now closed) and U1H009 at Shozi, the latter two being close to the outlet of the river at the town of Umkomaas. In the upper uMlaza River catchment the available gauges are U6H002 at Nooitgedacht and U6H003 at Umlaas. A summary of the results of the hydrological analysis is provided in **Figure 127** and a breakdown of the final adopted hydro-meteorological characteristics of the uMkhomazi and upper uMlaza River catchments is contained in **Table 54**.

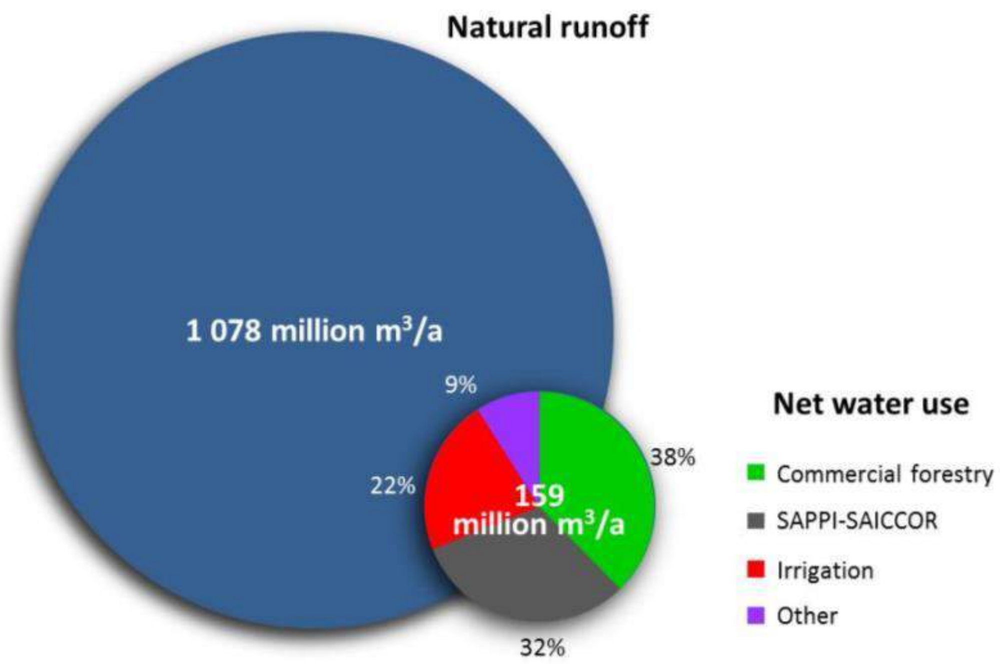


Figure 127: Summary of results of hydrological analysis (DWA, 2013c)

Table 54: Hydro-meteorological characteristics of the uMkhomazi and upper uMlaza river catchments (DWA, 2013c)

Quaternary catchment	Incremental catchment area (km^2)	MAP(1) (mm)	MAE(2) (mm)	Incremental natural MAR(3)		
				(million m^3/a)	(mm/a)	(% MAP)
uMkhomazi River Catchment						
U10A	418	1 287	1 300	209.52	501	39%
U10B	392	1 176	1 300	164.49	420	36%
U10C	267	1 091	1 300	96.70	362	33%
U10D	337	999	1 300	98.22	291	29%
U10E	327	1 034	1 300	100.92	309	30%
U10F	379	963	1 300	67.08	177	18%
U10G	353	981	1 250	70.12	199	20%
U10H	458	924	1 200	82.66	180	20%
U10J	505	878	1 200	77.99	154	18%
U10K	364	793	1 200	40.42	111	14%
U10L	307	758	1 200	29.56	96	13%
U10M	280	858	1 200	40.06	143	17%
Totals:	**4 387**	**981**	**1 252**	**1 077.74**	**246**	**25%**
Upper uMlaza River catchment						
U60A	105	981	1 200	22.65	216	22%
U60B	316	822	1 200	-(4)	-	-
Totals:	**421**	**862**	**1 200**	-	-	-

Note: *(1) Mean annual precipitation.*
(2) Mean annual evaporation (Symons-pan).
(3) Mean annual runoff, calculated over an 84-year period from 1925 to 2008 (hydrological years).
(4) Catchment not included in this analysis.

10.8.3 Water Use

Irrigation developments in the uMkhomazi River catchment are fairly small, with a total estimated irrigated crop area of only 60 km^2. The annual irrigation water requirement is around 38 million m^3 which accounts for 23% of all current in-catchment water use. Approximately 60 % of irrigation is supplied from run-of-river schemes while the remainder is supplied from small storage dams. Irrigation from groundwater sources is negligible. The predominant irrigated crops in the catchment are pastures and rye grass for the dairy industry, while small areas of sugarcane and vegetables are irrigated particularly in the lower portion of the catchment.

Irrigation is fairly extensive in the upper uMlaza catchment, with a total crop area of almost 40 km^2 and an estimated annual water use of 23 million m^3 – the majority of which is supplied from run-of-river schemes. Irrigated crops include primarily sugarcane and vegetables.

The Sappi Saiccor Mill is a major producer of chemical cellulose (dissolving pulp) and the largest single water user within the uMkhomazi River catchment. The mill is currently licensed to abstract a total of 53 million m^3/a directly from the uMkhomazi River upstream of the river mouth.

Livestock farming has been one of the most important agricultural activities in the southern KZN region for over 100 years and it is estimated that annual currently almost 3 million m^3 is used annually for stock watering in the uMkhomazi and upper uMlaza river catchments.

Commercial forestry is currently the largest water user in the study area. Plantations, including pine, eucalyptus and wattle species, occur mainly in the central areas of the uMkhomazi River catchment, particularly in quaternary catchments U10E to U10K around the towns of Richmond, Ixopo, Bulwer and Impendle. The total area under commercial forestry in the uMkhomazi and upper uMlaza catchments is estimated at almost 700 km^2, with an associated water use of almost 70 million m^3/a – 35% of all current in-catchment water use.

Some dry-land sugarcane occurs in the lower portion of the uMkhomazi River catchment, particularly in quaternary catchments U10K and U10L. However, with a total estimated total area of only 26 km^2 (compared to the 600 km^2 of commercial forestry) and an associated water use of under 2 million m^3/a, dry-land sugarcane is not a major water user in the uMkhomazi River catchment. However, the extent of dry-land sugarcane in the upper uMlaza River catchment is significant – particularly in quaternary catchment U60B, with a total area of 76 km^2 and estimated annual water use of almost 5 million m^3.
Alien plant infestation in the uMkhomazi and upper uMlaza river catchments is considerable and cover an area of 47 km^2 – almost half the extent of dry-land sugarcane. The impact of alien invasive plants (AIPs) on the water resources of the catchments is, however, small, with an associated annual water use of under 7 million m^3.

The water use estimates for the study area are summarised in the table to follow (refer to **Figures 128 - 129**). Apart from the users listed in **Table 55**, the uMkhomazi River is also used for recreational purposes. The river is particularly favoured for canoeing and it hosts the popular Umkomaas Canoe Marathon.

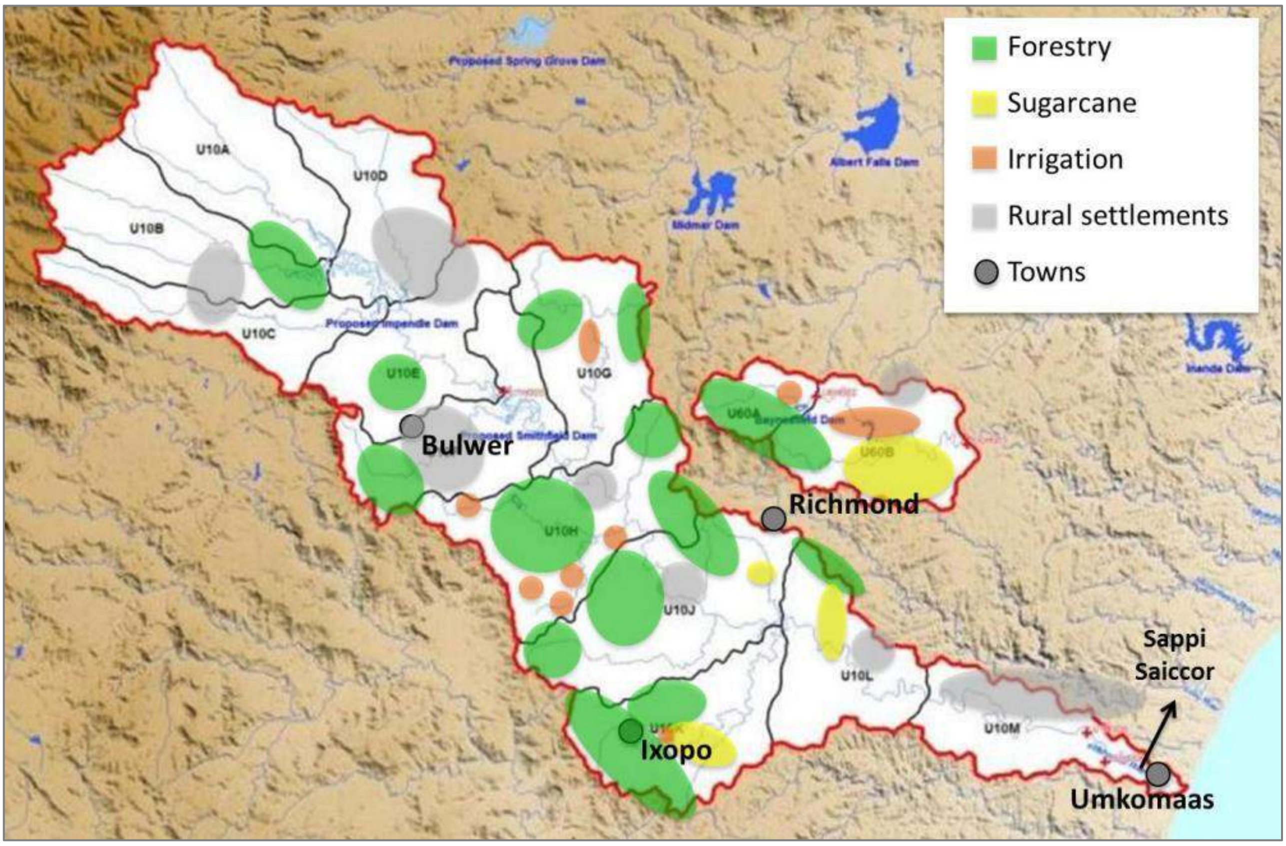


Figure 128: Major land use in relevant uMWP-1 catchments

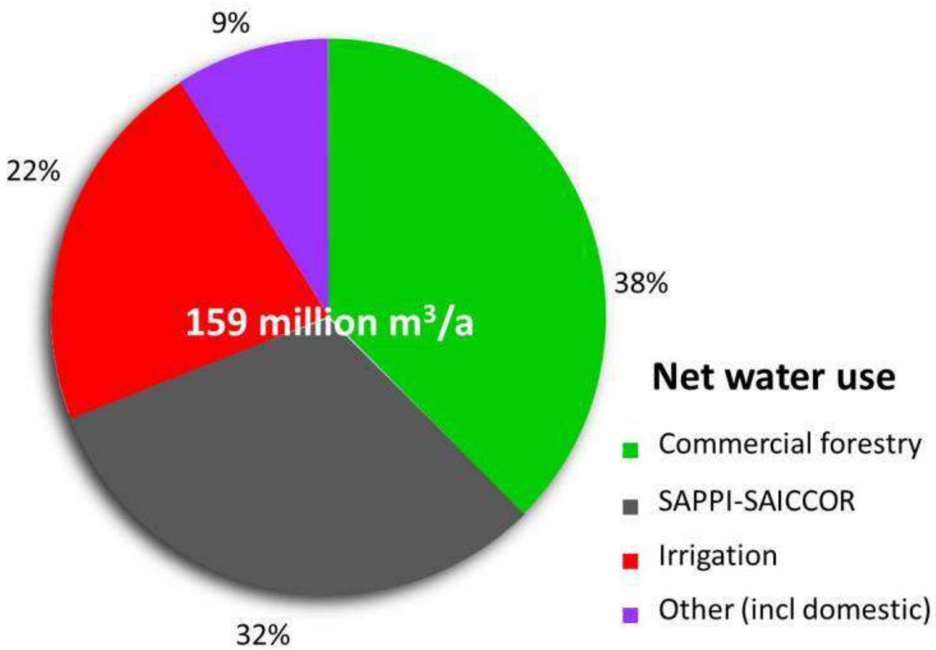


Figure 129: Net Water Use in the uMkhomazi Catchment

Table 55: Summary of final water use estimates adopted for this study, at the 2008-development level (DWA, 2013c)

Quaternary catchment	Water use[1] (million m^3/a)										
	Irrigation, from indicated source			Commercial forestry	Dry-land sugarcane	Invasive alien plants	Stock watering	Urban and rural use, from indicated source[2]		Industrial users	Totals
	Dams	Run-of-river	Ground-water[3]					Surface water	Ground water[3]		
U10A	0.00	0.00	0.00	0.88	0.00	0.38	0.36	0.03	0.04	0.00	**1.68**
U10B	0.00	0.00	0.00	4.26	0.00	1.46	0.10[5]	0.04	0.05	0.00	**5.91**
U10C	0.47	1.23	0.00	3.29	0.00	0.81	0.02[5]	0.04	0.05	0.00	**5.91**
U10D	1.12	0.00	0.00	0.42	0.00	0.87	0.29	0.13	0.14	0.00	**2.97**
U10E	0.00	0.00[4]	0.00	4.82	0.00	0.66	0.23[5]	0.50	0.55	0.00	**6.76**
U10F	0.00[4]	0.59	0.00	4.70	0.00	0.32	0.26	0.16	0.41	0.00	**6.44**
U10G	2.96	3.91	0.00	5.55	0.00	0.36	0.27	0.01	0.13	0.00	**13.20**
U10H	5.70	6.92	0.00	14.35	0.04	0.41	0.22[5]	0.08	0.31	0.00	**28.03**
U10J	1.83	6.88	0.02	13.35	0.00	0.42	0.30	0.17	0.13	0.00	**23.10**
U10K	2.52	3.40	0.13	6.74	0.79	0.35	0.41	0.48	0.19	0.00	**15.01**
U10L	0.00	0.17	0.06	1.24	0.75	0.15	0.19[5]	0.05	0.16	0.00	**2.77**
U10M	0.00	0.00[4]	0.00	0.12	0.06	0.18	0.00[5]	0.10	0.01	53.00[6]	**53.46**
Totals:	**14.60**	**23.10**	**0.20**	**59.71**	**1.64**	**6.37**	**2.66**	**1.78**	**2.18**	**53.00**	**165.24**
U60A	0.00[4]	0.69	0.00	4.75	0.25	0.07	0.01[5]	0.00	0.11	0.00	**5.89**
U60B	5.93	15.41	1.03	3.77	4.87	0.23	0.03[5]	0.71	0.23	0.00	**32.21**
Totals:	**5.93**	**16.10**	**1.03**	**8.52**	**5.13**	**0.30**	**0.04**	**0.71**	**0.34**	**0.00**	**38.10**

Note: (1) Modelled average based on an analysis over the 1925 to 2008 period (hydrological), at a constant development level as indicated.
(2) Final estimates of domestic water use, but not used in the hydrological analysis (as discussed above).
(3) The impact on surface water of irrigation and domestic users supplied from groundwater is insignificant and was not accounted for in the hydrological analysis.
(4) Irrigation requirement not modelled because total irrigated area in quaternary catchment supplied from specific source is less than 0.25 km^2.
(5) Stock watering not modelled in quaternary catchments where the requirement is less than 0.25 million m^3/a.
(6) Licenced water use by SAPPI-SAICCOR.

Especially in the Traditional Authority areas, people use the run of the river for drinking, cooking, livestock watering, irrigation, building, washing, recreation and religious purposes.

10.8.4 Ecological Status

10.8.4.1 National Freshwater Ecosystem Priority Areas

The uMkhomazi is one of 62 rivers in South Africa which are free-flowing (Nel *et al*., 2011). A free-flowing river is a large river that has not been dammed and it flows undisturbed from its source to the confluence with another large river or to the sea. According to Nel *et al.* (2011), it is acknowledged that not all of the free-flowing rivers will remain as such due to development needs and thus only 19 rivers have been identified as flagship free-flowing rivers, which does not include the uMkhomazi River.

The conservation status of the rivers in the study area, as defined by the National Freshwater Ecosystem Priority Areas (FEPA) assessment, is provided in **Figure 130**. FEPA rivers, wetlands and estuaries need to stay in a good condition in order to conserve freshwater ecosystems and protect water resources for human use (Nel *et al*, 2011). The current and recommended condition for all river FEPAs is A (unmodified, natural) or B (largely natural) ecological category. The following is noted with regards to the FEPA river map (note that wetlands and estuaries as discussed separately):

- The entire section of the uMkhomazi River that will be inundated by Smithfield Dam is classified as a FEPA;
- The section of the Luhane River that will be inundated by Smithfield Dam is classified as a fish support area;
- The reaches of the uMkhomazi and Luhane Rivers inundated by Smithfield Dam are regarded as fish sanctuaries;
- The alternative gauging weir sites are located in river FEPAs; and
- There are no FEPA rivers in the area earmarked for the raw water pipeline and balancing dam options.

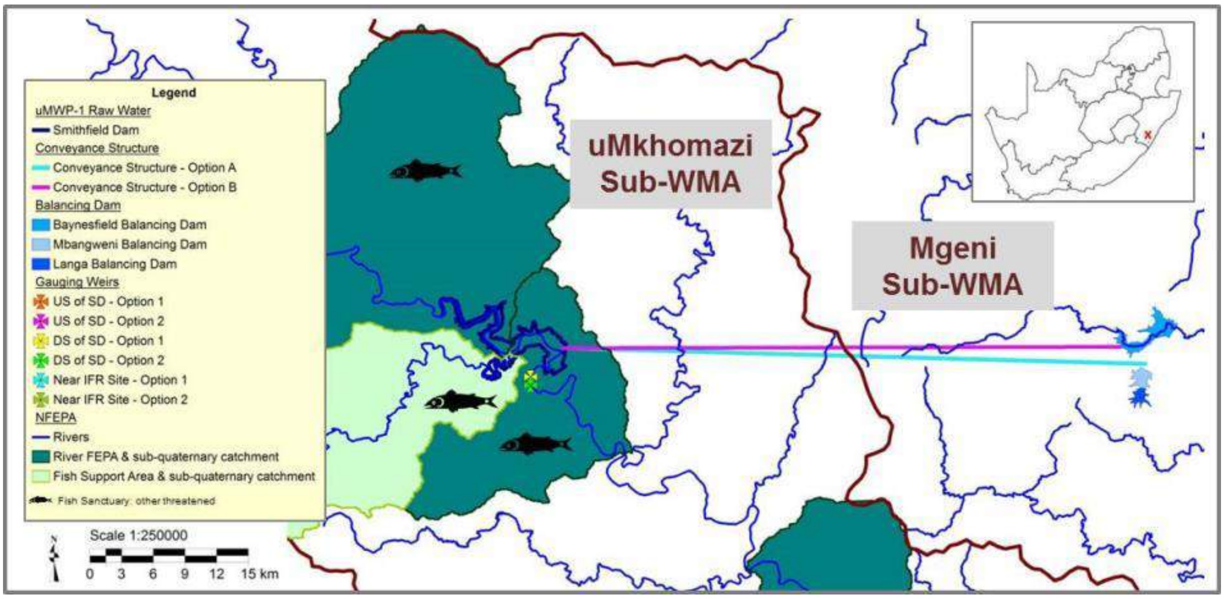


Figure 130: River FEPA information related to project footprint

(Note: disregard reference to "Conveyance Structure Option B" – this option was discarded after Scoping)

10.8.4.2 Reserve Determination

General

The Chief Directorate: Resource Directed Measures of DWS initiated a study during 2012 to undertake the Comprehensive Reserve, classify all significant water resources and determine the Resource Quality Objectives (RQOs) in the Mvoti to Umzimkulu WMA.

Box 1:	What is the "Reserve"?

The **Reserve** is central to water resource management and enjoys priority of use according to the National Water Act (No. 36 of 1998). The Reserve relates to the quantity and quality of water required to satisfy the following two elements:

- The **Basic Human Needs Reserve**, which provides for essential needs of individuals; and
- The **Ecological Reserve**, which relates to the water required to protect the functional integrity of aquatic ecosystems.

Present Ecological State per Sub Quaternary

A Status Quo Report was prepared as part of the aforementioned study, where the objective was to define the current status of the water resources in the study area in terms of the water resource systems, the ecological characteristics, the socio-economic conditions and the community well-being. **Table 56** shows the Present Ecological State (PES) per Sub Quaternary (SQ) river reaches that have bearing on uMWP-1.

Table 56: uMkhomazi & uMlaza Rivers PES and key drivers resulting in modification from natural (DWA, 2013a)

SQ number	River	River PES (EC)	Key PES Driver
U10E-04380	uMkhomazi	**C**	Non-flow: Sedimentation, overgrazing, erosion
U10F-04528	uMkhomazi	**B/C**	Non-flow: Sedimentation, riparian zone, erosion
U60A-04533	uMlaza	C	Non flow[1]: Forestry, water quality, agriculture lands. Flow[2]: Instream dams – irrigation

All SQs within the Middle uMkhomazi zone (including the U10E, F and G quaternary catchments) have a C PES, and all occur within the grassland biome. The uMkhomazi River is dominated by non-flow related impacts (mainly forestry and rural settlements with informal agriculture).

In the Upper uMlaza zone, which includes the area designated for the balancing dam, the SQ has a C PES. Predominant impacts are non-flow related (forestry, agricultural activities, alien invasive vegetation and water quality).

EWR

An extract from the Determination of Water Resource Classes – River Ecological Consequences of Operational Scenarios (DWS, 2014a), which formed part of the Comprehensive Reserve determination, follows.

The details of the EWR sites that were selected as part of the Reserve Determination for the uMkhomazi River are provided in **Table 57** and shown in **Figure 131**.

Table 57: EWR Sites on the uMkhomazi River (DWS, 2014a)

EWR site name	SQ[1]	River	Latitude	Longitude	MRU[2]	Quat[3]
Mk_I_EWR1	*U10E-04380*	*Mkomazi*	*-29.74338*	*29.91165*	*MRU Mkomazi B*	*U20F*
Mk_I_EWR2	*U10J-04679*	*Mkomazi*	*-29.921*	*30.08448*	*MRU Mkomazi C*	*U20J*
Mk_I_EWR3	*U10M-04746*	*Mkomazi*	*-30.132*	*30.66245*	*MRU Mkomazi D*	*U10M*

1: Sub Quaternary reach; 2: Management Resource Unit; 3: Quaternary catchment

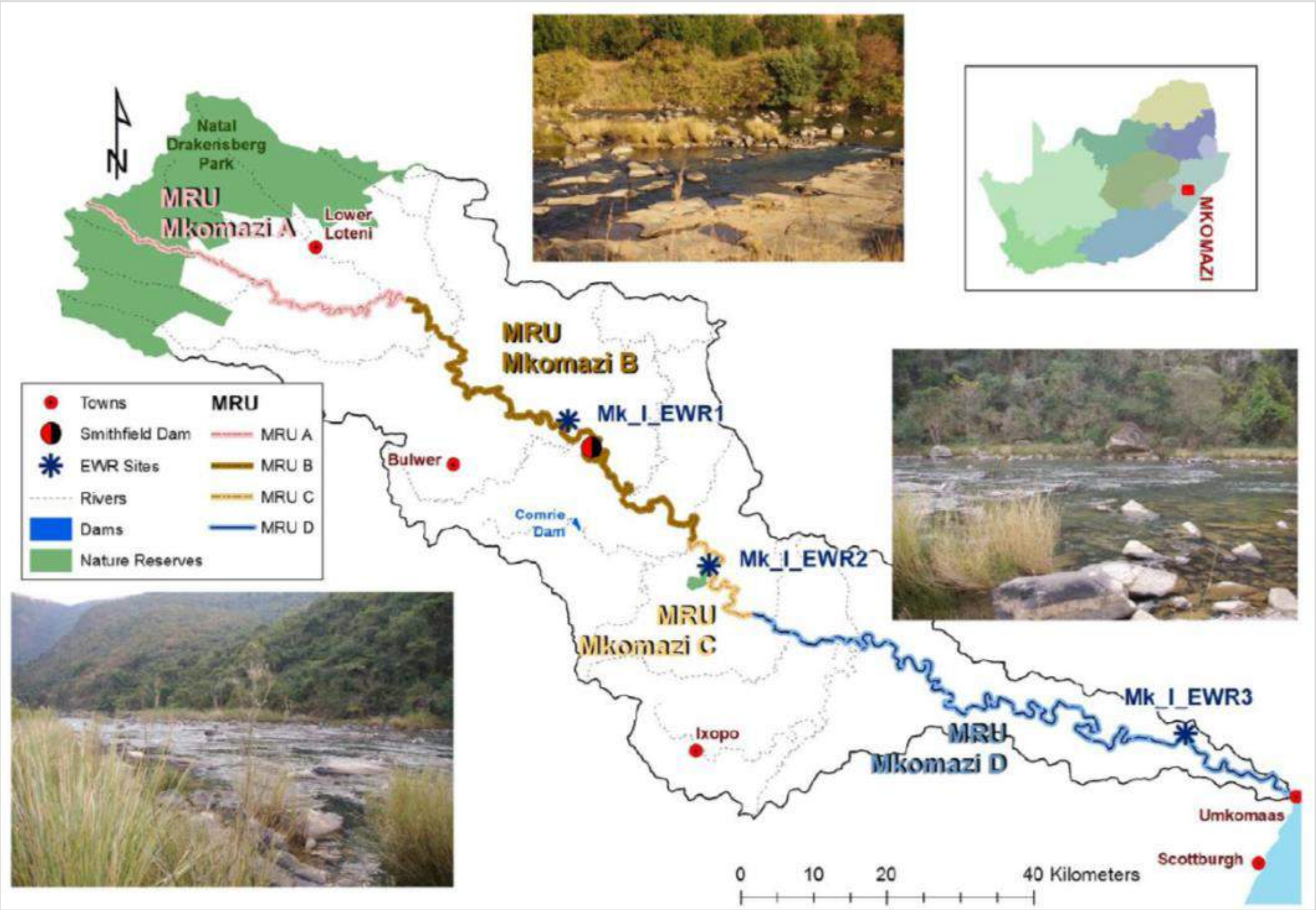


Figure 131: EWR sites on the uMkhomazi River (DWS, 2014a)

A summary of the Present Ecological State (PES) results for the various EWR sites is provided in **Table 58**.

Table 58: Summary of the EcoClassification results of the EWR sites (DWS, 2014a)

Component	uMkhomazi River		
	EWR1	EWR2	EWR3
Physico chemical	A/B	A/B	A/B
Geomorphology	A/B	B	B
Fish	B	B	B
Macro-invertebrates	B/C	B	B
Riparian vegetation	C	B	D
EcoStatus	**C**	**B**	**C**
Ecological Importance and Sensitiy (EIS)	**Moderate**	**High**	**Moderate**

The impacts of operational scenarios to the EWR are discussed in **Section 12.6.5**.

10.8.4.3 Aquatic Biota

Fish species recorded in the uMkhomazi River Catchment were obtained from EKZNW in March 2012. These species are listed in **Table 59** with a Red Data Categorisation in terms of the International Union for Conservation of Nature and Natural Resources.

Table 59: Fish species in the uMkhomazi River Catchment (Karssing, 2012)

Taxon name	English name	Locality
Endangered (En)		
Pseudobarbus quathlambae	Maloti minnow	Sani Top, presence in uMkhomazi not confirmed
Data Deficient (DD)		
Platycephalus indicus	Bartail flathead	uMkhomazi Estuary
Near Threatened (NT)		
Favonigobius reichei	Tropical sand goby	uMkhomazi estuary
Oreochromis mossambicus	Mozambique tilapia	uMkhomazi River and Estuary, Lufafa River, Umhlanga Lagoon Nature Reserve
Taenioides jacksoni	Bearded eel goby	uMkhomazi estuary
Least Concerned (LC)		
Ambassis ambassis	Longspine glassy	uMkhomazi Estuary
Ambassis gymnocephalus	Bald glassy	Umhlanga Lagoon Nature Reserve
Ambassis productus	Longspine glassy	uMkhomazi Estuary
Amphilius natalensis	Natal mountain catfish	Gqunu, KuZinkwana, uMkhomazi, Elands and NZinga Rivers
Anguilla bengalensis labiata	African mottled eel	Mzinhlanga river
Barbus anoplus	Chubbyhead barb	Lurane, KuZinkwana, Elands, uMkhomazana, Nzinga Rivers
Barbus viviparus	Bowstripe barb	uMkhomazi River
Caranx sexfasciatus	Bigeye kingfish	Umhlanga Lagoon Nature Reserve and uMkhomazi Estuary
Croilia mossambica	Burrowing goby	uMkhomazi estuary
Eleotris fusca	Dusky sleeper	uMkhomazi estuary

Taxon name	English name	Locality
Glossogobius callidus	River goby	uMkhomazi Estuary
Hippichthys heptagonus	Belly pipefish	uMkhomazi Estuary
Labeobarbus natalensis	KwaZulu-Natal yellowfish	Good Hope Dam, Nhlavini, Xobho, uMkhomazi, Lufafa, Gqunu, Masikelenjane, Mzinhlanga, KuZinkwana Rivers
Mugil cephalus	Flathead mullet	Umhlanga Lagoon Nature Reserve and uMkhomazi Estuary
Myxus capensis	Freshwater mullet	uMkhomazi River and Estuary
Redigobius dewaali	Checked goby	uMkhomazi Estuary
Not Evaluated (NE)		
Acanthopagrus berda	Riverbream	uMkhomazi estuary
Ambassis natalensis	Slender glassy	uMkhomazi Estuary
Amblyrhynchotes honckenii	Evileye blaasop	uMkhomazi Estuary
Anguilla mossambica	Longfin eel	uMkhomazi, Nhlavini, Lufafa, Gqunu, Xobho and Mzinhlanga Rivers and Good Hope Dam
Argyrosomus hololepidotus	Southern meagre	uMkhomazi Estuary
Arothron immaculatus	Blackedged blaasop; Blackedged puffer	uMkhomazi Estuary
Awaous aeneofuscus	Freshwater goby	uMkhomazi River
Bothus pantherinus	Leopard flounder	uMkhomazi Estuary
Caffrogobius natalensis	Baldy	uMkhomazi Estuary
Clarias gariepinus	Sharptooth catfish	Lufafa, Nhlavini, Mzinhlanga Rivers and uMkhomazi Estuary
Crenimugil crenilabis	Fringelip mullet	Umhlanga Lagoon Nature Reserve
Drepane punctata	Spotted sicklefish	uMkhomazi Estuary
Gerres filamentosus	Longspine pursemouth	uMkhomazi Estuary
Gerres methueni	Evenfin pursemouth	KwaZulu-Natal (RSA)
Gilchristella aestuaria	Estuarine round herring	Umhlanga Lagoon Nature Reserve and uMkhomazi Estuary
Glossogobius giuris	Tank goby	Umhlanga Lagoon Nature Reserve and uMkhomazi Estuary
Hypseleotris cyprinoides	Golden sleeper	uMkhomazi River SAICCOR weir
Leiognathus equulus	Slimy	Umhlanga Lagoon Nature Reserve and uMkhomazi Estuary
Liza alata	Diamond mullet	Umhlanga Lagoon Nature Reserve and uMkhomazi Estuary
Liza dumerilii	Groovy mullet	Umhlanga Lagoon Nature Reserve and uMkhomazi Estuary
Liza macrolepis	Large scale mullet	Umhlanga Lagoon Nature Reserve and uMkhomazi Estuary
Lobotes surinamensis	Tripletail	uMkhomazi Estuary
Lutjanus argentimaculatus	River snapper	KwaZulu-Natal (RSA)
Lutjanus fulviflamma	Dory snapper	KwaZulu-Natal (RSA)
Megalops cyprinoides	Oxeye tarpon	KwaZulu-Natal (RSA)
Monodactylus falciformis	Oval moony	Umhlanga Lagoon Nature Reserve and uMkhomazi Estuary
Oligolepis acutipennis	Sharptail goby	uMkhomazi Estuary
Periophthalmus sobrinus	Bigfin mudhopper	uMkhomazi estuary
Pomadasys commersonnii	Smallspotted grunter	Umhlanga Lagoon Nature Reserve and uMkhomazi Estuary
Pomadasys hasta		uMkhomazi Estuary
Pomadasys maculatus	Saddle grunt	uMkhomazi Estuary
Pomadasys multimaculatum	Cock grunter	uMkhomazi Estuary
Psammogobius knysnaensis	Speckled sandgoby	uMkhomazi Estuary
Rhabdosargus holubi	Cape stumpnose	Umhlanga Lagoon Nature Reserve and uMkhomazi Estuary
Rhabdosargus sarba	Natal stumpnose	Umhlanga Lagoon Nature Reserve and uMkhomazi Estuary
Scomberoides commersonianus	Talang queenfish	uMkhomazi Estuary
Secutor insidiator	Slender soapy	uMkhomazi Estuary
Solea bleekeri	Blackhand sole	Umhlanga Lagoon Nature Reserve and uMkhomazi Estuary
Stolephorus commersonii	Commerson's anchory	uMkhomazi Estuary
Terapon jarbua	Thornfish	Umhlanga Lagoon Nature Reserve and uMkhomazi Estuary
Valamugil buchanani	Bluetail mullet	uMkhomazi Estuary
Valamugil cunnesius	Longarm mullet	Umhlanga Lagoon Nature Reserve and uMkhomazi Estuary
Alien Invasive Species (AIS)		
Cyprinus carpio	Carp	Home Farm Dam
Lepomis macrochirus	Bluegill sunfish	Xobho and Ngudwini Rivers
Micropterus salmoides		Good Hope Dam, Ngudwini and Mzinhlanga Rivers
Salmo trutta	Brown trout	uMkhomazi River, Lotheni Nature Reserve
No Category		
Anguilla sp.		uMkhomazi River Mouth
Barbus natalensis	Scaly	uMkhomazi Estuary

Taxon name	English name	Locality
Gerres acinaces	Smallscale pursemouth	uMkhomazi Estuary
Glossogobius sp.		uMkhomazi estuary
Johnius belangerii	Belanger's croaker	uMkhomazi Estuary

**AIS: Alien Invasive Species; DD: Data Deficient; En: Endangered; NE: Not Evaluated; NT: Near Threatened*

Sensitive fish species include *Labeobarbus natalensis*, classified as "Least Concern", which has been recorded at the proposed Smithfield Dam and in the areas between the proposed Smithfield and existing Baynesfield Dams. Also recorded between the proposed Smithfield is *Anguilla mossambica*, which is not evaluated by IUCN but still considered to be of local importance, along with the alien invasive species *Micropterus salmoides. Barbus anoplus* and *Amphillius natalensis,* both classified as "Least Concern", were recorded at both the existing Baynesfield Dam and the proposed Smithfield Dam area. Of specific concern with fish species is the presence of species such as *Myxus capensis* (freshwater mullet) which is catadromous, meaning that they live in fresh water but breed in the sea. Catadromous species are particularly sensitive to the impoundment of rivers. However, none of these species were recorded close to the proposed dam basin, with the only representatives of these species recorded in the lower reaches of the river catchment (DWA, 2012b).

As mentioned, the IFR were determined for the uMkhomazi River as part of the Pre-feasibility Study. Some of the key findings with regards to the aquatic biota follow (DWAF, 1999e):

- **Fish** –
  - The uMkhomazi River supports a moderate diversity of fish species, with many of these being limited to the lower reaches near the coast where the impact of a dam in the middle reaches would probably be minimal. *Amphilius natalensis* is the only riffle-dependent species present, but riffle habitats are likely to remain available even if river flows become reduced. The impact of a dam on the migrations of scaly, sharptooth catfish and eels could be considerable and therefore the provision of a fishway, or at least an eelway, is considered essential. The release of summer spate flows from the dam would probably stimulate successful breeding by the flood-dependent species.

- **<u>Aquatic invertebrates</u>** –
  - The uMkhomazi shows an exceptional diversity of aquatic insects dominated by hydropneustic groups. Both rivers are swift flowing with mostly stony reaches and there are diverse communities of filter feeding Hydropsychidae and Simuliidae as well as Elmidae and baetid mayflies. This rich diversity of species with low numbers of individuals for each species indicates a healthy, rich heterogeneous environment with a wide range of ecological conditions, which has also ensured that pest species have not become abundant and problematic in the uMkhomazi River.

The conservation status of the rivers in the study area, as defined in terms of NFEPA, is discussed in **Section 12.7.3**.

10.8.4.4 Aquatic Impact Assessment

An Aquatic Impact Assessment was conducted (see **Appendix H2**) for the project. Refer to **Sections 11.1.2** and **12.6.6** for a synopsis of the study and a related impact assessment, respectively.

10.8.4.5 Aquatic Critical Biodiversity Areas

Critical Biodiversity Areas (CBAs) are natural or near natural landscapes that are considered critical for meeting biodiversity targets and thresholds, and which safeguard areas required for the persistence of viable populations of species and the functionality of ecosystems.

Based on the Biodiversity Sector Plan Maps for both Harry Gwala DM and uMgungundlovu DM (see **Figures 144** and **145**, respectively), the project does not fall within Aquatic CBAs.

10.8.5 <u>Water Quality</u>

As part of the initial Environmental Screening for uMWP-1 (DWA, 2012b), water quality data was obtained from the DWS monitoring station MS 102619 (see **Figure 132**), which is located just upstream of the proposed Smithfield Dam where frequent sampling is done. The table to follow presents the data for this station compared to the DWS domestic standards (DWAF, 1996).

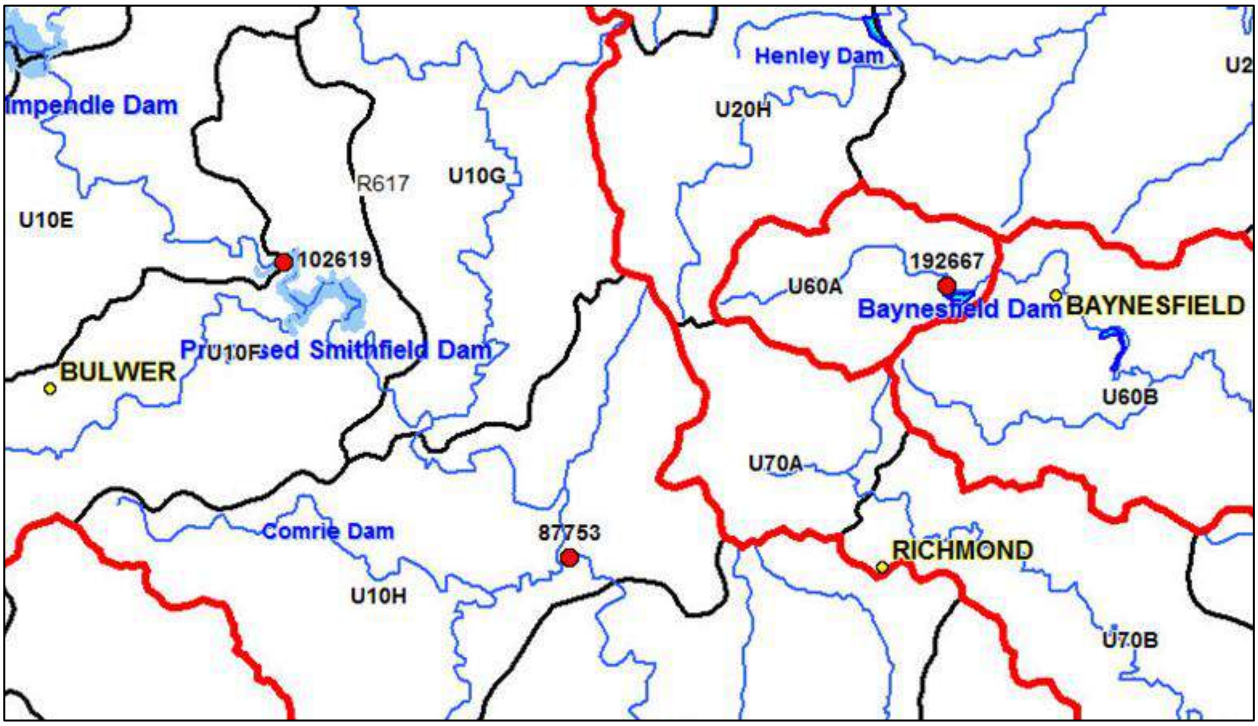


Figure 132: DWS monitoring station 102619 (DWA, 2012b)

Table 60: Water quality statistics at monitoring station 102619 upstream of Smithfield Dam (DWA, 2012b)

Parameter	Unit	Min	P5	Median	P95	Max	Mean	Ecosystem Standard	Domestic Standard
Calcium	mg/l	2.200	3.300	6.320	9.950	30.000	6.640		32
Chloride	mg/l	0.450	1.500	3.500	7.140	26.000	3.790		100
TDS	mg/l	21.000	34.540	56.760	87.680	173.000	59.120		450
Electrical Conductivity	mS/m	3.000	4.400	7.300	11.010	33.200	7.570		70
Potassium	mg/l	0.058	0.150	0.570	1.720	4.660	0.730		50
Magnesium	mg/l	0.500	1.480	2.700	4.400	7.800	2.760		30
Sodium	mg/l	0.221	1.000	3.460	5.600	23.300	3.690		100
Ammonia	mg/l	0.015	0.020	0.040	0.130	0.420	0.049		1
pH		5.040	6.400	7.440	8.010	8.560	7.320		6 to 9
Phosphates	µg/l	0.003	0.003	0.014	0.072	0.248	0.022	<5 Oligotrophic; 5-25 Mesotrophic; 25-250 Eutrophic; >250 Hypertrophic	
Sulphates	mg/l	0.380	2.000	2.000	9.610	15.500	3.740		200

Key:

Domestic standard

Exceed domestic standard	Within domestic standard

Ecosystem status (Phosphor)

<5µg/l Oligotrophic	5-25 µg/l Mesotrophic	25-250 µg/l Eutrophic	>250 µg/l Hypertrophic

Median values of all parameters shown in **Table 60** indicate that water quality at the proposed Smithfield Dam is within acceptable limits.

A water quality assessment was conducted for uMWP-1 by Umgeni Water with the following aims:

- Assess the catchment land uses of uMkhomazi and uMlaza Rivers and activities upstream of the proposed impoundments (Smithfield Dam and balancing dam) and their potential impacts on water quality;
- Assess the water quality of the uMkhomazi raw water source and implications for water treatment;
- Predict the water quality of impounded water, implications for treatment and river release to the downstream environment, and recommend best management practices for abstraction, storage, fill and release, and
- Provide water quality information needed for the preliminary design of the proposed Smithfield Dam.

The main conclusions of the Water Quality Assessment follow (Umgeni Water, 2013):

- There is a significant population (approximately 200 000), with some associated subsistence farming, but no significant industry or mining. Overall, the Smithfield Dam catchment is considered to be in moderately good condition, with low potential for serious pollution issues in the proposed dam, largely as a result of the lack of large population numbers and industry. The greatest risk to water quality in the Smithfield impoundment is from the significant soil erosion occurring in the catchment. This accelerated erosion is associated with livestock related erosion (trails and overgrazing), subsistence farming practices, loss of indigenous vegetation and colonization by invasive species (which bind the soil less well), disturbed lands associated with forestry and clear-felling of trees, and erosion associated with compaction of the soils in the road network. High intensity rain events also occur in this catchment.
- The very small Langa Dam catchment which comprises natural bush and grassland with forestry plantations appears in good condition with very limited potential for significant pollution issues in this dam.

- Good long-term data records indicated that water quality measured to date in the Smithfield Dam catchment is generally satisfactory, with the exception of elevated turbidity, total organic carbon and phosphorus concentrations recorded during high intensity rainfall events (particularly the first flush of the summer rainfall period). Low conductivity results reflect that this water is likely to be aggressive and will require lime stabilization during treatment. There are no indications of elevated heavy metals such as copper, cobalt, lead or mercury and there are no known mining activities (other than for sand or stone). Similarly, the limited data record so far available indicated good water quality in the balancing dam catchment, but with elevated total phosphorus results in the summer high rainfall period.
- In-dam processes such as sedimentation of suspended material, biological processing of nutrients, predation and natural mortality of potential pathogens, and ultra-violet light disinfection are anticipated to improve surface water quality between the uMkhomazi Smithfield inflow and the proposed Smithfield Dam wall. Significant improvements will thus occur in recorded concentrations of suspended materials and the bacteriological quality of the river water, despite relatively short impoundment residence times.
- The algal response models predicted an average chlorophyll 'a' concentration from 5.7 – 5.8 µg/l and a peak chlorophyll 'a' concentration of 16 µg/l for the proposed Smithfield Dam. The anticipated trophic status of the proposed Smithfield Dam is mesotrophic - moderately enriched with nutrients, with occasional blooms of nuisance algal species.
- The Smithfield Dam is likely to stratify thermally during summer (from October), with dam turnover (destratification) occurring around April, dependent on air temperatures and impoundment drawdown. The most severe stratification can be expected during February and will result in *ca.* 8-10 m of surface aerobic water being available for optimal abstraction. Water abstracted from below the oxycline is likely to cause treatment problems. At the onset of the annual impoundment turnover, anoxic water will be mixed into the water column, reducing dissolved oxygen concentrations throughout the water column. Elevated concentrations of metals which will be liberated from the sediments under anoxic conditions will thus be mixed through the water column at turnover. These metals may require additional treatment for removal and to avoid post-precipitation in final drinking waters. From

information at impoundments in adjacent or nearby catchments, elevated concentrations of both iron and manganese may present a risk at these times.

- The impoundment size is relatively small compared to the Mean Annual Runoff and significant rain events are likely in the catchment at times. Under very severe storm conditions, inflows of highly turbid water may be sufficient to reach the abstraction zone or temporarily mix the dam (particularly if the impoundment is drawn-down). Under these conditions, significantly elevated turbidities are possible in the raw water abstracted from the impoundment.
- In order to allow abstraction from the aerobic zone as well as abstraction when the proposed Smithfield impoundment is significantly drawn-down, it is recommended that a number of abstraction levels are constructed at 6m intervals from FSL.
- A dam scour is recommended to be constructed to be able to release dam bottom water during high summer inflows. Sleeve valves with dispersers are recommended to oxygenate the water used for environmental releases.
- Spilling is the recommended release mechanism when algal numbers are high and water levels permit. Water from the abstraction levels are recommended to be able to be used for downstream environmental releases, and it is recommended that combination spill - scour releases are managed to minimise the impact on downstream aquatic life. As far as possible, water for environmental flows is recommended to be distributed according to the natural flow patterns. The scour should be big enough to emulate natural flood events downstream.
- Water quality and biological monitoring is recommended during the pre-construction, construction and operational phase of the proposed Smithfield and Langa Dams to assess impacts on the environment, and to optimise dam management as well as raw water quality for treatment.

The most significant land uses and activities that present a risk to current or future water quality in the upper uMkhomazi catchment are presented in **Table 61**.

Reservoir sedimentation is dependent on catchment sediment yield, which is a function of catchment location and size, as well as sediment yield potential within the catchment. The catchment sediment yield was estimated and the consequent reductions in future storage capacity that can be expected for the proposed Smithfield Dam was determined as part of the uMWP-1 Feasibility Study. This study included selected information on the verification of catchment sediment yield of the proposed Smithfield Dam and the potential impact thereof on the proposed dam development (DWA, 2013b).

Table 61: Summary of current land cover issues affecting water quality of the proposed Smithfield impoundment (Umgeni Water, 2013)

Land use/issue	Extent & severity	Water quality impact
Erosion (natural and accelerated)	Significant extent, moderate to major severity.	Increased impoundment turbidity and treatment costs, Sedimentation of impoundment.
Animal Husbandry: associated overgrazing and livestock-related soil erosion	Extensive, Moderate- high severity relative to carrying capacity of land.	Increased impoundment turbidity and treatment costs, Sedimentation of impoundment, potential pathogen risk.
Population-associated sewage provision, refuse removal, road network and potential for contaminated runoff.	Low extent (approximately 8.5 km^2 in total and 0.4% of catchment) and low severity. Potential for increase in the next 20 years.	Pathogen contamination from human sources is anticipated to be low. The road network has an impact on soil erosion, and associated increase in turbidity in the rivers and dam.
Timber	Moderate extent (approximately 100 km^2 in total and 5 % of catchment) and low severity.	Increased impoundment turbidity and treatment costs, Sedimentation of impoundment associated with clear-felling. Elevated total organic carbon results associated with burning.
Alien invasive terrestrial weeds	Extensive, moderate severity (but do tend to colonise river courses).	Consumptive water use and destabilization of soils, leading to increased soil loss and elevated river and dam turbidity.
Dryland farming	Limited extent (approximately 86 km^2 in total and 4% of catchment) and low severity.	Impacts of fertilisers and pesticides are limited. Some soil loss does occur.
Transport Spillages	Unknown.	Potentially high, depending on substance transported.

10.8.6 Riparian Habitat

A Terrestrial Ecology Assessment, contained in **Appendix H1**, was undertaken for the project. Refer to the summary and impact assessment of this study contained in **Sections 11.1.1** and **12.8**, respectively. In addition, an Aquatic Impact Assessment was also conducted (see **Appendix H2**) and **Sections 11.1.2** and **12.6.6** contain a synopsis of the study and a related impact assessment, respectively.

10.8.6.1 Smithfield Dam

The IFR survey revealed that the uMkhomazi is a highly modified river due to high levels of utilisation. As a consequence of this disturbance, the river system has been heavily infested with alien species and the diversity of the riparian vegetation has been drastically reduced. The conservation status of most of the surveyed river sections is low. Species diversity within the riparian vegetation is very low despite the change in altitude and flanking vegetation types. It is postulated that all but the most resilient riparian species have been lost from most of the watercourse (DWF, 1999e).

In the middle reaches of the river *Syzygium cordatum*, *Ficus sur* and *Combretum erythrophyllum* occur sporadically in the riparian zone. These species are common components of rivers traversing Valley Bushveld. The phreatic zone (beyond the riparian area) is dominated by *Acacia karroo* interspersed with smaller trees such as *Dalbergia obovata*, *Tricalysia lanceolata* and *Kraussia floribunda*. Many sections of the middles reaches of the uMkhomazi are not heabilty utilised, however, the riparian is not well developed (DWAF, 1999e).

The riparian zone at the Smithfield Dam site, as shown in **Figure 133**, is in a good condition.

Figure 133: Area near Smithfield Dam site

Cattle grazing in the riparian zone, with associated trampling, is one of the major causes of the degraded state of the riparian zone. Other impacts include vegetation removal (firewood), infestation of exotic vegetation, bank erosion and localised inundation.

10.8.6.2 Balancing Dams

Alien species associated with forestry, such as *Acacia* species (wattle) and *Eucalyptus* species (bluegum), are found within the riparian zone of the uMlaza River channel (DWA, 2012b).

At the Langa Dam site, wetland-type vegetation in encountered, as shown in **Figure 134**.

Figure 134: Langa Dam site

10.8.6.3 Gauging Weir

A detailed ecological survey still needs to be undertaken of the riparian habitats at the alternative gauging weir sites. The riparian zone at both site options is disturbed (refer to **Figures 135 – 136**).

Figure 135: **View of river reach at site Option 1 for the gauging weir (DWA, 2014b)**

Figure 136: **View of river reach at site Option 2 for the gauging weir (DWA, 2014b)**

Subsistence grazing is the primary source of impact, and erosion is found within the riparian zone. These sites are also situated in the grassland biome.

10.8.7 Wetlands

10.8.7.1 Aquatic Impact Assessment

All wetland components were delineated and assessed as part of the Aquatic Impact Assessment (see **Appendix H2**). Refer to **Sections 11.1.2** and **12.6.6** for a synopsis of the study and a related impact assessment, respectively.

10.8.7.2 FEPA

The types of wetlands in the study area are shown in **Figures 123** – **125** and the FEPA wetlands (based on CSIR, 2011) are shown in **Figures 137 – 138**. The following is noted with regards to wetlands, based on desktop appraisal of the NFEPA coverage (CSIR, 2011):

- Western part of study area (**Figure 137**) –
  - Smithfield Dam will inundate various channelled and unchannelled valley bottom wetlands, which are also classified as FEPA wetlands;
  - Dam Sites A and B cross FEPA wetlands;
  - Options 2 and 3 of the power line deviations cross small sections of FEPA wetlands;
  - Borrow Area A and Quarry II encroach on FEPA wetlands;
  - The construction road crosses a FEPA wetland within the proposed dam's basin;
  - The gauging weir Option 1 is located to the immediate west of a FEPA wetland;
- Eastern part of study area (**Figure 138**) –
  - All the balancing dam options inundate sections of FEPA wetlands;
  - All the raw water pipeline options cross FEPA wetlands in the western parts of the routes;
  - Both road options to the balancing dam cross FEPA wetlands;
  - The quarry and borrow pit at Langa Balancing Dam encroach on a FEPA wetland; and
  - The waste disposal site for spoil material at the tunnel outlet, as well as the spoiling site at the Langa dam wall, encroach on FEPA wetlands.

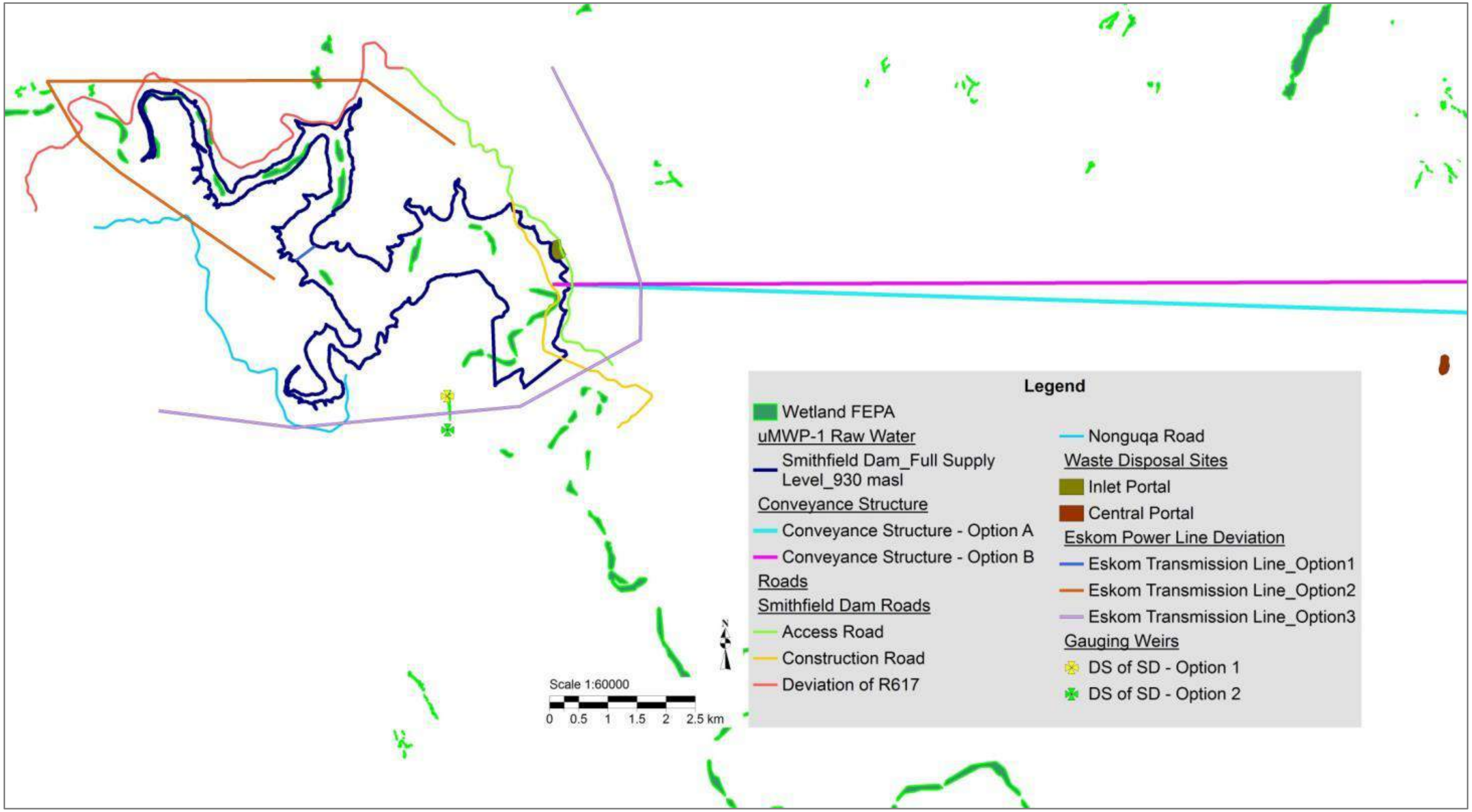


Figure 137: FEPA Wetlands – western part of study area

(Note: disregard reference to “Conveyance Structure Option B” and “Eskom Transmission Line Option 2” in legend – these options were discarded after Scoping)

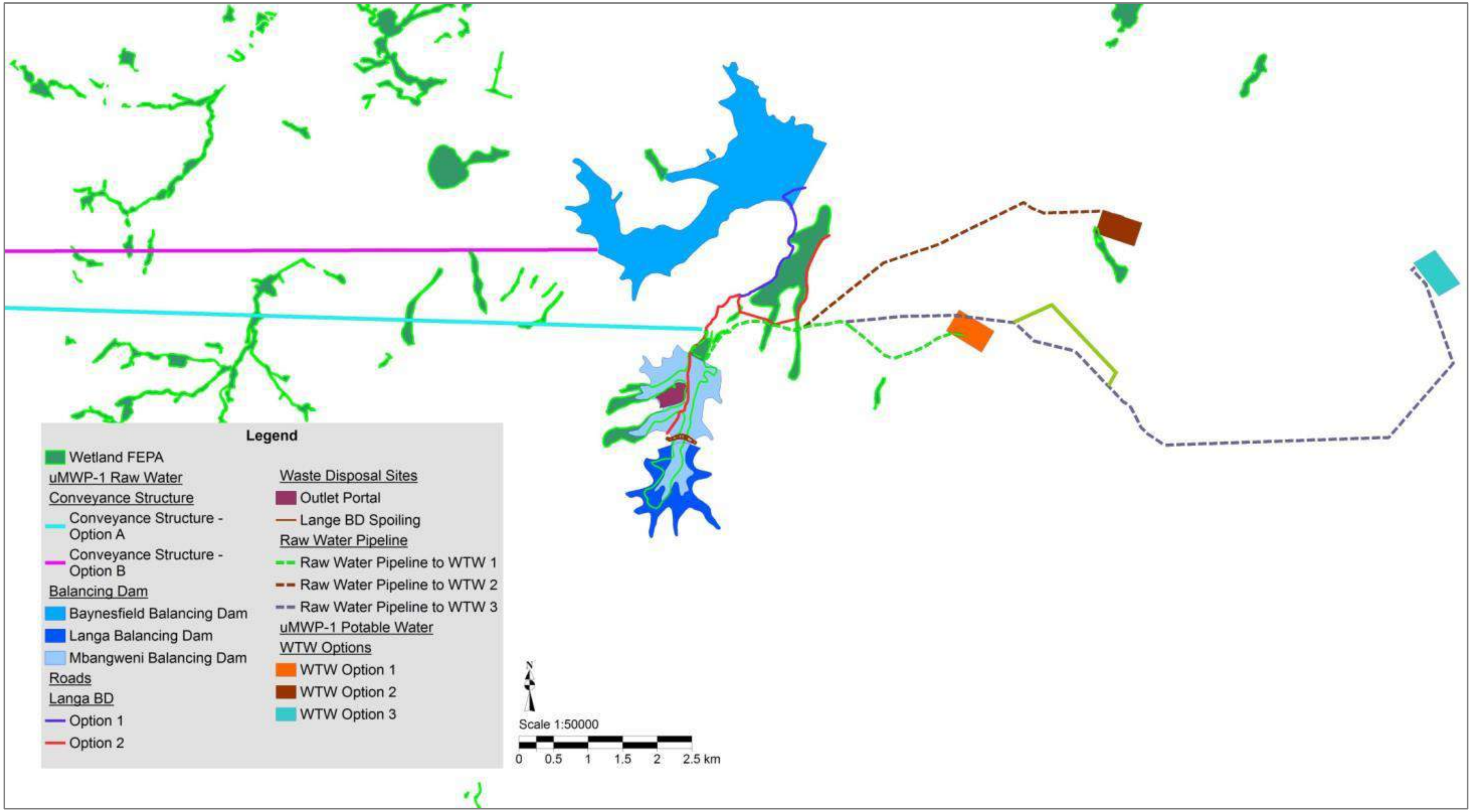


Figure 138: FEPA Wetlands – eastern part of study area

(Note: disregard reference to "Conveyance Structure Option B" and "Baynesfield Balancing Dam" in legend – these options were discarded after Scoping)

10.8.7.3 Hydrological Assessment

As part of the uMWP-1 Feasibility Study's hydrological assessment (DWA, 2013c), information on the extent and distribution of wetlands in the uMkhomazi and upper uMlaza River catchments was obtained from a wide variety of sources which were assessed, compared and evaluated in order to obtain the most reliable available data set. Some of the key findings include the following:

- Wetlands are fairly widely distributed across the study area, although it is estimated that over 50% of wetland areas have been drained or inundated for agricultural purposes (Enviromap CC, 1999);
- Wetlands in the study area are predominantly connected to river channels. Although the majority of wetland areas in the uMkhomazi River catchment have now been lost to agricultural activities the remaining 48% of wetland areas are in a moderate to good condition with limited disturbance to their functional behaviour;
- Images derived from Spot 5 images indicate that the majority of wetlands in the uMlaza River catchment are currently located within cultivated land and are assumed to be significantly degraded; and
- From an assessment of maps and aerial photography it was concluded that most of the wetlands in the study area are channelled valley bottom wetlands, with some located in floodplains.

10.8.8 <u>Estuary</u>

10.8.8.1 General

By definition, an estuary constitutes a partly enclosed coastal body of water with one or more rivers or streams flowing into it, and with a free connection to the open sea. These systems form a transition zone between river and ocean environments and are subject to both marine influences (e.g. tides, waves, and the influx of saline water) and riverine influences (e.g. flows of fresh water and sediment). The high productivity in estuaries stems from the inflow of both seawater and freshwater, which provide high levels of nutrients in both the water column and sediment.

The uMkhomazi Estuary is situated approximately 50 km south of central Durban. The suburb of Umkomaas lies on the south bank of the estuary. An aerial perspective of the estuary is provided in **Figure 139**.

Figure 139: Aerial view of the uMkhomazi Estuary

The uMkhomazi estuary is relatively straight for much of its length only undulating around the headland on which the Sappi Saiccor factory is located. It is a wide shallow system with a mouth that very seldom closes.

A study was undertaken during the Pre-feasibility Study to determine the Estuarine Freshwater Requirements of the uMkhomazi Estuary (DWAF, 1999d). Sub-studies that formed part of this initiative included the following:

- ❖ Physical aspects of the uMkhomazi Estuary;
- ❖ Freshwater requirements of the uMkhomazi Estuary: assessment of water quality issues;
- ❖ Preliminary assessment of the botanical status and effects of altered flow on the uMkhomazi Estuary;
- ❖ The invertebrates of the uMkhomazi Estuary;
- ❖ A preliminary assessment of the effects of reduced riverine inflows on the fishes of the uMkhomazi Estuary; and
- ❖ A preliminary review of the potential impact of reduced river runoff on the bird fauna of the uMkhomazi Estuary.

An extract from the Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu WMA: Volume 7a: Recommended Water Resource Classes for the Umkhomazi (U1) and Mvoti (U4) River Systems (DWS, 2014b) follows.

10.8.8.2 PES, Estuary Importance & REC

The uMkhomazi Estuary in its present state is estimated to be 69% similar to the natural condition, which translates into a PES of a C Category. This is attributed to the following factors:

- ❖ The weir in the upper reaches reducing the connectivity between the river and estuary;
- ❖ Sandmining that has taken away the sandbanks in the upper reaches (Zone C), resulting in loss of intertidal areas and back-water refuge areas. It has also impacted on access to grazing areas as the river cannot be crossed in this section anymore;
- ❖ Recreational activities (e.g. boat launching) in the lower reaches affecting bird abundance;
- ❖ Over exploitation of living resources (e.g. cast netting and line fishing); and
- ❖ Agricultural activities and disturbance in the Estuary Functional Zone causing loss of estuarine habitat.

Estimates of the contribution of non-flow related impacts on the level of degradation suggests that non-flow related impacts have played a role in the degradation of the estuary to a C, but that flow-related impacts are also driving degradation. The highest priority from a flow related perspective is to address the quality of influent water. Of the non-flow-related impacts, loss of open water areas as a result of the weir, habitat loss within the 5m contour and the related vegetation integrity along with water quality problems as a result of the high nutrient load associated with the WWTWs were the most important factors influencing ecological health of the system. The excess nutrients in the inflowing water are considered to be an important factor to consider with increased abstraction from the system. Increased retention (further reduction in flow) of these high concentrations of nutrients will lead to nuisance algal growth, low dissolved oxygens and reduced habitat quality.

The Estuary Importance Score takes size, the rarity of the estuary type within its biographical zone, habitat, biodiversity and functional importance of the estuary into account. Biodiversity importance, in turn is based on the assessment of the importance of the estuary for plants, invertebrates, fish and birds, using rarity indices. Estuary Importance was estimated at 85, i.e. the estuary is rated as "Highly Important". The functional Importance of the uMkhomazi Estuary is very high. It serves as an important nursery for exploited fish stock and plays a very important role from a fish egg production perspective. In addition, it is also an important movement corridor for eels (CITES listed species). Similar to the Mvoti Estuary, the functional importance is also very high for the nearshore marine environment. It is one of a number key systems that supply sediment, nutrients and detritus to the coasts.

The PES for the uMkhomazi Estuary is a C, but the Estuary is rated as "Very Important" from a biodiversity perspective and should therefore be in a B Category. In addition, the system also forms part of the core set of priority estuaries in need of protection to achieve biodiversity targets in the National Estuaries Biodiversity Plan for the National Biodiversity Assessment. Taking the current conditions (PES = C), the reversibility of the impacts, the ecological importance and the conservation requirements of the uMkhomazi Estuary the REC for the system is a B Category.

10.9 Terrestrial Ecology

A Terrestrial Ecology Assessment, contained in **Appendix H1**, was undertaken for the project. Refer to the summary of this study contained in **Section 11.1.1** and impact assessment contained in **Sections 12.8** and **12.9**.

10.9.1 Flora

10.9.1.1 General Description

The study area is situated within the Maputaland-Pondoland Region, which is a floristic unit that incorporates a number of smaller centres of endemism. Scott-Shaw and Escott (2011) described the study as falling within Grassland, Forest, Savanna and Wetland Biomes (**Figure 140**).

According to Scott-Shaw and Escott (2011), the vegetation types in the study area (as shown in **Figure 141**) include the following:

- Southern KwaZulu-Natal Moist Grassland;
- Midlands Misbelt Grassland;
- Eastern Misbelt Forests;
- Moist Coast Hinterland Grassland;
- KwaZulu-Natal Hinterland Thornveld;
- Eastern Temperate Freshwater Wetlands;
- Eastern Valley Bushveld;
- Dry Coast Hinterland Grassland;
- Alluvial Wetlands: Temperate Alluvial Vegetation: Midlands Alluvial Woodland & Thicket; and
- Alluvial Wetlands: Temperate Alluvial Vegetation.

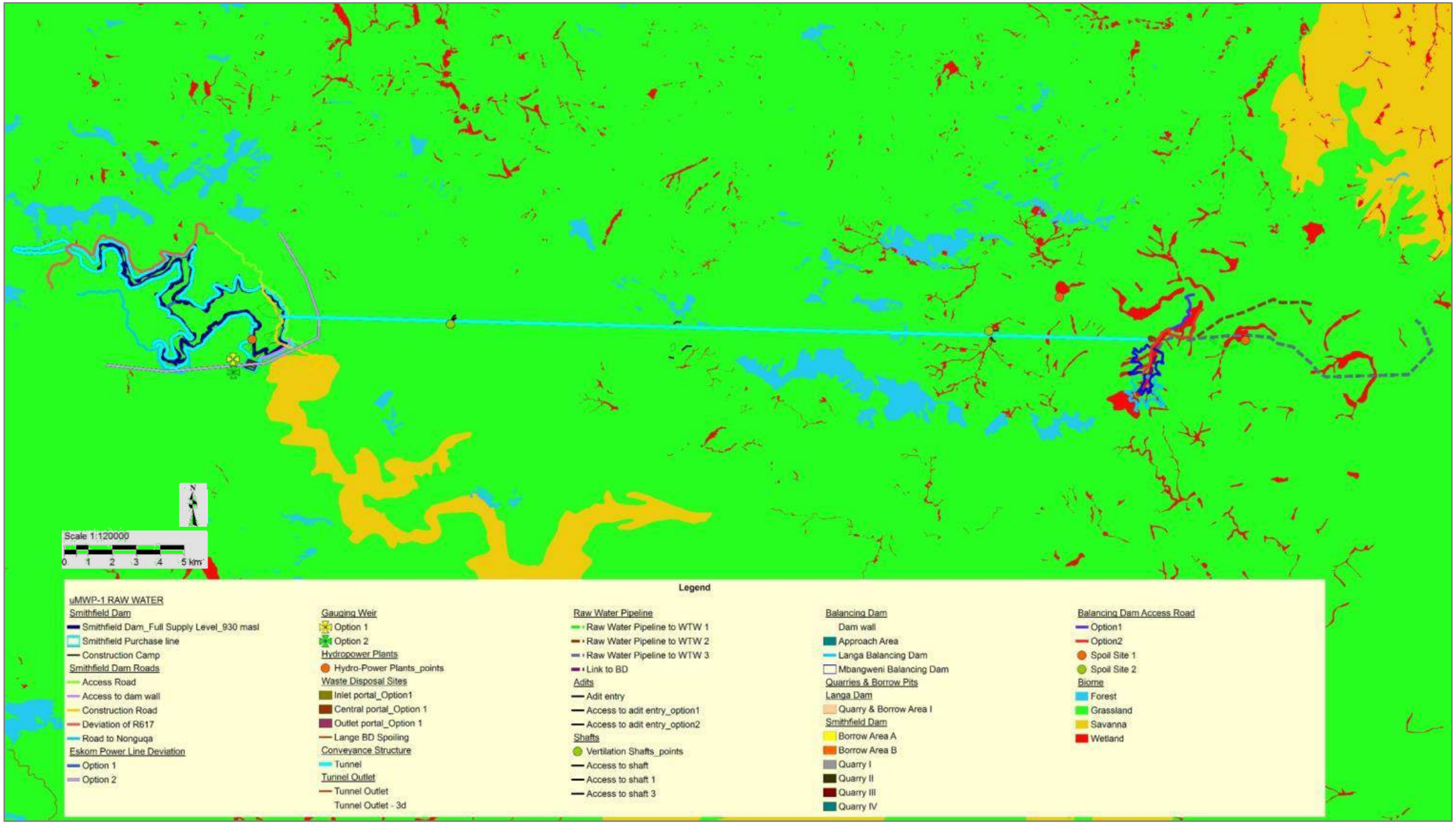


Figure 140: Biomes in project area

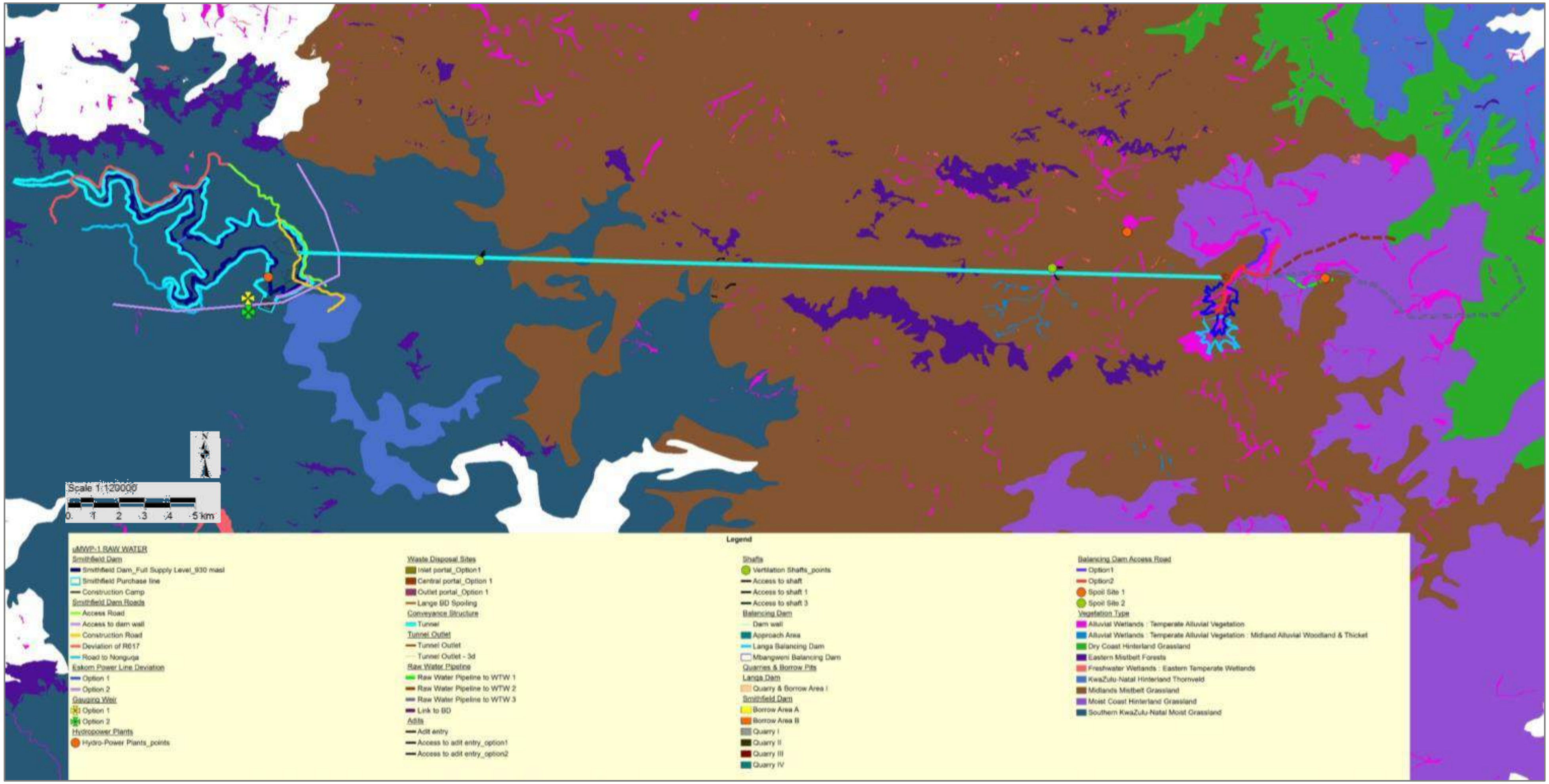


Figure 141: Vegetation types in project area

The description of each vegetation type follows.

- **Southern KwaZulu-Natal Moist Grassland** vegetation type occurs in KwaZulu-Natal and Eastern Cape Provinces. The interior valley basins are found in Creighton, Malenge and Centocow in the south and the upper uMkhomazi River and Howick in the north. This vegetation type is classified as Vulnerable with a conservation target of 23%. About 4% is statutorily conserved in the Impendle, Midmar, Igxalingenwa and Ingelabantwana Nature Reserves as well as in the Soada Forest Nature Reserve and in the uKhahlamba Drakensberg Park. More than one third is already transformed due to cultivation, plantations, urban sprawl and building of dams (Midmar). Several woody aliens (*Solanum mauritianum, Arundo donax, Eucalyptus species, Melia azedarach, Sesbania punicea, Populus alba*) occur in these grasslands, but their impact is only of local importance (Mucina and Rutherford, 2006).
- **Midlands Mistbelt Grassland** vegetation type occurs in the KwaZulu-Natal and Eastern Cape provinces. This area is a hilly and rolling landscape, characterised by an east facing scarp formed by dolerite intrusions. This vegetation type is dominated by forb-rich, tall, sour *Themeda triandra* grasslands that have been transformed by the invasion of *Aristida junciformis* subsp. *junciformis.* This vegetation type is classified as Endangered (one of the most threatened vegetation types in KwaZulu-Natal) by Mucina and Rutherford (2006), with a conservation target of 23% and only 0.5% statutorily conserved. More than 50% has already been transformed for plantations, cultivated land or by urban sprawl (Mucina and Rutherford, 2006).
- **Eastern Misbelt Forests** are small (<1 ha) to large (>1500 ha) forests. They occur in an extensive band at middle altitudes (850-1600 m above sea level) often on steep eastern to western slopes of the mountains or escarpments from the Kokstad to the midlands of KwaZulu-Natal. The habitat is characterized by heavy summer mist. The forests are dominated by *Xymalos monospora, Podocarpus henkelii, P latifolius, P. falcatus, Celtis africana, Kiggelaria africana* and *Ocotea bullata* in the canopy. Understorey species vary in importance and include tree/shrub species such as *Eugenia*

zuluensis, *Trichocladus ellipticus*, *Maytenus mossambicensis* and *Peddiea africana*, and a range of fern species often at high density. There are a number of deciduous and semi-deciduous species such as *Celtis africana, Calodendrum capense, Ptaeroxylon obliquum, Kiggelaria africana* and *Zanthoxylum davyi*. The forests are generally moist. Historically they were surrounded by grassland, but in many areas are now surrounded by commercial timber plantations, as is the case for the study site (Von Maltitz *et al.* 2003).

- **Moist Coast Hinterland Grassland** vegetation occurs in KwaZulu-Natal and Eastern Cape Provinces. It is found near Melmoth in the north and near Libode in the south (including Eshowe, New Hanover, Thornville, Richmond, Harding, Lusikisiki) generally occurring below Midlands Mistbelt Grassland (Camp 1999, 2001; Scott-Shaw, 2011a). It occurs in rolling and hilly landscapes. The dense tall sour grassland is dominated by unpalatable Ngongoni grass (*Aristida junciformis*) with this mono-dominance associated with low species diversity, when in good condition, this vegetation type is dominated by *Themeda triandra* and *Tristachya leucothrix*. This vegetation type is statutorily conserved in Vernon Crookes and Entumeni Nature Reserves (Camp 1999, 2001; Scott-Shaw, 2011a).
- **KwaZulu-Natal Hinterland Thornveld** vegetation type occurs in the KwaZulu-Natal Province. The patches are scattered immediately above Eastern Valley Bushveld in river valleys of mainly the Mpisi (in the Thukela River catchment), Mvoti, Umgeni (below the Howick Falls), uMlaza, and Lufafa (vicinity of Ixopo) and Mtungwane (tributaries of the uMkhomazi). This vegetation type is classified as **Vulnerable** with a conservation target of 25%. None of this vegetation type is conserved in statutory conservation areas. Some 22% is already transformed by cultivation and some urban or built-up areas.
- **Eastern Temperate Freshwater Wetlands** vegetation occurs in the Northern Cape, Eastern Cape, Free State, North-West, Gauteng, Mpumalanga and KwaZulu-Natal Provinces as well as in neighbouring Lesotho and Swaziland: It occurs around water bodies with stagnant water (lakes, pans, periodically flooded vleis, edges of calmly flowing rivers) and is entrenched within the

Grassland Biome (Mucina and Rutherford, 2006). Reed and Sedge Beds are dominated by species such as *Phragmites austrails, Schoenoplectus corymbosus, Typha capensis, Cyperus immensus and Carex cernua.* Currently, Eastern Temperate Freshwater Wetlands vegetation unit is listed as Least Threatened with a national conservation target of 24%. About 5% is statutorily conserved in the Blesbokspruit (a Ramsar site), Hogsback, Marievale, Olifantsvlei, Seekoeivlei (a Ramsar site), Wakkerstroom Wetland, Umgeni Vlei, Mvoti Vlei and Pamula Park Nature Reserves. It is also protected in private nature reserves such as the Korsman Bird Sanctuary and Langfontein. About 15% has been transformed due to cultivated land, urban areas or plantations. In places of intensive grazing and use of lakes and freshwater pans as drinking pools for cattle or sheep, major damage to the wetland vegetation occurs. The following alien species are encountered in this type of wetland: Bidens bidentata, Cirsium vulgare, Conyza bonariensis, Oenothera rosea, Physalis viscosa, Plantago lanceolata, Rumex crispus, Sesbania punicea, Schkuhria pinnata, Stenotaphrum secundatum, Trifolium pratense, Verbena bonariensis, V. brasiliensis, Xanthium strumarium, etc. (Mucina and Rutherford, 2006).

- **Eastern Valley Bushveld** vegetation occurs in KwaZulu-Natal and Eastern Cape Provinces. It is found in deeply incised valleys of rivers including the lower reaches of the Thukela, Mvoti, Mgeni, uMlaza, Mkhomazi, Mzimkulu, Mzimkulwana, Mtamvuna, Mtentu, Msikaba, Mzimvubu (and its several tributaries), Mthatha, Mbhashe, Shixini, Qhorha and Great Kei. Very seldom it extends towards the coast. It is found in semi deciduous savanna woodlands in a mosaic with thickets, often succulent and dominated by species of *Euphorbia* and *Aloe.* Most of the river valleys run along a northwest-southeast axis which results in unequal distribution of rainfall on respective north-facing and south-facing slopes since the rain-bearing winds blow from the south. The steep north-facing slopes are sheltered from the rain and also receive greater amounts of insulation adding to xerophilous conditions on these slopes (Mucina and Rutherford, 2006).
- **Dry Coast Hinterland Grassland** vegetation is found in KwaZulu-Natal and Eastern Cape Provinces. It occurs in Melmoth in the north and near Libode in

the former Transkei (including Camperdown, Umlaas Road, Eston, Bisi, iZingolweni, Ngqeleni near Mthatha) generally occurring above the KwaZulu-Natal Hinterland Thornveld, Bisho Thornveld and the Eastern Valley Bushveld (Camp 1999, 2001; Scott-Shaw, 2011). It lies in undulating plains and hilly landscape mainly associated with drier coast hinterland valleys in the rain-shadow of the rain-bearing frontal weather systems from the east coast. Sour sparse wiry grassland is dominated by unpalatable Ngongoni grass (*Aristida junciformis*) with this mono-dominance associated with low species diversity. In good condition, this vegetation type is dominated by *Themeda triandra* and *Tristachya leucothrix*. Wooded areas are found in valleys at lower altitudes, where this vegetation unit grades into KwaZulu-Natal Hinterland Thornveld and Bisho Thornveld. Termitaria support bush clumps with *Acacia* species, *Cussonia spicata*, *Ehretia rigida, Grewia occidentalis* and *Coddia rudis* (Camp 1999, 2001; Scott-Shaw, 2011a).

- **Alluvial Wetlands: Temperate Alluvial Vegetation** is classified as Vulnerable with a conservation target of 24%. Only 3.4% is protected (Scott-Shaw and Escott, 2011).
- **Alluvial Wetlands: Temperate Alluvial Vegetation: Midlands Alluvial Woodland & Thicket** is classified as **Critically Endangered** with a conservation target of 24%. Only 3.2% is protected (Scott-Shaw and Escott, 2011).

A general overview of the plant life in the study area follows.

<u>Smithfield Dam</u>

Smithfield Dam falls within the grassland biome. Ecosystem services provided by grassland include the following:

- Water production, wetland functioning and flood attenuation;
- Good quality soil and forage for livestock;
- Culture, heritage and recreational amenities; and
- Support for livelihoods such as grasses for housing and weaving and medicinal plants.

According to DWA (1999c), most of the important flora species are located within the river course or on the river banks and terraces. Woody vegetation is found along the steep slopes and cliffs.

The site is impacted by agricultural practices by the local rural community and grazing, which has resulted in the loss of topsoil. The fallow lands situated within the proposed basin consist of an altered species composition.

The Pre-feasibility Study (DWAF, 1999d) noted the following with regards to the area that will be impounded by the Smithfield Dam:

- The area is highly disturbed and degraded;
- Alien vegetation and altered communities are all that remain;
- It is likely that the level of human pressure would increase with time (with or without dam development); and
- Areas with high biotic diversity are fragmented and limited to a few small, more inaccessible areas. Inundation would further aggravate habitat fragmentation.

Raw Water Conveyance Infrastructure

The tunnel route options pass underneath an area that is predominantly situated within the grassland biome. Impacts to the plant life along the tunnel routes include rural subsistence agriculture (western section), forest plantations and commercial farming (eastern section).

The raw water pipeline routes traverse wetland and grassland biomes. Existing impacts to the local vegetation include commercial farming and timber plantation.

Balancing Dam

All three the balancing dam options will inundate wetland and grassland biomes. The Baynesfield Dam option will inundate the largest area, followed by the Dam upstream of Mbangweni Dam and lastly the Langa Balancing Dam.

As with the balancing dam, the vegetation has been impacted by commercial farming and timber plantations.

10.9.1.2 Plant species

The proposed project site is located within 2929DB, 2929DD, 2930CC and 2930CD quarter degree square in terms of the 1:50 000 grid of South Africa. The South African National Biodiversity Institute (SANBI) uses this grid system as a point of reference to determine any Red Data plant species or any species of conservation importance occurring in South Africa. **Table 62** provides details on the Red Data plant species which have been recorded in the aforementioned grid cells.

Table 62: Threatened plant species recorded in QDS 2929DB, 2929DD, 2930CC & 2930CD

Family	Species	Threat status	SA Endemic	Growth forms
Acanthaceae	*Thunbergia venosa* C.B.Clarke	Rare	No	Herb
Amaryllidaceae	*Cyrtanthus falcatus* R.A.Dyer	Rare	No	Geophyte
Amaryllidaceae	*Haemanthus deformis* Hook.f.	VU	No	Geophyte
Asphodelaceae	*Aloe pruinosa* Reynolds	VU	No	Herb
Apocynaceae	*Brachystelma petraeum* R.A.Dyer	VU	No	Geophyte,
Apocynaceae	*Asclepias concinna* (Schltr.) Schltr.	VU	No	Herb
Aquifoliaceae	*Ilex mitis* (L.) Radlk. var. mitis	Declining	No	Shrub
Asteraceae	*Helichrysum drakensbergense* Killick	Rare	No	Dwarf shrub
Asteraceae	*Macowania hamata* Hilliard & B.L.Burtt	Rare	No	Shrub
Asteraceae	*Cineraria atriplicifolia* DC.	VU	No	Herb
Asteraceae	*Senecio umgeniensis* Thell.	Threatened	No	Herb
Asteraceae	*Gerbera aurantiaca* Sch.Bip.	EN	No	Herb
Asteraceae	*Senecio dregeanus* DC.	VU	No	Herb
Celastraceae	*Gymnosporia bachmannii* Loes.	VU	No	Shrub, tree
Celastraceae	*Pterocelastrus rostratus* (Thunb.) Walp.	Declining	No	Tree
Hyacinthaceae	*Bowiea volubilis* Harv. ex Hook.f. subsp. *volubilis*	VU	No	Climber
Iridaceae	*Moraea graminicola* Oberm. subsp. *graminicola*	NT	No	Geophyte
Amaryllidaceae	*Cyrtanthus falcatus* R.A.Dyer	Rare	No	Geophyte
Asphodelaceae	*Aloe pruinosa* Reynolds	VU	No	Herb
Celastraceae	*Gymnosporia bachmannii* Loes.	VU	No	Shrub
Celastraceae	*Pterocelastrus rostratus* (Thunb.) Walp.	Declining	No	Tree
Cornaceae	*Curtisia dentata* (Burm.f.) C.A.Sm.	NT	No	Shrub
Ericaceae	*Erica cooperi* Bolus var. cooperi	Rare	No	Dwarf shrub
Geraniaceae	*Geranium natalense* Hilliard & B.L.Burtt	Threatened	No	Herb
Hyacinthaceae	*Bowiea volubilis* Harv. ex Hook.f. subsp. volubilis	VU	No	Climber
Hyacinthaceae	*Merwilla plumbea* (Lindl.) Speta	NT	No	Geophyte
Hydrostachyaceae	*Hydrostachys polymorpha* Klotzsch ex A.Br.	VU	No	Herb
Iridaceae	*Moraea graminicola* Oberm. subsp. *graminicola*	NT	No	Geophyte
Iridaceae	*Gladiolus oppositiflorus* Herb.	Declining	No	Geophyte
Iridaceae	*Moraea hiemalis* Goldblatt	NT	No	Geophyte
Myrsinaceae	*Rapanea melanophloeos* (L.) Mez	Declining	No	Tree
Malvaceae	*Hermannia sandersonii* Harv.	VU	No	Dwarf shrub

Family	Species	Threat status	SA Endemic	Growth forms
Myrsinaceae	*Rapanea melanophloeos* (L.) Mez	Declining	No	Tree
Proteaceae	*Faurea macnaughtonii* E.Phillips	Rare	No	Tree
Proteaceae	*Leucospermum hypophyllocarpodendron* (L.) Druce subsp. *hypophyllocarpodendron*	VU	No	Dwarf shrub
Proteaceae	*Protea coronata* Lam.	NT	No	Shrub
Scrophulariaceae	*Selago longiflora* Rolfe	EN	No	Herb
Zamiaceae	*Encephalartos natalensis* R.A.Dyer & I.Verd.	NT	No	Shrub, tree

***Note**: NT=Near Threatened; VU=Vulnerable; EN=Endangered;*

10.9.1.3 KZN Provincial Biodiversity Plan

According to Escott *et al.* (2013), the KZN Provincial Biodiversity Plan is an amalgamation of the four systematic conservation plans and provides a spatial representation of land and coastal marine area that is required to ensure the persistence and conservation of biodiversity within the KZN Province. The plan further provides the framework for the Bioregional Plans which in turn feed into a range of multi-sect oral planning and assessment processes such as IDPs, SDFs, Environmental Implementation or Environmental Management Plans (EIPs & EMPs), Environmental Management Frameworks (EMFs), as well as EIAs.

The KZN Provincial Biodiversity Plan covers terrestrial, aquatic and marine environs, and consists of two main layers namely, Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) with legislated Protected Areas, modified areas, and other natural areas included as a base layer.

The above layers are informed by the outcomes of the KZN systematic conservation planning process, as well as several other datasets identifying CBA areas, including the National Threatened Ecosystems coverage's, and the NFEPAs.

According to the KZN Provincial Biodiversity Plan (see **Figure 142**), the following can be deduced:

- Smithfield Dam –
  - The majority of the basin inundates an area that is not of conservation importance;
  - Some parts of the basin fall within a CBA 3 Optimal;

- A CBA 1 Mandatory is affected by the Transmission Line Deviation Option 2 and a small part of the Smithfield Dam basin;
- The remaining footprint of the infrastructure options at Smithfield Dam fall within areas that are not of conservation importance, and to a lesser extent areas categorised as CBA 3 Optimal;

❖ Raw Water Conveyance Infrastructure –

- The western part of the tunnel route options cross areas that are not of conservation importance and CBA 3 Optimal;
- The eastern part of the tunnel route options mostly traverse CBA 1 Mandatory;
- The raw water pipeline routes cross CBA 1 Mandatory, CBA 3 Optimal, areas that are not of conservation importance and transformed areas;

❖ Balancing Dam –

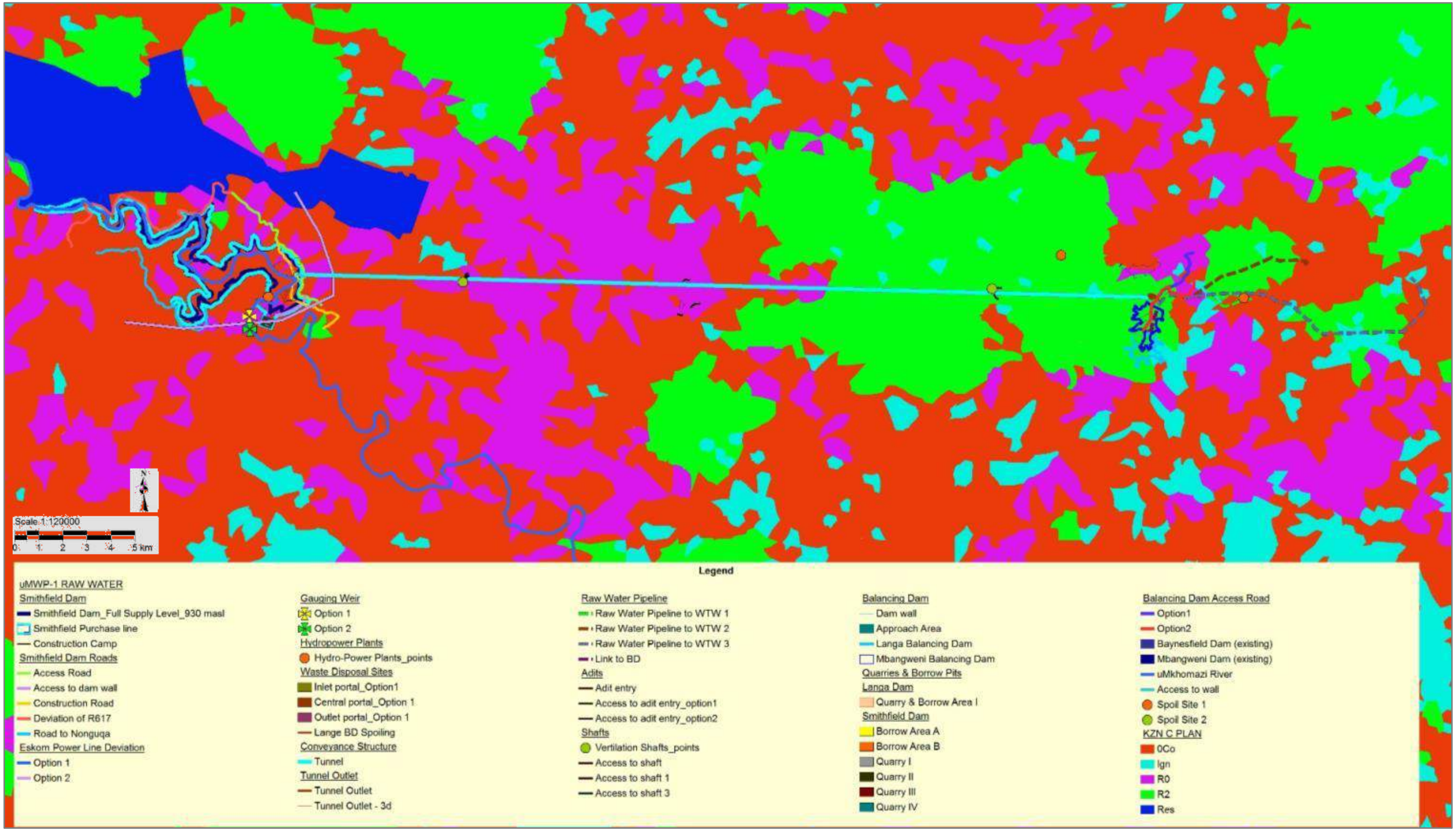
- The Mbangweni and Langa Balancing Dam options fall predominantly within a CBA 1 Mandatory, with a portion of the latter impoundment also occurring in CBA 3 Optimal;
- The two access road options cross CBA 1 Mandatory, CBA 3 Optimal, areas that are not of conservation importance and transformed areas;

❖ Gauging weir –

- Downstream of Smithfield Dam Options 1 and 2 are located within a CBA 3 Optimal.

CBA: Mandatory are areas which are required to meet biodiversity conservation targets, and where there are no alternative sites available.

CBAs: Optimal are areas that are the most optimal solution to meet the required biodiversity conservation targets while avoiding high cost areas as much as possible.



Note: ***0Co*** *(Not of Conservation Importance);* ***Res*** *(Existing protected area,)* ***R0*** *(CBA 3 Optimal),* ***R2*** *(CBA 1 Mandatory) and* ***Ign*** *(100% transformed based on 2005 land cover)*

Figure 142: KZN Provincial Biodiversity Plan in relation to the project area

10.9.1.4 Threatened Ecosystem

The following threatened ecosystems are affected by the project (see **Figure 143**):

- **Impendle Highlands** –
  - Western part of Smithfield Dam basin (northern shoreline only);
  - Transmission Line Deviation Options 2 and 3;
  - Deviation of the R617;
- **Pietermaritzburg South** –
  - Tunnel route Options 1 and 2;
  - All three balancing dam options;
  - Both access road options in the Baynesfield area;
  - Outlet portal waste disposal site;
  - All three raw water pipeline options;
- **Midlands Mistbelt Grassland** –
  - Tunnel route Options 1 and 2;
  - Central portal waste disposal site;
  - Raw water pipeline to WTW Option 3;
- **Ngongoni Veld** –
  - Option 2 of the balancing dam access road; and
  - All three raw water pipeline options.

SANBI, in conjunction with the Department of Environmental Affairs and Tourism (DEAT), released a draft report in 2009 entitled "Threatened Ecosystems in South Africa: Descriptions and Maps", to provide background information on the above List of Threatened Ecosystems. The purpose of this report was to present a detailed description of each of South Africa's ecosystems and to determine their status using a credible and practical set of criteria (SANBI, 2009). The following criteria were used in determining the status of threatened ecosystems:

- Irreversible loss of natural habitat;
- Ecosystem degradation and loss of integrity;
- Limited extent and imminent threat;
- Threatened plant species associations;

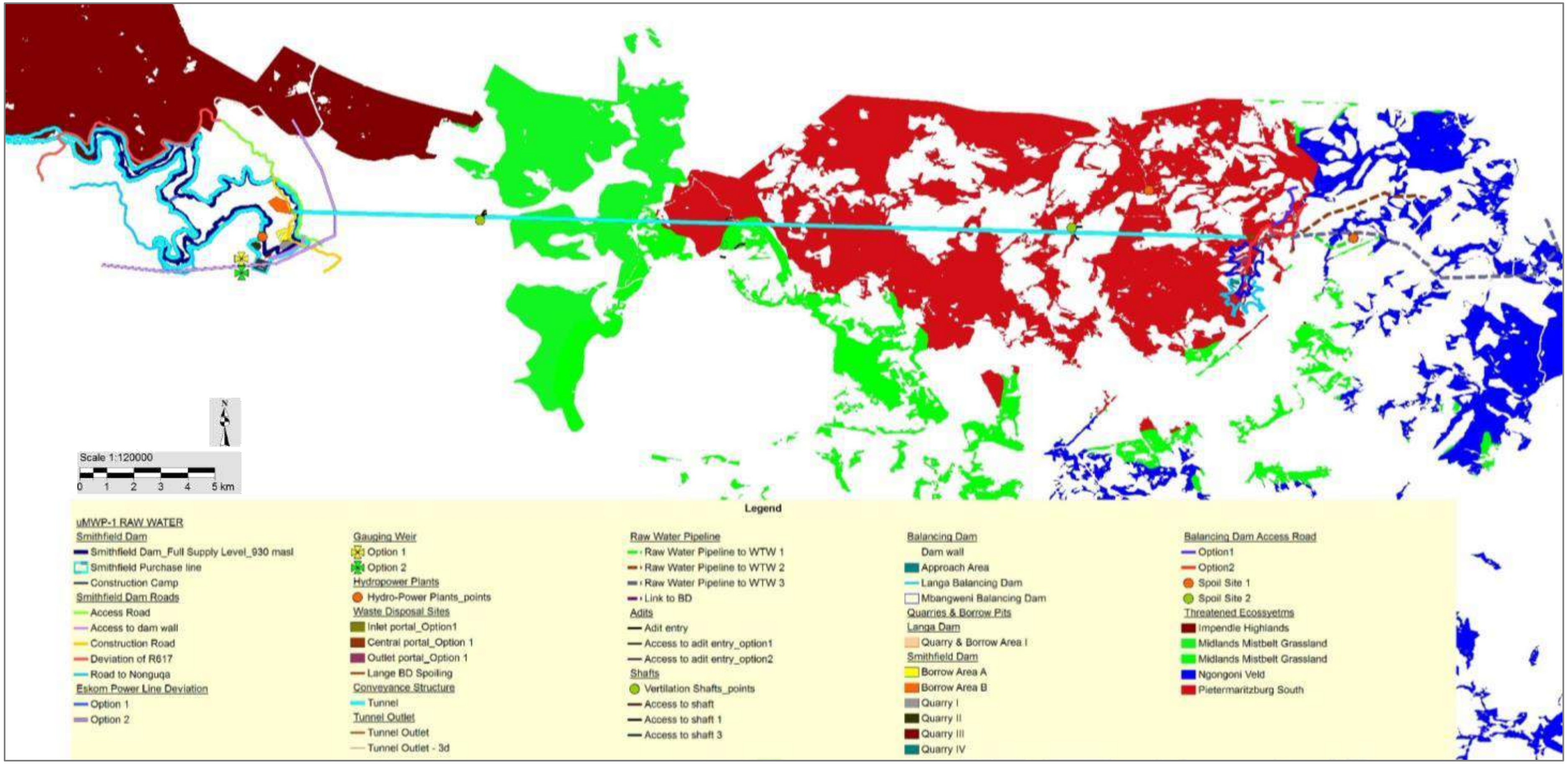


Figure 143: Threatened Ecosystems

- Threatened animal species associations; and
- Priority areas for meeting explicit biodiversity targets as defined in a systematic conservation plan.

In terms of section 52(1) (a), of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004), a national list of ecosystems that are threatened and in need of protection was gazetted on 9 December 2011, GN 1002 (http://bgis.sanbi.org/ecosystems/project.asp). The list classified all threatened or protected ecosystems in South Africa in terms of four categories; *Critically Endangered* (CR), *Endangered* (EN), *Vulnerable* (VU), or *Protected*. The purpose of categorising these ecosystems is to prioritise conservation areas to reduce the rates of ecosystem and species extinction, as well as preventing further degradation and loss of structure, function, and composition of these ecosystems. It is estimated that threatened ecosystems make up 9.5% of the South Africa, with critically endangered and endangered ecosystems accounting for 2.7%, and vulnerable ecosystems 6.8% of the land area. It is therefore vital that Threatened Terrestrial Ecosystems inform proactive and reactive conservation and planning tools (SANBI, 2009).

A description of each of the threatened ecosystems relevant to the project area follows.

- **Impendle Highlands** –

According to Goodman (2007), the key biodiversity features in this ecosystem include one amphibian species, *Afrixalus spinifrons intermedius*; two bird species including Blue Swallow and Wattled Crane; three millipede species including *Centrobolus rubricollis, Centrobolus tricolour* and *Doratogonus montanus*; three plant species *Hesperantha woodii* and *Kniphofia buchananii;* two reptile species including *Bradypodion bourquini* and *Bradypodion thamnobates*; and four vegetation types including Drakensberg Foothill Moist Grassland, Eastern Mistbelt Forest, Midlands Mistbelt Grassland and Southern KwaZulu-Natal Moist Grassland. Approximately 50% of the ecosystem is protected in the Impendle Nature Reserve. .

❖ **Pietermaritzburg South** –

According to Goodman (2007), key biodiversity features include two amphibian species, inlcuding *Arthroleptella ngongoniensis* and *Leptopelis xenodactylus*; one bird species, the Blue Swallow; one mammal species, the Oribi; eight millipede species including *Centrobolus decoratus, Centrobolus lawrencei, Centrobolus tricolor, Doratogonus avius, Doratogonus cristulatus, Doratogonus hoffmani, Doratogonus montanus* and *Doratogonus natalensis*; six plant species including *Dierama reynoldsii, Geranium natalense, Gerbera aurantiaca, Hesperantha woodii, Plectranthus rehmannii* and *Senecio exuberans*; one reptile species, *Bradypodion bourquini*; and four vegetation types including Drakensberg Foothill Moist Grassland, Eastern Mistbelt Forest, Midlands Mistbelt Grassland and Ngongoni Veld. This ecosystem is not protected in any of the game or nature reserves.

❖ **Midlands Mistbelt Grassland**

This vegetation type occurs in the KwaZulu-Natal and Eastern Cape provinces. This area is a hilly and rolling landscape, characterised by an east facing scarp formed by dolerite intrusions. This vegetation type is dominated by forb-rich, tall, sour *Themeda triandra* grasslands that have been transformed by the invasion of *Aristida junciformis* subsp. *junciformis.* This vegetation type is classified as **Endangered** (one of the most threatened vegetation types in KwaZulu-Natal) by Mucina and Rutherford (2006), with a conservation target of 23% and only 0.5% statutorily conserved. More than 50% has already been transformed for plantations, cultivated land or by urban sprawl (Mucina and Rutherford, 2006).

❖ **Ngongoni Veld**

This threatened ecosystem is found in From Melmoth in the north to near Libode in the former Transkei including Eshowe, New Hanover, Camperdown, Eston, Richmond, Dumisa, Harding, Lusikisiki and the Libode area. It is dominated by dense, tall grassland and is characterised by unpalatable, wiry Ngongoni grass (*Aristida junciformis*), with this mono-dominance associated with low species diversity. Wooded areas (thornveld) are found in valleys at lower altitudes, where this ecosystem grades into KwaZulu-Natal Hinterland Thornveld and Bhisho Thornveld. Termitaria support bush clumps with, for example, *Acacia* species, *Cussonia spicata*, *Ziziphus mucronata, Coddia rudis* and *Ehretia rigida*. Less than 1% of the ecosystem is protected in the Ophathe and Vernon Crookes Nature Reserves (Rutherford *et al.,* 2006)

10.9.1.5 Biodiversity Sector Plans

Biodiversity Sector Plans have been developed for both the Harry Gwala DM and uMgungundlovu DM (see maps contained in **Figures 144** and **145**, respectively). A Biodiversity Sector Plan is informed by the provincial conservation priorities of EKZNW Wildlife's Systematic Conservation Planning products, but which are further tailored to the district through additional information sources to develop CBAs, ESAs and associated land use guidelines. The Biodiversity Sector Plan then feeds into the development of a Bioregional Plan, a legislated requirement by the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).

Amongst others, the Biodiversity Sector Plans serve to provide a spatial dataset and common point of reference to inform municipal planning regarding land use and biodiversity management, land use change decision making and the development of planning frameworks, such as IDPs, SDFs, Environmental Management Frameworks, SEA and also EIAs.

According to the Biodiversity Sector Plan of the Harry Gwala DM, parts of the project infrastructure at Smithfield Dam as well as sections of the tunnel route traverse CBA 3 Optimal. The deviation of the R617 passes through a CBA irreplaceable, which are the sections of the proposed new road alignment through the Impendle Nature Reserve.

The uMgungundlovu DM Biodiversity Sector Plan shows the project infrastructure to encroach onto CBA irreplaceable, CBA optimal and ESA corridors.

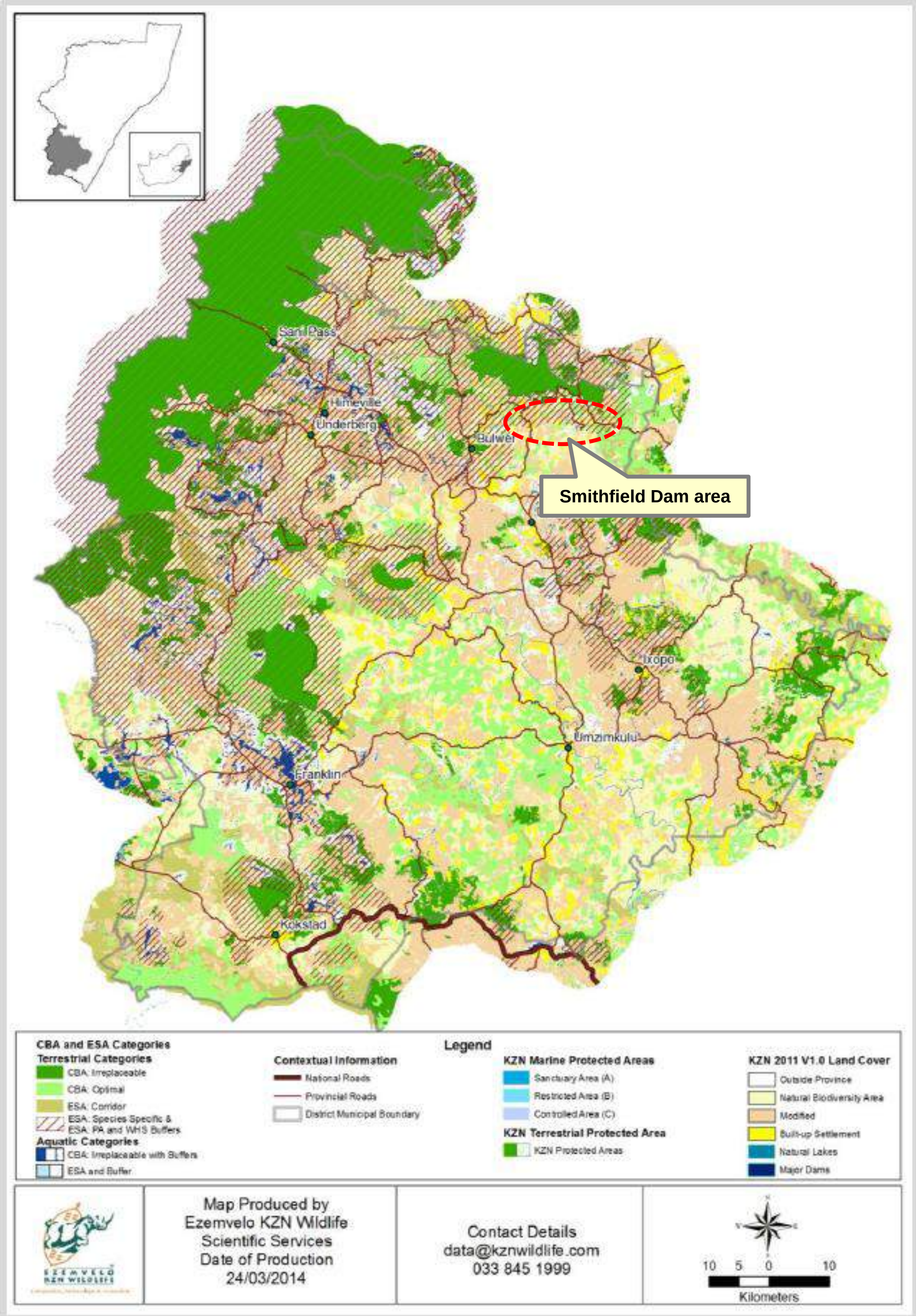


Figure 144: Harry Gwala DM Biodiversity Sector Plan Map (EKZNW, 2014a)

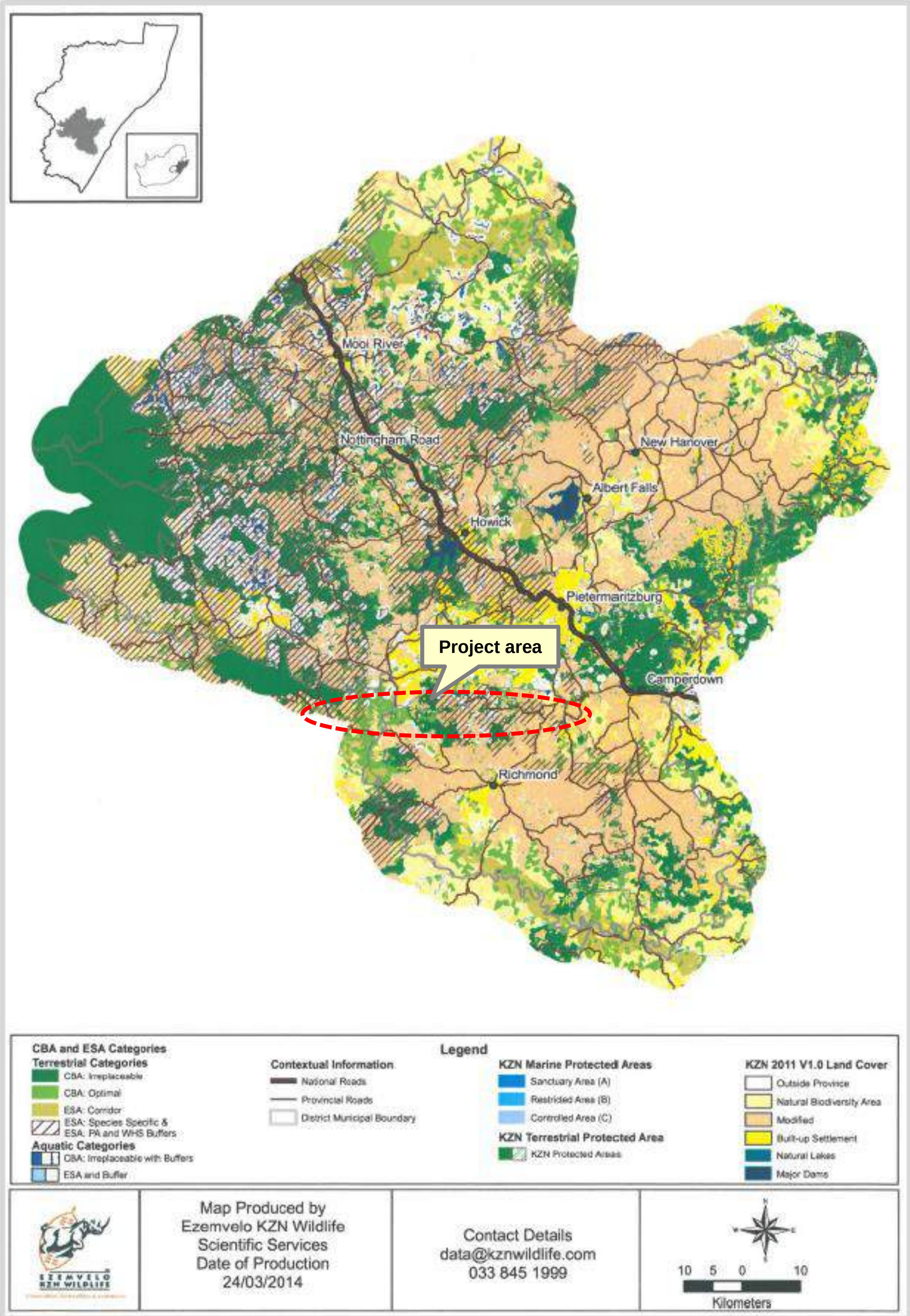


Figure 145: uMgungundlovu DM Biodiversity Sector Plan Map (EKZNW, 2014b)

10.9.2 Fauna

10.9.2.1 Mammals

The mammal species that have been recorded in the grid cells 2929DB, 2929DD, 2930CC and 2930CD (Animal Demography Unit, 2015b) are listed in **Table 63**. According to this list, Oribi, Blue Duiker, Serval, Ground Pangolin, Honey Badger, Anchieta's Pipistrelle and Botswanan Long-eared Bat were mammal species of conservation importance known to occur in the region. Due to the habitat disturbance and human interactions in some parts of the study area, the list is likely to overestimate the occurrence of mammal species in the area and thus should be viewed with a degree of caution. Parts of the proposed study area passes through the Impendle Nature Reserve and most of these species listed are found in the Reserve.

Table 63: Mammals recorded in 2929DB, 2929DD, 2930CC and 2930CD grid cells (Animal Demography Unit, 2015b)

Family	Genus	Species	Subspecies	Common name	Red list category	No. records	Atlas region endemic
Bathyergidae	*Cryptomys*	*hottentotus*		Southern African Mole-rat	Least Concern	4	Yes
Bathyergidae	*Georychus*	*capensis*		Cape Mole-rat	Least Concern	1	Yes
Bovidae	*Connochaetes*	*gnou*		Black Wildebeest	Least Concern	4	Yes
Bovidae	*Ourebia*	*ourebi*		Oribi	Endangered	12	Yes
Bovidae	*Pelea*	*capreolus*		Vaal Rhebok	Least Concern	2	Yes
Bovidae	*Aepyceros*	*melampus*		Impala	Least Concern	2	Yes
Bovidae	*Philantomba*	*monticola*		Blue Duiker	Vulnerable	1	Yes
Bovidae	*Tragelaphus*	*scriptus*		Bushbuck	Least Concern	2	Yes
Canidae	*Canis*	*mesomelas*		Black-backed Jackal	Least Concern	1	Yes
Cercopithecidae	*Papio*	*ursinus*		Chacma Baboon	Least Concern	56	Yes
Cercopithecidae	*Cercopithecus*	*pygerythrus*	*pygerythrus*	Vervet Monkey	Least Concern	1	
Chrysochloridae	*Amblysomus*	*hottentotus*		Hottentot Golden Mole	Data Deficient	3	Yes
Felidae	*Caracal*	*caracal*		Caracal	Least Concern	2	Yes
Felidae	*Felis*	*silvestris*		Wildcat	Least Concern	2	Yes
Felidae	*Leptailurus*	*serval*		Serval	Near Threatened	7	Yes
Felidae	*Panthera*	*pardus*		Leopard	Least Concern	4	Yes
Hyaenidae	*Proteles*	*cristata*		Aardwolf	Least Concern	2	Yes

Family	Genus	Species	Subspecies	Common name	Red list category	No. records	Atlas region endemic
Herpestidae	*Atilax*	*paludinosus*		Marsh Mongoose	Least Concern	1	Yes
Herpestidae	*Mungos*	*mungo*		Banded Mongoose	Least Concern	1	Yes
Leporidae	*Pronolagus*	*crassicaudatus*		Natal Red Rock Hare	Least Concern	1	Yes
Leporidae	*Lepus*	*saxatilis*		Scrub Hare	Least Concern	3	Yes
Manidae	*Smutsia*	*temminckii*		Ground Pangolin	Vulnerable	2	Yes
Muridae	*Mus*	*minutoides*		Southern African Pygmy Mouse	Least Concern	2	Yes
Muridae	*Otomys*	*laminatus*		KwaZulu Vlei Rat	Least Concern	1	Yes
Muridae	*Lemniscomys*	*rosalia*		Single-Striped Lemniscomys	Data Deficient	1	Yes
Muridae	*Mastomys*	*natalensis*		Natal Mastomys	Least Concern	26	
Muridae	*Otomys*	*angoniensis*		Angoni Vlei Rat	Least Concern	2	Yes
Muridae	*Aethomys*	*ineptus*		Tete Veld Aethomys	Least Concern	3	Yes
Muridae	*Rattus*	*rattus*		Roof Rat	Least Concern	1	
Muridae	*Rhabdomys*	*pumilio*		Xeric Four-striped Grass Rat	Least Concern	1	Yes
Mustelidae	*Mellivora*	*capensis*		Honey Badger	Near Threatened	1	Yes
Mustelidae	*Poecilogale*	*albinucha*		African Striped Weasel	Data deficient	1	Yes
Mustelidae	*Aonyx*	*capensis*		African Clawless Otter	Least Concern	1	Yes
Nesomyidae	*Dendromus*			African Climbing Mice	Not listed	1	
Nesomyidae	*Dendromus*	*mystacalis*		Chestnut African Climbing Mouse	Least Concern	3	Yes
Nesomyidae	*Dendromus*	*melanotis*		Gray African Climbing Mouse	Least Concern	1	Yes
Procaviidae	*Procavia*	*capensis*		Rock Hyrax	Least Concern	7	Yes
Soricidae	*Crocidura*	*cyanea*		Reddish-gray Musk Shrew	Data Deficient	1	Yes
Soricidae	*Crocidura*	*flavescens*		Greater Red Musk Shrew	Data Deficient	4	Yes
Soricidae	*Myosorex*	*cafer*		Dark-footed Mouse Shrew	Data Deficient	3	Yes
Soricidae	*Myosorex*	*varius*		Forest Shrew	Data Deficient	1	Yes
Vespertilionidae	*Hypsugo*	*anchietae*		Anchieta's Pipistrelle	Near Threatened	1	
Vespertilionidae	*Laephotis*	*botswanae*		Botswanan Long-eared Bat	Vulnerable	3	Yes
Viverridae	*Genetta*	*tigrina*		Cape Genet	Least Concern	1	Yes

Table 64 indicates the probability of occurrence of red data mammal species in the region based on the presence of suitable habitat.

Table 64: Probability of occurrence of red data listed mammal species with suitable habitat

Common name	Red list category	Suitable habitat	Probability of occurrence
Oribi	Endangered	Inhabits open grasslands, preferring habitats with short grasses on which to graze, interspersed with tall grasses for hiding in.	Found in Impendle NR and also on grasslands on Baynesfield Estate
Blue Duiker	Vulnerable	Inhabits a wide range of forest and wooded habitats, including lowland rainforest, gallery forest, coastal scrub farmland, dense thicket and montane forest up to elevations of 3,000 metres. It is found in both primary and secondary forest and can also survive in small patches of modified or degraded forest and thicket, including close to human settlements	Likely
Serval	Near Threatened	A Serval's habitat ranges from tall grasslands, savannas, woods, brushes, forests and marsh.	Likely
Ground Pangolin	Vulnerable	Inhabits savanna and woodland, avoiding desert or forest. They are surprisingly capable swimmers and are often found living near a water source	Maybe
Honey Badger	Near Threatened	The honey badger may be found in a vast diversity of habitats, from harsh scrublands and savannas to lush tropical rainforests. It is a very opportunistic creature and so is able to survive in most conditions.	Likely
Anchieta's Pipistrelle	Near Threatened	This species is typically associated with dry and moist savanna.	Likely
Botswanan Long-eared Bat	Vulnerable	Animals have been recorded from dry and moist savanna, and heathland habitats. It is often found in the vicinity of rivers and prefers habitats at higher elevations.	Likely

10.9.2.2 Reptiles

According to the Animal Demography Unit (2015c), the reptiles listed in **Table 65** have been recorded in the 2929DB, 2929DD, 2930CC and 2930CD grid cells. According to the list, Natal Black Snake, KwaZulu Dwarf Chameleon, Natal Midlands Dwarf Chameleon and Large-scaled Grass Lizard are the reptiles' species of conservation importance known to occur in the region (grid cells).

Table 65: Reptiles recorded in 2929DB, 2929DD, 2930CC and 2930CD grid cells (Animal Demography Unit, 2015c)

Family	Genus	Species	Subspecies	Common name	Red list category	Atlas region endemic
Agamidae	*Agama*	*atra*		Southern Rock Agama	Least Concern (SARCA 2014)	
Atractaspididae	*Atractaspis*	*bibronii*		Bibron's Stiletto Snake	Least Concern (SARCA 2014)	
Atractaspididae	*Macrelaps*	*microlepidotus*		Natal Black Snake	Near Threatened (SARCA 2014)	Yes
Boidae	*Python*	*natalensis*		Southern African Python	Least Concern (SARCA 2014)	
Chamaeleonidae	*Bradypodion*	*melanocephalum*		KwaZulu Dwarf Chameleon	Vulnerable (SARCA 2014)	Yes
Chamaeleonidae	*Bradypodion*	*thamnobates*		Natal Midlands Dwarf Chameleon	Vulnerable (SARCA 2014)	Yes
Colubridae	*Boaedon*	*capensis*		Brown House Snake	Least Concern (SARCA 2014)	
Colubridae	*Duberria*	*lutrix*	*lutrix*	South African Slug-eater	Least Concern (SARCA 2014)	Yes
Colubridae	*Lycodonomorphus*	*inornatus*		Olive House Snake	Least Concern (SARCA 2014)	Yes
Colubridae	*Lycophidion*	*capense*	*capense*	Cape Wolf Snake	Least Concern (SARCA 2014)	
Colubridae	*Philothamnus*	*natalensis*	*occidentalis*	Western Natal Green Snake	Least Concern (SARCA 2014)	Yes
Colubridae	*Psammophis*	*crucifer*		Cross-marked Grass Snake	Least Concern (SARCA 2014)	
Colubridae	*Psammophylax*	*rhombeatus*	*rhombeatus*	Spotted Grass Snake	Least Concern (SARCA 2014)	
Cordylidae	*Chamaesaura*	*macrolepis*		Large-scaled Grass Lizard	Near Threatened (SARCA 2014)	
Cordylidae	*Pseudocordylus*	*melanotus*	*subviridis*	Drakensberg Crag Lizard	Least Concern (SARCA 2014)	Yes
Gekkonidae	*Lygodactylus*	*capensis*	*capensis*	Common Dwarf Gecko	Least Concern (SARCA 2014)	
Gerrhosauridae	*Gerrhosaurus*	*flavigularis*		Yellow-throated Plated Lizard	Least Concern (SARCA 2014)	
Lacertidae	*Nucras*	*lalandii*		Delalande's Sandveld Lizard	Least Concern (SARCA 2014)	Yes
Lacertidae	*Tropidosaura*	*montana*	*natalensis*	Natal Mountain Lizard	Not listed	
Pelomedusidae	*Pelomedusa*	*subrufa*		Central Marsh Terrapin	Least Concern (SARCA 2014)	
Scincidae	*Trachylepis*	*punctatissima*		Speckled Rock Skink	Least Concern (SARCA 2014)	
Scincidae	*Trachylepis*	*homalocephala*		Red-sided Skink	Least Concern (SARCA 2014)	Yes
Typhlopidae	*Afrotyphlops*	*bibronii*		Bibron's Blind Snake	Least Concern (SARCA 2014)	
Viperidae	*Bitis*	*arietans*	*arietans*	Puff Adder	Least Concern (SARCA 2014)	

Table 66 indicates the probability of occurrence of red data reptile species in the region based on the presence of suitable habitat.

Table 66: Probability of occurrence of red data listed reptile species with suitable habitat

Species	Scientific name	Suitable habitat	Probability of Occurrence
Natal Black Snake	*Macrelaps microlepidotus*	Only found on the KZN East Coast. Its favoured habitat is lowland forest and Coastal bush (it's also often found in urban gardens).	Likely
Kwa-Zulu Dwarf Chameleon	*Bradypodion melanocephalum*	Indian Ocean Coastal Belt and Savanna Biomes where it is found in coastal forest, riverine bush and reed beds.	Likely
Large-scaled Grass Lizard	*Chamaesaura macrolepis*	Grassveld and mountain plateaus	Likely
Natal Midlands Dwarf Chameleon	*Bradypodion thamnobates*	This chameleon is native to woodland habitat in the Midlands area of KZN. It is found between Balgowan and Rosetta in the KZN Midlands.	Likely

10.9.2.3 Amphibians

According to the Frog Atlas of Southern African (Animal Demography Unit, 2015a), the frog species listed in **Table 67** have been recorded in the 2929DB, 2929DD, 2930CC and 2930CD grid cells. Red data frog species that are known to occur in the region include the Longtoed Tree Frog, Natal Leaf-folding Frog, and Mistbelt or Ngongoni Moss Frog. **Table 67** indicates frogs that were recorded in grid cells 2929DB, 2929DD, 2930CC and 2930CD.

Table 67: Amphibian species recorded in 2929DB, 2929DD, 2930CC and 2930CD grid cells (Animal Demography Unit, 2015a)

Family	Genus	Species	Common name	Red list category	No. records	Atlas region endemic
Arthroleptidae	*Arthroleptis*	*wahlbergi*	Bush Squeaker	Least Concern	1	
Arthroleptidae	*Leptopelis*	*natalensis*	Forest Tree Frog	Least Concern	1	
Arthroleptidae	*Leptopelis*	*xenodactylus*	Longtoed Tree Frog	Endangered	4	Yes
Brevicepitidae	*Breviceps*	*verrucosus*	Plaintive Rain Frog	Least Concern	5	
Brevicepitidae	*Breviceps*	*adspersus*	Bushveld Rain Frog	Least Concern	1	
Bufonidae	*Amietophrynus*	*gutturalis*	Guttural Toad	Least Concern	5	
Bufonidae	*Amietophrynus*	*rangeri*	Raucous Toad	Least Concern	7	
Bufonidae	*Schismaderma*	*carens*	Red Toad	Least Concern	1	
Hyperoliidae	*Afrixalus*	*spinifrons*	Natal Leaf-folding Frog	Vulnerable	5	

Family	Genus	Species	Common name	Red list category	No. records	Atlas region endemic
Hyperoliidae	*Hyperolius*	*marmoratus*	Painted Reed Frog	Least Concern	3	
Hyperoliidae	*Kassina*	*senegalensis*	Bubbling Kassina	Least Concern	6	
Hyperoliidae	*Semnodactylus*	*wealii*	Rattling Frog	Least Concern	1	
Hyperoliidae	*Hyperolius*	*pusillus*	Water Lily Frog	Least Concern	1	
Hyperoliidae	*Hyperolius*	*semidiscus*	Yellowstriped Reed Frog	Least Concern	3	
Hyperoliidae	*Hyperolius*	*tuberilinguis*	Tinker Reed Frog	Least Concern	1	
Pipidae	*Xenopus*	*laevis*	Common Platanna	Least Concern	4	
Phrynobatrachidae	*Phrynobatrachus*	*natalensis*	Snoring Puddle Frog	Least Concern	1	
Ptychadenidae	*Ptychadena*	*oxyrhynchus*	Sharpnosed Grass Frog	Least Concern	2	
Pyxicephalidae	*Amietia*	*fuscigula*	Cape River Frog	Least Concern	1	
Pyxicephalidae	*Amietia*	*quecketti*	Drakensberg River Frog	Least Concern	8	Yes
Pyxicephalidae	*Anhydrophryne*	*hewitti*	Hewitt's Moss Frog	Least Concern	1	
Pyxicephalidae	*Anhydrophryne*	*ngongoniensis*	Mistbelt or Ngongoni Moss Frog	Critically Endangered	3	Yes
Pyxicephalidae	*Cacosternum*	*boettgeri*	Common Caco	Least Concern	2	
Pyxicephalidae	*Cacosternum*	*nanum*	Bronze Caco	Least Concern	4	
Pyxicephalidae	*Cacosternum*	*striatum*	Stiped Caco	Data Deficient	1	Yes
Pyxicephalidae	*Strongylopus*	*fasciatus*	Striped Stream Frog	Least Concern	3	
Pyxicephalidae	*Strongylopus*	*grayii*	Clicking Stream Frog	Least Concern	3	
Pyxicephalidae	*Tomopterna*	*natalensis*	Natal Sand Frog	Least Concern	3	

Table 68 indicates the probability of occurrence of red data frog species in the region based on the presence of suitable habitat.

Table 68: Probability of occurrence of red data listed frog species with suitable habitat

Species	Scientific name	Suitable habitat	Probability of Occurrence
Longtoed Tree Frog	*Leptopelis xenodactylus*	It is found in temperate grassland, swamps, freshwater marshes, and intermittent freshwater marshes.	Likely
Natal Leaf-folding Frog	*Afrixalus spinifrons*	It is associated with low vegetation in shrubland and dry forest. It breeds in vleis (including dams) and temporary pools and pans (including roadside pools) and uses emergent vegetation to create egg nests.	Likely
Mistbelt or	*Anhydrophryne*	It is known from montane forest and, to a	Likely

Species	Scientific name	Suitable habitat	Probability of Occurrence
Ngongoni Moss Frog	*ngongoniensis*	lesser extent, high-altitude grassland. It appears to be strongly associated with riparian zones, and in grassland sites, with very dense vegetation. Most sites from which it has been recorded are surrounded by exotic tree plantations. It generally prefers steep slopes, close to seepages.	

10.9.2.4 Avifauna

An Avifaunal Study (**Appendix H8**) was conducted for the project. Refer to the summary and impact assessment of this study contained in **Sections 11.1.8** and **12.10**, respectively. An extract from this study follows.

It is necessary to provide a broader perspective on the study area in order to gain some understanding of the importance of the potential bird impacts on a national scale. What needs to be established is the relative importance of the study area for sensitive bird species, especially Red Listed species, as this will have a bearing both on the expected frequency of the impacts and the significance of those impacts. The following data sources were used in determining the distribution and abundance of bird species in the study area:

Southern African Bird Atlas Project 1 (SABAP 1 - Harrison *et al,* 1997) & 2 (SABAP2 – www.sabap2.adu.org.za) Data

The first atlas data was collected over an 11 year period between 1986 and 1997. Although it is now quite old, it remains the best long term data set on bird distribution and abundance available to us at present. This data was collected on the basis of quarter degree squares, which is a relatively large spatial scale. The more recent SABAP2 collected data on the basis of pentads which are roughly 8km x 8km squares, and are hence much smaller than the quarter degree squares used in SABAP 1. This project is ongoing and as more counts are done in each pentad the data becomes available.

A full list of approximately 450 bird species recorded in the broader area within which this site falls, by the above two atlas projects, has been compiled. **Table 69** details the Red List bird species amongst these. Using this information in combination with the above assessment of the habitat on site and various other factors, an assessment can be made of the likelihood of each species occurring on the site itself. This has been presented in **Table 69**.

Important Bird Areas

Important Bird Areas are classified on the basis of the following criteria:

- The site regularly holds significant numbers of a globally threatened species;
- The site is thought to hold, a significant component of a group of species whose breeding distributions define an Endemic Bird Area (EBA) or Secondary Area; and
- The site is known or thought to hold a significant component of a group of species whose distributions are largely or wholly confined to one biome.

Two important Bird Areas are relevant to this study: the Impendle Nature Reserve SA077 and the KwaZulu-Natal Mistbelt Grasslands SA078. **Figure 146** shows the location of these IBA's relative to the proposed project. These IBA's are each described in more detail below using information sourced from www.birdlife.org.za:

- **SA077** is a nature reserve and consists mostly of grassland. Up to 8 pairs of Blue Swallow breed here. Other important bird species include: African Marsh Harrier *Circus ranivorus*, Grey Crowned Crane *Balearica regulorum;*. Blue Crane *Anthropoides paradiseus*, Denham's Bustard *Neotis denhami*, Southern Ground-Hornbill *Bucorvus leadbeateri;* Black-winged Lapwing *Vanellus melanopterus*; Southern Bald Ibis *Geronticus calvus.* Bush Blackcap *Lioptilus nigricapillus*; Orange Ground Thrush *Zoothera gurneyi*, Knysna Turaco *Tauraco corythaix* and Forest Canary *Crithagra scotops* occur in the forest sections.
- **SA078** consists of several smallish polygons which together amount to approximately 5 000 hectares. The main criterion for identifying these areas was the presence of viable units of mistbelt grassland. Most of these polygons support Blue Swallows (described in more detail later in this section) and the area encompassed by this IBA holds one of the highest concentrations of

breeding Blue Swallows in southern Africa. Additional important species include: Denham's Bustard; Southern Bald Ibis; Black Stork *Ciconia Nigra*; the 3 crane species Wattled, Blue and Grey Crowned; Secretarybird; Black-winged Lapwing *Vanellus melanopterus;* Corncrake *Crex crex;* Striped Flufftail *Sarothrura affinis;* Cape Vulture; Martial Eagle and Black Harrier.

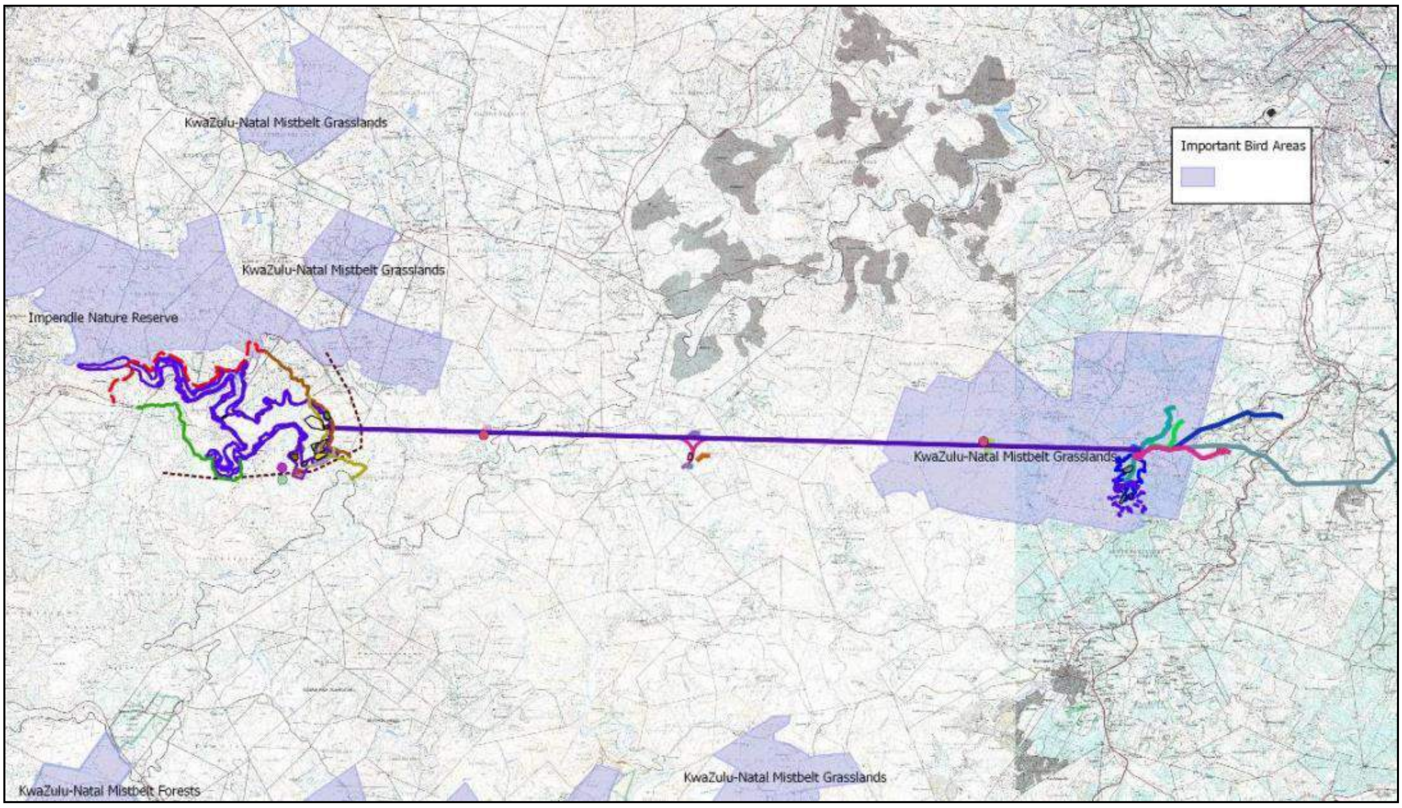


Figure 146: The position of Important Bird Areas relative to the proposed infrastructure (Wildskies, 2015)

EKZNW Terrestrial Systematic Conservation Plan Data (EKZNW 2010)

This conservation planning exercise identified planning units across the province based on species occurring in those units and requiring conservation attention. **Figure 147** shows the relevant units for this project. Those units identified primarily on the basis of bird species are shown in grey, which are the majority of the units along this alignment. These units were identified as important on the basis of Wattled Crane (historic sites), Blue Crane, Blue Swallow, Cape Parrot, and Grey Crowned Crane. Many of these polygons are also classified by EKZNW as 'Irreplaceability 1' areas. This means that EKZNW were unable to find any other localities which may act as alternates to try and meet the conservation target for these particular species. It must be emphasised that the Wattled Crane polygons in **Figure 147** were identified on the basis of historic Wattled Crane occurrence, and this species is not believed to occur in these areas currently.

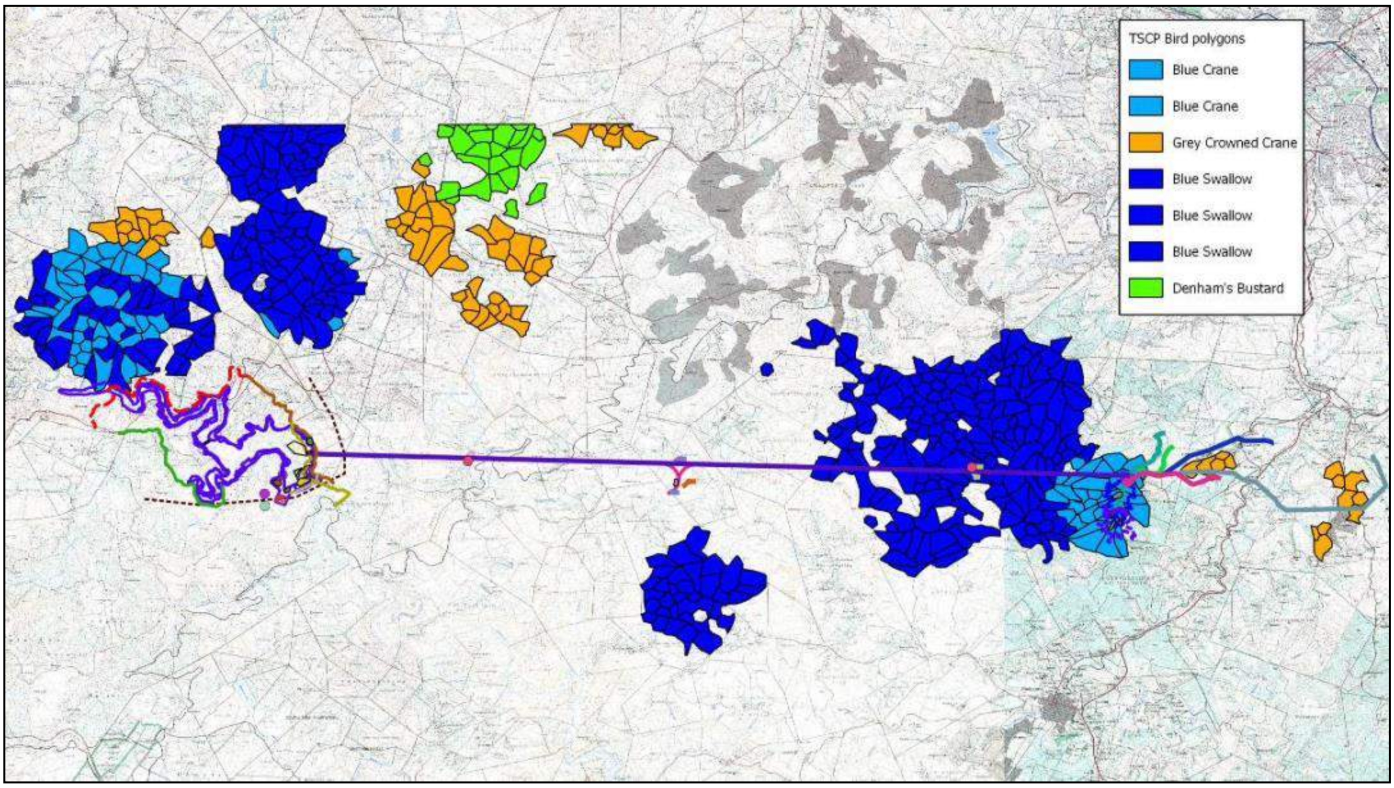


Figure 147: Terrestrial Systematic Conservation Plan Data – Polygons identified on the basis of bird features (Wildskies, 2015)

EKZNW Blue Swallow habitat model (2014)

Figure 148 presents the results of a Blue Swallow habitat modelling exercise conducted by EKZNW. This exercise identified potential Blue Swallow breeding habitat on the basis of several parameters. Polygons were classified according to the likelihood of being used by swallows, ranging from 60% to 90%. This is an index of the suitability of the habitat, and does not in any way guarantee the sites use by this species. With a species as critically threatened it is important to conserve potential habitat in addition to currently used habitat. This species also serves as an important indicator or flagship species for mistbelt grassland and so areas important for the swallow are also important for various other mistbelt associated biodiversity, although this is beyond the scope of this particular report. It is clear that many of these potential areas are situated in the eastern parts of the current study area. Of particular interest, and in addition to findings associated with other data sources in this study, it is evident (although not clear in **Figure 148** due to scale) that the central outlet portal is sited in a polygon with a 60% likelihood of being used by Blue Swallows.

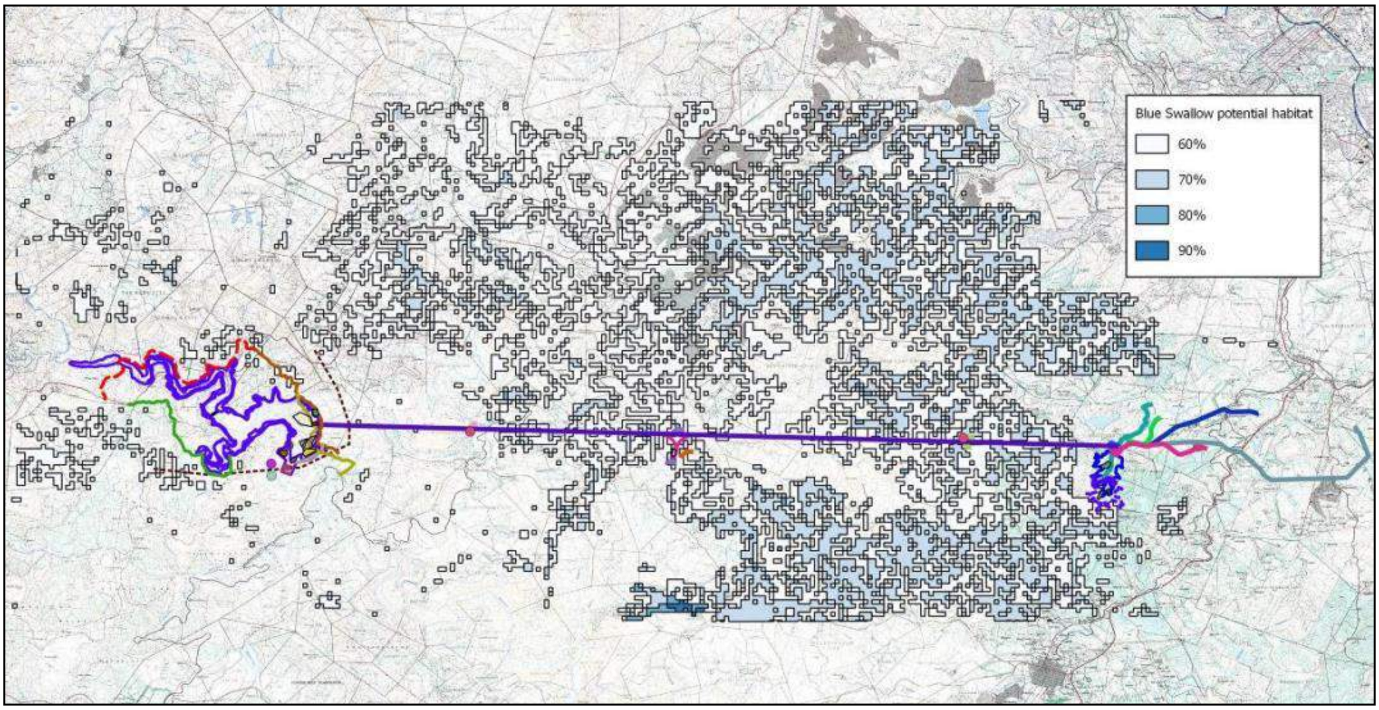


Figure 148: Potential Blue Swallow breeding habitat as modelled by EKZNW (2014). Identified polygons have a 60% or greater likelihood of being used by Blue Swallows, with darker polygons having greater likelihood (Wildskies, 2015)

Relevant sightings during field work

Field work attempted to view as much as possible of the site by vehicle and foot. Certain areas were not reachable, but overall a good understanding of the site was developed. Although as discussed elsewhere in this report, Blue Swallow breeding sites are central to this study, these were not specifically visited as there is already excellent existing data on their locations (Coverdale pers comm, 2014). The time could therefore be better spent visiting less well known areas to assess habitat. In addition, field work was constrained by visibility on two of the days, with low mist and rain. **Figure 149** below shows the Red Listed bird species sightings made during field work. This data should be used with caution as it is the product of a once off, short term site visit in which time was not allocated evenly to all parts of the site. More emphasis is therefore placed on the other longer term data sources described elsewhere in this report.

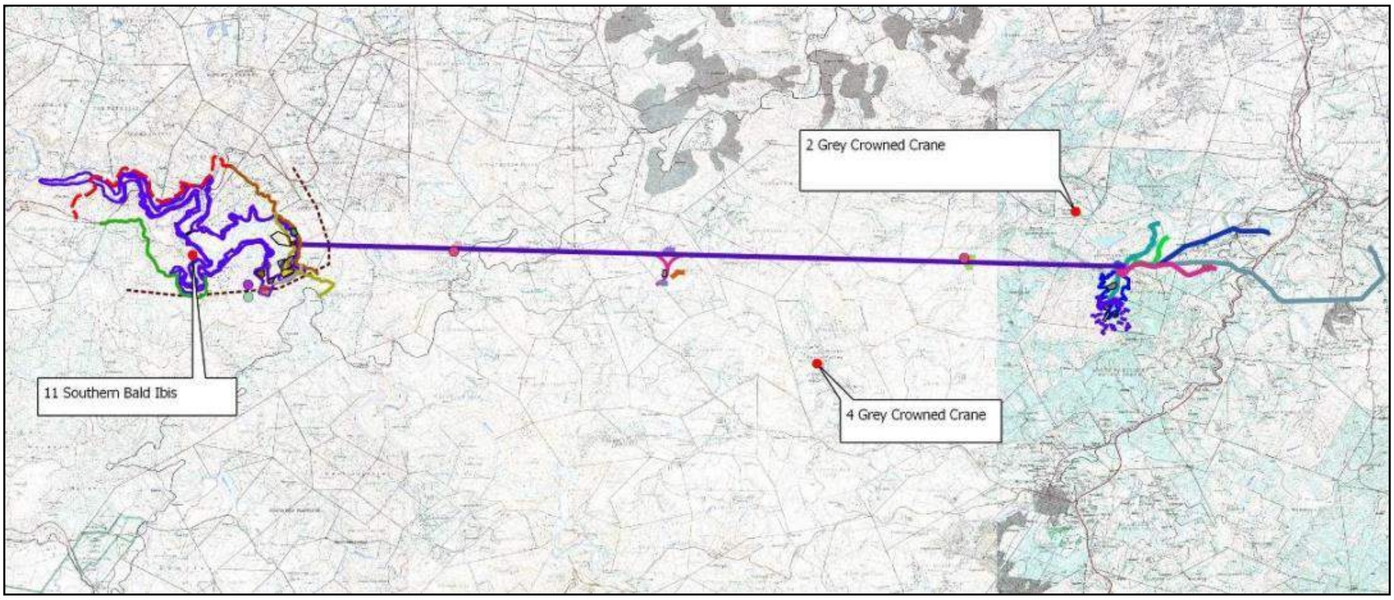


Figure 149: Relevant Red Listed bird species sightings recorded during field work for the Raw Water Module (Wildskies, 2015)

Taking the above described sources of information into account, it is believed that a total of 32 of the Red Listed species listed in **Table 69** could occur on site. This includes 1 Critically Endangered species, the Blue Swallow – which definitely occurs and breeds on site. The most important of these species have been shaded in grey in **Table 69**. These species are selected on the basis of: having the highest probability of utilising the site frequently; being of most concern in terms of conservation; most relevant to the specific impacts of this project; and being good representative species for suites of other less threatened species (such as Bush Blackcap and Cape Parrot representing all forest specialist species).

Table 69: The Red Listed bird species for the proposed project, their preferred microhabitats and possible interactions with the proposed development (Wildskies, 2015)

Common name	*Species name*	SABAP 1	SABAP 2	BARNES 2000	IUCN 2012	TOPS	Likelihood of occurring on site	Preferred micro habitat	Possible impacts
Crane, Wattled	*Bugeranus carunculatus*	X	X	CE	V	CE	Unlikely – no known breeding pairs or floater flocks on site	-	
Swallow, Blue	*Hirundo atrocaerulea*	X	X	CE	V	CE	Confirmed – several breeding pairs	Grassland	Disturbance Habitat destruction

Common name	*Species name*	SABAP 1	SABAP 2	BARNES 2000	IUCN 2012	TOPS	Likelihood of occurring on site	Preferred micro habitat	Possible impacts
Stork, Saddle-billed	*Ephippiorhynchus senegalensis*		X	E	LC	E	Unlikely	-	
Parrot, Cape	*Poicephalus robustus*	X		E	LC	CE	Possible in forest patches	Forest	Disturbance Habitat destruction
Buttonquail, Blackrumped	*Turnix hottentotta*	X		E	LC		Possible	Grassland	Disturbance Habitat destruction
Ground-Thrush, Spotted	*Zoothera guttata*	X		E	E		Unlikely	-	
Marsh-Harrier, African	*Circus ranivorus*	X	X	VU	LC	Protected	Probable	Grassland, wetland	Disturbance Habitat destruction
Crane, Blue	*Anthropoides paradiseus*	X	X	VU	V	E	Confirmed – at least one breeding pair	Grassland, wetland, arable lands, dams	Disturbance Habitat destruction Collision with overhead lines
Pipit, Short-tailed	*Anthus brachyurus*	X		VU	LC		Possible	Grassland	Disturbance Habitat destruction
Crane, Grey Crowned	*Balearica regulorum*	X	X	VU	E	E	Confirmed – several breeding pairs on site	Grassland, wetland, arable lands, dams	Disturbance Habitat destruction Collision with overhead lines
Pigeon, Eastern Bronze-naped	*Columba delegorguei*	X		VU	LC		Possible	Forest	Disturbance Habitat destruction
Crake, Corn	*Crex crex*	X	X	VU	LC		Possible	Grassland	Disturbance Habitat destruction
Korhaan, White-bellied	*Eupodotis senegalensis*	X		VU	LC		Possible	Grassland	Disturbance Habitat destruction Collision with overhead lines
Kestrel, Lesser	*Falco naumanni*	X	X	VU	LC	V	Probable	Grassland	Disturbance Habitat destruction
Ibis, Southern Bald	*Geronticus calvus*	X	X	VU	V	V	Confirmed during field work	Grassland	Disturbance Habitat destruction Collision with overhead lines
Bustard, Denham's	*Neotis denhami*	X	X	VU	NT	Protected	Probable	Grassland	Disturbance Habitat destruction Collision with overhead lines
Pelican, Pink-backed	*Pelecanus rufescens*	X	X	VU	LC	E	Unlikely	-	
Finfoot, African	*Podica senegalensis*		X	VU	LC		Possible	Riverine	Disturbance Habitat destruction
Eagle, Martial	*Polemaetus bellicosus*	X	X	VU	NT	V	Possible	Generalist	Disturbance Habitat destruction Collision with overhead lines Electrocution on overhead lines
Flufftail, Striped	*Sarothrura affinis*	X		VU	LC		Possible	Grassland	Disturbance Habitat destruction
Grass-Owl, African	*Tyto capensis*	X	X	VU	LC	V	Possible	Grassland, wetland	Disturbance Habitat destruction Collision with

Common name	*Species name*	SABAP 1	SABAP 2	BARNES 2000	IUCN 2012	TOPS	Likelihood of occurring on site	Preferred micro habitat	Possible impacts
									overhead lines
Kingfisher, Half-collared	*Alcedo semitorquata*	X	X	NT	LC		Possible	Riverine	Disturbance Habitat destruction
Openbill, African	*Anastomus lamelligerus*		X	NT	LC		Possible	Waterbodies, dams	Disturbance Habitat destruction Collision with overhead lines
Oxpecker, Red-billed	*Buphagus erythrorhynchus*		X	NT	LC		Unlikely	-	
Stork, Woolly-necked	*Ciconia episcopus*	X	X	NT	LC		Unlikely	-	
Stork, Black	*Ciconia nigra*	X	X	NT	LC	V	Possible	Riverine, cliff	Disturbance Habitat destruction Collision with overhead lines
Harrier, Black	*Circus maurus*	X	X	NT	V		Probable	Grassland, wetland	Disturbance Habitat destruction Collision with overhead lines
Falcon, Lanner	*Falco biarmicus*	X	X	NT	LC		Probable	Grassland, arable land	Disturbance Habitat destruction Collision with overhead lines
Falcon, Peregrine	*Falco peregrinus*	X	X	NT	LC	V	Probable	Grassland	Disturbance Habitat destruction Collision with overhead lines
Pratincole, Collared	*Gloriole pratincola*	X		NT	LC		Unlikely	-	
Stork, Marabou	*Leptoptilos crumeniferus*	X		NT	LC		Unlikely	-	
Blackcap, Bush	*Lioptilus nigricapillus*	X	X	NT	NT		Probable	Forest	Disturbance Habitat destruction
Bustard, Black-bellied	*Lissotis melanogaster*	X	X	NT	LC		Possible	Grassland and open woodland	Disturbance Habitat destruction Collision with overhead lines
Jacana, Lesser	*Microparra capensis*	X		NT	LC		Unlikely	-	
Stork, Yellow-billed	*Mycteria ibis*	X		NT	LC		Unlikely	-	
Pygmy-Goose, African	*Nettapus auritus*	X	X	NT	LC		Unlikely	-	
Pelican, Great White	*Pelecanus onocrotalus*	X		NT	LC		Unlikely	-	
Cormorant, Cape	*Phalacrocorax capensis*		X	NT	NT		Unlikely	-	
Flamingo, Lesser	*Phoenicopterus minor*	X	X	NT	NT		Unlikely	-	
Flamingo, Greater	*Phoenicopterus ruber*	X	X	NT	LC		Unlikely	-	
Wattle-eye, Black-throated	*Platysteira peltata*	X		NT	LC		Possible	Forest	Disturbance Habitat destruction
Secretarybird	*Sagittarius serpentarius*	X	X	NT	V		Probable	Grassland, arable land	Disturbance Habitat destruction Collision with overhead lines
Fan-tailed Grassbird	*Schoenicola brevirostris*	X	X	NT	LC		Possible	Grassland, wetland	Disturbance Habitat destruction

Common name	*Species name*	SABAP 1	SABAP 2	BARNES 2000	IUCN 2012	TOPS	Likelihood of occurring on site	Preferred micro habitat	Possible impacts
Eagle, African Crowned	*Stephanoaetus coronatus*	X	X	NT	NT		Probable	Forest	Disturbance Habitat destruction Collision with overhead lines Electrocution on overhead lines
Lapwing, Black-winged	*Vanellus melanopterus*	X	X	NT	LC		Possible	Grassland	Disturbance Habitat destruction
Ground-Thrush, Orange	*Zoothera gurneyi*	X	X	NT	LC		Possible	Forest	Disturbance Habitat destruction
Stork, White	*Ciconia ciconia*	X	X	BONN			Confirmed	Grassland, wetland, arable land	Disturbance Habitat destruction Collision with overhead lines

Note: E = Endangered; V = Vulnerable; NT = near-threatened, LC = least concern (Barnes, 2000; IUCN, 2012); TOPS = Threatened or Protected Species List – under NEMA.

10.10 Protected Areas

10.10.1 Provincial Nature Reserves

The proximity of the project infrastructure in the western part of the study area to the Impendle Nature Reserve is shown in **Figure 150**.

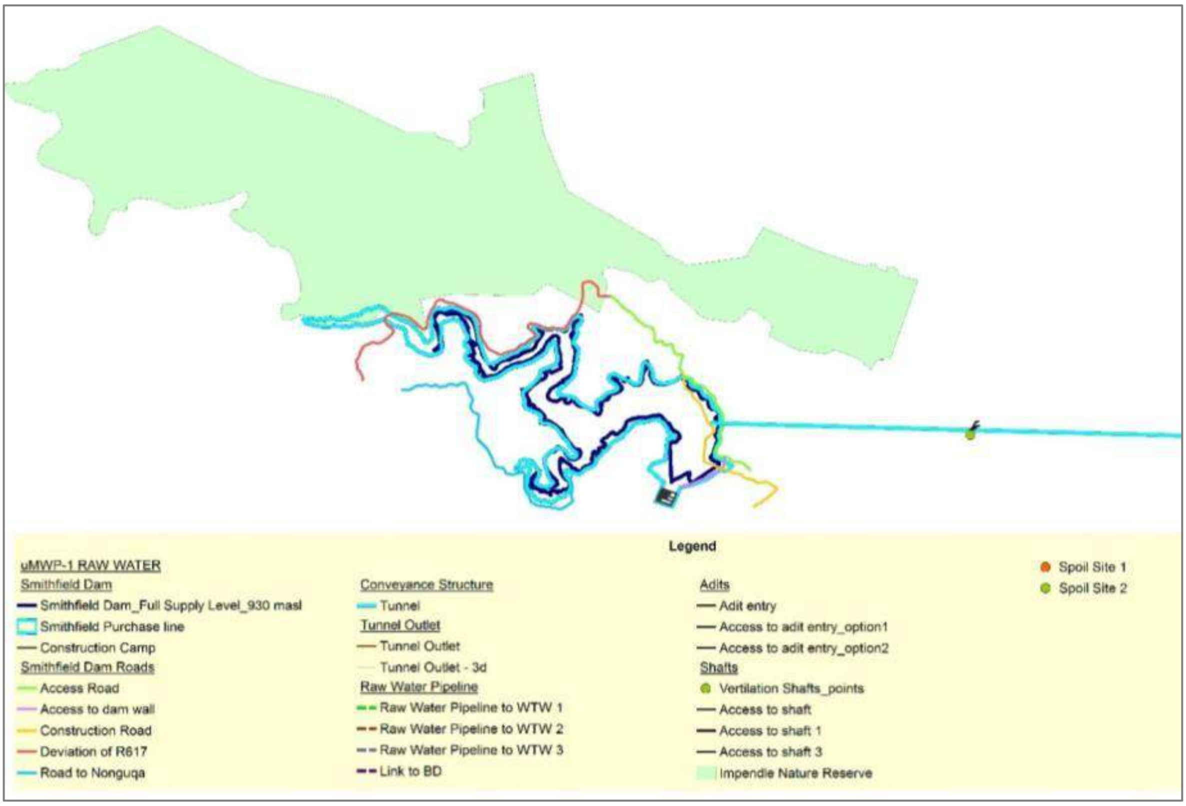


Figure 150: Protected areas (only western part of study area applies)

According to EKZNW (2012), the 8759 ha Impendle Nature Reserve is divided by the Underberg Road (R617) into a larger western and a smaller eastern section. To the south west of the Impendle Nature Reserve lies the Bulwer complex of forest reserves consisting of Indhloveni Nature Reserve (NR), Ingelabantwana NR, Marustwa NR, Marwaqa NR and Xotsheyake NR. The uMkhomazi River forms part of the southern boundary of the reserve and the protected area is an important part of the catchment of the uMkhomazi River with some tributaries of the river that originates within the Impendle Nature Reserve. The reserve plays a key role in conserving critically endangered Midlands Mistbelt Grassland. Two Critically Endangered species, the Blue swallow and Wattled cranes are present and breed in the area. A significant portion of South Africa's Blue swallow population breeds within the boundaries of Impendle Nature Reserve. The area is extremely rich in biodiversity and supply a range of ecosystem services which includes but is not limited to the protection of the hydrological system including a series of wetlands which forms part of the catchment of the uMkhomazi River.

The Impendle Nature Reserve is directly affected by the proposed deviation of the R617, which passes through the reserve in two areas, as shown in **Figure 151**. In addition, option 2 of the power line relocation crosses the Impendle Nature Reserve.

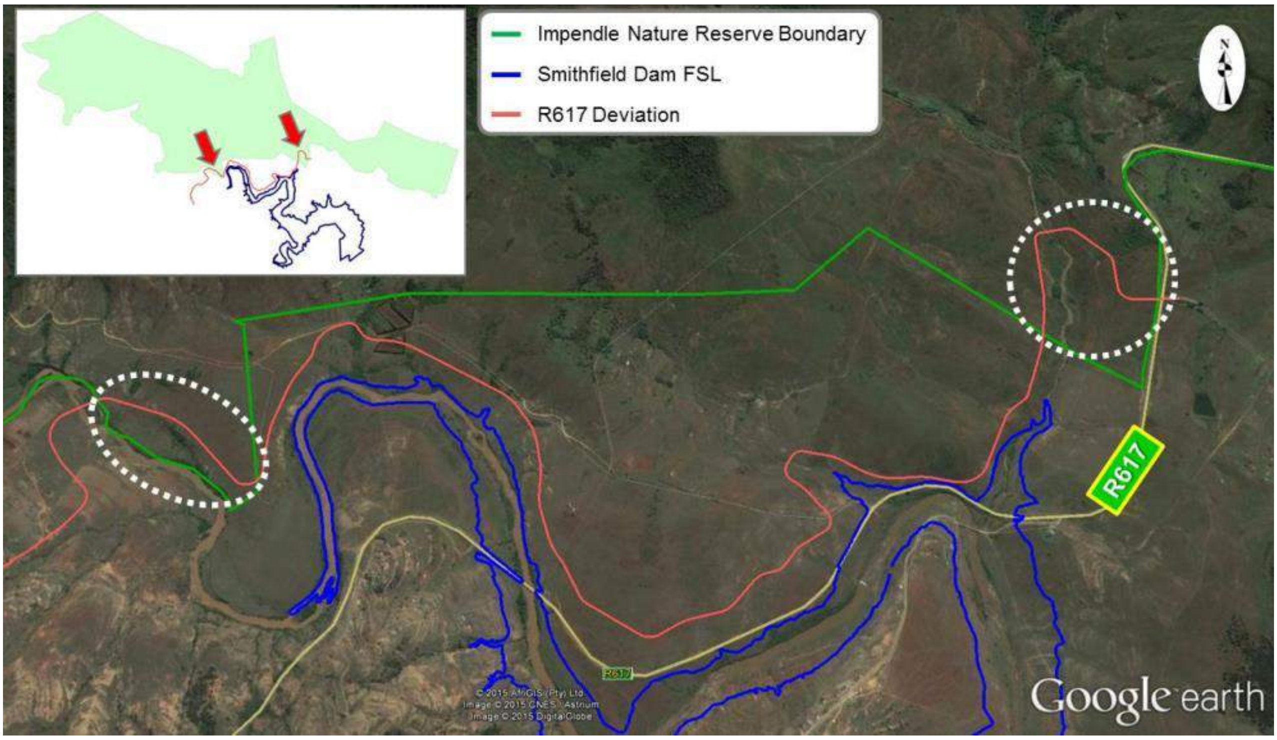


Figure 151: Encroachment of R617 deviation into Impendle Nature Reserve

10.10.2 Conservancies

Known conservancies that are traversed by the project infrastructure from west to east include (see **Figure 152**)

- Byrne Valley Conservancy;
- Baynesfield Conservancy; and
- Mkuzane Conservancy.

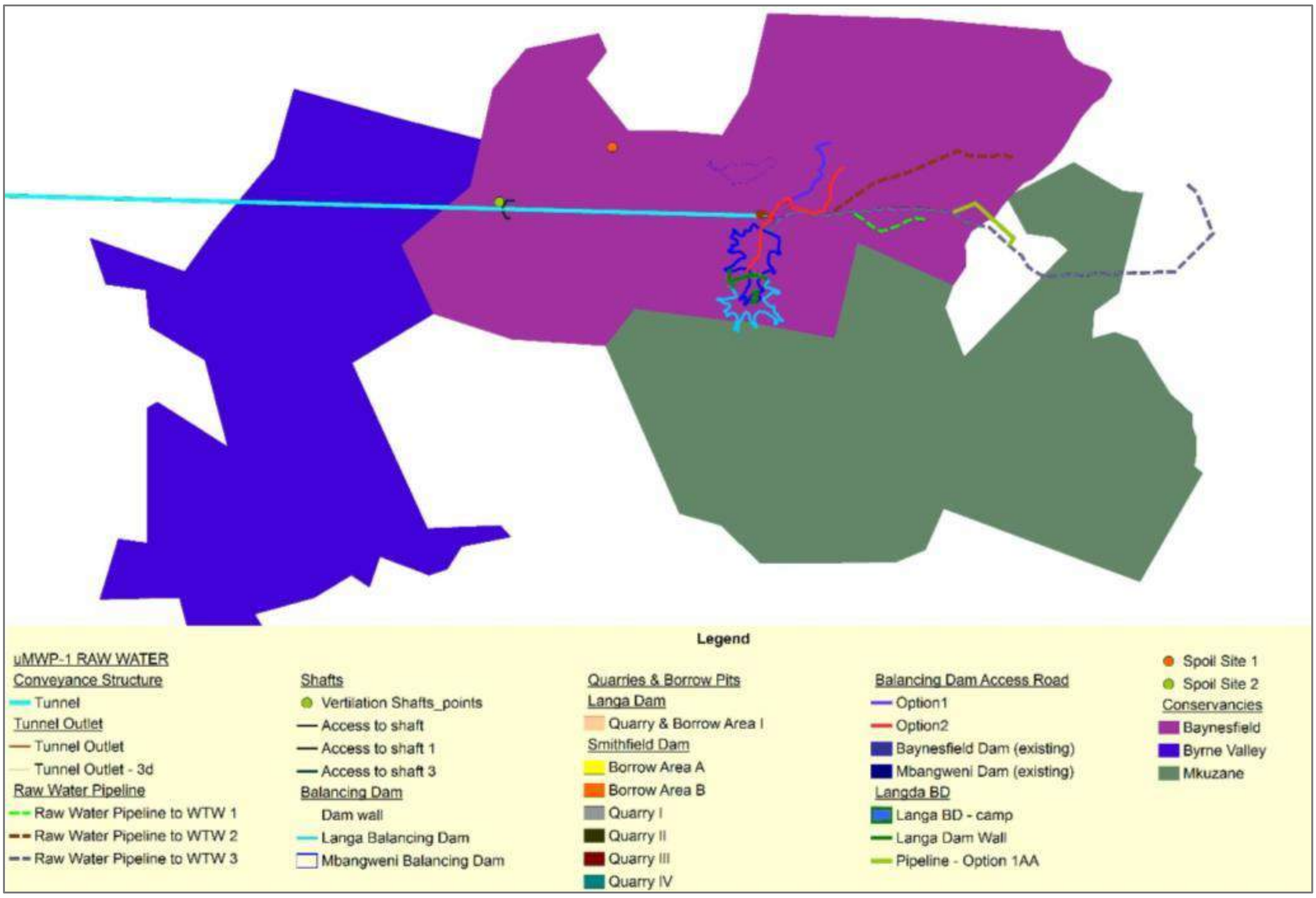


Figure 152: Conservancies

The Baynesfield Conservancy is involved in the conservation of the natural environment of Baynesfield Estate with a particular focus on maintaining the biodiversity of this environment. The conservancy encompasses the entire 9,300ha of Baynesfield Estate, including agricultural areas and commercial forests. A large part of the conservancy consists of mistbelt grasslands which are threatened. These grasslands are important habitats for 3 endangered species, namely the Oribi antelope, Blue Swallow and Hilton Daisy, all of which are found on Baynesfield Estate (http://www.baynesfield.co.za/social-responsibility/conservancy.aspx).

10.10.3 uKhahlamba World Heritage Site Buffer

As shown in **Figure 153**, the project footprint does not encroach on the uKhahlamba Drakensberg Park (UDP) World Heritage Site (WHS) Buffer Zone, except for the Upstream of Smithfield Dam Option 1 gauging weir site, which will be assessed under a separate EIA.

The UDP WHS Buffer Zone is an area outside the boundary of the protected area where actions are taken and agreements are made to protect the integrity of the protected area and to enhance the livelihoods of protected area neighbours. The zone serves to influence land use adjacent to the protected area to manage external pressures and threats that may jeopardise its values and objectives.

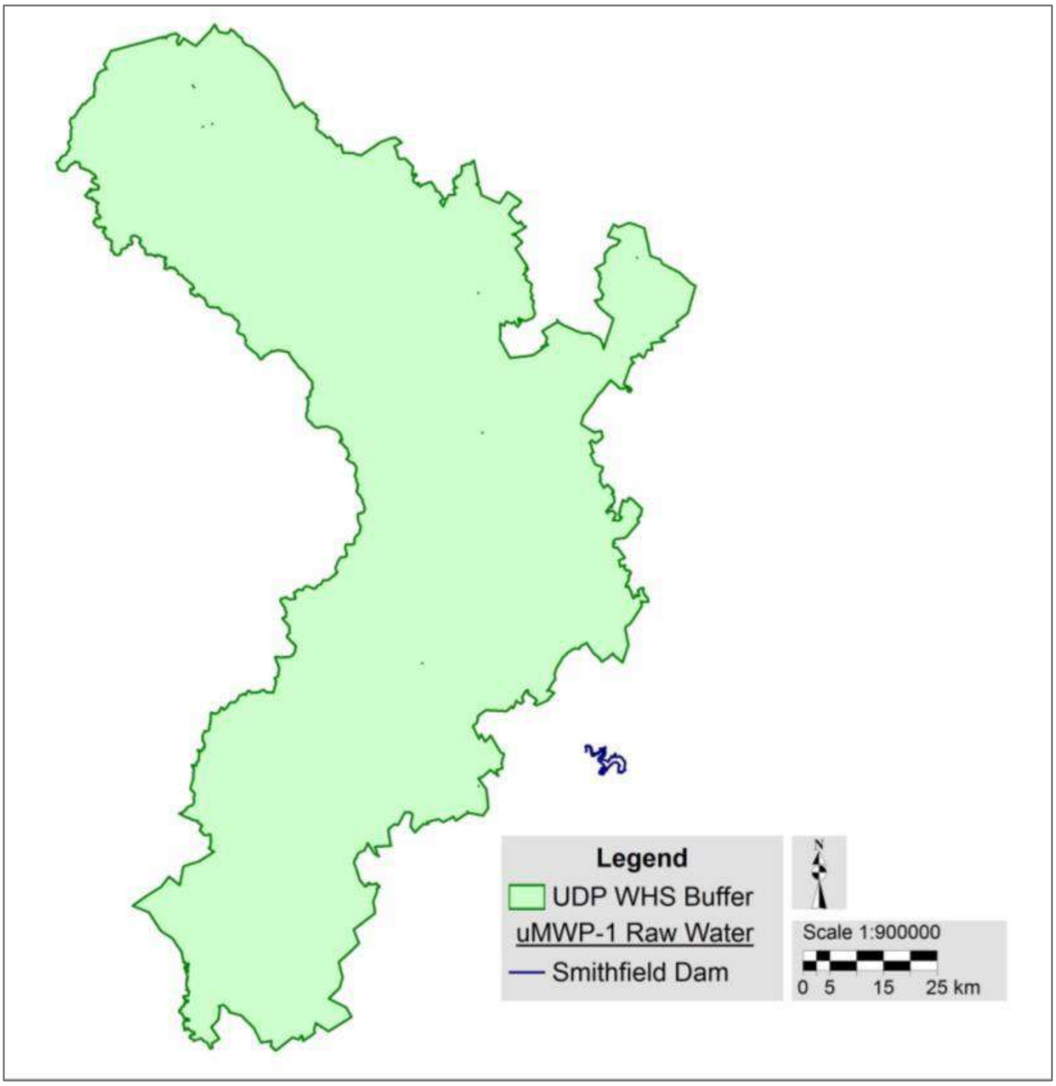


Figure 153: Project area in relation to UDP WHS Buffer Zone

10.11 Socio-Economic Environment

The following relevant specialist studies were conducted as part of the EIA:

- Socio-Economic Survey (**Appendix H6**);
- Socio-Economic Study (**Appendix H6**) - refer to the summary and impact assessment contained in **Sections 11.1.6** and **12.17**, respectively; and
- Social Impact Assessment (**Appendix H7**) - refer to the summary and impact assessment contained in **Sections 11.1.7** and **12.16**, respectively.

10.11.1 Smithfield Dam

The Traditional Authorities in the western part of the project area are shown in **Figure 154**. The footprint of the dam on the right-hand bank (south) of the uMkhomazi River is situated on land under the Zashuke and Bhidla Tribal Authorities. The majority of the basin on the left bank (north) inundates state land that is under the management of the Department of Rural Development and Land Reform.

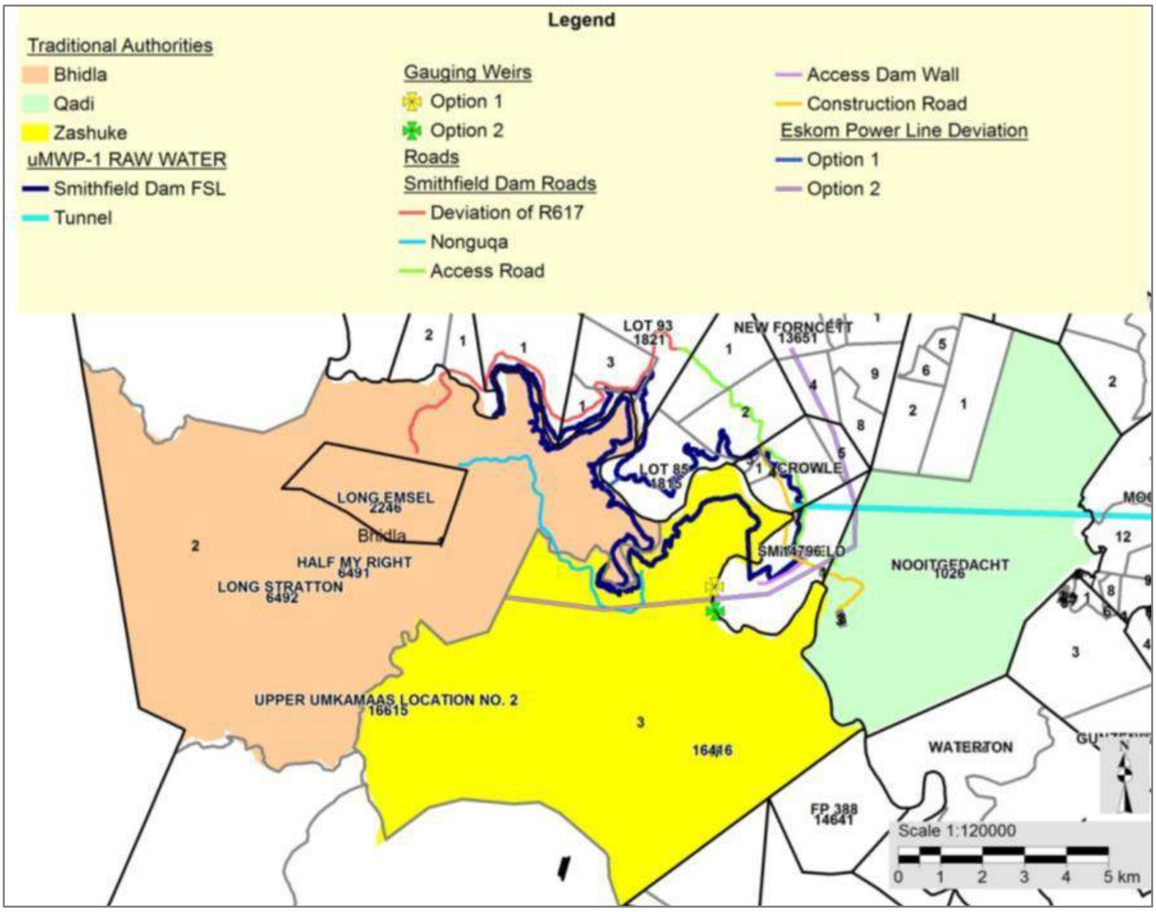


Figure 154: Traditional Authorities affected by the Smithfield Dam basin

The local economic activity is largely of a subsistence nature, specifically taking the form of food crop cultivation and livestock grazing. Formal employment opportunities are very limited and most of the local economic activity revolves around retailing and trading. In view of the limited local economic resources, there is a high reliance on outside employment and income sources. Migrant remittances and welfare transfers are two of the most important income sources in the uMkhomazi valley (DWAF, 1999f).

The area alongside the uMkhomazi River is used by the local community for sand excavations for brick and block making, gathering of firewood and building material, medicinal plants and material for handicrafts. The various ways in which the community utilises the river water is discussed in **Section 12.6.2**.

The land to be affected by Smithfield Dam consists of scattered traditional settlements, which have been influenced by geographical, biophysical and land tenure features. A detailed logging of dwellings and structures that are situated within the dam's FSL and buffer zone was undertaken as part of the Socio-Economic Survey (see **Appendix H6**), which fed into the Socio-Economic Impact Assessment and Social Impact Assessment.

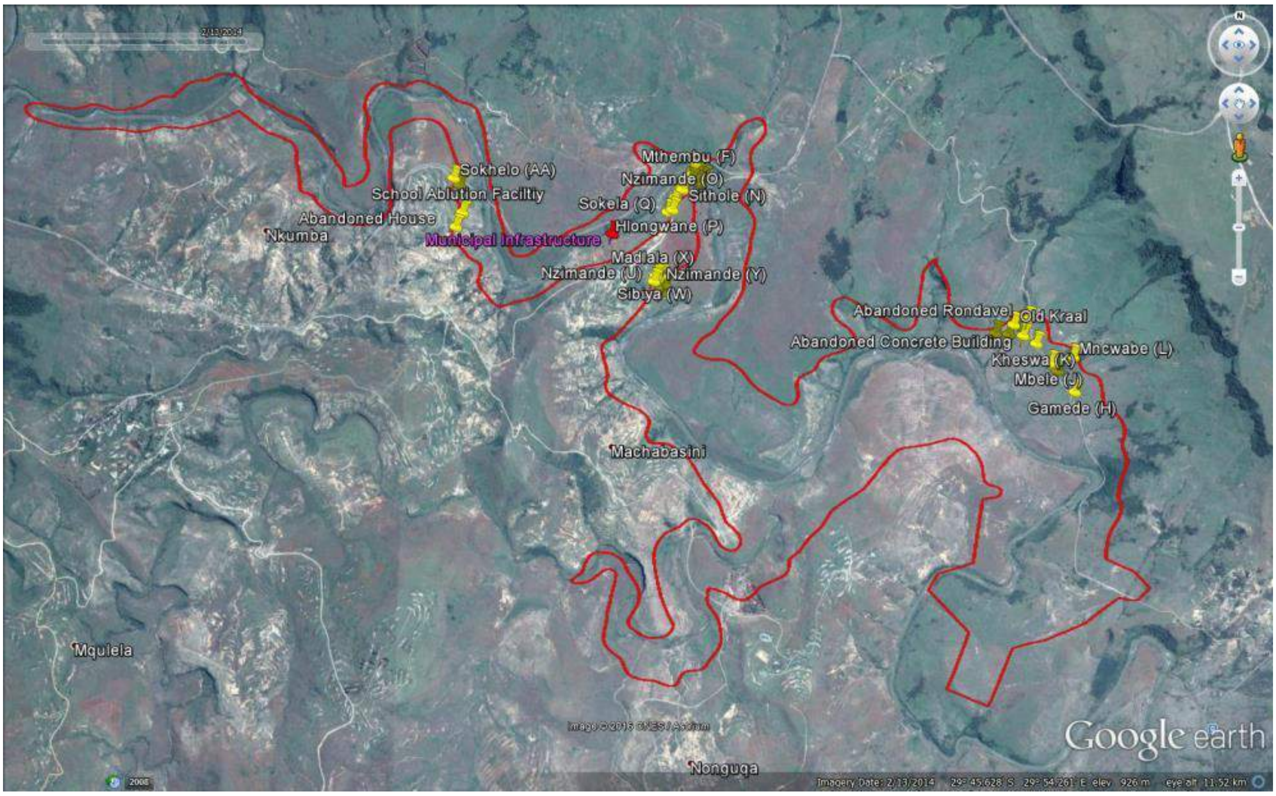


Figure 155: Google Earth Image of Communities surveyed

Lounge and two bedroom –
Corrugated roof with mud walls
Coordinates: 29°44'33.96"S – 29°54'32.83"E

Ancestral structure –
Grass roof with bricks walls
Coordinates: 29°44'29.29"S – 29°54'45.03"E

Main house –
Corrugated roof with mud walls
Coordinates: 29°44'33.216"S – 29°54'30.30"E

Graves x 4
Coordinates: 29°44'32.78"S – 29°54'31.11"E

Figure 156: Examples of affected structures

10.11.2 Tunnel

A section of the tunnel traverses state land as well as land under the Qadi Traditional Authority (Remainder of the Farm Nooitgedacht 1026). The land traversed by the eastern part of the tunnel is privately owned.

Apart from the inlet, central and outlet portals as well as the shafts for ventilation purposes, the tunnel runs below ground. The tunnel thus has limited surface impacts. However, the spoil material generated during the tunnelling exercise will be disposed of at sites situated close to the portals (except for the option at the outlet portal to use the spoil material in the dam wall).

10.11.3 Raw Water Pipeline & Balancing Dam

The raw water pipeline routes to WTW Options 1 and 2, the first part of the route for the raw water pipeline route to WTW Option 3, as well as the balancing dam options are situated on Baynesfield Estate, which is a diversified commercial farming operation. The estate is predominantly surrounded by private farms. The timber land on the estate that is affected by the project infrastructure is leased to NCT Forestry Co-operative Limited.

The Baynesfield Estate Lodge is located next to the Mbangweni Dam and it offers tourist accommodation, recreational fishing on the dam and environmental education opportunities (**Figure 157**). The lodge will be affected during the construction phase where the surrounding roads will be used for construction purposes (refer to access road options under **Section 11.3.5**) and other related potential impacts such as noise, visual and security.

Figure 157: Baynesfield Estate Lodge (http://www.baynesfield.co.za/gallery.aspx)

Apart from cultivated land and timber plantations, some notable socio-economic features along the raw water pipeline routes include the following:

- ❖ The raw water pipeline to WTW Option 2 –
  - Passes more than 100m to the north of the Baynesfield Estate piggery;
  - Passes some residential dwellings and the Baynesfield Club sports grounds; and
- ❖ The raw water pipeline to WTW Option 3 travels to the north of Hopewell and also traverses Rainbow Farms property where the route passes chicken houses.

10.11.4 Socio-economic Context

A baseline assessment of the socio-economic situation within the entire uMkhomazi Catchment was conducted (DWA, 2012a) as part of the Technical Feasibility Study. The study area for this assessment is shown in **Figure 158**. An extract from this assessment follows.

Note that a situational analysis of the project area was undertaken as part of the Socio-Economic Impact Assessment (Nemai Consulting, 2016a) and Social Impact Assessment (Dr Neville Bews & Associates, 2016), based on Statistics South Africa (2013). Refer to these respective studies for further details in this regard.

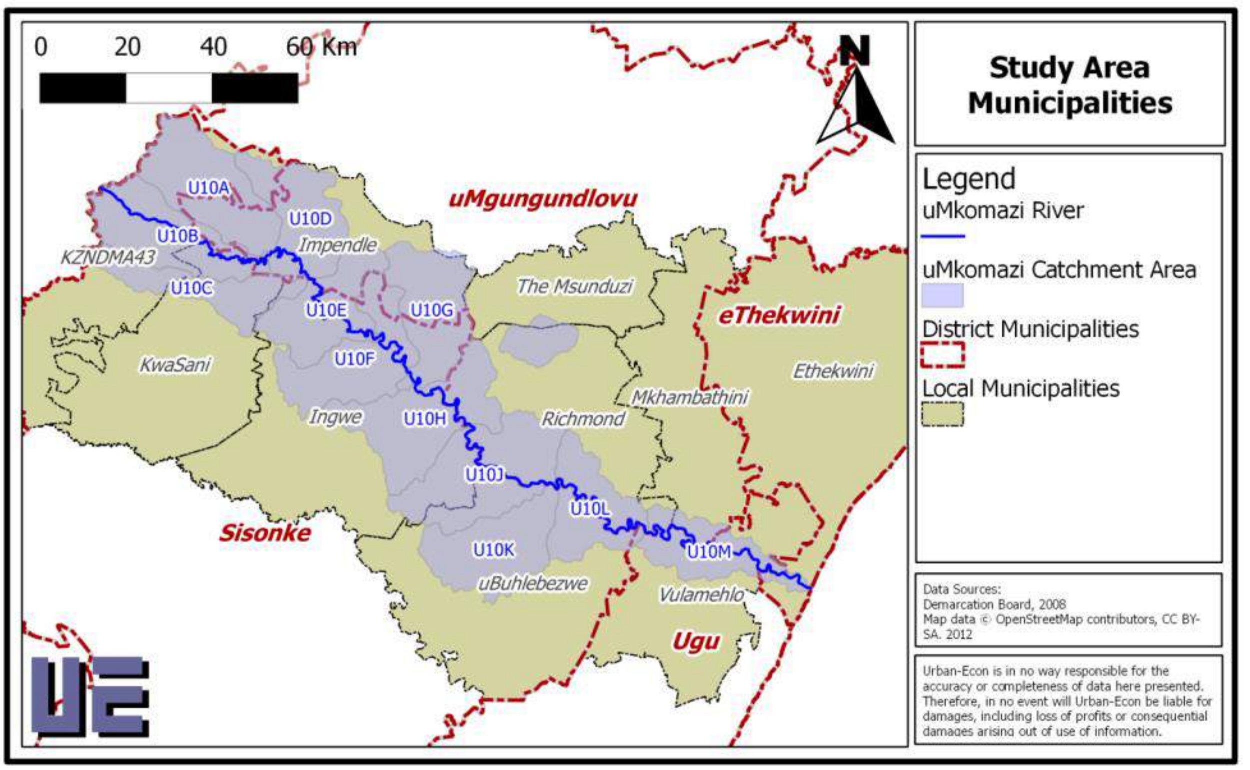


Figure 158: Study Area - Baseline Socio-Economic Assessment (DWA, 2012a)

10.11.5 Population

The table to follow indicates the estimated population and number of households in the catchment area in 2012.

Table 70: Demographics (DWA, 2012a)

Market Area	Estimated 2012
Population total	203 912
Households total	45 548
Household size (average)	4.5
Population density (People per km^2)	24
Household density (Households per km^2)	5

Based on population growth projections made for the local market area, the following estimated population sizes and households can be highlighted:

- A total of 203 912 people and 45 548 households reside in the local market area. This represents 1.9% of the total number of people in KZN; and
- The average household size in this market is 4.5 persons per household.

The following map gives an indication of the population density within the catchment area.

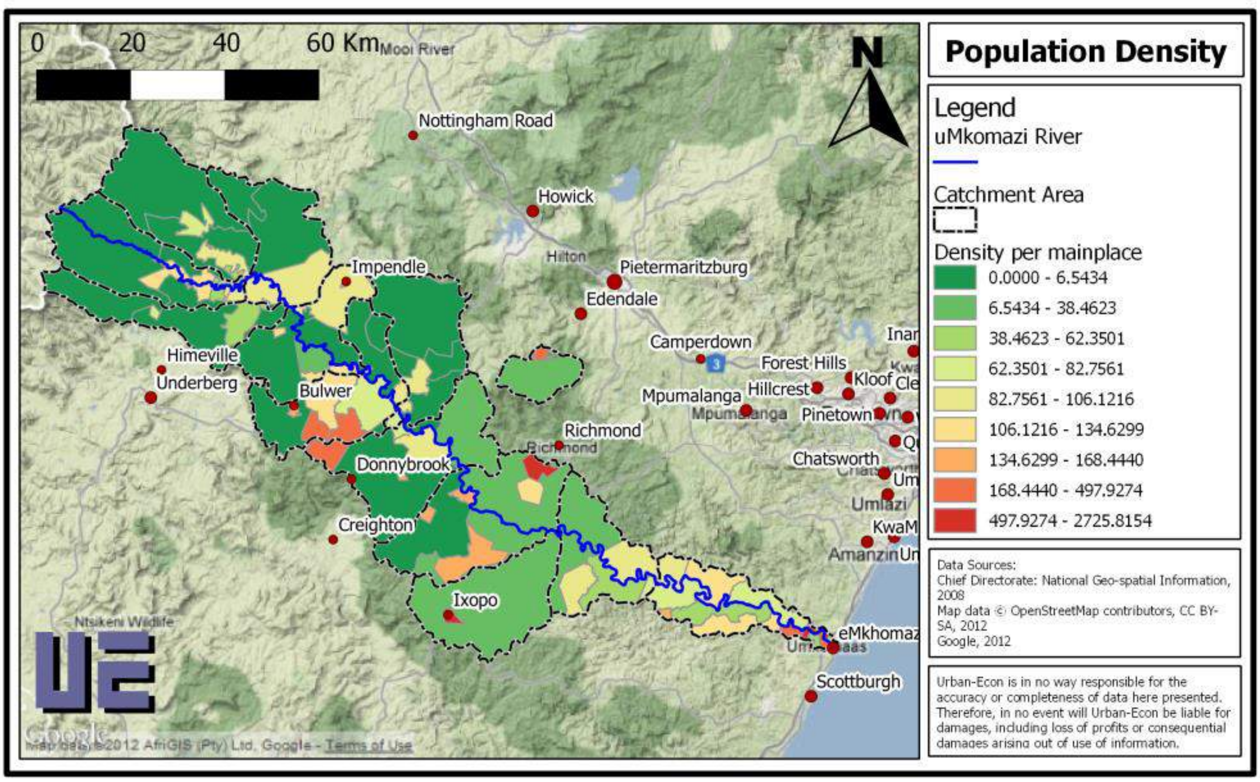


Figure 159: Population density (DWA, 2012a)

10.11.6 Age profile

The graph below describes the age profile for the catchment area. The potentially economically active population of a specific population is defined as the component of the local population that has the potential to perform labour. This definition excludes individuals below the age of 15 and over the age of 65. The potentially economically active population is shown in red in the graph below.

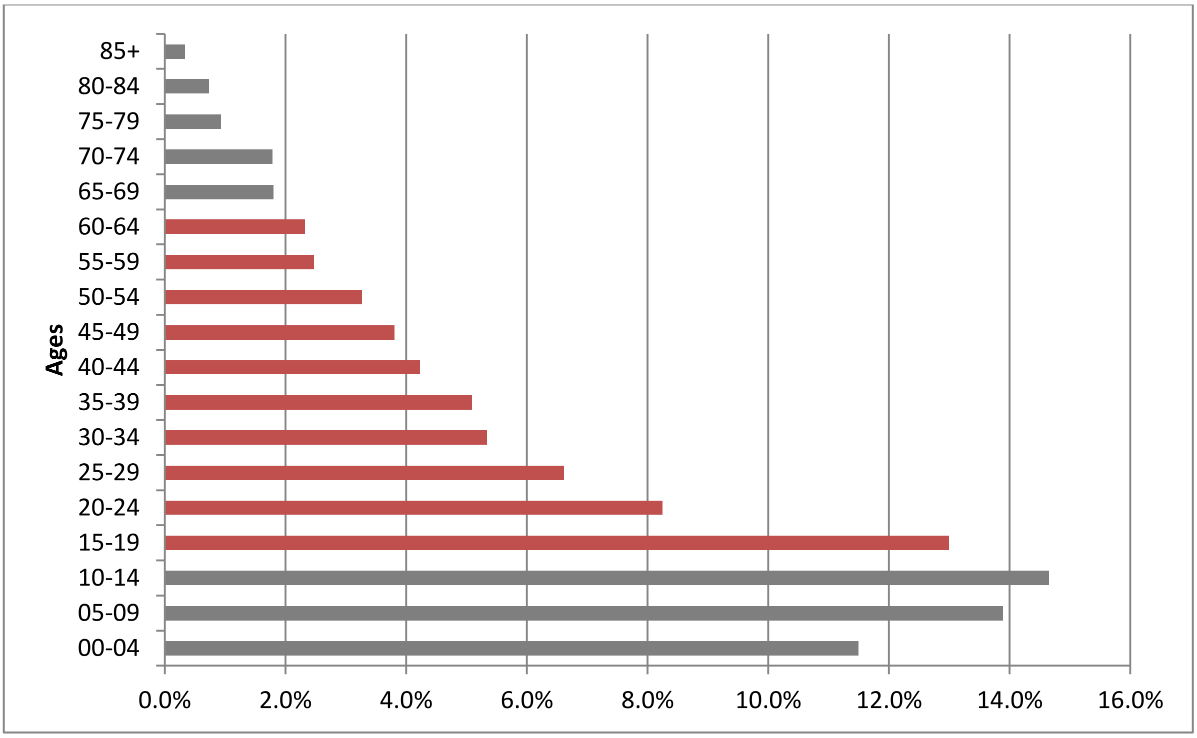


Figure 160: Age Profile (DWA, 2012a)

Based on the preceding figure and definition, the following main findings can be highlighted:

- 40.0% of the population is younger than 15 years;
- 38.3% of the population falls within the young age group of between 15 to 39 years;
- 54.4% of the population forms part of the potentially economically active population;
- 16.1% of the population falls within the young age group of between 40 to 64 years; and
- 5.6% of the population is older than 65 years old.

10.11.7 Gender

45.7% of the catchment area population is male and 54.3% of the catchment area population is female.

10.11.8 Employment

Unemployment is expressed as a percentage of the working age population. Officially, the working age population refers to all the people between the ages of 15 and 64 years that are able and willing to partake in economic activities (this excludes people not looking for work, students, pensioners, homemakers, etc.). The unemployment and employment levels within the local study area are important to investigate, as it is indicative of the ability of local residents to earn household income (generated from economic activities and which are employed to purchase goods and services). The table below indicates the employment profile for the catchment area.

Table 71: Employment profile (DWA, 2012a)

	Number	Percentage
Working age population	107 495	100.0%
Economically active population	44 319	41.2%
Employed	18 808	42.4%
Unemployed	25 511	57.6%

10.11.9 Sources of income

The graph to follow gives an indication of the sources of income for the people within the catchment area.

The following main findings can be highlighted:

- The majority of people (28.4%) are employed within the 'agriculture; hunting; forestry and fishing' industry. This is typical of rural areas within KZN;
- 27.8% of the people are employed within the 'community; social and personal services' industry; and
- A significant number of people are employed within the 'wholesale and retail trade' industry, predominantly within urban and peri-urban areas.

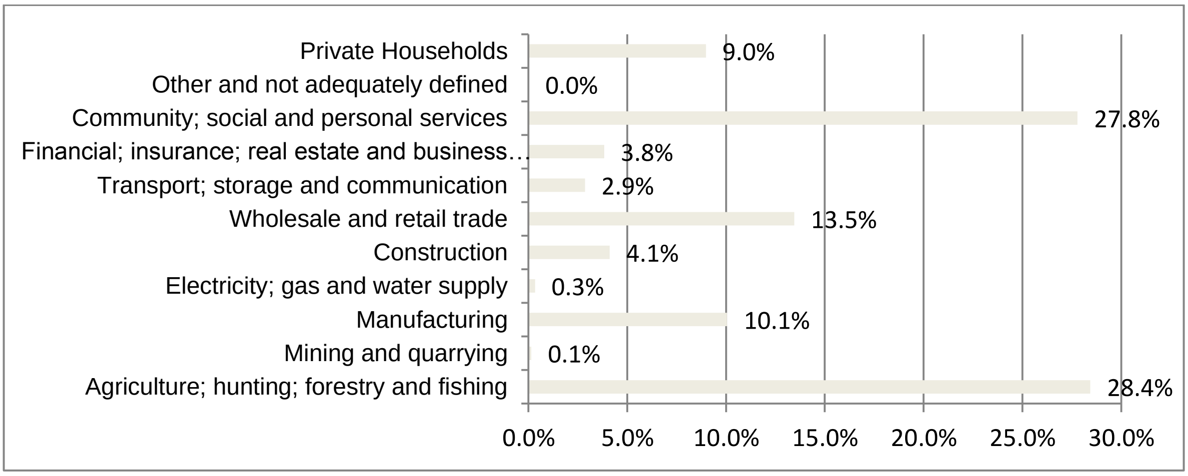


Figure 161: Sources of income (DWA, 2012a)

10.11.10 Types of dwellings

The graph below gives an indication of the types of dwellings for the households within the catchment area.

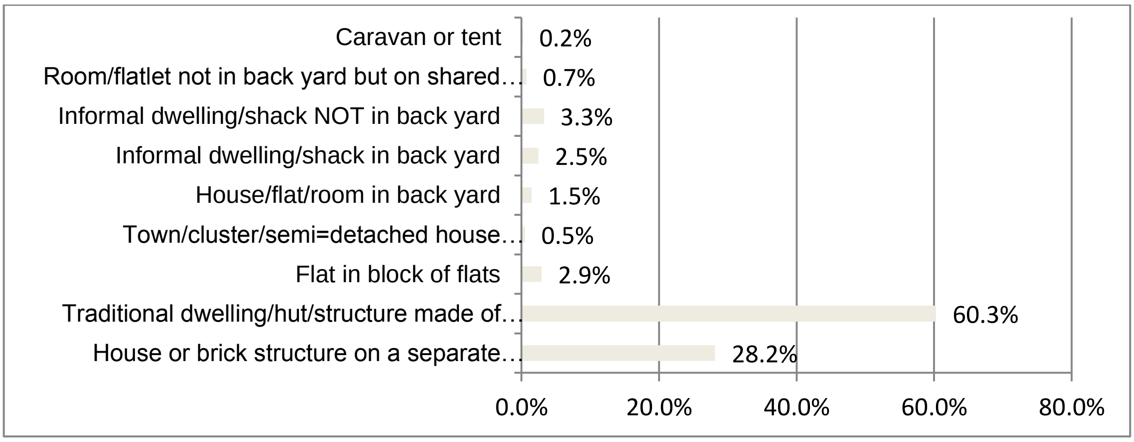


Figure 162: Types of dwellings (DWA, 2012a)

The following main findings can be highlighted:

- The majority of households (60.3%) reside in traditional dwellings or huts made of traditional materials. This is typical of rural areas within KZN; and
- 28.2% of households reside in a house or brick structure on a separate stand or yard.

10.11.11 Health Facilities

The following table provides a summary of the health facilities within each municipality.

Table 72: Health Facilities (DWA, 2012a)

Municipality	Facilities in municipality	Facilities in catchment area
eThekwini	244	0
Vulamehlo	7	1
Impendle	3	2
Msunduzi	53	1
Mkhambathini	5	2
Richmond	5	0
Ingwe	11	6
KwaSani	5	1
uBuhlebezwe	12	3
uMkhomazi Wilderness Area	0	0

The following map shows the health facilities within the catchment area.

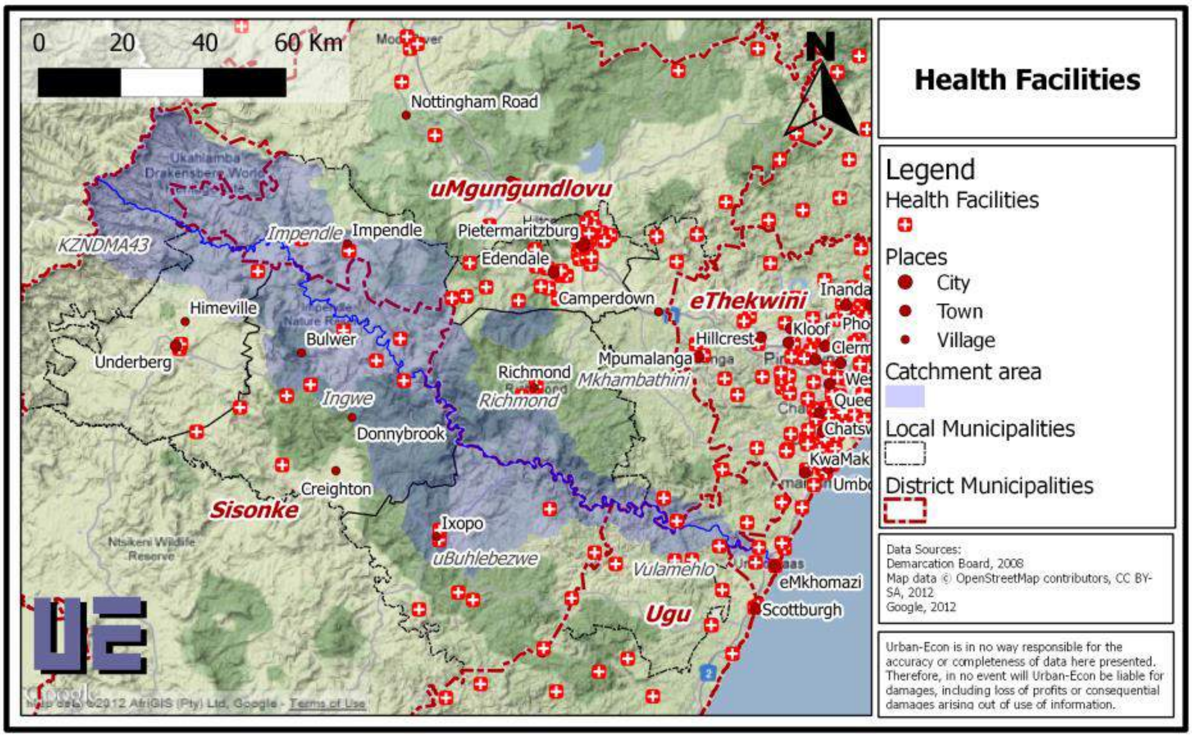


Figure 163: Health Facilities (DWA, 2012a)

10.11.12 HIV/AIDS

The number of people that are HIV positive and the number of AIDS related deaths is a major health risk within KZN. The following table gives an indication of the estimated number of people who are HIV positive, the estimated number of AIDS related deaths as well as the estimated number of other deaths within the municipalities in the study area. The growth rate between the year 2000 and 2010 is also indicated for each of the fields.

Table 73: HIV/AIDS per municipality (DWA, 2012a)

Municipality	HIV positive 2012	HIV positive growth rate 2000 to 2010	AIDS deaths 2012	AIDS deaths growth rate 2000 to 2010	Other deaths 2012	Non-HIV death growth rate 2000 to 2010
Vulamehlo Local Municipality	13 346	2.0%	1 185	7.5%	724	-0.7%
Impendle Local Municipality	6 316	4.0%	565	9.5%	360	1.0%
The Msunduzi Local Municipality	114 241	4.2%	9 362	10.0%	5 485	1.0%
Mkhambathini Local Municipality	9 448	2.0%	799	7.6%	413	-1.3%
Richmond Local Municipality	11 353	2.1%	942	7.7%	487	-1.2%
Ingwe Local Municipality	20 219	4.7%	1 767	9.7%	999	0.9%
KwaSani Local Municipality	2 729	2.6%	239	8.3%	122	-1.3%
uBuhlebezwe Local Municipality	15 423	2.8%	1 339	8.0%	764	-0.8%
uMkhomazi Wilderness Area	198	1.4%	19	8.3%	10	-1.7%
eThekwini Metropolitan Municipality	628 655	4.6%	50 567	10.3%	29 980	1.1%

The following main findings can be highlighted:

- The number of people who are HIV positive has grown the fastest within Ingwe Local Municipality (4.7%) and eThekwini Metropolitan Municipality (4.6%);
- The number of AIDS related deaths has increased the fastest within eThekwini Metropolitan Municipality (10.3%) and the Msunduzi Local Municipality (10.0%).

10.11.13 Educational Facilities

The graph to follow gives an indication of the level of education within the catchment area.

The following main findings can be highlighted:

- 31.1% of the population has no schooling;
- 23.7% of the population has some secondary schooling;
- 10.2% of the population has completed grade 12; and
- Only 3.4% of the population has a higher education qualification.

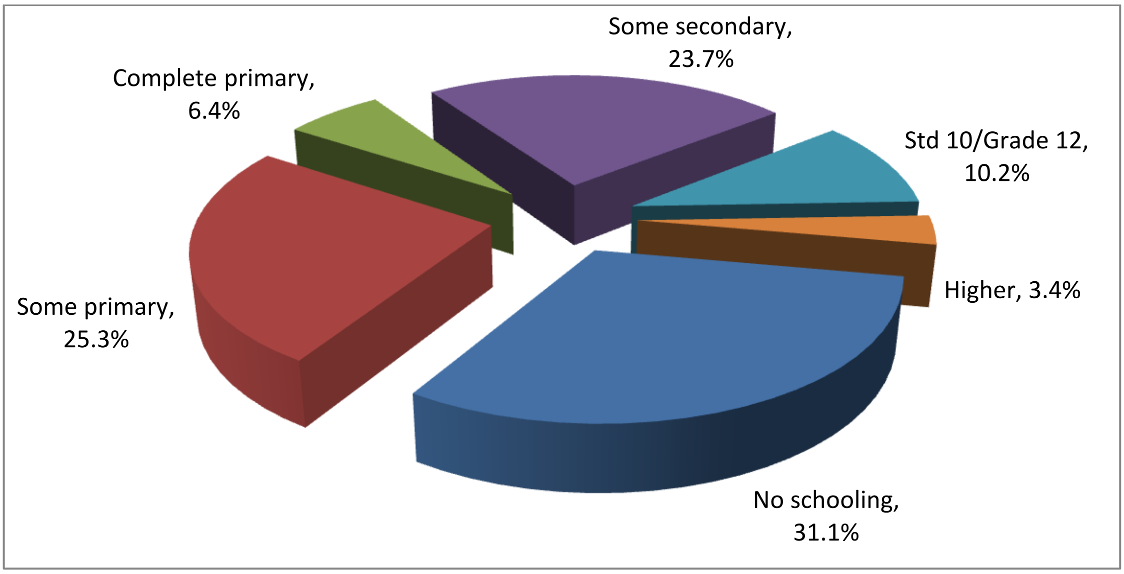


Figure 164: Education (DWA, 2012a)

Table 73: Schools (DWA, 2012a)

Municipality	Schools in municipality	Schools in catchment area
eThekwini	1 034	2
Vulamehlo	95	20
Impendle	41	38
Msunduzi	205	3
Mkhambathini	61	6
Richmond	65	24
Ingwe	111	70
KwaSani	28	14
uBuhlebezwe	125	31
uMkhomazi Wilderness Area	0	0

10.12 Planning

10.12.1 Harry Gwala DM

The western part of the project area falls within the Harry Gwala DM (previously known as the Sisonke DM) and Ingwe LM. The area is characterised by traditional homestead settlements and rural subsistence agriculture. The proposed Smithfield Dam falls within Wards 7, 8 and 10 of the Ingwe LM. The western part of the tunnel traverses Ward 7 of this municipality. Refer to **Figure 165**.

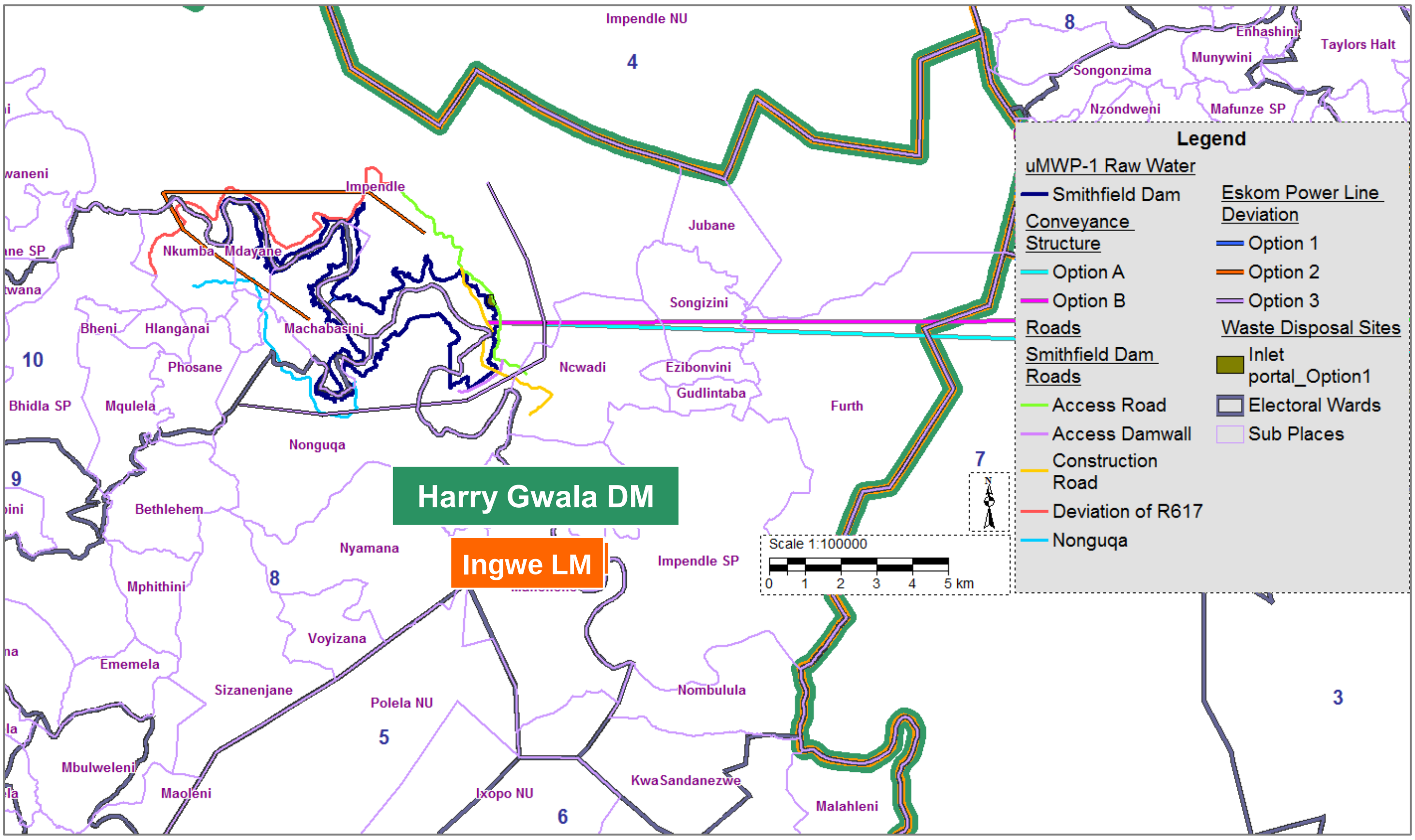


Figure 165: Project footprint in Harry Gwala DM

The settlement types in the Ingwe LM, based on Census 2011, are shown in **Figure 166**.

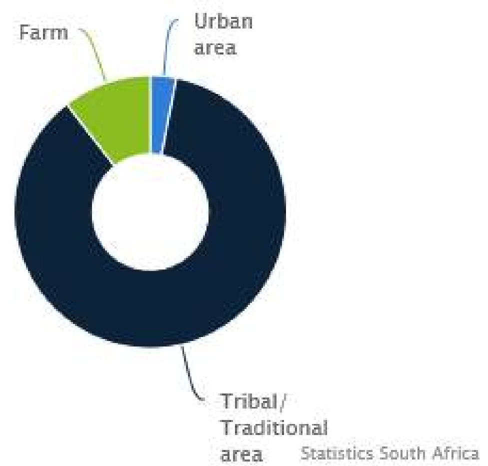


Figure 166: Settlement Types - Ingwe LM (Stats SA)

According to the SDF for the Harry Gwala DM (see **Figure 167**), the area to the north of the uMkhomazi River at Smithfield Dam is categorised as 'land claims' and to the south falls under 'Traditional Authority Area'. The first portion of the tunnel options that falls within the Harry Gwala DM traverses both of the aforementioned categories.

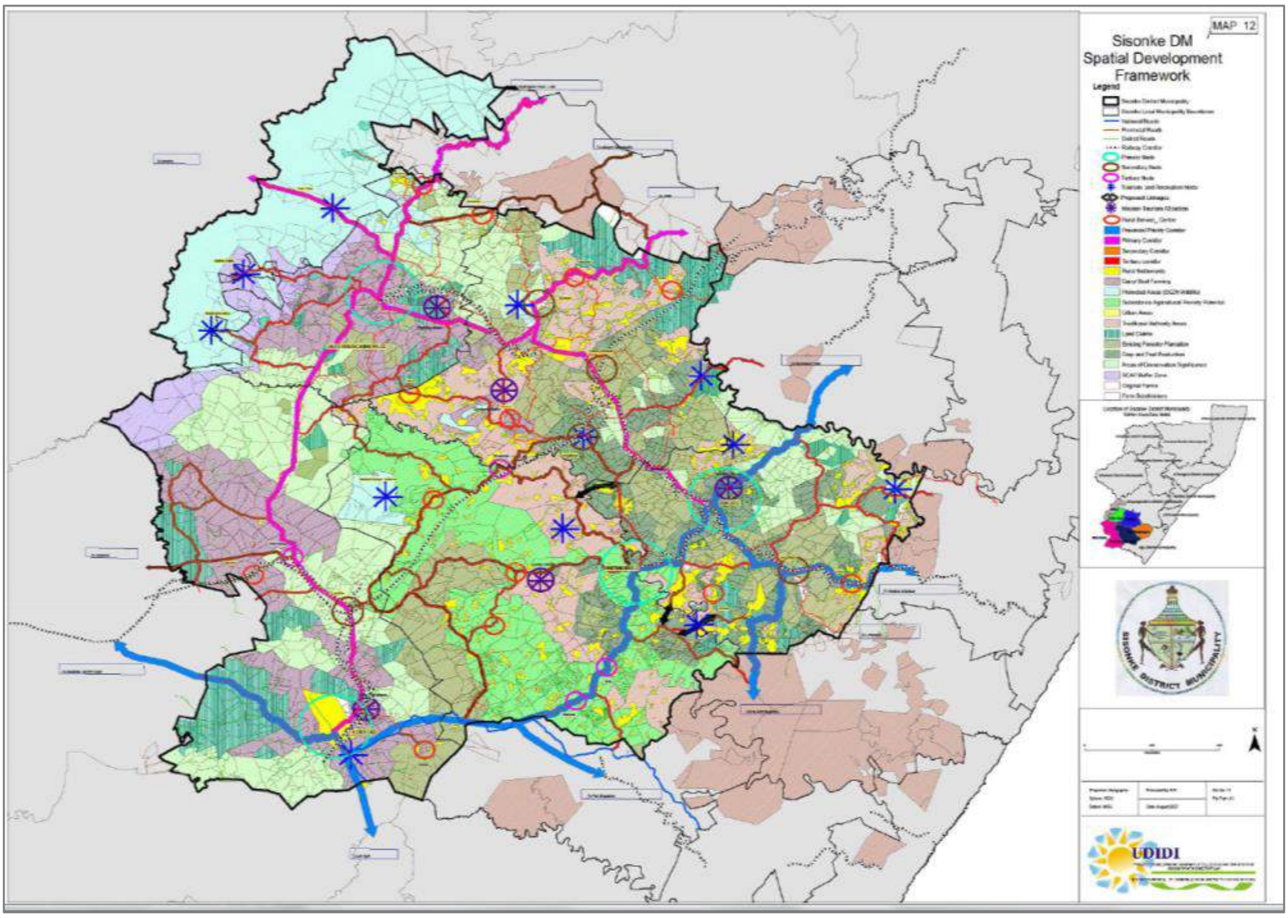


Figure 167: Harry Gwala DM's SDF (Sisonke DM, 2013)

The Harry Gwala DM is predominantly rural and is characterised by small urban centres with larger agricultural, plantations, natural vegetation and traditional authority land. Bulwer is the closest Secondary Node to the project area in the Harry Gwala DM. Typical services that can be expected at these nodes can include police stations, low level retail services, low levels of housing development (less than 1000 lots), small scale tourism, education facilities (primary and secondary), clinics, pension payout points, community halls etc. Although Bulwer is categorized as Secondary Node, it is being treated as a primary node considering the potential posed by its strategic location once planned properly (Sisonke DM, 2013). Ncwadi is the closest rural node, which fulfils the function of a rural service centre to the surrounding area.

The Harry Gwala DM SDF outlines the following Spatial Development Priorities for the Ingwe LM (amongst others):

- Promotion of commercial farming (livestock, dairy farming). Good quality agricultural land is a scarce natural resource and should be managed in a sustainable manner.
- Promotion of Avi, Eco and Mission Tourism as part of the cultural heritage.
- Potential of railway line to promote Mission tourism, Agric-commercial development with the establishment of bio-fuel plant in Donnybrook and milk factory development and Zibambele initiative on maintaining the railway line.
- Need for land for Agricultural development for emergent farmers.

10.12.2 uMgungundlovu DM

The eastern part of the project area falls within the uMgungundlovu DM, which includes the Richmond LM and Mkhambathini LM. This area, which includes the remaining part of the tunnel, balancing dam options and raw water pipeline routes, is privately owned and predominantly used for commercial farming and forestry. The eastern part of the tunnel traverses Wards 7 and 3 of the Richmond LM. The area affected by the balancing dam options and raw water pipeline routes falls within Ward 3 of this municipality. The western part of the raw water pipeline to WTW Option 3 is situated in Ward 4 of the Mkhambathini LM. Refer to **Figure 168**.

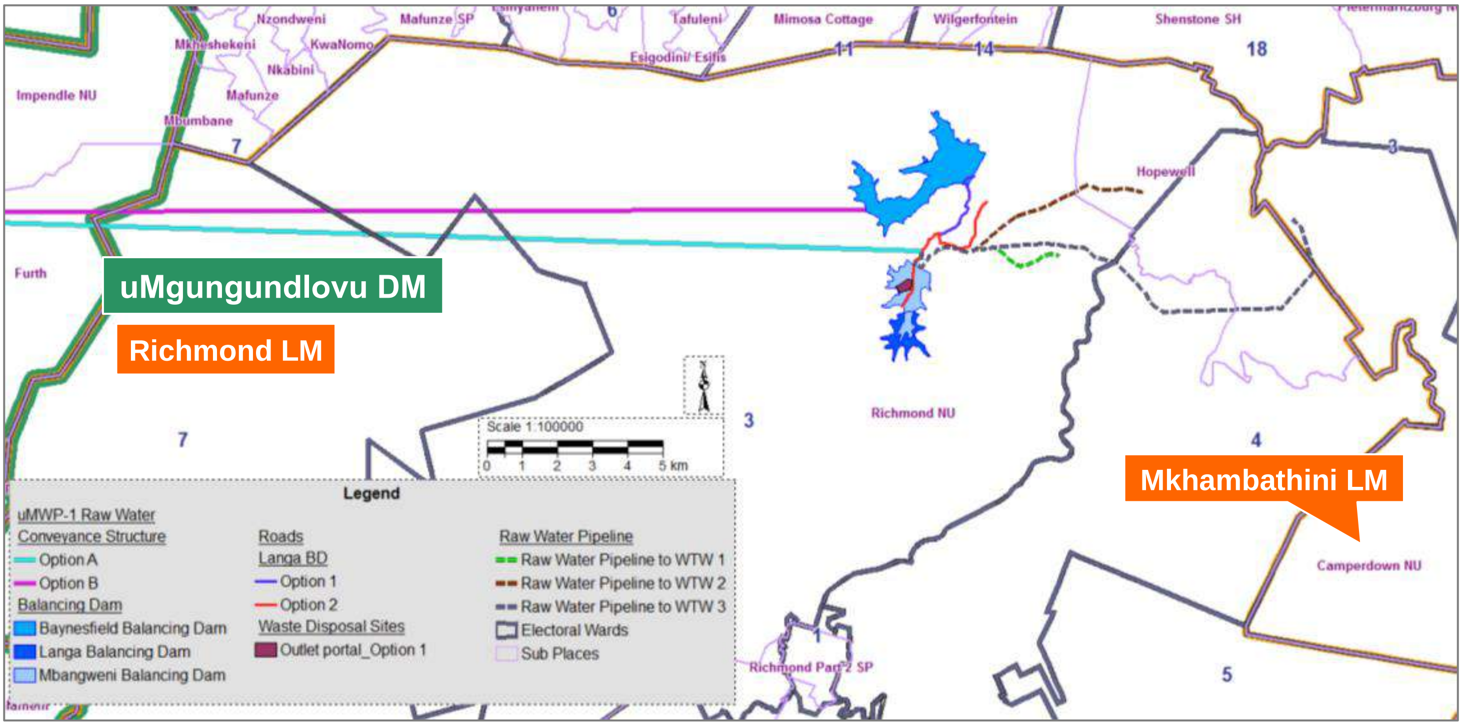


Figure 168: **Project footprint in uMgungundlovu DM**

The settlement types in the Richmond LM, based on Census 2011, are shown in **Figure 169**.

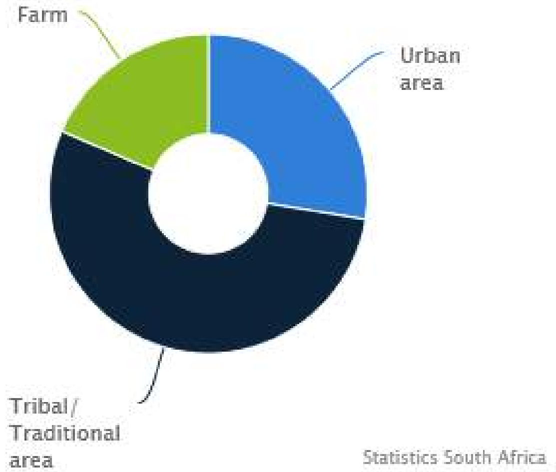


Figure 169: Settlement Types - Richmond LM (Stats SA)

According to the uMgungundlovu DM's SDF (see **Figure 170**), the remaining portion of the tunnel options as well as the balancing dam fall within an area categorised as 'Agricultural Priority Areas' with a section of the tunnel also traversing an area categorised as 'Strategic Water Production Area'.

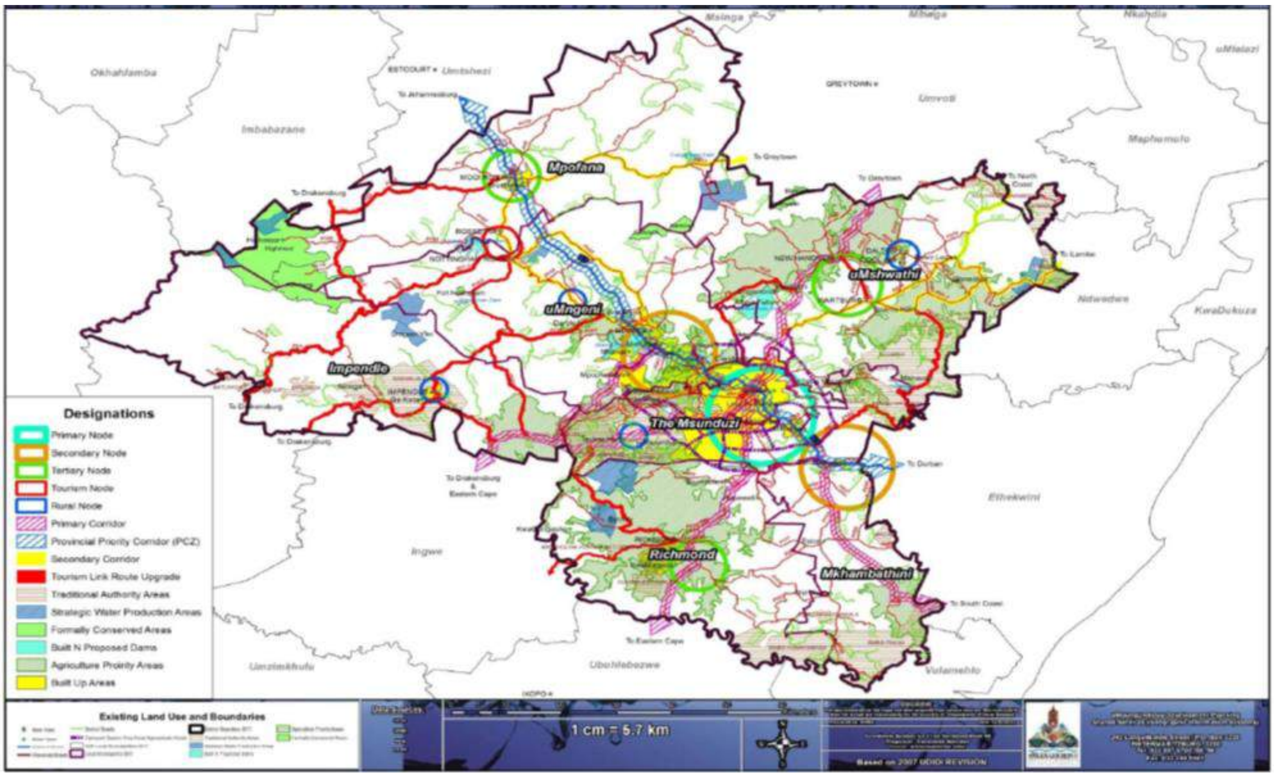


Figure 170: uMgungundlovu DM's SDF (uMgungundlovu DM, 2013)

The nearest development node in the uMgungundlovu DM to the project area is Richmond, which is classified as a Tertiary Node. These nodes are centres with lower potential for economic growth and a relatively high dependence on agriculture, providing services mainly to the local economy. Impendle is the closest rural node.

Development corridors in the greater area include the R617 (Howick – Boston – Underberg) and R56 Primary Corridors. These corridors provide major linkages with the adjoining districts. The primary function of these corridors is long distance traffic movement, but development should be encouraged at appropriate locations along the corridors.

According to the uMgungundlovu DM (2013), the Richmond LM enjoys a distinct competitive advantage in the field of agriculture that contributes to more than 50% of the gross geographic product and employment in this area. Closely related to this is the timber industry and manufacture of wood products. Investment opportunities in manufacturing enterprises linked to timber and agricultural activities centre on dairy, citrus, vegetable, poultry, pig, cattle and sugar production.

The uMgungundlovu DM undertook a Strategic Environmental Assessment (SEA) and developed a Strategic Environmental Management Plan (SEMP), which serves as a pro-active tool that will guide decision-making within the district from an environmental management perspective. The SEMP provides specific action plans aimed at addressing pressing environmental management issues in the district. The compatibility of the project with the SEMP will need to be scrutinised at a municipal level.

The uMWP-1 is not in direct conflict with the planning frameworks of the affected municipalities. It is not anticipated that the project will adversely affect the rural nature of the project area. Communal land, which includes natural areas, dwellings and subsistence farming, within the Smithfield Dam basin will be converted to a waterbody.

10.13 Agriculture

10.13.1 General

An Agricultural Impact Assessment (**Appendix H3**) was conducted for the project. Refer to the summary and impact assessment of this study contained in **Sections 11.1.4** and **12.12**, respectively.

10.13.1.1 Smithfield Dam

The majority of the Smithfield Dam basin is used by the local community for subsistence farming purposes (dominated by grazing). A cultivated area of approximately 20 Ha occurs on the north-eastern side of the dam, on the left-bank of the uMkhomazi River (Portions 1 and 3 as well as Remainder of the Farm Crowle 2260 (shown in **Figure 171**). It is understood that the allotments were arranged by DRD&LR. A number of dwellings are also associated with these agricultural fields.

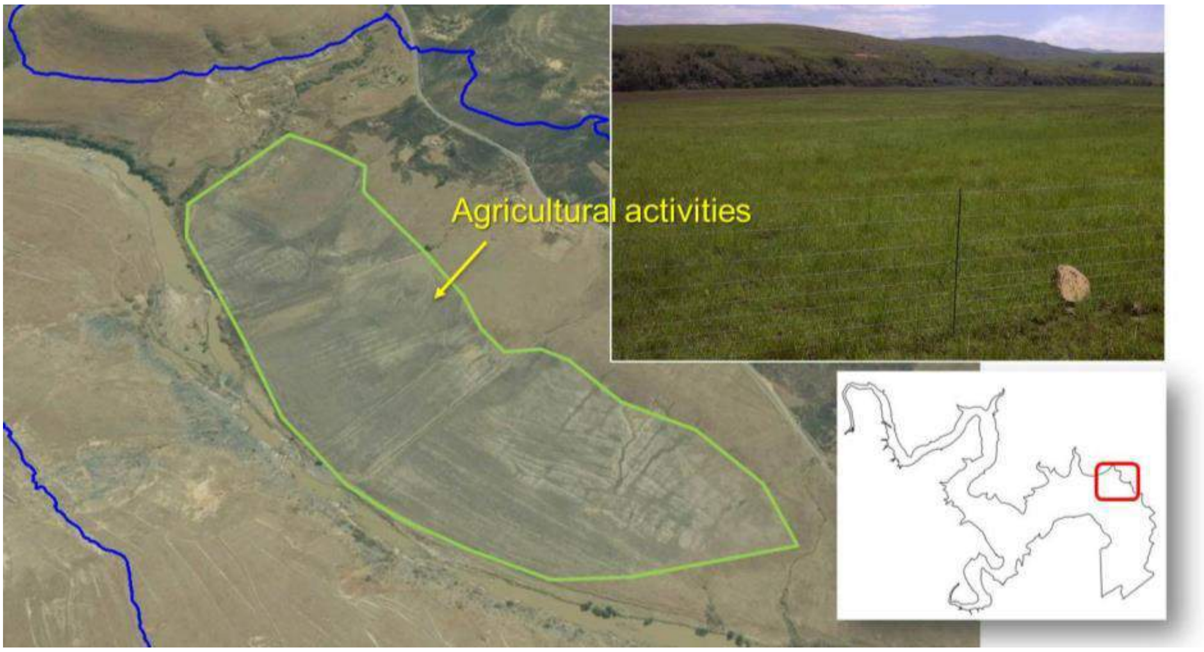


Figure 171: Cultivated area within Smithfield Dam basin

10.13.1.2 Raw Water Conveyance Infrastructure

As mentioned, surface impacts associated with the tunnel are limited to the inlet, central and outlet portals as well as ventilation shafts and spoil disposal sites.

Although no direct impacts are anticipated to agricultural land at this stage (based on the locations of the aforementioned features), this will need to be considered through a specialist Agricultural Study.

Cultivated land and timber land are encountered along the alternative raw water pipeline routes in the western part of the project area (see **Figures 172 – 173**).

Figure 172: South-western view of timber plantation (in background) traversed by raw water pipeline routes to WTW Options 1 and 3

Figure 173: Example of agricultural land affected by raw water pipeline to WTW Option 3 (over Portion 6 of Brasfort Park 1295)

10.13.1.3 Balancing Dam

The proposed balancing dam options are situated on Baynesfield Estate (see **Figure 174**). Baynesfield Estate has a large agricultural concern operated by the company, Joseph Baynes Estate (Pty) Ltd. The company employs over one hundred permanent employees and farms a large diversified operation of about 3,600ha. The Estate also employs a large number of seasonal workers during peak production harvest times. The company currently farms Avocados, Pigs, Beef Cattle, Cane and Grains (Maize and Soya Bean).

A large portion of the Estate is leased to NCT Farming for timber by the Timber Trust. In addition to farming, the company also has strategic shareholdings in a number of other entities involved in agriculture. The estate is predominantly surrounded by private farms.

Figure 174: Agricultural activities at Baynesfield Estate (http://www.baynesfield.co.za/gallery.aspx)

10.13.2 Grazing Capacity

10.13.2.1 Smithfield Dam

The grazing capacity, according to the National Department of Agriculture, is 3 hectare per large livestock unit (LSU). This was adapted as part of the Agricultural Impact Assessment after a grazing evaluation during the site visit. It is estimated that the grazing capacity is more than 6 ha per LSU on the eastern section and on eroded parts (Index, 2015). Refer to **Figure 175**.

10.13.2.2 Balancing Dam

Based on the findings of the Agricultural Impact Assessment, the grazing capacity at the balancing dam options is shown in **Figure 176**.

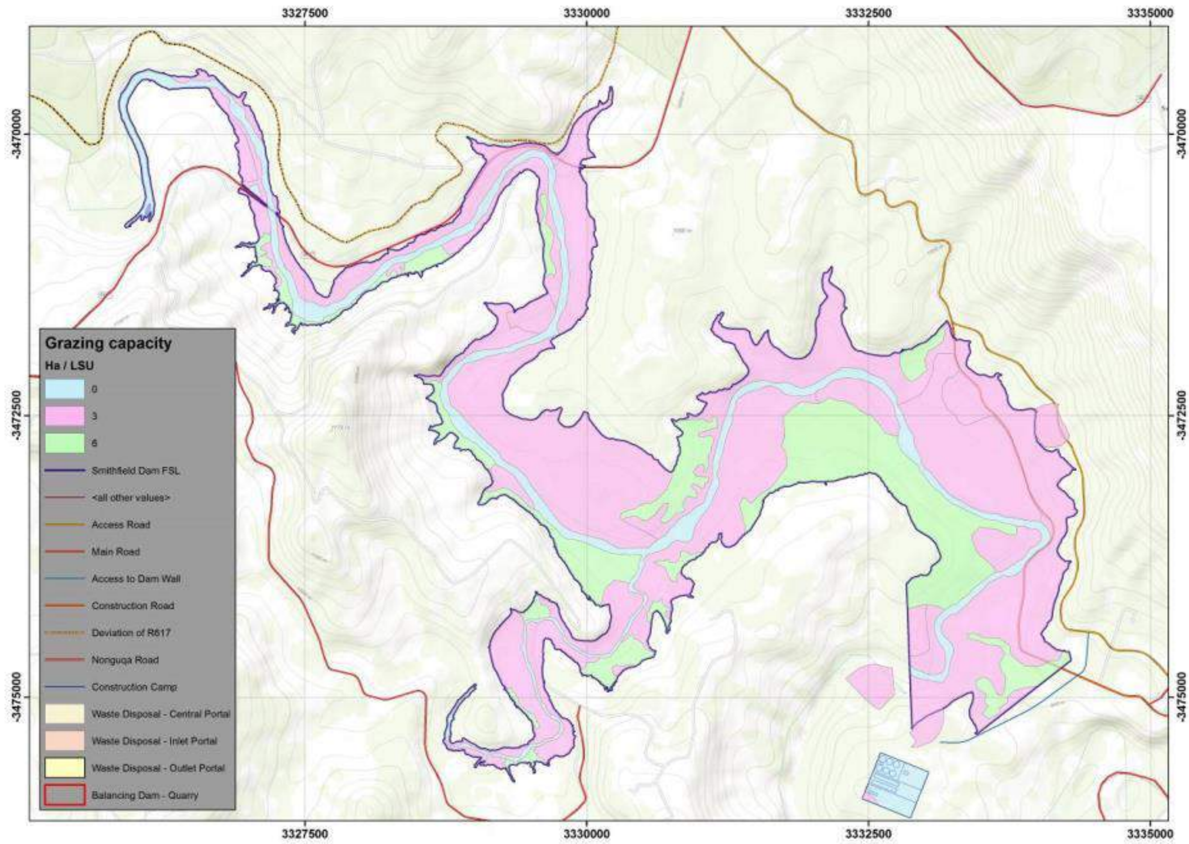


Figure 175: Grazing capacity of land at Smithfield Dam (Index, 2015)

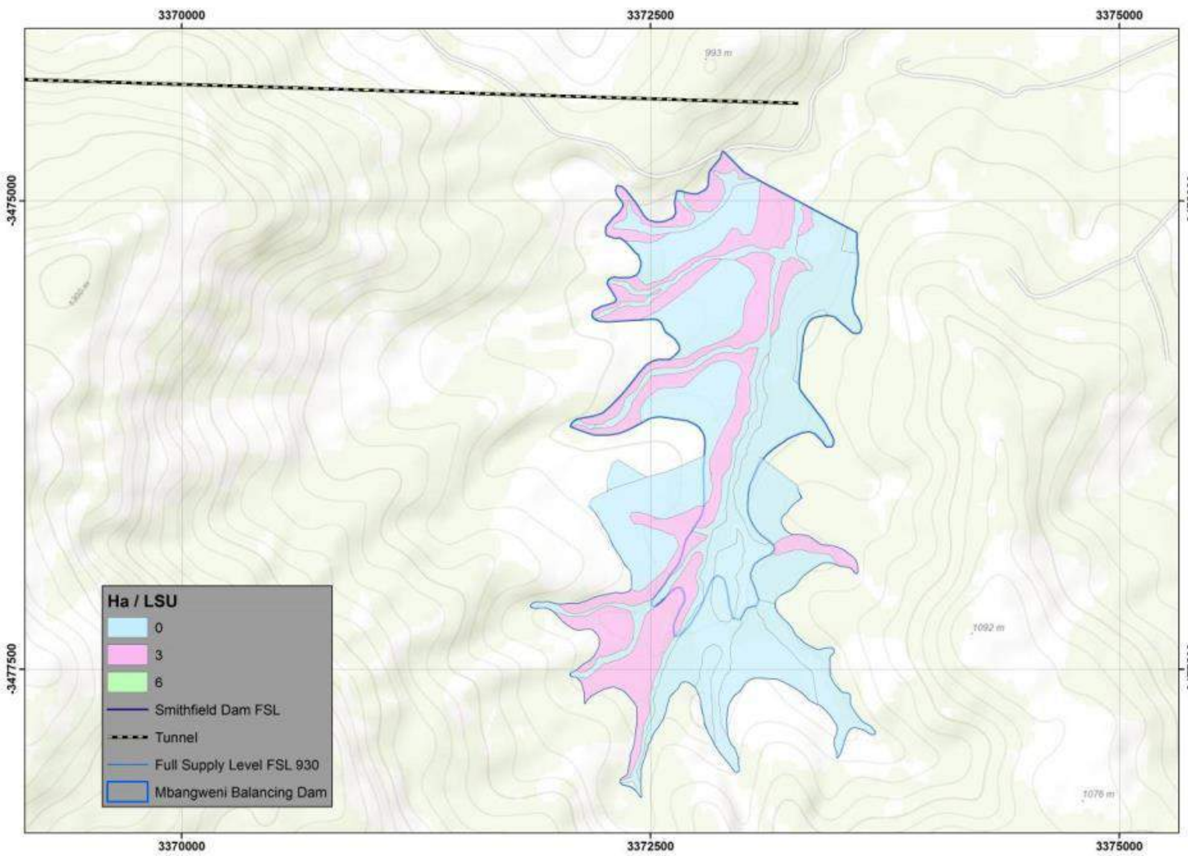


Figure 176: Grazing capacity of the balancing dam area (Index, 2015)

10.13.3 Soil Potential

10.13.3.1 General

According to the KZN Agricultural Land Categories Spatial Decision Support tool, land units are subdivided into the following five categories, each with a description of the sensitivity of the land and the protection status that will decide future land uses (refer to map of study area in **Figure 177**):

- Category A: IRREPLACEABLE;
- Category B: THREATENED;
- Category C: PRIMARY AGRICULTURAL LAND USE;
- Category D: SECONDARY AGRICULTURAL LAND USE; and
- Category E: MIXED LAND USE.

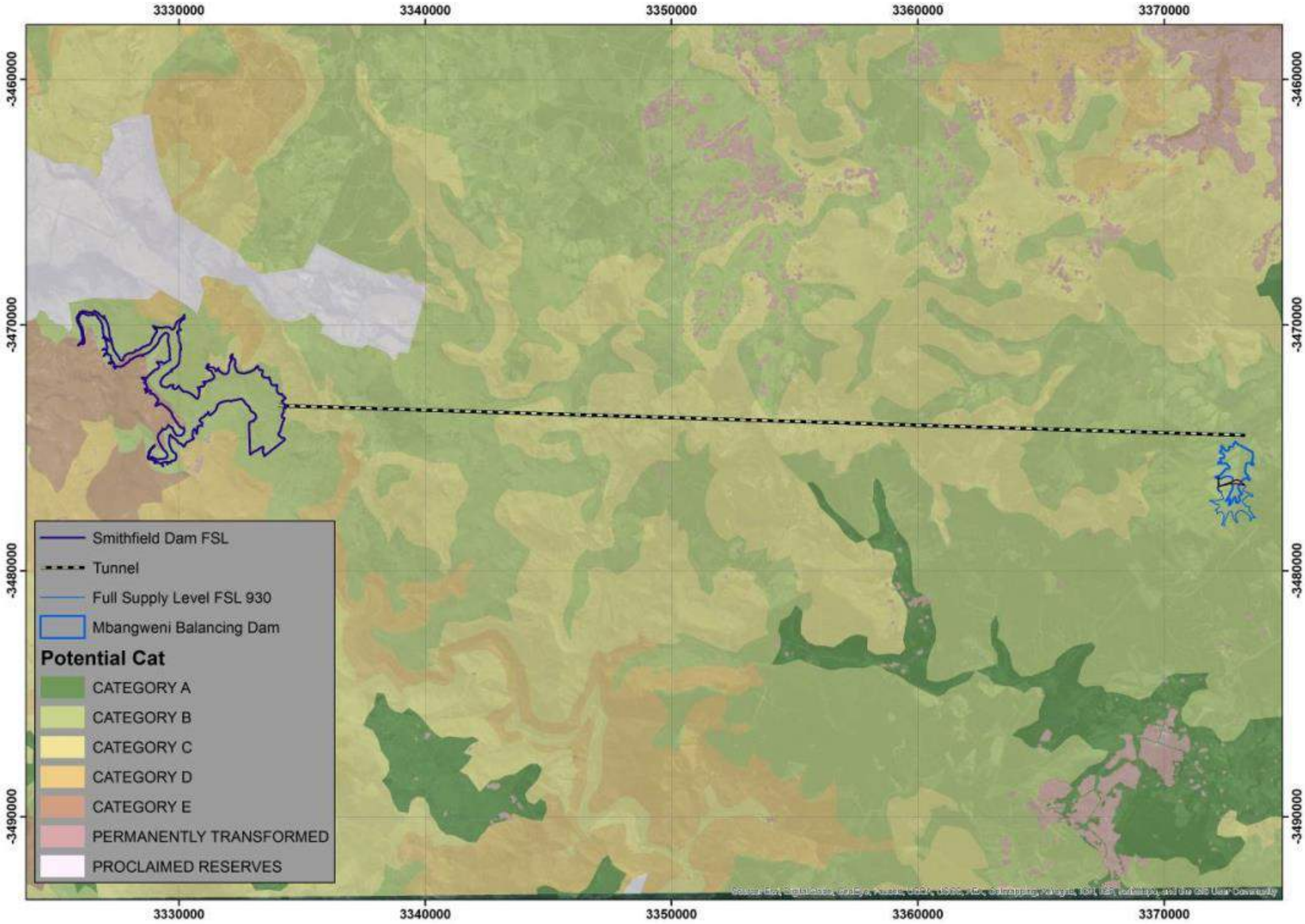


Figure 177: Land Classification (Index, 2015)

Except for a small portion on the south-western side of the river in the Smithfield Dam site that is classed as Category E, all the land is Category B, which is regarded as high potential agricultural land. The reconnaissance survey done of the site, however, found that erosion has made its mark on the land and large portions to the south-west of the river at Smithfield Dam now has very low potential and would rather fall within Permanently Transformed land (Index, 2015).

10.13.3.2 Smithfield Dam and Balancing Dam

From a more detailed soil and land analysis undertaken as part of the Agricultural Impact Assessment a description of the land classes was developed, as contained in **Table 74** and shown in **Figures 178 – 179**.

Table 74: Description of land use classes (Index, 2015)

Potential rating	General description	Map units
Arable classes		
Class i - High	Soil in this climatic zone is deeper than 1 000 mm. It has a granular structure with a clay content of around 25%. The NDA criteria include land with permanent irrigation infrastructure and land with unique value.	I
Class ii – High/Medium	These soils are 600 to 1000 mm deep and have a clay content of between 18 and 28% with a granular structure. Nodules and stone fragments in the subsoil impede root development.	II
Class iii - Medium	These soils are 600 to 800 mm deep. Nodules and stone fragments in the subsoil impede root development. Deep soil with scattered rock outcrops is included in this class.	III
Non-arable classes		
Class vi – Low	Shallow and rocky soil or soil with impeding layers fall into this class. These are normally not arable should only be used as animal grazing.	IV
Class v – Very low	Very shallow, rocky soil and waterlogged soil fall into this category. These should only be used as grazing.	V

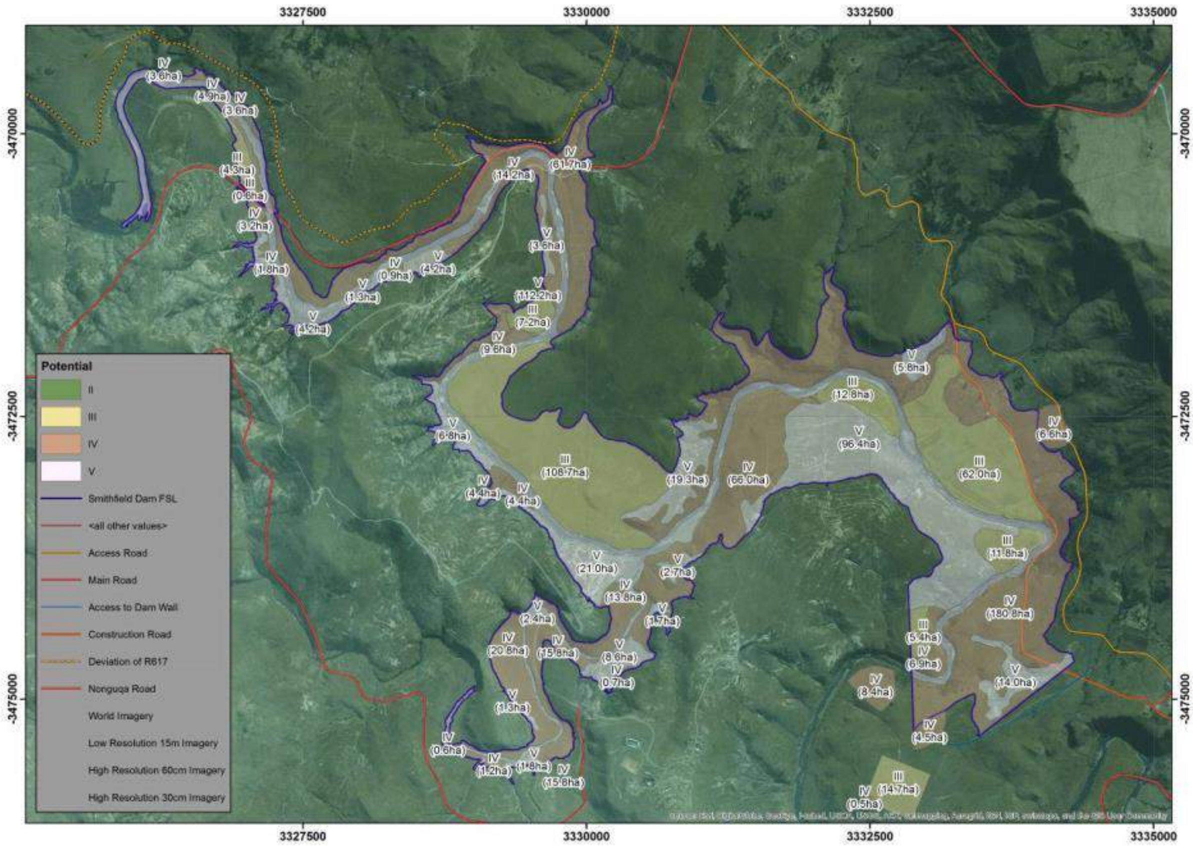


Figure 178: Land use Potential map: Smithfield Dam Area (Index, 2015)

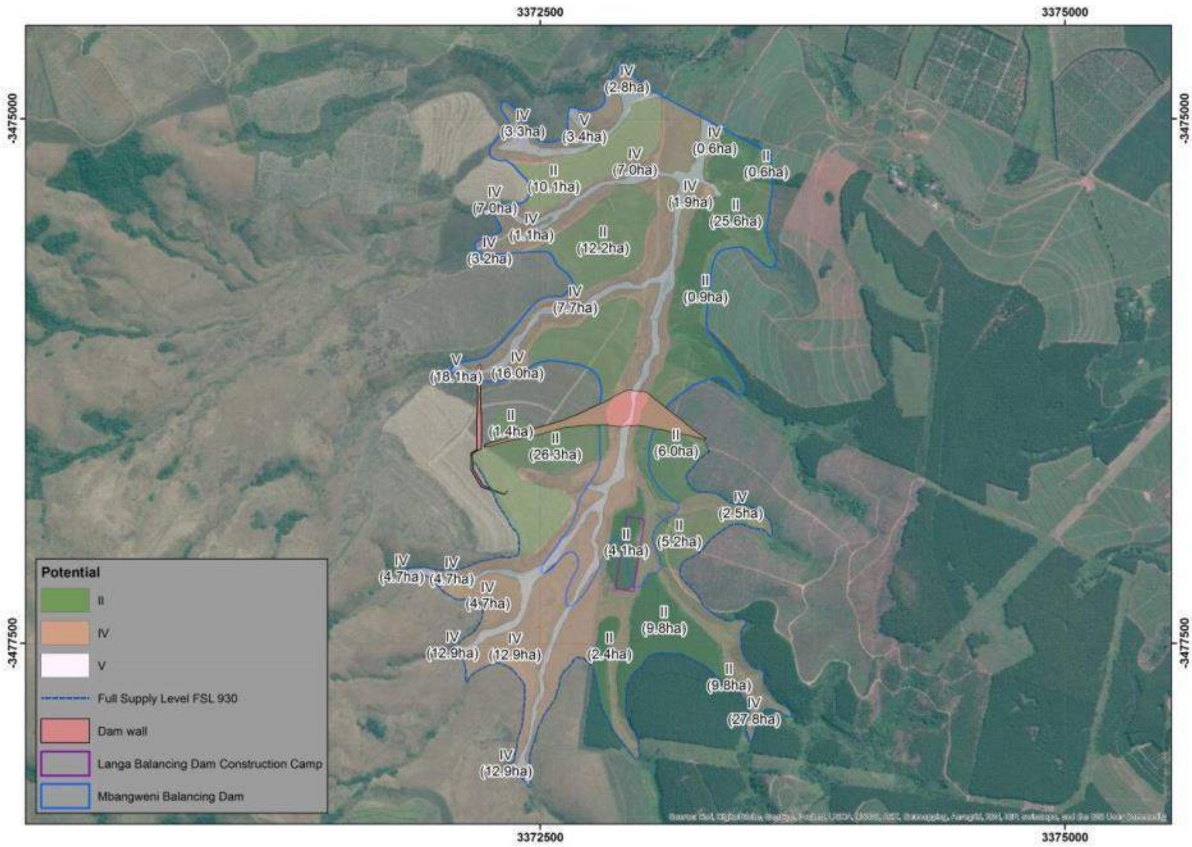


Figure 179: Land use Potential map: Balancing Dam Area (Index, 2015)

10.14 Air quality

Due to the predominantly rural nature of the study area, the air quality is regarded to be good. Localised impacts to air quality include burning of fossil fuels, emissions from vehicles travelling on the surrounding road network, dust from un-vegetated areas and dirt roads, smoke (veld fires), agricultural activities, and methane release from larger livestock.

In the greater area, air quality is influenced by anthropogenic activities in urbanised areas such as Bulwer, Richmond, southern parts of Pietermaritzburg, Camperdown and Cato Ridge. However, a significant factor that needs to be borne in mind is that the prevailing wind direction is south-east for the Pietermaritzburg weather station (refer to wind rose contained in **Section 12.2.3**). Sugar cane burning also constitutes a substantial seasonal source of particulates and CO emissions.

Sensitive receptors to dust and other air quality impacts are discussed in **Section 12.14.1**.

10.15 Noise

The rural state of the study area affords it tranquillity. Dwellings are sparsely situated within the project footprint.

Noise in the region emanates primarily from households, farming operations (e.g. use of farming equipment), and vehicles on the road network. The low mountainous terrain (western and central parts) and the undulating hills and lowlands (eastern part) serves as noise attenuation features, although the ambient noise levels are regarded as insignificant.

Sensitive receptors to noise are discussed in **Section 12.14.1**.

10.16 Historical and Cultural Features

A Phase 1 Heritage Impact Assessment (including an archaeological and palaeontological assessment), in accordance with the National Heritage Resources Act (Act No. 25 of 1999) and KZN Heritage Act (Act No. 04 of 2008), was conducted (see **Appendix H4**) for the project. Refer to **Sections 11.1.3** for a synopsis of the study. An extract from this study is provided in the sub-sections to follow.

10.16.1 Smithfield Dam

Although various significant archaeological sites, such as rock art occurrences, occur in the greater Boston and Bulwer areas none were located the areas that were accessed during the site visit. Small shelters that were noticed adjacent to the uMkhomazi River were investigated but these all are located within the river flood zone and no archaeological deposit would remain (**Figure 180**).

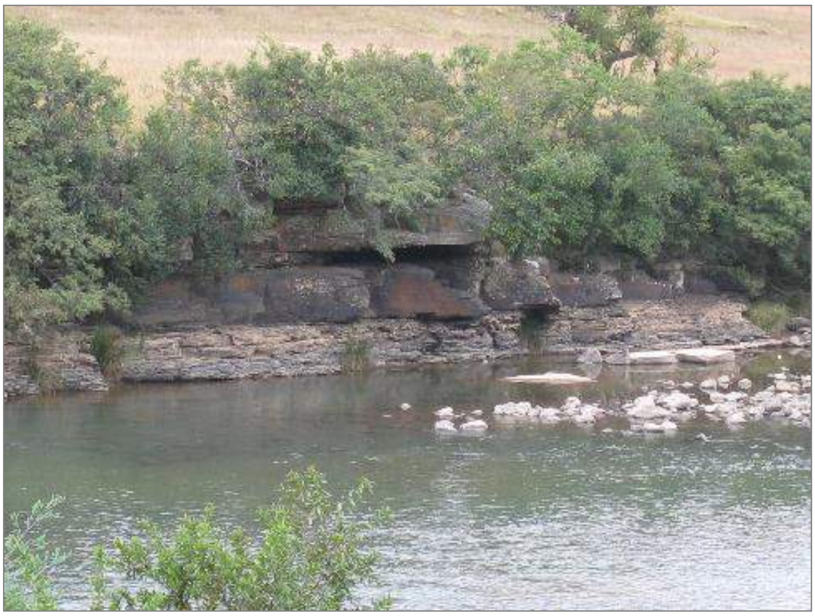


Figure 180: Small shelter adjacent to the uMkhomazi River (Jean & Prins, 2015)

A survey conducted by the Natal Museum in the 1960's located a few Middle Stone Age flakes and blades approximately 800m south of the proposed Smithfield Dam (**Figure 181**). These tools occurred on the surface and were out of context. In addition, they have been removed and taken to the Museum for safekeeping. There is no evidence of the site today.

The remainders of several Late Iron Age (LIA) / historic period structures will be impacted by the proposed dam and are listed in the following section.

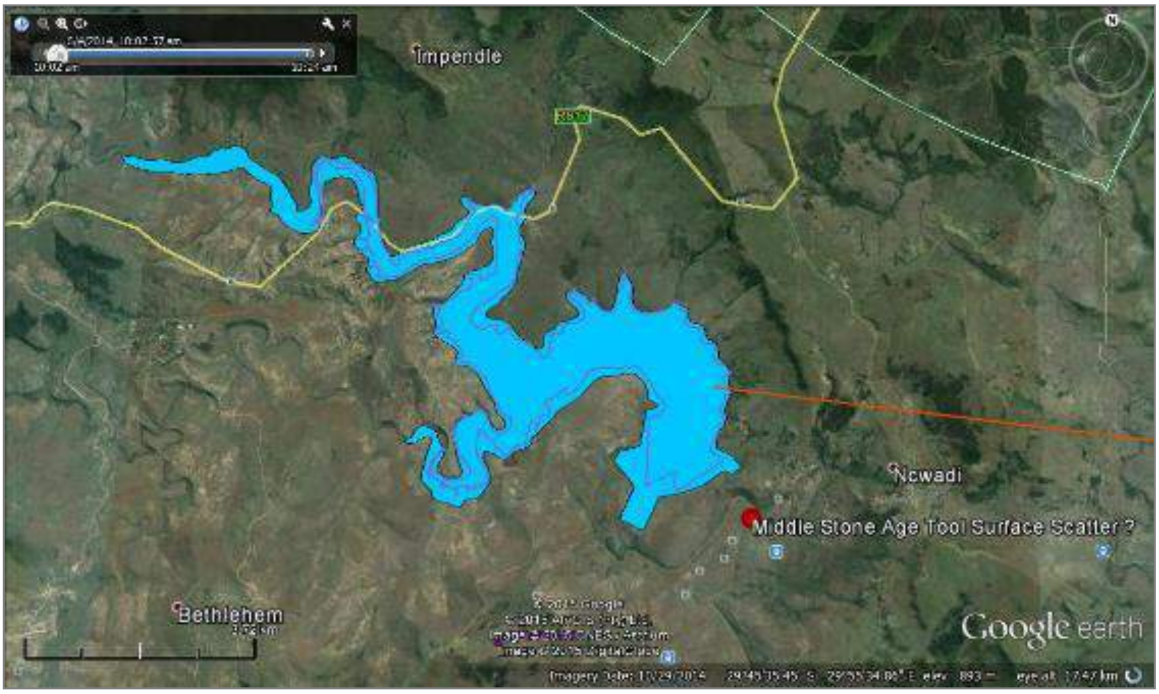


Figure 181: Google Earth image showing location of MSA tools recorded close to Smithfield Dam (Jean & Prins, 2015)

10.16.2 Historical

The area where the Smithfield Dam is proposed is characterized by steeply undulating topography with hills, steep slopes, flat plateaus and ridges, rivers and drainage lines. Traditional homesteads are clustered on the mid slopes of the uMkhomazi Valley due to the availability of water from the river and arable riparian land. This arable land is used for subsistence farming in the form of food crop cultivation and livestock grazing. There are a number of churches and stores in the project area.

Close to where the R617 will be inundated by the proposed Dam, the Lundy's Hill Supply Store can be found. It forms part of a complex of buildings. The store is situated at 29°44'28.97"S / 29°54'53.75"E. Although in poor condition, the building is older than 60 years and is protected by section 33 of the KwaZulu-Natal Heritage Act.

Figure 182: **Lundy's Hill Supply Store (Jean & Prins, 2015)**

Immediately west of the store is the Deepdale Bridge which was built in 1896 and reconstructed in 1913 (**Figure 183**). The single lane bridge on the D1212 is a reminder of the economic development of the Colony of Natal in the 19th Century with the spread of roads to the interior of the Colony. The centre of the bridge is located at 29°44'28.75"S / 29°54'40.07"E. Two additional bridges on the R617 will be inundated by the proposed dam. These bridges were built more recently in the 1960s and have no heritage significance.

Figure 183: **Plaque on Deepdale Bridge (Jean & Prins, 2015)**

Figure 184: Deepdale Bridge (Jean & Prins, 2015)

Two causeways on the gravel road to KwaZashuke that cross the Luhane River, a tributary of the uMkhomazi River, will be inundated by the proposed dam. The causeways are located at 29°46'20.23"S / 29°54'36.17"E. The date of when the structures were built is unknown. The lower causeway could be older than 60 years (especially in light of the fact that construction of bridges was already taking place in 1896 in the area).

Figure 185: Causeways on the Luhane River (Jean & Prins, 2015)

Some 50 m north of the R617 and on the other side of the valley to the above-mentioned terraced area, an old drystone wall was found (**Figure 186**). The wall was used to either keep animals in a secure area or to demarcate fields / pastures. These types of walls have their origins in the stone walling found in the British Isles. Drystone walls are, with hedgerows, one of the most commonly used field boundaries in England. Drystone walls are not merely features of agricultural interest; they are in a sense, living history; a legacy of the movement towards enclosure of common farming and grazing land as English society moved away from feudalism (Britain Express 2015: 1 of 2). The drystone wall will be impacted by the proposed deviation of the R617 at 29°44'40.57"S / 29°53'56.16"E.

Figure 186: Section of drystone wall (Jean & Prins, 2015)

Figure 187: View of raised area indicating drystone walling (Jean & Prins, 2015)

Several homesteads along the R124 gravel road (the Deepdale road) will be inundated by the proposed Smithfield Dam.

At Kheswa's Kraal, six graves were found in a fenced off area (29°45'20.26"S / 29°56'36.33"E) which was overgrown with grass (**Figure 188**). There was no-one at the homestead so the people buried in the small informal cemetery are unknown but are most probably family members. The neighbours' provided the name of the owner of the property. The remains of a small tombstone can be partially seen in Fig. 14 below.

Figure 188: Outline of grave at Kheswa's Kraal (Jean & Prins, 2015)

At Mbele's Kraal, the family at the homestead indicated that there was one grave of a family member which is located in the vegetable garden (29°45'26.49"S / 29°56'41.50"E) which was densely overgrown with vegetation (**Figure 189**).

Figure 189: Grave at Mbele's Kraal (Jean & Prins, 2015)

To the north-west of Mbele’s Kraal, the remains of old dwellings could be seen (29°45'24.48"S / 29°56'40.07"E). No obvious graves were noted however, the undergrowth / grass cover was very thick making observation difficult.

At Dlamini’s Kraal, Mr. Dlamini informed the specialist that he had recently bought the homestead and that there were no graves to his knowledge in or close to the homestead. He telephonically contacted the previous owner who confirmed that there were no graves at the homestead.

At Mncwabe’s Kraal, two graves of family members were pointed out by Mr. Mncwabe. The two graves are situated next to one another in a vegetable garden (29°45'24.67"S / 29°56'49.44"E) (**Figure 190**).

Figure 190: Graves at Mncwabe’s Kraal (Jean & Prins, 2015)

Mr. Mncwabe then mentioned that there were many graves situated directly east of his homestead where he said the old people were buried. The grass cover was very thick but an inspection revealed between 10 and 20 graves stretching several metres eastwards together with the remains of structures. Some of the graves are outlined with stones and some are covered with stones. There are no identifying tombstones. The graves are located roughly between 29°45'25.72"S / 29°56'50.41”E and 29°45'29.92"S / 29°56'54.58"E.

Figure 191: **Outline of grave adjacent to and east of Mncwabe's Kraal (Jean & Prins, 2015)**

Figure 192: **Remains of a grave (Jean & Prins, 2015)**

The spoil site at the inlet portal and the proposed new P124 access road will impact on the remains of a circular structure at 29°45'26.33"S / 29°57'4.15"E which could possibly be a LIA / Sotho herder hut.

Close to Borrow Area A, a number of sites were found including the remains of stone structures and graves (29°46'38.26"S / 29°56'41.89"E).

There are at least two graves (29°46'05.19"S / 29°55'14.35"E) located at what was known as Hlope's Kraal. There is only the outline of a structure.

Figure 193: Possible grave site at Hlope's Kraal (Jean & Prins, 2015)

Alongside the above site, the remains of a stone structure were found and at least one grave site. The site is known locally as Ngcobo's kraal (29°46'7.09"S / 29°55'11.21"E). The square structure suggests European influence and possibly dating from the late 1890s / early 20th Century.

Figure 194: Ngcobo's Kraal (Jean & Prins, 2015)

The remains of a small stone structure can be found a short distance from the above site at (29°46'9.08"S / 29°55'11.2"E). The structure could date from the Late Iron Age / early historic period and was possibly used by Sotho herders whilst looking after animals.

Figure 195: Small stone structure (Jean & Prins, 2015)

10.16.3 Tunnel

The central portal to the tunnel is situated in a valley with a stream approximately half way between the proposed Smithfield Dam and proposed balancing dam. Although there are residences above the area, the project area itself is untouched by development and there is a possibly of the central portal excavations and waste disposal site affecting heritage resources especially archaeological material due to the water course.

10.16.4 Balancing Dam

The outlet portal of the tunnel emerges above the southern-western end of the existing Mbangweni Dam. The outlet is situated on a steep slope hence it is not expected that heritage sites will be impacted by the tunnel. However, the area where the tunnel outlet works is proposed is one of the few areas in the surrounding area that is undisturbed by agricultural activities.

The area upstream from Mbangweni Dam, apart from the Mbangweni River and associated wetland, is transformed by maize cultivation on one side and sugar cane and tree plantations on the other side. No heritage sites were identified during the site visit.

10.16.5 Raw Water Pipeline

All the raw water pipelines cross heavily impacted areas where intensive agricultural activities take place including the growing of avocados, sugar cane and maize.

10.16.6 Palaeontology

The sites lie in eastern margin of the Karoo Basin, in the Volksrust Formation and Adelaide Subgroup in particular, which are of early Permian Ecca age and known to include fossil plants associated with the coal flora (see **Figure 196**). The distribution, however, is patchy. Plants of this age include Glossopteris leaves, cordaitalean leaves, ginkgophytes, ferns, sphenophytes, lycopods. According to the palaeo-sensitivity map produced by South African Heritage Resources Information System (SAHRIS), the central and eastern sections of the Raw Water component fall in the green area which means that there is a moderate risk of fossils occurring there. There are no records of fossils from this region on the Evolutionary Studies Institute (ESI) database or published records (Anderson and Anderson, 1985; Plumstead, 1969).

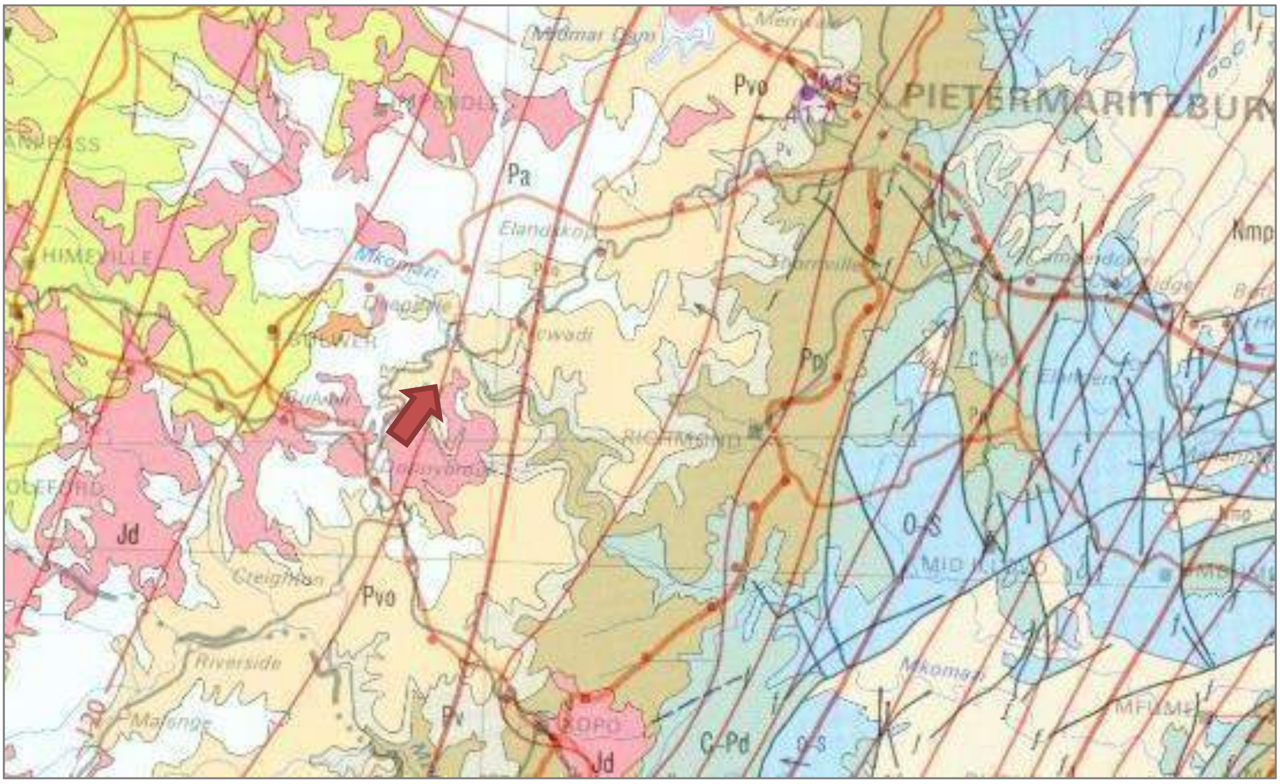


Figure 196: Geological map of the area along the uMkhomazi River where the development will take place (Jean & Prins, 2015)

Table 75: Abbreviations of the rock types (Jean & Prins, 2015)

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quarternary	Alluvium, sand, calcrete	Last ca 20 Ma
O-S	Natal	Quartzitic sandstone, arkose, shale	Ordovician, Silurian
Jd	Jurassic dykes	Intrusive dolerite	Jurassic ca. 180 Ma
Pvo	Volksrust	Shale	Permian 300-250 Ma
Pa	Adelaide & Estcourt	Mudstone, sandstone	Permian 300-250 Ma
C-Pd	Dwyka	Tillite, sandstone, mudstone, shale	Carboniferous-Permian

No further palaeontological impact assessment is required for the central and eastern section of the project because there are no records of fossils from there. If, however, fossil plants are discovered during any excavations, a professional palaeontologist must be called to rescue them (after obtaining the appropriate Amafa permit).

However, according to the palaeo-sensitivity map produced by SAHRIS, the western side where the Smithfield Dam is proposed, falls in both red and orange areas which means that the area is very sensitive to sensitive and a Phase 2 Paleontological Impact Assessment is required for all aspects of the Western side as there is a high probability of finding some fossil plants in the area.

10.17 Existing Structures and Infrastructure

10.17.1 Smithfield Dam

The following existing structures and infrastructure are affected by the proposed Smithfield Dam and associated works:

- Inundation of two sections of road R617 (from east to west - approx. 1200m and 330m). The options for the relocation of this road affect existing access roads to the Traditional Authority areas;
- Inundation of high voltage Eskom power line (approximately 700m). The relocation of the power line affects existing homesteads and access roads in the Traditional Authority area;
- Inundation of municipal water abstraction works (shown in **Figure 199**);
- Access roads to traditional areas;
- Telephone line;

- 11 homesteads (with associated kraals) located on the north-eastern side of the proposed dam; and
- Fencing erected around cultivated land on Portions 1 and 3 as well as the Remainder of the Farm Crowle 2260.

Buildings that occur in the western part of the study area, which were primarily identified on a desktop level, are shown in **Figure 197**.

10.17.2 Raw Water Conveyance Infrastructure

Apart from the inlet, central and outlet portals as well as the shafts for ventilation purposes, the tunnel runs below ground and has limited surface impacts. No known structures or infrastructure are directly affected by the tunnel and associated works.

Buildings that occur along the Raw Water Conveyance Infrastructure, which were primarily identified on a desktop level, are shown in **Figures 197 - 198**.

The raw water pipeline route options affect the following existing structures and infrastructure:

- The routes cross various public and private roads;
- The raw water pipeline routes to WTW Options 2 and 3 cross a railway line;
- The raw water pipeline to WTW Options 2 passes in close proximity to the Baynesfield Club sports ground as well as residential dwellings (on Portions 65 and 85 of the Farm Nels Rust 849);
- The raw water pipeline to WTW Options 3 travels past buildings (on Portions 22, 43 and 44 of the Farm Brasfort Park 1295) as well as chicken houses (on Portion 43 of the Farm Hopewell 881); and
- It is possible that the pipeline routes may affect infrastructure associated with agricultural practices, such as irrigation pipelines.

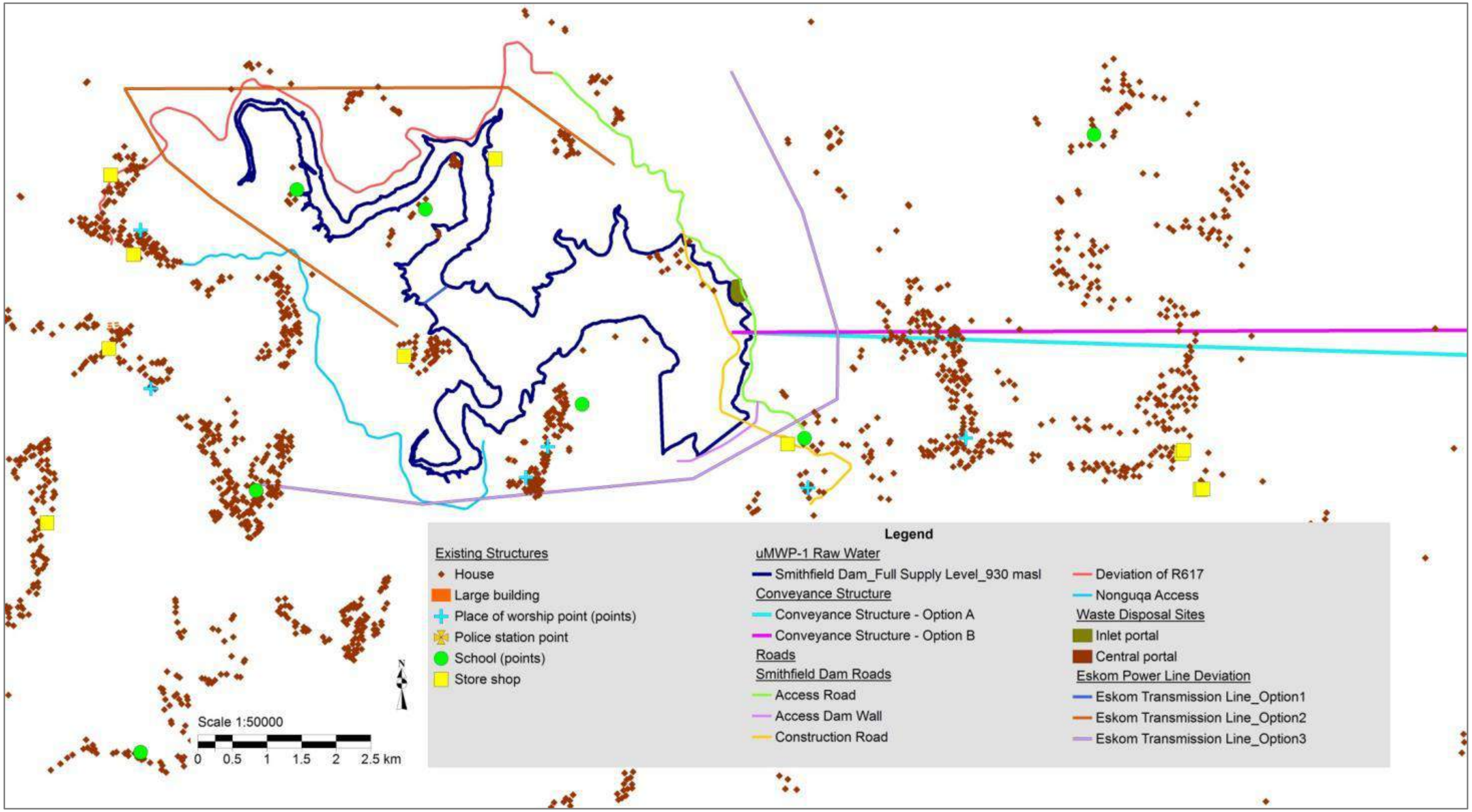


Figure 197: **Existing structures – western part of study area**

(Note: disregard reference to "Conveyance Structure Option B" and "Eskom Transmission Line Option 2" in legend – these options were discarded after Scoping)

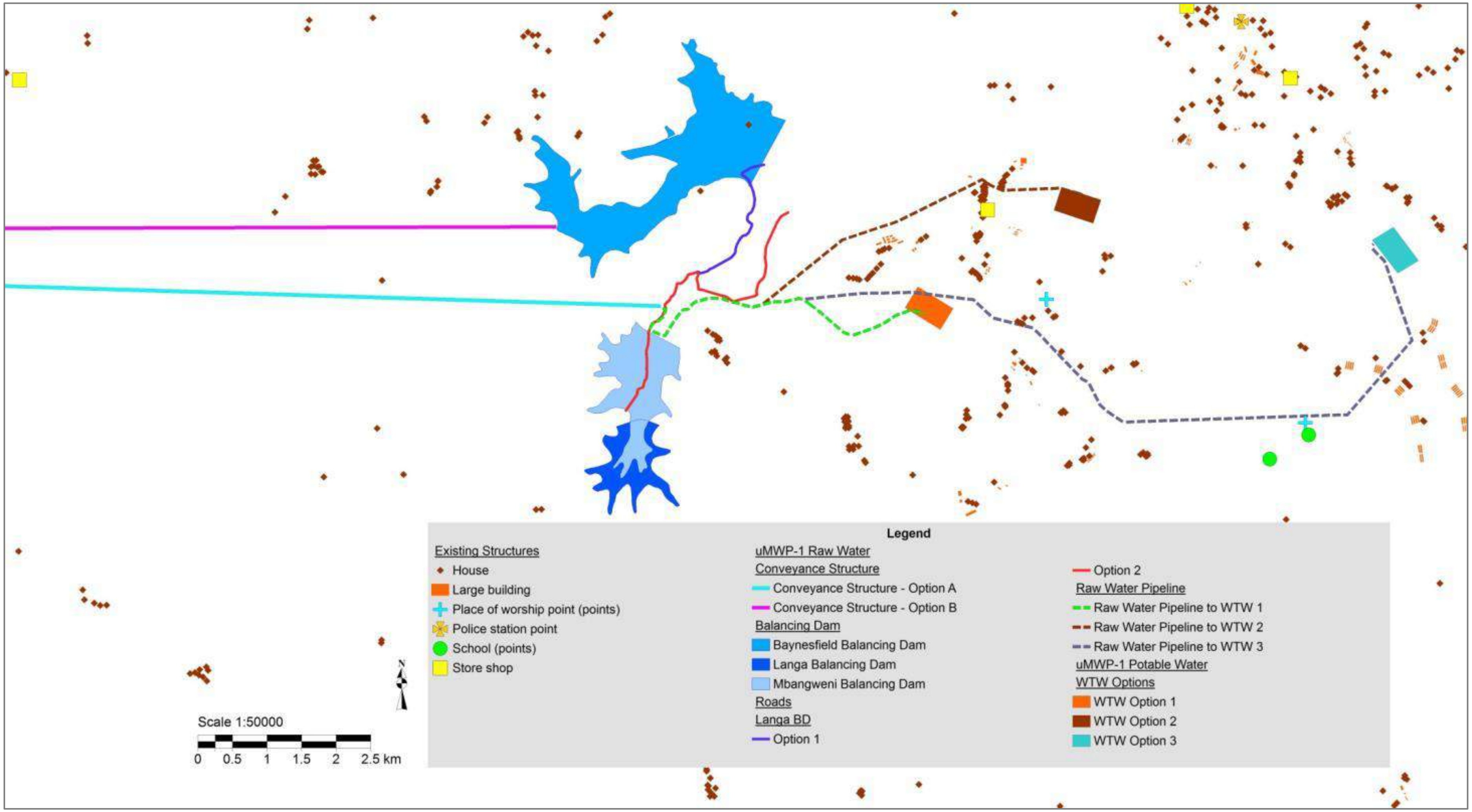


Figure 198: **Existing structures – eastern part of study area**

(Note: disregard reference to "Conveyance Structure Option B" and "Baynesfield Balancing Dam" in legend – these options were discarded after Scoping)

Figure 199: Municipal water abstraction works within Smithfield Dam basin

10.17.3 Balancing Dam

The proposed balancing dam options potentially affect the following existing structures and infrastructure:

- Mbangweni balancing dam –
  - Private farm road;
  - Access roads to cultivated areas and timber plantations;
  - Farming-related infrastructure (e.g. irrigation pipelines);
- Langa balancing dam –
  - Private farm road;
  - Access roads to cultivated areas and timber plantations; and
  - Farming-related infrastructure (e.g. irrigation pipelines).

Buildings that occur in the eastern part of the study area, which were primarily identified on a desktop level, are shown in **Figure 198**.

10.17.4 Gauging Weir

The proposed gauging weir will be located instream of the uMkhomazi River, surrounded by rural areas. It is not anticipated the gauging weir will affect existing structure or infrastructure. A new access road will need to be created for the gauging weir. Further details of this road will be provided in the EIA Report.

10.18 Land Claims

The information to follow was sourced from the Socio-Economic Impact Assessment (Nemai Consulting, 2016a).

There are a large number of gazetted land claims on the properties affected by the uMWP-1 Raw Water infrastructure, as shown in **Table 76** and **Figure 200**. Each of the land claims form part of a broader claim per claimant. The DRD&LR, through the Land Claims Commission, may still have to carry out further investigations to satisfy the validity of the claims. The process involved is lengthy.

The land claims are from the following claimants:

1. Bhekumuzi William Jili, on behalfof the Lundy's Hill Community;
2. Felokwakhe Saxson Zuma, on behalf of the Magxabeni Community;
3. KwaDushu;
4. Mphenduli Michion Dladla on behalf of Jardini Community;
5. Mr Norman Sibisi on behalf of the Baynesfield Land Claim Committee;
6. The Magxabeni Community, represented by Felokwakbe Saxson Zuma;
7. Thembu/Mkuzane; and
8. Zwelani Robert Dlamini, on behalf of the Bhidla Tribe.

Table 76: Land Claims (Nemai Consulting, 2016a)

SG Code	Claimant
N0FS00000000181500000	Bhekumuzi William Jili, on behalfof the Lundy's Hill Community
N0FS00000000181500001	Bhekumuzi William Jili, on behalfof the Lundy's Hill Community
N0FS00000000181500002	Bhekumuzi William Jili, on behalfof the Lundy's Hill Community
N0FS00000000182100000	Bhekumuzi William Jili, on behalfof the Lundy's Hill Community
N0FS00000000182100001	Bhekumuzi William Jili, on behalfof the Lundy's Hill Community
N0FS00000000182100003	Bhekumuzi William Jili, on behalfof the Lundy's Hill Community
N0FS00000000182400001	Zwelani Robert Dlamini, on behalf of the Bhidla Tribe
N0FS00000000226000000	KwaDushu
N0FS00000000226000001	KwaDushu
N0FS00000000226000003	No Claim
N0FS00000000226000004	KwaDushu
N0FS00000001479600000	KwaDushu
N0FT00000000082600017	Thembu/Mkuzane
N0FT00000000082600043	Thembu/Mkuzane
N0FT00000000082600080	Thembu/Mkuzane
N0FT00000000084700000	Mr Norman Sibisi on behalf of the Baynesfield Land Claim Committee
N0FT00000000084700001	Mr Norman Sibisi on behalf of the Baynesfield Land Claim Committee
N0FT00000000084800000	Mr Norman Sibisi on behalf of the Baynesfield Land Claim Committee
N0FT00000000084900000	Mr Norman Sibisi on behalf of the Baynesfield Land Claim Committee
N0FT00000000131300001	The Magxabeni Community, represented by Felokwakbe Saxson Zuma
N0FT00000000147800184	The Magxabeni Community, represented by Felokwakbe Saxson Zuma
N0FT00000000147800529	Felokwakhe Saxson Zuma, on behalf of the Magxabeni Community
N0FT00000000147800550	Felokwakhe Saxson Zuma, on behalf of the Magxabeni Community
N0FT00000000184800000	Zwelani Robert Dlamini, on behalf of the Bhidla Tribe
N0FT00000000184800001	Zwelani Robert Dlamini, on behalf of the Bhidla Tribe

SG Code	Claimant
N0FT00000000185100010	Mphenduli Michion Dladla on behalf of Jardini Community
N0FT00000000185900004	Zwelani Robert Dlamini, on behalf of the Bhidla Tribe
N0FT00000000199500000	Zwelani Robert Dlamini, on behalf of the Bhidla Tribe
N0FT00000000199500002	Zwelani Robert Dlamini, on behalf of the Bhidla Tribe
N0FT00000000199500003	Zwelani Robert Dlamini, on behalf of the Bhidla Tribe
N0FT00000000199500005	Zwelani Robert Dlamini, on behalf of the Bhidla Tribe
N0FT00000000199700002	Zwelani Robert Dlamini, on behalf of the Bhidla Tribe
N0FT00000000199700005	Zwelani Robert Dlamini, on behalf of the Bhidla Tribe
N0FT00000000199700010	Zwelani Robert Dlamini, on behalf of the Bhidla Tribe
N0FT00000000199700012	Zwelani Robert Dlamini, on behalf of the Bhidla Tribe
N0FT00000000296100001	Zwelani Robert Dlamini, on behalf of the Bhidla Tribe
N0FT00000000296100004	Zwelani Robert Dlamini, on behalf of the Bhidla Tribe

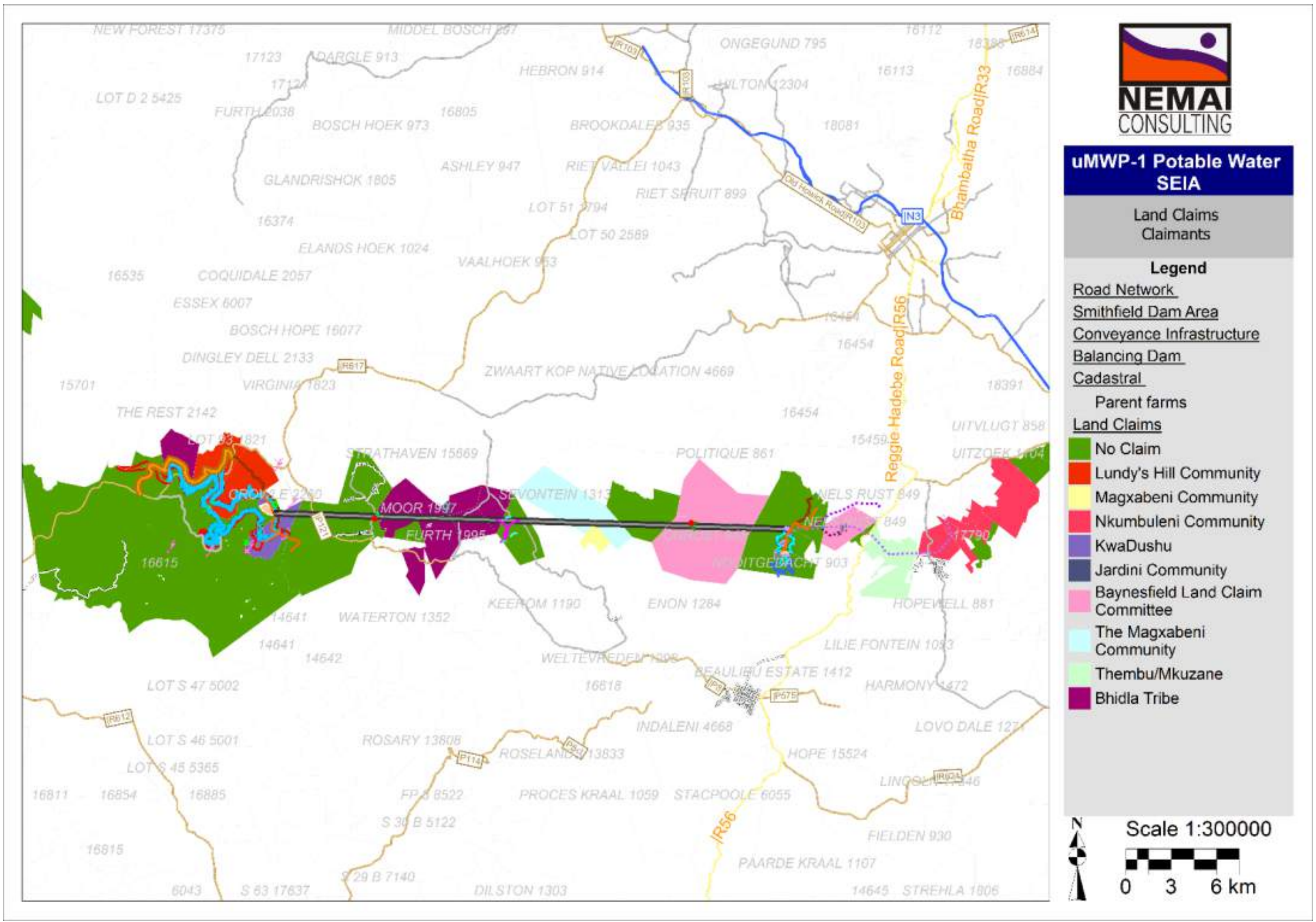


Figure 200: **Land Claims (*entire land claim per claimant not shown*)**

10.19 Services

The dispersed low-density settlement pattern and topography in the project area complicate the provision of service, and substantially increase the costs of installing, maintaining and operating the associated infrastructure.

10.19.1 Water

The graph to follow gives an indication of the households' access to water within the catchment area. The following main findings can be highlighted:

- The majority of households (33.2%) have access to piped water either inside their dwellings or inside their yard;
- The percentage of households with access to piped water on a community stand is 23.3%;
- 10.0% of all the households in the catchment area have access to piped water less than 200 m from their dwelling, while 13.2% have access to piped water a distance greater than 200 m from their dwelling;
- 22.2% of the households still get their water either from a river/stream or from a dam/pool/stagnant water.

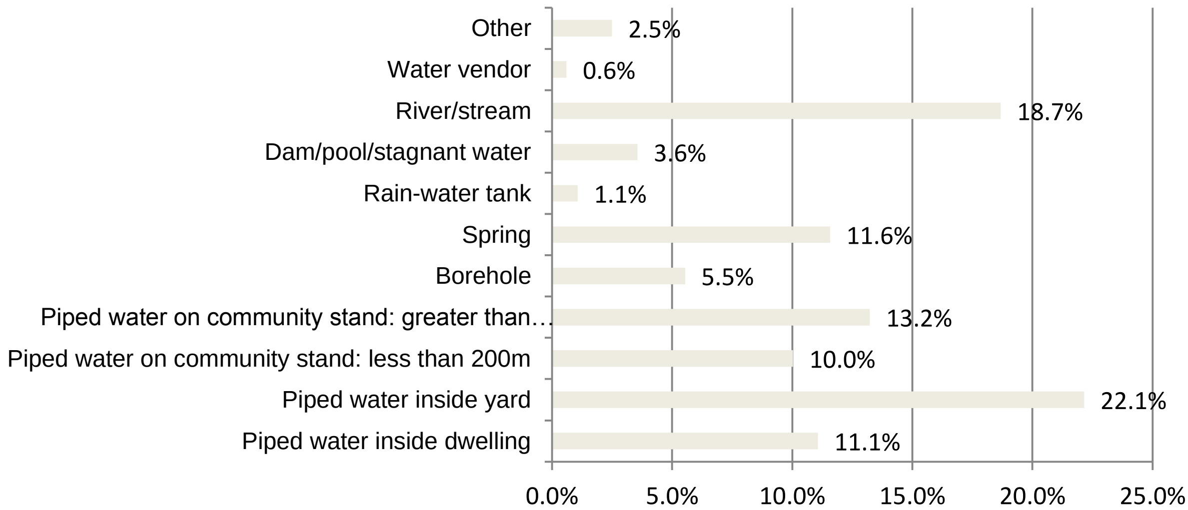


Figure 201: Access to water (DWA, 2012a)

The sources of water in the Ingwe LM and Richmond LM, based on Census 2011, are shown in **Figure 201**.

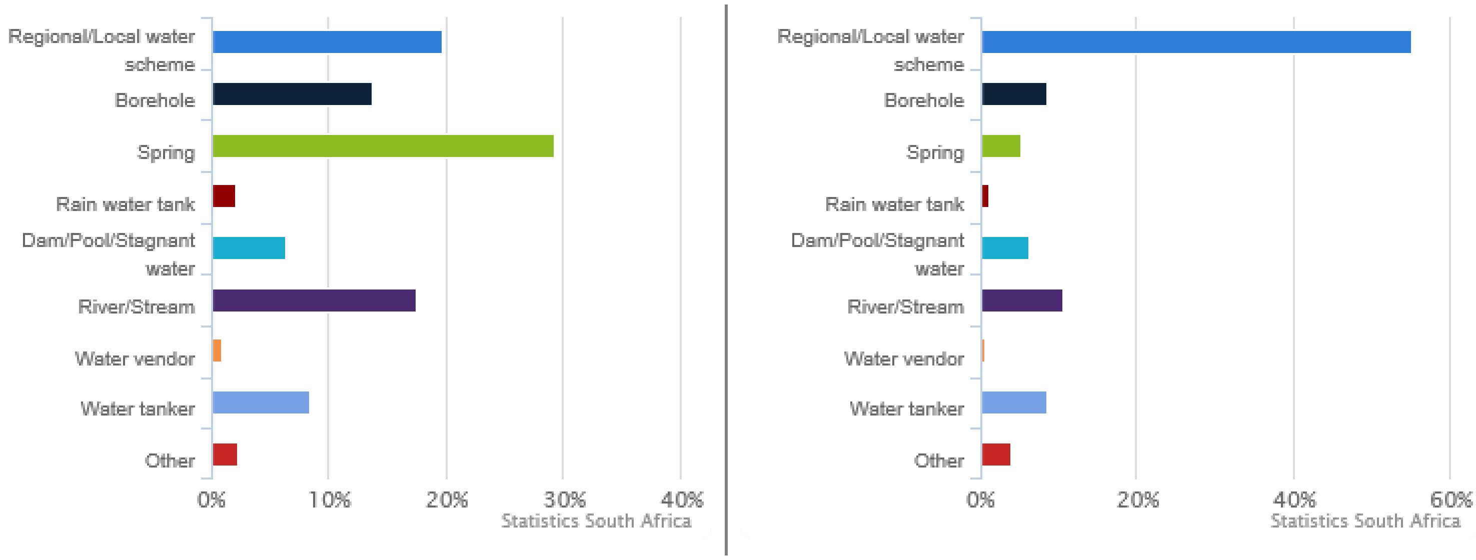


Figure 202: Source of water - Ingwe LM (left) and Richmond LM (right) (Stats SA)

Ultimately, the transfer scheme is deemed to be the most viable option to provide a large volume of water to fulfil the long-term water requirements of the Mgeni system, including the Reserve. Provision of water to the rural areas is however a function of the Water Services Authority (WSA).

Water requirements during the construction phase to be met through the municipality (delivered by tanker trucks) and river abstraction.

10.19.2 Sanitation

The graph below gives an indication of the types of toilets used by the households within the catchment area.

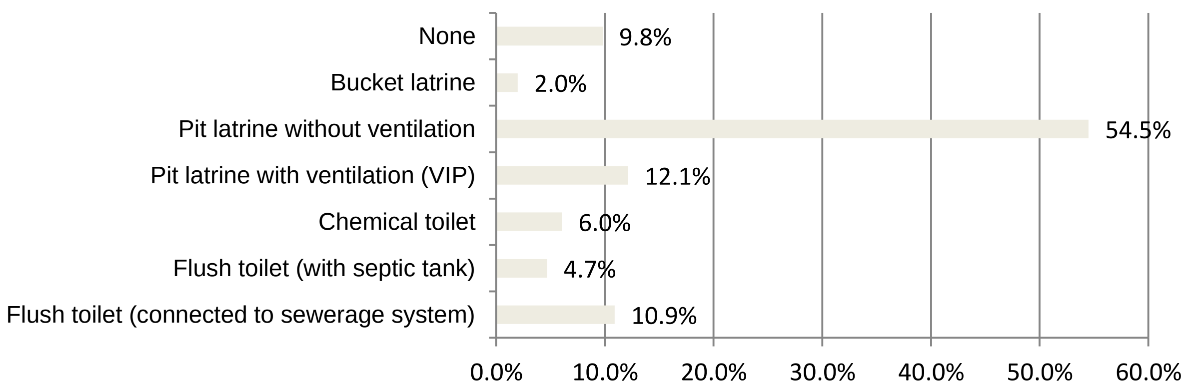
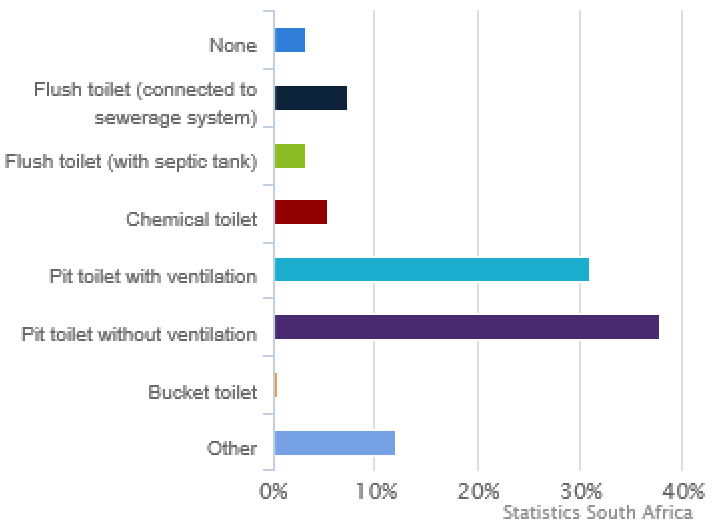


Figure 203: Types of toilets (DWA, 2012a)

The following main findings can be highlighted:

- The majority of households (66.6%) use pit latrines. 12.1% of all toilets within the catchment area are pit latrines with ventilation (VIP) and 54.5% of all the toilets in the catchment area are pit latrines without ventilation;
- The percentage of households with access to a flush toilet is 15.6%. 10.9% of all the households have a flush toilet connected to a sewerage system, while 4.7% have a flush toilet which is connected to a septic tank;
- 6% of the households use chemical toilets and 2% use a bucket latrine;
- A total of 9.8% of the households have no access to a toilet.

The toilet facilities in the Ingwe LM and Richmond LM, based on Census 2011, are shown in **Figure 204**.



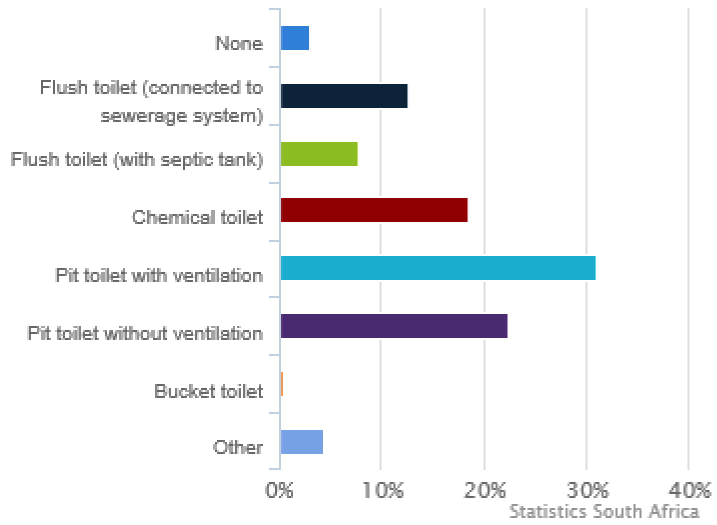


Figure 204: Toilet facilities - Ingwe LM (left) and Richmond LM (right) (Stats SA)

Sanitation facilities during the construction phase for construction workers will primarily be in the form of chemical toilets, which will be located so as to minimise the environmental impacts and serviced regularly.

Suitable provisions for sanitation during the construction phase to be included in EMPr.

10.19.3 Electricity

Energy use in the Ingwe LM and Richmond LM, based on Census 2011, is shown in **Figures 205** and **206** respectively.

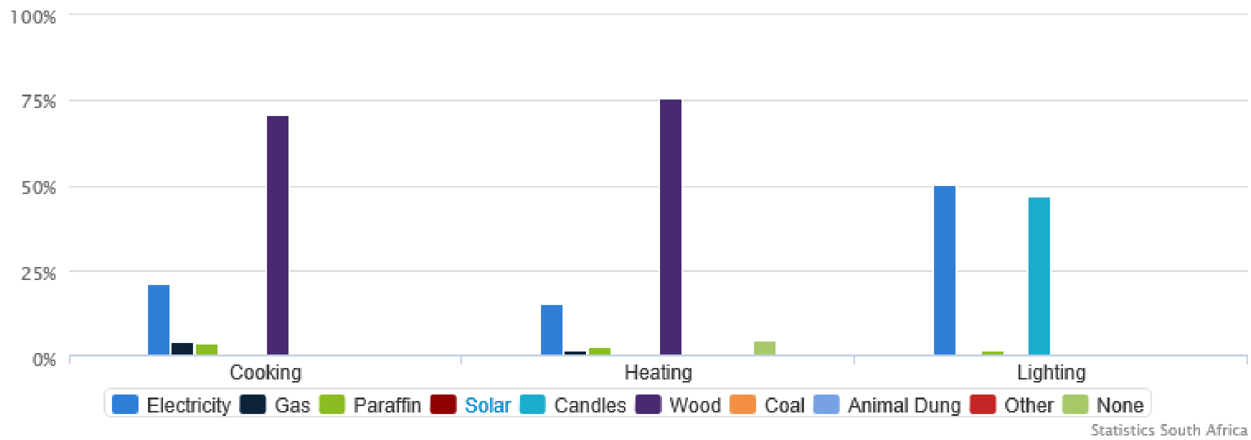


Figure 205: Energy use - Ingwe LM (Stats SA)

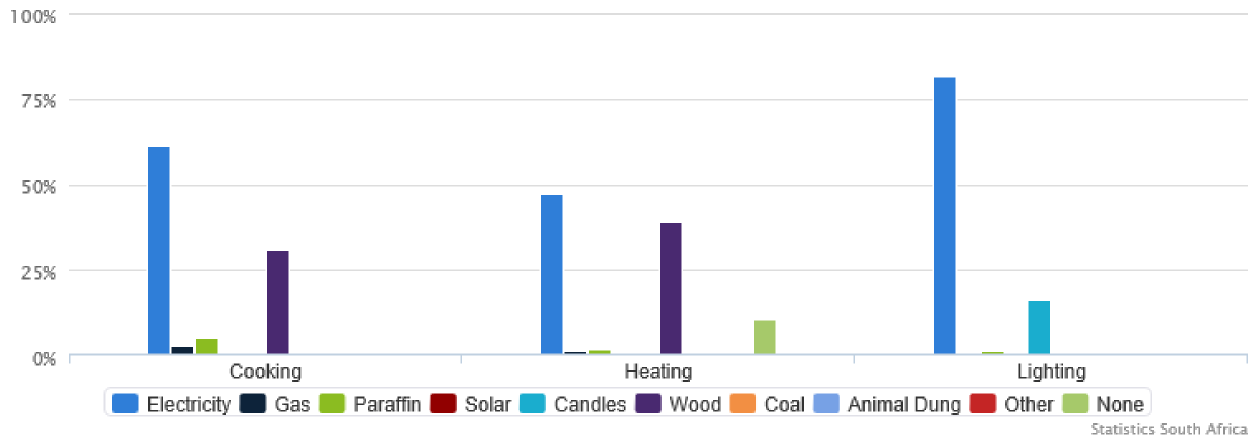


Figure 206: Energy use - Richmond LM (Stats SA)

It is noted that the proposed 400 kV / 132 kV multi-circuit transmission line from the Ariadne Substation (near Pietermaritzburg) to the vicinity of Oribi Substation (near Port Shepstone) and the expansion and upgrade of the Ariadne and Eros Sub-stations will increase electrical infrastructure within the greater uMkhomazi River Catchment (DWA, 2012b).

As discussed in **Section 9.8**, the Smithfield Dam will impact on an existing high voltage Eskom power line that will need to be relocated to make provision for the impoundment’s FSL.

The power requirements of uMWP-1 Raw Water is discussed in **Section 9.13**. Discussions were held with Eskom during the Scoping phase and the availability of power supply was confirmed. A separate EIA will be conducted to seek approval for a new high voltage power line to supply electricity to the site.

Suitable provisions for electricity supply during the construction phase are included in the EMPr.

10.19.4 Transportation

The major road infrastructure in the study area is shown in **Figures 207 - 208**. Main roads affected by Smithfield Dam include the R617 (P7-3), P124, D1212 and D1211. The main roads in the Baynesfield area include the R56 (P5-4), P334 and private roads. The project will influence the road network as follows:

- Smithfield Dam:
  - Inundation of two sections of road R617 (from east to west – approx. 1200m and 330m), which is administered by the KZN Department of Transport;
  - Inundation of approx. 3km of the P124;
  - Inundation of approx. 460m of the D1212;
  - Inundation of approx. 730m of the D1211;
  - Inundation of other access roads to traditional areas;
- Tunnel:
  - Although there should be minimal surface impacts, the tunnel routes cross various public (P121, D2161, D63, D58) and private roads;
  - Use of access roads to cultivated areas and timber plantations, in order to reach construction sites;
- Raw water pipeline routes:
  - Crossing of various public and private roads, including the following –
    - All three raw water pipeline routes – crossing of D41;
    - Raw water pipeline to WTW 2 – two crossings of P334; and
    - Raw water pipeline to WTW 3 – alignment alongside the D360, crossing of R56, P117 and P547.

    - Use of access roads to cultivated areas and timber plantations, in order to reach construction sites;
- ❖ Balancing Dam:
    - Inundation and use of private roads in the Baynesfield area;
- ❖ Gauging Weir:
    - Use of existing roads, as far as possible, in order to reach construction site.

The tunnel route crosses the same railway line three times. The raw water pipeline routes to WTW Options 2 and 3 cross the same railway line once at different locations (see **Figure 208**).

The options for the relocation of the affected roads are discussed in **Section 9.9.3**.

During the construction period there will be an increase in traffic on the local road networks, especially in the western and eastern parts of the project area, due to the delivery of plant and material, transportation of staff and normal construction-related traffic. This impact will be exacerbated if aggregate is to be obtained from a commercial source (refer to **Section 11.3.8**). Haul roads and access roads will also be created on site, within the construction domain.

As part of the construction phase measures will be implemented for the selective upgrade of the roads (if necessary) and to render these roads safe for other users (amongst others). Dust suppression on the access and hauls roads will also be addressed. After the construction phase the local roads will only need to be used for operation and maintenance purposes.

A Traffic Impact Assessment was undertaken for the project, and it is contained in **Appendix H9**. Refer to the summary and impact assessment of this study contained in **Sections 11.2.3** and **12.18**, respectively.

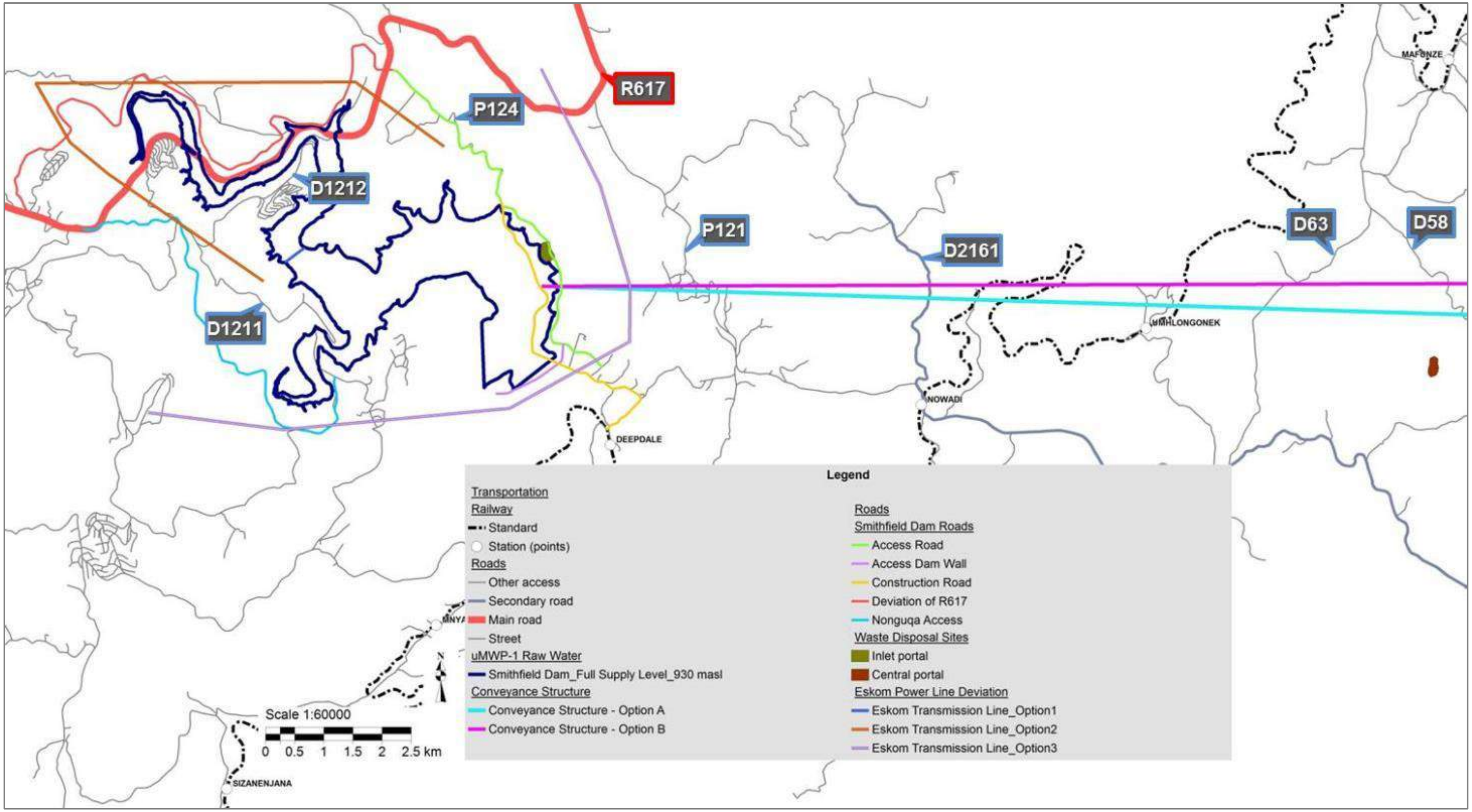


Figure 207: Transportation Network – western part of study area

(Note: disregard reference to "Conveyance Structure Option B" and "Eskom Transmission Line Option 2" in legend – these options were discarded after Scoping)

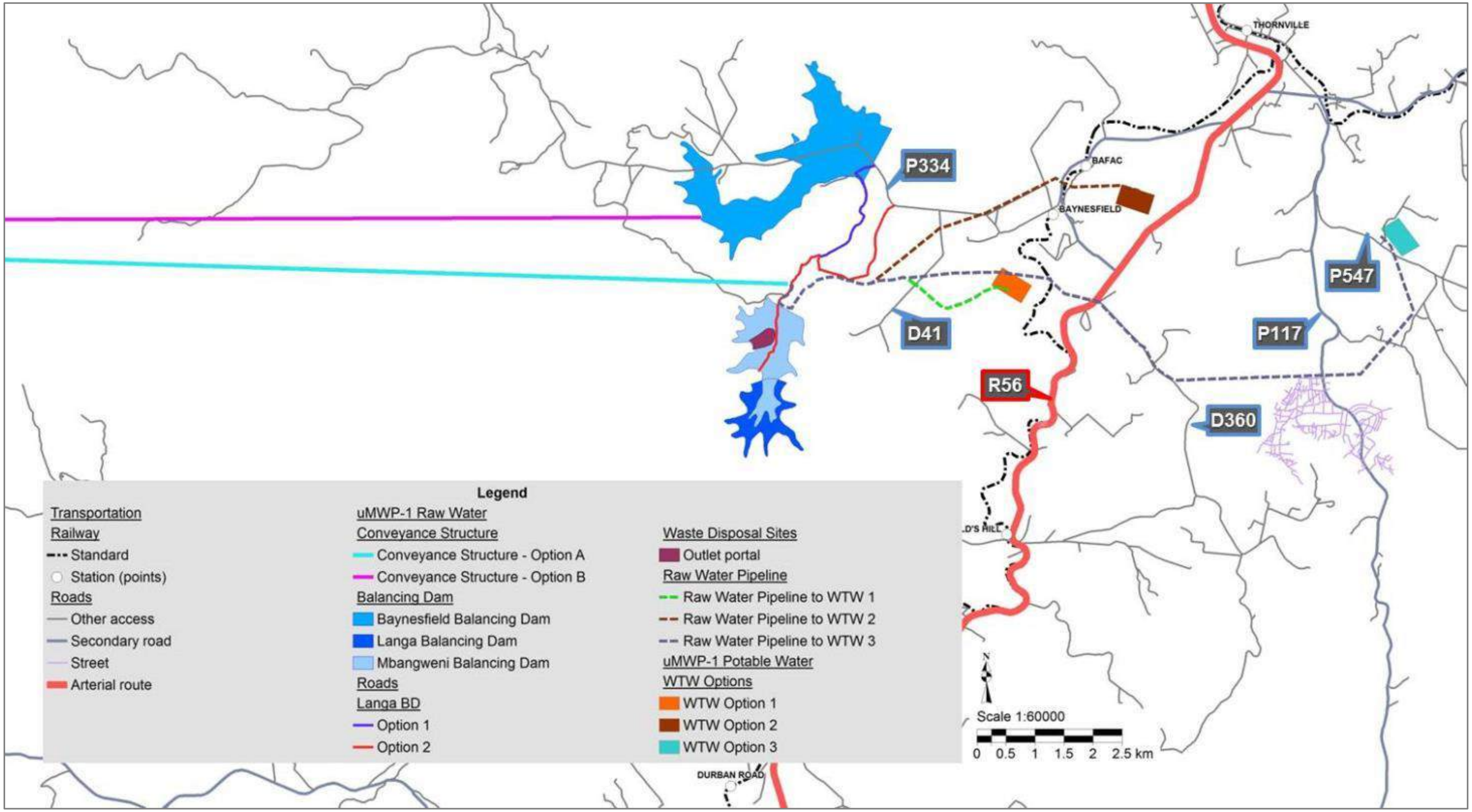


Figure 208: Transportation Network – eastern part of study area

(Note: disregard reference to "Conveyance Structure Option B" and "Baynesfield Balancing Dam" in legend – these options were discarded after Scoping)

10.19.5 Solid Waste

The types of refuse disposal in the Ingwe LM and Richmond LM, based on Census 2011, are shown in **Figure 209**.

According to the Msunduzi LM Integrated Waste Management Plan (IWMP) (Umgungundlovu DM, 2010), the New England Road landfill site is the largest in the district but only had about six years of airspace left in 2010. The permitted landfill is classified as G:L:B+ (i.e. general large waste disposal site that generates significant leachate). The Richmond Landfill Site, which is situated in the Richmond LM, is also permitted and is classified as G:S:B+ (general small waste disposal site that does not generate significant leachate).

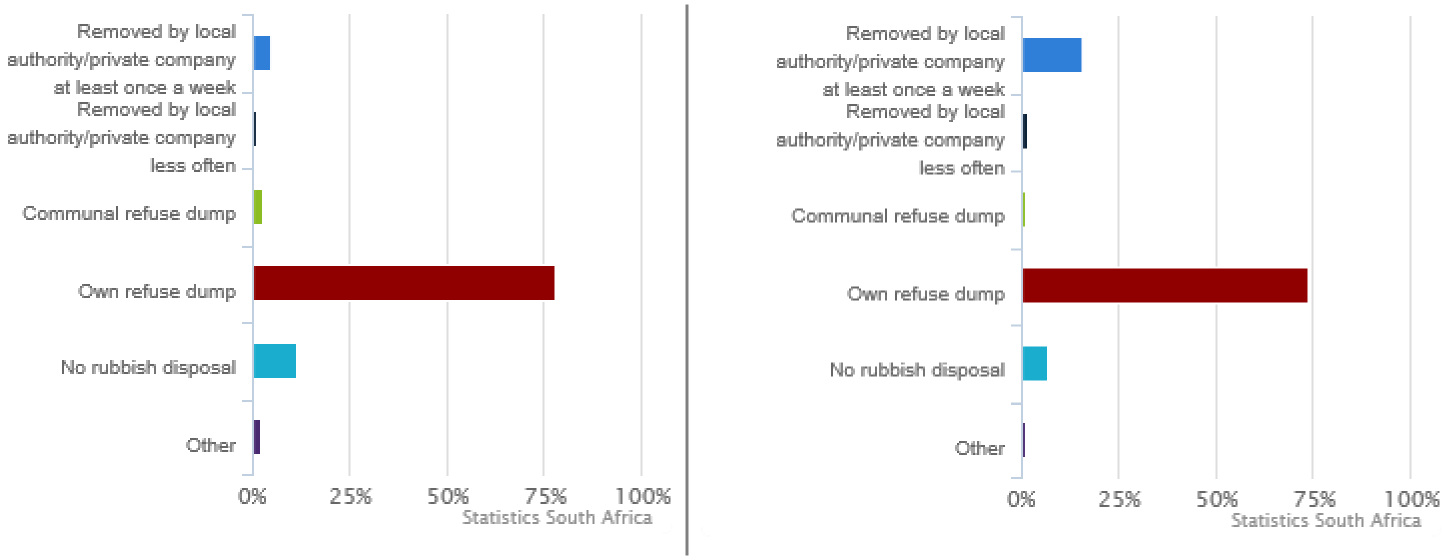


Figure 209: Types of refuse disposal - Ingwe LM (left) and Richmond LM (right) (Stats SA)

The project will directly or incidentally generate various types of solid waste during the construction phase, such as:

- Waste generated from site preparations (e.g. plant material);
- Domestic waste;
- Surplus and used building material; and
- Hazardous waste (e.g. chemicals, oils, soil contaminated by spillages, diesel rags).

Wastewater will also be produced during construction from the sanitation facilities, washing of plant, operations at the batching plant, etc.

Excess spoil material (soil and rock) will be generated as part of the bulk earthworks associated with the construction phase of the project. This spoil material will be hauled and dumped at three new disposal sites that will be created at the inlet portal, central adit portal and outlet portal of the tunnel (refer to **Section 10.2**).

During construction a waste management area will be established at the camp where waste from site will be collected, sorted, weighed and placed in skips and recycling containers for removal to service providers and appropriate registered landfill sites (hazardous and general sites, as required).

Further provisions for waste and wastewater management will be attended to in the EMPr.

10.20 Aesthetic Qualities

A Visual Impact Assessment was undertaken for the project, and it is contained in **Appendix H5**. Refer to the summary and impact assessment of this study contained in **Sections 11.1.5** and **12.20**, respectively.

10.20.1 Smithfield Dam

The area around the proposed Smithfield Dam is afforded high aesthetic appeal through topographical features such as low mountains, valleys and watercourses. The area's undeveloped, rural state further contributes to the visual quality encountered in the area.

The sense of place is typical of rural KZN, and presents a tribal setting with dispersed settlements and subsistence agriculture.

Figure 210: View of Smithfield Dam site

10.20.2 Raw Water Conveyance Infrastructure

The sense of place of the area along the tunnel route options is similar to that of Smithfield Dam in the west, and changes to predominantly agriculture and forestry in the east (including the raw water pipeline routes).

10.20.3 Balancing Dam

The balancing dam options are located in the Baynesfield area, where the sense of place is associated with agriculture and forestry. The area also has a strong heritage character which is linked to the Heritage Centre at the Baynesfield Estate. Features such as grassland, watercourses and the topography, as well as the rural setting, afford visual quality to the area.

Figure 211: View of valley at Langa Balancing Dam (Wildskies, 2015)

10.20.4 Gauging Weir

The aesthetic value of the alternative sites for the gauging weir is high due to the riverine setting and the adjoining riparian zones. Surrounding land use consists of communal grazing.

10.21 Tourism

Tourism-related features in the study area include the following:

- The uMkhomazi River is used for recreational purposes and it is particularly favoured for canoeing;
- The Impendle Nature Reserve is located to the north of Smithfield Dam;
- The Baynesfield Estate Lodge is located next to the Mbangweni Dam and it offers tourist accommodation, recreational fishing on the dam and environmental education opportunities;

- The greater area holds aesthetic values which are associated with its landscape, watercourses and habitats.

The Smithfield Dam reservoir may be suitable for a variety of recreational activities (e.g. fishing, canoeing, camping etc.). However, the river is not currently used for recreational activities in the reach to be affected by the basin, suggesting that its relative remoteness will tend to restrict such uses.

The Visual Impact Assessment (**Appendix H5**) includes an appraisal of the project's impacts on tourists from an aesthetics perspective. - refer to the summary and impact assessment of this study contained in **Sections 11.7** and **12.11**, respectively.

11 SUMMARY OF SPECIALIST STUDIES

11.1 Specialist Studies undertaken as part of the EIA

A crucial element of the Plan of Study for the EIA prepared during the Scoping phase was to provide the Terms of Reference for the requisite specialist studies triggered during Scoping. According to Münster (2005), a 'trigger' is "*a particular characteristic of either the receiving environment or the proposed project which indicates that there is likely to be an issue and/or potentially significant impact associated with that proposed development that may require specialist input*". The requisite specialist studies 'triggered' by the findings of the Scoping process, aimed at addressing the key issues and compliance with legal obligations, include:

1. Terrestrial Ecological Impact Assessment;
2. Aquatic Impact Assessment;
3. Heritage Impact Assessment;
4. Agricultural Impact Assessment;
5. Visual Impact Assessment;
6. Socio-Economic Impact Assessment;
7. Social Impact Assessment;
8. Avifauna Study; and
9. Relocation Framework Plan.

For the inclusion of the findings of the specialist studies into the EIA report, the following guideline was used: *Guideline for the review of specialist input in EIA processes* (Keatimilwe & Ashton, 2005). Key considerations included:

- Ensuring that the specialists have adequately addressed I&APs' issues;
- Ensuring that the specialists' input is relevant, appropriate and unambiguous; and
- Verifying that information regarding the receiving ecological, social and economic environment has been accurately reflected and considered.

The information obtained from the respective specialist studies was incorporated into the EIA report in the following manner:

7. The assumptions and limitations identified in each study were included in **Section 7**;

8. The information was used to complete the description of the receiving environment (**Section 10**) in a more detailed and site-specific manner;
9. A summary of each specialist study is contained in the sub-sections to follow (**Sections 11.1.1 – 11.1.9**), focusing on the approach to the study, key findings and conclusions drawn;
10. The specialists' impacts assessment, and the identified mitigation measures, were included in the overall project impact assessment contained in **Section 12**;
11. The evaluations performed by the specialists on the alternatives of the project components were included in the comparative analysis (**Section 13**) to identify the most favourable option;
12. Specialist input was obtained to address comments made by I&APs that related to specific environmental features pertaining to each specialist discipline; and
13. Salient recommendations made by the specialists were taken forward to the final EIA Conclusions and Recommendations (**Section 15**).

Refer to **Appendix H13** for declarations from the respective specialists.

11.1.1 Terrestrial Ecological Impact Assessment

The key issues and triggers identified during Scoping for the Terrestrial Ecological Impact Assessment include:

- Species with a known conservation status occur in the project area;
- Potential loss of significant flora and fauna species;
- Impacts to sensitive terrestrial ecological features; and
- Management actions for controlling exotic vegetation.

The details of the nominated specialists follow.

Specialist	
Name, qualifications and number of years' experience:	Ronald Phamphe - MSc – Botany, 8 years
Affiliation (if applicable):	❖ Professional Natural Scientist - Ecological Science (Reg number: 400349/12) with SACNASP ❖ Professional member of SAIEES & SAAB

This section provides a summary of the Terrestrial Ecological Impact Assessment (Nemai Consulting, 2016b), as contained in **Appendix H1**.

Scott-Shaw and Escott (2011) described the study area as falling within the Forest, Grassland, Savanna and Wetland biomes. It traverses nine vegetation types, namely Alluvial Wetlands : Temperate Alluvial Vegetation, Alluvial Wetlands : Temperate Alluvial Vegetation : Midland Alluvial Woodland & Thicket, Dry Coast Hinterland Grassland, Eastern Mistbelt Forests, Freshwater Wetlands : Eastern Temperate Wetlands, KwaZulu-Natal Hinterland Thornveld, Midlands Mistbelt Grassland, Moist Coast Hinterland Grassland and Southern KwaZulu-Natal Moist Grassland. In terms of the Terrestrial Threatened Ecosystems, two ecosystems were recorded, namely Impendle Highlands and Impendle Lowland Grasslands.

According to the KZN Provincial Biodiversity Plan the following can be deduced:

- *Smithfield Dam –*
  - *The majority of the basin inundates an area that is not of conservation importance;*
  - *The deviation of R617 and Eskom powerline deviation fall within the Impendle Nature Reserve;*
  - *Some parts of the basin fall within a CBA 3 Optimal;*
  - *A CBA 1 Mandatory is affected by the Transmission Line Deviation Option 2 and a small part of the Smithfield Dam basin;*
  - *The remaining footprint of the infrastructure options at Smithfield Dam fall within areas that are not of conservation importance, and to a lesser extent areas categorised as CBA 3 Optimal;*
- *Raw Water Conveyance Infrastructure –*
  - *The western part of the tunnel route options cross areas that are not of conservation importance and CBA 3 Optimal;*
  - *The eastern part of the tunnel route options mostly traverse CBA 1 Mandatory;*
  - *The raw water pipeline routes cross CBA 1 Mandatory, CBA 3 Optimal, areas that are not of conservation importance and transformed areas;*
- *Balancing Dam –*

- *The Mbangweni and Langa Balancing Dam options fall predominantly within a CBA 1 Mandatory, with a portion of the latter impoundment also occurring in CBA 3 Optimal;*
- *The Baynesfield Balancing Dam option inundates CBA 1 Mandatory, CBA 3 Optimal and area that is not of conservation importance;*
- *The two access road options cross CBA 1 Mandatory, CBA 3 Optimal, areas that are not of conservation importance and transformed areas;*

❖ *Gauging weir –*

- *Downstream of Smithfield Dam Options 1 and 2 are located within a CBA 3 Optimal.*

The majority of the project area is located in an already disturbed landscape, which is dominated by rural homesteads and communal subsistence agriculture with heavy grazing and some bush clearing for firewood. Patches of natural habitats were noted along the rivers and on slopes. During the field surveys, no threatened flora species were observed on site but four species of conservation importance were noted in the proposed Smithfield Dam area, namely Merwilla plumbea (Wild squill), Bowkeria verticillata (Natal shell-flower bush), Hypoxis hemerocallidea (Star flower/African potato)) and Boophane disticha (Century plant). Merwilla plumbea is listed as Near Threatened, Bowkeria verticillata as Rare, and Hypoxis hemerocallidea and Boophane disticha as Declining. No plant species of conservation importance were noted in in the areas affected by the conveyance infrastructure and balancing dam options.

The project area consists of suitable habitats such as rivers, cliffs, mountains, bushveld and grasslands for mammalian species. The Transmission Line Deviation Option 2 and the relocation of the R617 fall within the Impendle Nature Reserve. A species of conservation importance recorded in the Reserve and also in grasslands on Baynesfield Estate is Oribi, which is listed as Endangered. The most common animals to be seen in the Impendle Nature Reserve are Common reedbuck, Mountain reedbuck, Grey duiker, Vervet monkey and Bushbuck. Rare animals that occur in the reserve are Oribi, Serval and Blue duiker. Other animals that can be seen are the Natal red rock rabbit, Caracal, Genet, Cape clawless otter and Rock hyrax. The fact that communities in these areas hunt for social, cultural and spiritual reasons will mean that no antelope will be found in *the immediate vicinity of the homesteads, although they may be maintaining an existence in natural bush close to the homesteads, albeit in very low numbers. Small predators will be present and, for the most part, will continue to survive in that environment, although they may be killed for muthi purposes. Snakes and frogs, and occasionally chameleons, are regularly killed in communal areas. Livestock, especially in the proposed Smithfield dam area, pose a considerable threat to wildlife since high numbers of domesticated animals generally cause a displacement of game, as there is less suitable habitat available. Moreover, wild predators such as the Black-backed Jackal have been destroyed by livestock farmers who see these animals as a threat to their livelihoods. Poisoned carcasses are often used for this purpose; this method is indiscriminate and therefore poses considerable threat to many animal species. Poaching and illegal hunting (dogs) are further reducing the remnant faunal populations. Overall, the impacts of the proposed development on animals in the area will be relatively small, and localised.*

The reptile assessment found that the rocky habitats, grasslands and riparian vegetation are of high importance to reptiles. Some sections of the study areas display habitat modification and transformation with increased human presence and associated disturbances (illegal reptile collecting, indiscriminate killing of all snake species, frequent fires). The increased habitat destruction and disturbances are all causal factors in the alteration and disappearance of reptile diversity in the area. Termite mounds were present on the study area. Some large mounds had been damaged by previous foraging by Antbears. This resulted in the exposing of tunnels into the interior of the termite mound. Old termite mounds offer important refuges especially during veld fires as well as cold winter months for numerous frog, lizard, snake and smaller mammal species. Large number of species of mammal, birds, reptiles and amphibians feed on the emerging alates (winged termites). According to the South African Reptile Conservation Assessment (ADU, 2015), four red data reptile species (Natal Black Snake, KwaZulu Dwarf Chameleon, Natal Midlands Dwarf Chameleon and Large-scaled Grass) have a higher possibility of being found in the project areas.

Frogs are useful environmental bio-monitors (bio-indicators) and may acts as an early warning system for the quality of the environment. Frogs and tadpoles are good species indicator on water quality, because they have permeable, exposed skins that readily *absorb toxic substances. The presence of amphibians is also generally regarded as an indication of intact ecological functionality and therefore construction activities within these habitat units should be undertaken in an ecologically-sensitive manner. Frog species recorded during the field surveys were common and of no conservation concern, namely Guttural Toad, Bubbling Kassina and Snoring Puddle Frog.*

Various Biodiversity Offset Guidelines were reviewed as part of the study. Biodiversity offsets should be considered to compensate for residual negative impacts on biodiversity and ecosystem services of 'medium' to 'high' significance. Although isolated portions of the Smithfield Dam basin fall within CBA 2, which are associated with high biodiversity, the majority of the inundated areas and footprint of the physical infrastructure are areas which have been transformed through agricultural activities, gravel roads, alien plant species, weeds and exotic plants. Portions of the balancing dam options which fall within CBA1 have been transformed through maize fields and pine plantations. It is expected that similar habitat as is encountered within the dam basin is readily available in the greater area (characterised by a rural landscape) to allow for the habitation of relocated species, without resulting in competition with similar species for resources (depending on the conditions of the receiving habitat).

The ecological function describes the intactness of the structure and function of the vegetation communities which in turn support faunal communities. It also refers to the degree of ecological connectivity between the identified vegetation communities and other systems within the landscape. Therefore, systems with a high degree of landscape connectivity among each other are perceived to be more sensitive. The following sensitivity ratings were used as part of the study:

- *High – Sensitive vegetation communities with either low inherent resistance or resilience towards disturbance factors or vegetation that is considered important for the maintenance of ecosystem integrity. Most of these vegetation communities represent late succession ecosystems with high connectivity with other important ecological systems.*
- *Medium – Vegetation communities that occur at disturbances of low-medium intensity and representative of secondary succession stages with some degree of connectivity with other ecological systems.*

- *Low – Degraded and highly disturbed vegetation with little ecological function.*

*The sensitivity map (**Figure 212**) was based on the following criteria:*

- *Critical Biodiversity Area 1 (High);*
- *Critical Biodiversity Area 2 (High);*
- *Impendle Nature Reserve (High);*
- *Species of conservation importance (Merwilla plumbea, Bowkeria verticillata, Hypoxis hemerocallidea and Boophane disticha) (Medium);*
- *Perennial river and its associated buffer zone (Medium); and*
- *Oribi and its habitat (High).*

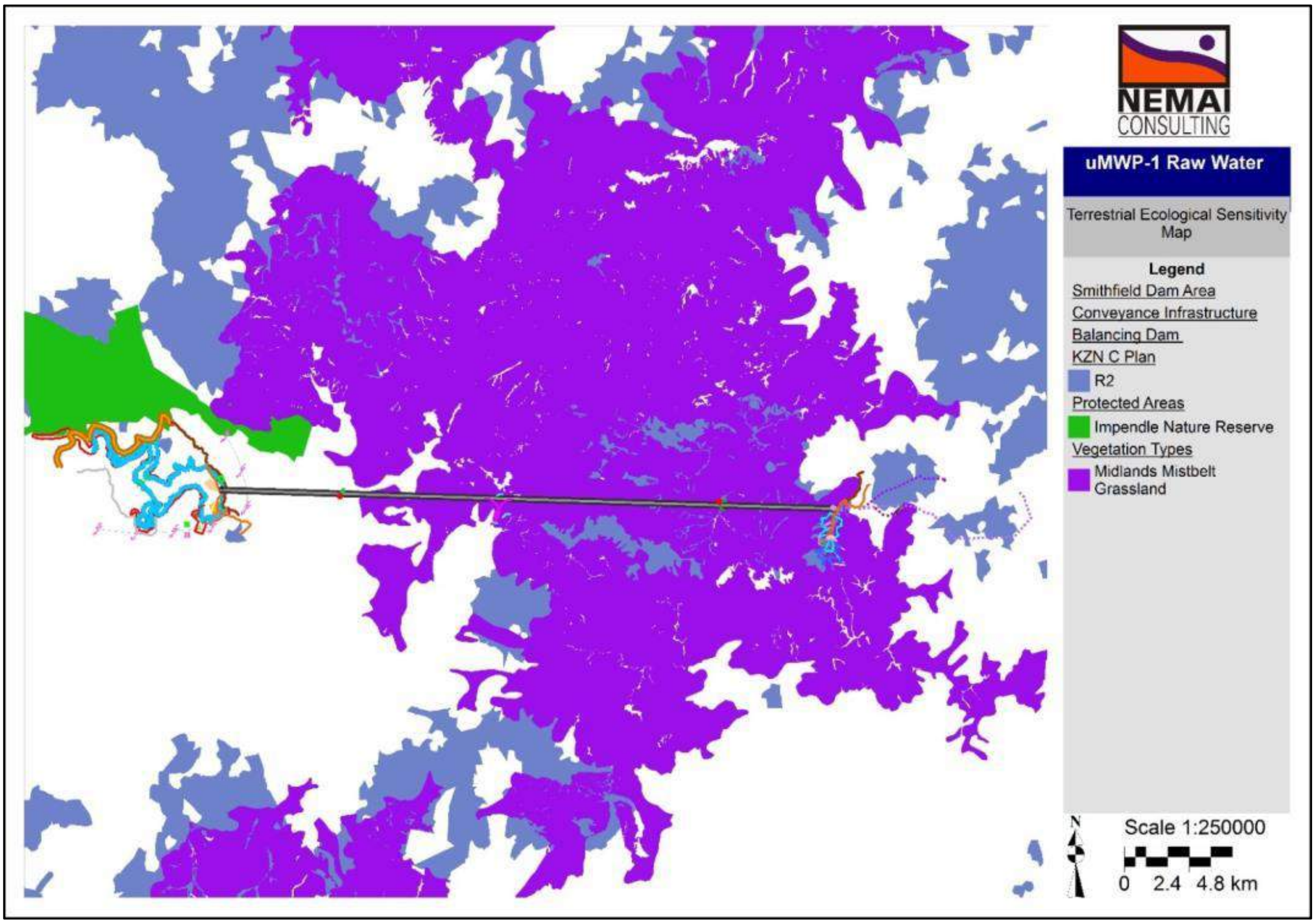


Figure 212: Terrestrial Ecological Sensitivity Map (Nemai Consulting, 2016b)

It is recommended that search and rescue be conducted prior to the construction in order to confirm the presence of species of special concern in the project area. This could be done through formalised trapping studies in the case of reptiles and small mammals. All *relocations will need to comply with the requirements of Ezemvelo KZN Wildlife, in terms of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) and Natal Nature Conservation Ordinance (15 of 1974).*

11.1.2 Aquatic Impact Assessment

The key issues and triggers identified during Scoping for the Aquatic Impact Assessment include:

- Impacts associated with instream works during construction in terms of Smithfield Dam, balancing dam, gauging weir and river crossings.
- Impacts associated with watercourse crossings by raw water pipeline, access roads and other project infrastructure and activities.
- Downstream impacts to aquatic ecology due to reduction in water quality in Smithfield Dam and balancing dam basins (e.g. temperature and dissolved oxygen stratification).
- Downstream impacts due to alteration of the flow regime.
- Prevention of up- and downstream movement of aquatic biota.
- Fragmentation of the main stem of the uMkhomazi River and uMlaza River.
- Loss of habitat for aquatic biota within the inundation zone.
- Loss of riparian habitat within inundated area.
- Proliferation of aquatic weeds
- Impacts to protected fauna and flora species (aquatic and riparian) and sensitive ecosystems.

The details of the nominated specialists follow.

Specialist	
Name, qualifications and number of years' experience:	Mathew James Ross - PhD – Aquatic Health, 8 years
Affiliation (if applicable):	❖ South African Society for Aquatic Scientists (SASAqS)

A summary of the Aquatic Impact Assessment (Enviross, 2016), as contained in **Appendix H2**, follows.

Methodology

A comprehensive desktop survey of the catchment region was undertaken prior to undertaking ground-truthing during the field survey. The standard South African DWA River EcoClassification and EcoStatus Models were utilised to determine the PES the EcoStatus category and the Ecological Importance and Sensitivity (EIS). Three aquatic survey sites were chosen that would best allow for determining any deleterious impacts emanating from the proposed development activities, namely upstream of the impact, at the impact and downstream of the impact.

The following methodologies were applied during the survey:

- *General riparian and habitat assessments:*
  - *Walk-about surveys at all survey sites;*
- *Aquatic habitat assessments:*
  - *In situ water quality (pH, oxygen content, dissolved oxygen, electro-conductivity (EC), total dissolved solids (TDS) and temperature);*
  - *River IHI (Index of Habitat Integrity);*
  - *MIRAI (Macro-invertebrate Response Assessment Index);*
  - *FRAI (Fish Response Assessment System); and*
  - *VEGRAI (Vegetation Response Assessment Index).*

The wetland habitat units were delineated according to standard DWS delineation techniques and guidelines (DWA, 2005/2008), with cross reference to aerial imagery. Wetland boundaries were delineated by utilising the terrain, soil wetness, soil form and vegetation unit indicators. Where applicable, conservation buffer zones were designated to the wetland boundaries. The PES of the wetlands was determined utilising the WETLAND-IHI as well as the WET-Ecoservices models. Where applicable, the quantification of the loss of the habitat units was determined.

Results and Discussions

Aquatic integrity

A desktop review of the catchment area indicated that the overall PES of the uMkhomazi River is regarded as a C category, which translates to a moderately modified system. The results of the field survey indicated that the PES has remained unchanged. A summary of *the various components is provided in **Table 77**. Instream habitat integrity is considered high (83.7%), which, together with relatively good water quality, allows for a good macro-invertebrate score (82.5%). Many invertebrate taxa known to be sensitive to poor water quality were sampled in good numbers. Riparian habitat and the vegetation components scores a relatively lower 75.6% and 74.6%, respectively, which is largely driven by erosion within the catchment area, livestock grazing within the riparian zones and some inclusion of invasive exotic vegetation.*

***Table 77:** Summary of the EcoStatus results for the section of the uMkhomazi River that would be impacted by the construction of the proposed Smithfield Dam (Enviross, 2016)*

Component	EC (%)	Ecological Category
IHI		
Instream IHI	83.7%	B
Riparian IHI	75.6%	C
FRAI	69.1%	C
MIRAI	82.5%	B
VEGRAI	74.6%	C
ECOSTATUS		**C (Confidence: 3.5)**

Overall fish ecological integrity was also rated relatively low (69.1%) but this is considered to be due to the survey being limited to one sampling run. The lack of any substantive migratory barriers, together with a diversity of habitat of good quality and good water quality means that all reference species are expected to occur. There is therefore a low confidence in the fish survey results for the river reach. The EIS of the system remains within a High category.

Figure 213: A selection of sensitive aquatic macro-invertebrate species sampled during the field survey (Psephenidae, Heptageniidae and Perlidae) (Enviross, 2016)

Figure 214: A selection of the fish species sampled during the field survey (*Amphilius natalensis, Labeobarbus natalensis* and *Barbus viviparous*) (Enviross, 2016)

Water Quality

Water quality results indicated that the river segment has retained relatively good water quality and that water quality is not regarded as a limiting factor to supporting aquatic biodiversity.

Riparian Zones

*The extent of the riparian zones pertaining to the Smithfield Dam is shown in **Figure 215**. The uMkhomazi River within this river reach has moderately wide riparian zones.*

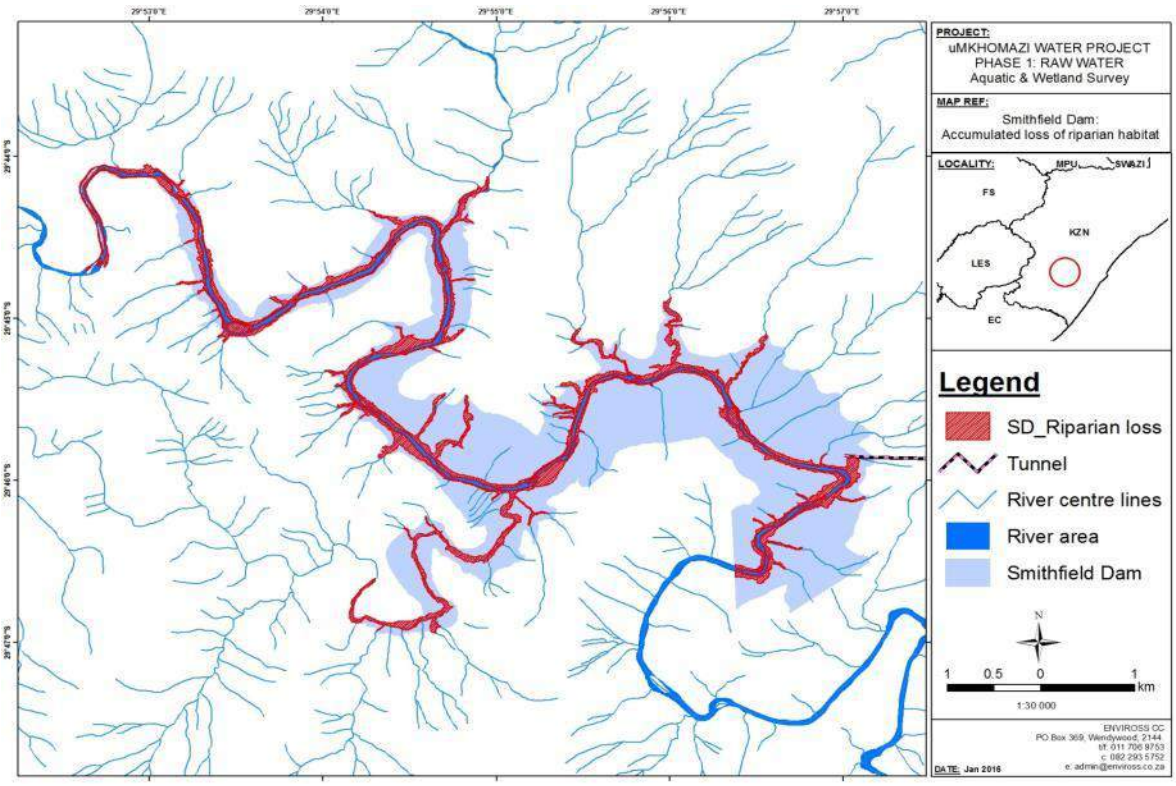


Figure 215: **Riparian zones pertaining to the proposed Smithfield Dam inundation area, indicating the extent of loss of riparian habitat (Enviross, 2016)**

Wetlands

*The summary of the results of the EcoStatus of the wetlands within the different areas is presented in **Table 78**. Wetlands associated with Smithfield Dam are limited to units adjacent to the main watercourse. These are dominated by seep zones and valley-bottom wetlands. They remain in a good ecological state. The wetland units associated with the balancing dam sites fall within an intensive formal agricultural area, which has impacted the overall ecological integrity of these units.*

Table 78: **Results from the WETLAND-IHI** ***(Enviross, 2016)***

Site	Vegetation	Hydrology	Geomorphology	Water quality	Overall PES
Smithfield Dam	**96.4%**	**93.0%**	**95.0%**	**98.3%**	**95.4%**
	A	**A**	**A**	**A**	**A**
Langa & Mbangweni Balancing Dams	84.9%	66.8%	68.8%	84.7%	**76.7%**
	B	**C**	**C**	**B**	**C**

*Wetland components were delineated according to standard guidelines and are shown in **Figures 216 - 219**.*

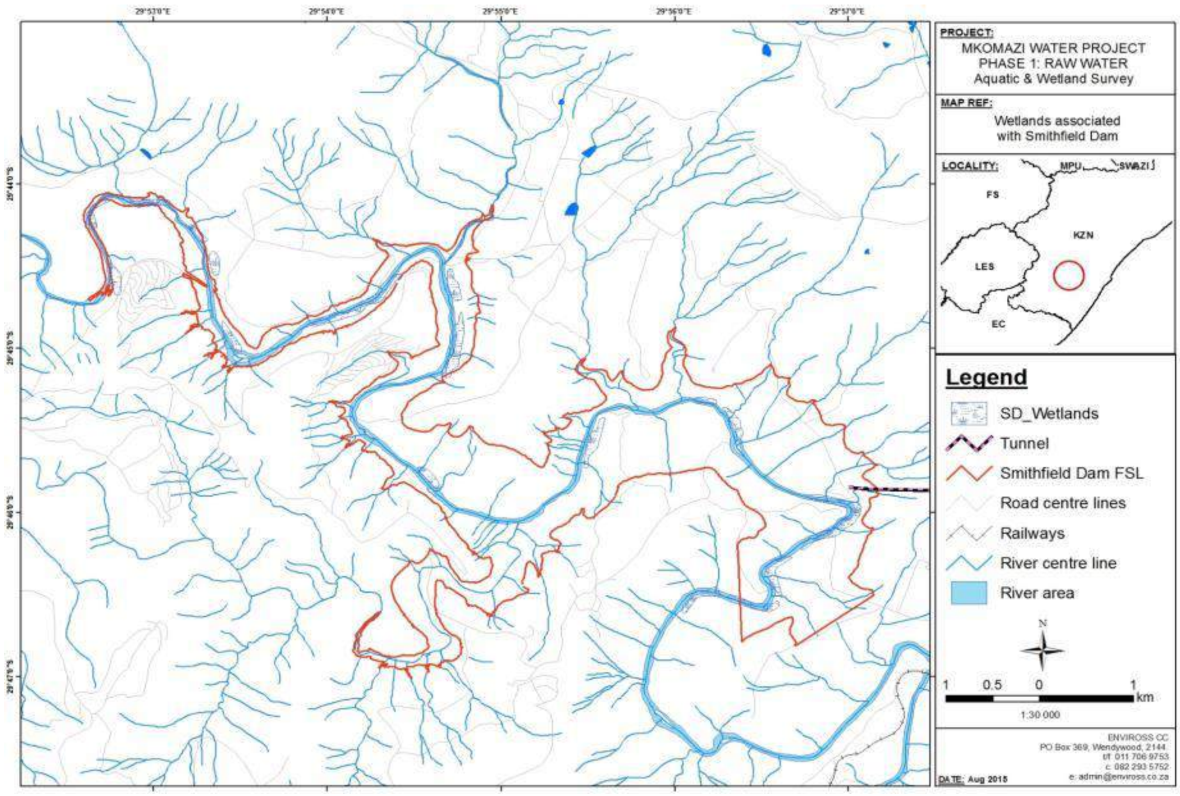


Figure 216: **Wetlands associated with the proposed Smithfield Dam (Enviross, 2016)**

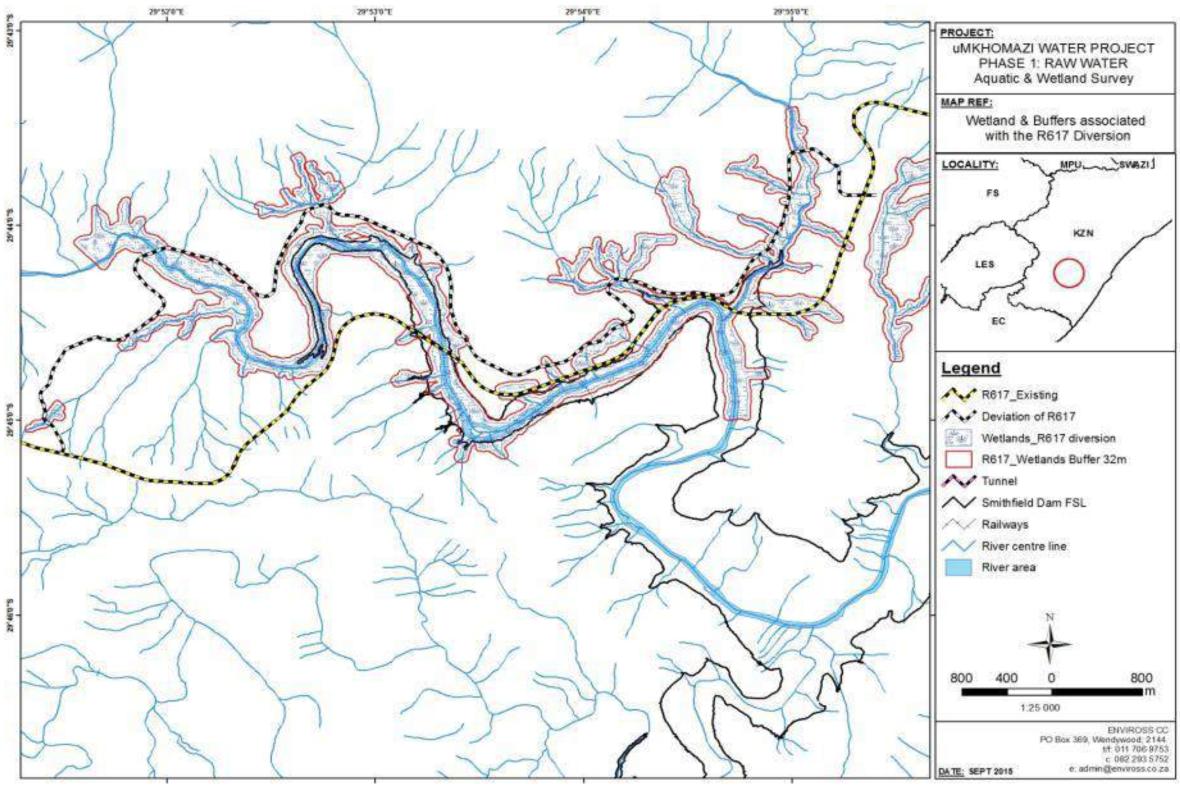


Figure 217: **Wetlands and 32m buffer zone - R617 deviation (Enviross, 2016)**

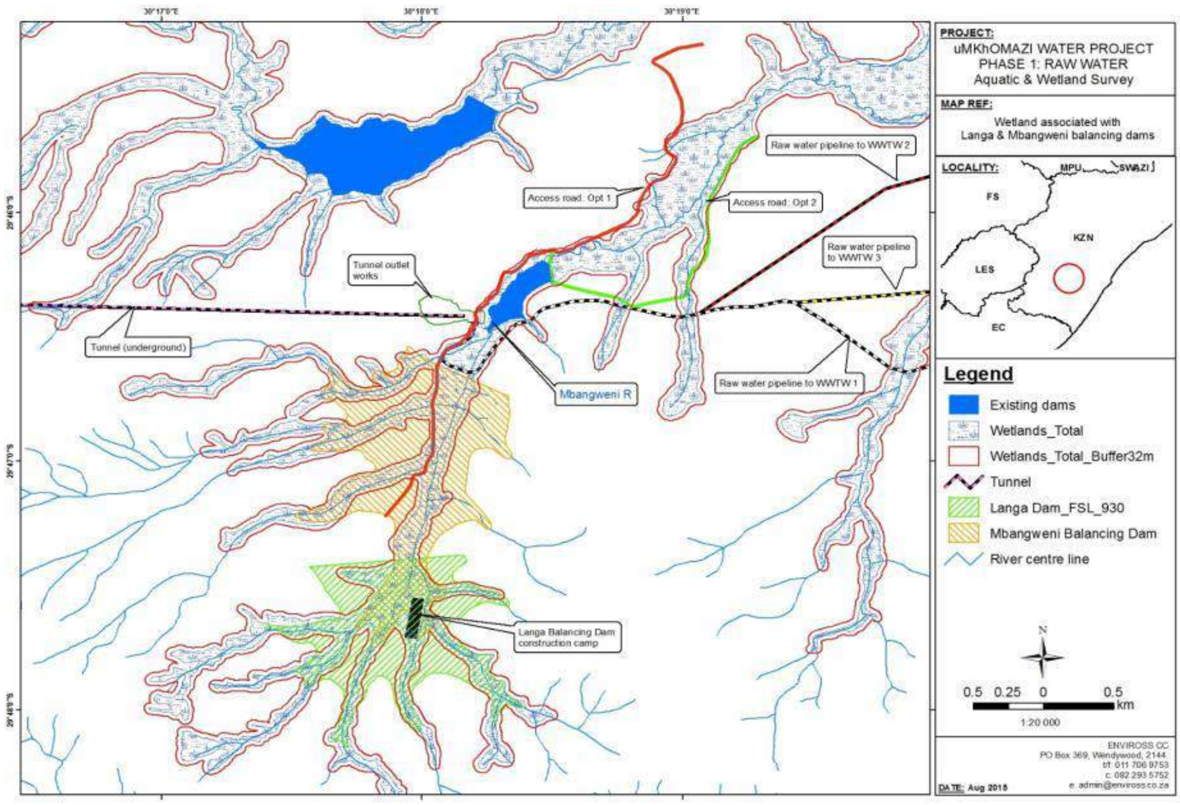


Figure 218: **Wetlands associated with the proposed balancing dam sites (Enviross, 2016)**

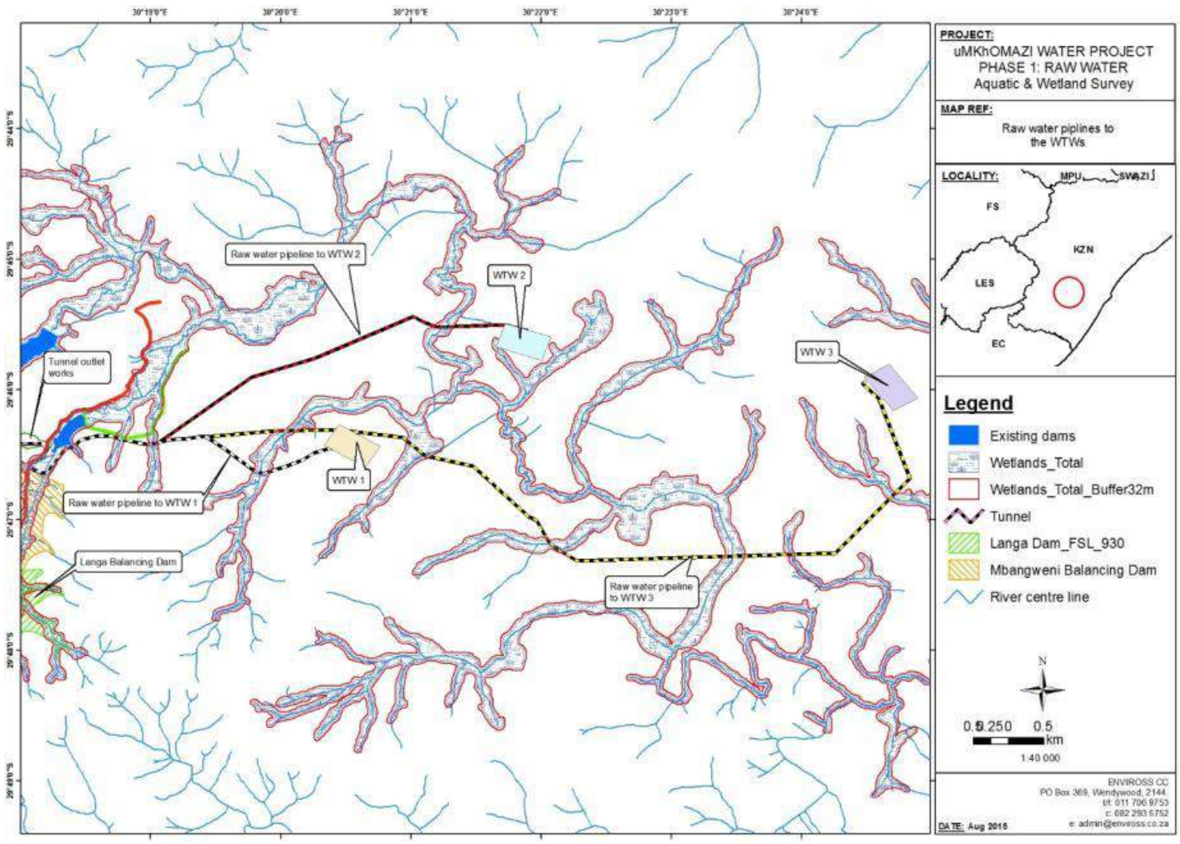


Figure 219: **Wetlands associated with the raw water pipeline routes (Enviross, 2016)**

The overall loss of wetland and riparian habitat due to inundation of the valleys following construction of the dams has been quantified and mapped. Approximately 135 ha of riparian vegetation and 55 ha of wetland habitat will be lost with the construction of Smithfield Dam. Approximately 44 ha and 59 ha of wetland habitat will become inundated with the completion of Langa and Mbangweni Balancing Dams, respectively.

The wetland associated with Smithfield Dam are localised and remain closely associated with the main watercourse. The hydro-geomorphic forms of these wetland units include some seep zones that are connected to the main watercourse and floodplain interaction where physical attributes of the watercourse channel allows for regular overtopping under elevated baseflow conditions. The ecological contribution of these wetlands in terms of contributions outside of what the main watercourse offers is relatively limited. Biodiversity maintenance and support in terms of hydrophyllous floral species and vegetation community structures is offered by seep zones. This allows for the maintenance of a relatively higher density of vegetation cover that stabilises the riverbanks and also increases the flood attenuation capacity of the watercourse. This is also largely the function of floodplains, which caters for a capacity of flood attenuation as well, although rather limited as there are no vast floodplains associated with the watercourse but rather terrace "shelving" associated with the larger macro-channel. The wetland units associated with the watercourse that will be impacted by the inundation of the Smithfield Dam FSL are supplementary to the main watercourse and do not offer a unique habitat type. They are in good ecological condition, however, and their contribution and functionality remains of high value. In terms of loss of functionality of these wetland units following the inundation of the river valley, the periphery of the impoundment will self-vegetate with hydrophyllous floral species, with a community structure that would still offer viable habitat for dependent biodiversity.

Langa Dam is located relatively high up within the catchment area, within an area with steeper topography valleys and hills. This area therefore is not subjected to agricultural transformation extent of the area proposed for the more downstream-located Mbangweni Dam. Natural areas remain that incorporate good quality wetlands that add valuable clean water into the watercourses downstream as well as supporting a good biodiversity. A lot of the catchment area has been transformed to accommodate forestry and therefore *a lot of the runoff water yield is lost to evapotranspiration via exotic tree species. Construction of the dam at the proposed Langa site will lead to a depletion of dependent biodiversity, but the water yield component should not be significantly altered and the wetland seepage zones will continue to provide a source of clean water. Although a cumulative loss of wetland habitat will result within the construction of the dam, this habitat type is relatively common within the upper catchment areas within the region and therefore the significance of the impact can be regarded as a medium negative rating. The actual loss of wetland habitat at the proposed site is regarded as a medium to medium-high, although it can be discounted to a medium rating due to the present and existing impacts that occur as a result of the local land use within the catchment area and the occurrence of exotic vegetation.*

Impact significance ratings

The impact significance of the various components of the proposed development activities on the surface water ecosystems have been rated, with mitigation measures provided where applicable in ***Section 12.6.6****. There are inevitable consequences and impacting features related to the proposed development that cannot be mitigated for, with their significance to ecologically sensitive features remaining high.*

Conclusions

- *The proposed development seeks to impound an ecologically sensitive river system, which will result in the only significant impoundment that inhibits migratory freedom within the system. It will also result in the drowning out of a significant amount of highly productive aquatic habitat (with the knock-on consequences to dependent aquatic biota) as well as drowning out of a significant stretch of riparian habitat. A significant volume of water is then also going to be removed from the system. The receiving environment of the interbasin transfer is also to have an impoundment developed that will drown out a significant amount of wetland habitat. All of these habitat features mentioned are regarded as being ecologically sensitive and therefore the whole development footprint will take place within an ecologically sensitive area.*
- *The reach of the uMkhomazi River that was surveyed was shown to suffer a change from reference conditions in terms of overall biological integrity, which resulted in an overall C (moderately modified) Ecological Category. Ratings for the fish, aquatic*

macro-invertebrates, water quality and riparian vegetation were notably high, however largescale erosion within the catchment area resulted in the downgrading of the overall ecological integrity of the system. Even though there were transforming and degrading features present within the river reach, the overall EIS remains High;

- *It is not thought that the proposed development activities will significantly impact the present Ecological Category of the uMkhomazi River;*
- *The wetlands associated with the uMkhomazi River were noted to have retained an A PES (natural), whereas the wetlands associated with the Langa and Mbangweni Balancing Dams were noted to be within a C PES (moderately modified). This is largely due to local land use, which is dominated by forestry and formal agriculture;*
- *The establishment of Smithfield Dam will result in a substantial migratory barrier within an otherwise open system. The viability of implementing a fishway as a means to mitigate habitat fragmentation was explored through meetings where project managers, engineers and ecologists workshopped various options and alternatives. It was concluded that the implementation of a fishway was not feasible due to economic, technical, operational and topographical constraints. Refer to **Section 15.3** for recommendations pertaining to a fishway.*

11.1.3 Heritage Impact Assessment

The key issues and triggers identified during Scoping for the Heritage Impact Assessment include:

- The KZN Heritage Act (Act No. 04 of 2008) needs to be complied with;
- Evaluate project in terms of Amafa aKwaZulu-Natali's heritage information management system;
- A Heritage Management Plan is required;
- Engage with Traditional Authority on location of graves and cultural sites and identify suitable mitigation measures;
- Consider cultural and indigenous beliefs surrounding the watercourse, as raised during the public meetings; and
- Potential occurrence of heritage resources, graves and structures older than 60 years within project footprint.

The details of the nominated specialists follow.

Specialist	
Name, qualifications and number of years' experience:	❖ Jean Beater - MA (Heritage Studies), 21 years ❖ Frans Prins - MA in Archaeology, 20 years
Affiliation (if applicable):	❖ Jean Beater - • International Association of Impact Assessors (IAIA)(SA Branch) • Member: HIA Adjudication Committee for the Gauteng Provincial Heritage Resources Authority • Affiliate member - Association of Southern African Professional Archaeologists – member No. 349 • Accredited heritage practitioner with Amafa aKwazulu Natali ❖ Frans Prins – • Full member of the Association of Southern African Professional Archaeologists – Member No. 112 • Accredited heritage practitioner with Amafa aKwazulu Natali

This section provides a summary of the Heritage Impact Assessment (Beater & Prins, 2015), as contained in **Appendix H4**.

The approach to the Heritage Impact Assessment included the following:

- *A survey of literature, including Heritage/Archaeological Impact Assessments undertaken in the surrounding area, was undertaken in order to place the development area in an archaeological and historical context.*
- *A desktop study was also conducted of the archaeological databases housed in the KwaZulu-Natal Museum. The SAHRIS website was consulted. In addition, the available heritage literature covering the greater Pietermaritzburg was also consulted.*
- *The published geological and palaeontological literature, unpublished records and databases were consulted to determine if there are any records of fossils from the sites and the likelihood of any fossils occurring there.*
- *A site inspection was undertaken on the eastern half of the project area on 4 May 2015 (exit point of tunnel, balancing dams, raw water pipeline). On 7 May 2015 and 27 May 2015, site visits were undertaken of the proposed location of the Smithfield Dam, borrow area sites, tunnel entrance, access roads, etc.*
- *Mrs. Busi Dlamini, wife of the Executive Council Member of the KwaZashuke Tribal Council, Mr. Bheka Dlamini and Mr. Mbumvu of KwaZashuke directed the specialist to*

several grave sites and remains of structures in the KwaZashuke area. Mr. D. Gangani assisted in communicating with members of the community affected by the Smithfield Dam.

*The heritage sites that were identified during the assessment are tabulated below together with a description, applicable protection in terms of the KZN Heritage Act (Act No. 04 of 2008). These sites are shown in **Figure 220** (refer to **Section 10.15** for a discussion on these features).*

Table 79: Identified Heritage Sites (Beater & Prins, 2015)

Description	Location	Protection	Significance
Lundys Hill Supply Store	29°44'28.97"S 29°54'53.75"E	Protected i.t.o Section 33(1)(a)	Low - Medium
Deepdale Bridge	29°44'28.75"S 29°54'40.07"E	Protected i.t.o Section 33(1)(a)	High
Drystone wall	29°44'40.57"S 29°53'56.16"E	Protected i.t.o Section 33(1)(a)	High
Graves at Kheswa's Kraal	29°45'20.26"S 29°56'36.33"	Protected by Section 35(1)(a)(b)	High
Grave at Mbele's Kraal	29°45'26.49"S 29°56'41.50"E	Protected by Section 35(1)(a)(b)	High
Graves at Mncwabe's Kraal	29°45'24.67"S 29°56'49.44"E	Protected by Section 35(1)(a)(b)	High
>10 graves east of Mncwabe's Kraal	Between 29°45'25.72"S 29°56'50.41 and 29°45'29.92"S 29°56'54.58"E	Protected by Section 35(1)(a)(b)	High
Circular structure (possibly Late Iron Age/Sotho herder hut)	29°45'26.33"S 29°57'4.15"E	Protected i.t.o Section 33(1)(a) & Section 36	Medium to High
Graves at Borrow Area A	29°46'38.26"S 29°56'41.89"E	Protected by Section 35(1)(a)(b)	High
Remains of stone structure / abandoned African homestead (late 19th – early 20th Century)	29°46'40.32"S 29°56'16.70"E	Protected i.t.o Section 33(1)(a) & Section 36	Medium to High
Remains of dwelling / abandoned homestead (late 19th – early 20th Century)	29°46'33.06"S 29°56'47.43"E	Protected i.t.o Section 33(1)(a) & Section 36	Medium to High
Remains of stone structure / abandoned African homestead (late 19th – early 20th Century)	29°46'30.73"S 29°56'43.73"E	Protected i.t.o Section 33(1)(a) & Section 36	Medium to High
Graves and remains of structure	29°46'06.39"S 29°55'21.41"E	Protected by Section 35(1)(a)(b) & Section 33	High
Graves at Hlope's Kraal	29°46'05.19"S 29°55'14.35"E	Protected by Section 35(1)(a)(b)	High
Ngcobo's Kraal and grave	29°46'7.09"S 29°55'11.21"E	Protected by Sections 33 and 35	High
Palaeontological finds (fossil plants)	Western section of raw water component including Dam	Fossil finds are protected i.t.o Section 36	High

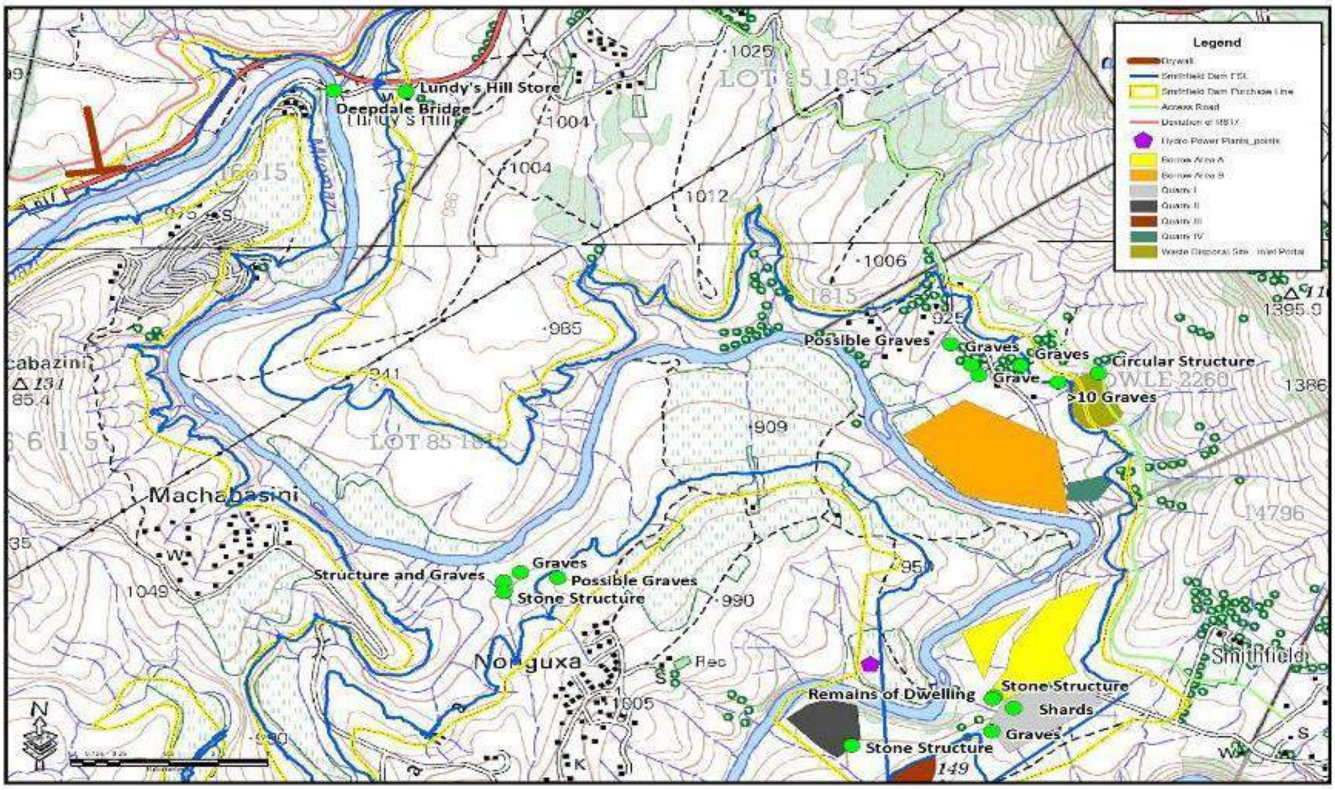


Figure 220: Heritage Sensitivity map (Beater & Prins, 2015)

The following recommendations emanated from the Heritage Impact Assessment:

- *Due to the extent of inundation by Smithfield Dam, it is recommended that a Phase 2 assessment is undertaken that systematically surveys the footprint of the proposed dam identifying all affected graves and homesteads.*
- *It is recommended that all sites (graves, structures, etc.,) situated close to the FSL of the dam are fenced with a 15 m buffer in which no development may take place. Alternatively, families will be given the option to choose an alternate reburial site.*
- *Specific attention to be given to the inlet site during the Phase 2 assessment to ascertain the presence of heritage resources especially graves.*
- *It is recommended that the Phase 2 assessment include the tunnel outlet works as it is one of the few areas currently undisturbed by agricultural activities.*
- *It is recommended that the Phase 2 assessment include the central portal area as the area was only assessed from afar due to access issues.*
- *The Phase 2 Archaeological Impact Assessment is recommended to establish spatial patterns of previous development in the project area as well as assessing the significance of archaeological remains found. In addition, the uMkhomazi River valley will thoroughly investigated for the presence of rock art sites.*

- *Due to the high fossil sensitivity of the Smithfield Dam / western section of the Raw Water component, a Phase 2 PIA is recommended. This is not required for the eastern section of the component.*

11.1.4 Agricultural Impact Assessment

The key issues and triggers identified during Scoping for the Agricultural Impact Assessment include:

- Loss of arable land;
- Loss of timber land;
- Loss of fertile soil in inundation areas (Smithfield Dam and balancing dam);
- Loss of cultivated area on the north-eastern side of Smithfield Dam, on the left-bank of the uMkhomazi River on Portions 1 and 3 as well as the Remainder of the Farm Crowle 2260;
- Loss of grazing land, which could place additional pressure on the remaining grazing resources; and
- Disruptions to farming practices during construction.

The details of the nominated specialists follow.

Specialist	
Name, qualifications and number of years' experience:	❖ Dr Andries Gouws - PhD Integrated Land Use Modelling, 29 years ❖ Dr Eugene Gouws - PhD Interdisciplinary Studies, 40 years
Affiliation (if applicable):	❖ Dr Andries Gouws – • Council of Natural Sciences.No:400036/93, Category: Agricultural sciences. • Member of the Soil Science Society of South Africa

This section provides a summary of the Agricultural Impact Assessment (Index, 2015), as contained in **Appendix H3**.

The study included an appraisal of the natural resources (climate, water, vegetation and soil) that influences agricultural potential in the study area. The present land use, grazing capacity and soil potential were assessed by interpretation of high resolution satellite images and site investigations. The findings are included in the relevant sections on the *environmental features in* ***Section 10****. Selected photographs from the study are included in* ***Figure 221*** *(Smithfield Dam) and* ***Figure 222*** *(balancing dam).*

Eroded cultivated land

View of the upper part of the valley.

View of the lower part of the valley.

Animals grazing on high potential veld

Figure 221: Photographs – Smithfield Dam (Index, 2015)

Forestry and cane production - southern part of site

Mixed land uses along the eastern bank

View towards the western bank showing field crops

Surveyors in discussion with the farm manager

Figure 222: Photographs – Balancing Dam Options (Index, 2015)

The trends in farming and the associated margins used to calculate potential income from main enterprises were assessed in terms of the following:

- *Pine forests;*
- *Sugar cane;*
- *Cash crops; and*
- *Livestock.*

The main impact on agriculture associated with the project is the loss of high potential land (cultivation and grazing). In the case of high potential land, on a national level, it is irreplaceable. On a local level, it can be replaced by buying new land and then making it available to the person experiencing the loss. For landowners with title to the land, this is easily achieved, but where the land is communal the problem is more complex.

The grazing land at Smithfield Dam along the right side of the river is communal, and even the stubble on the arable land is collectively used during the off-season. Because the land is already overgrazed, the net effect will be that fewer animals can be kept by the affected community.

In essence, the loss of high potential arable land cannot be mitigated, but the loss on income to the land users can be, by compensating them for the loss of income.

For this reason, the impact assessment focussed on the financial implication of the development rather than an assessment related to pre and post mitigation. Refer to ***Section 12.12*** *for the impact assessment that was undertaken as part of this study.*

11.1.5 Visual Impact Assessment

The key issues and triggers identified during Scoping for the Visual Impact Assessment include:

- Visual impacts associated with project infrastructure; and
- Impacts to the visual quality and sense of place of the project area.

The details of the nominated specialist follow.

Specialist	
Name, qualifications and number of years' experience:	Gerhard Griesel - Masters Degree In Landscape Architecture, 8 years
Affiliation (if applicable):	Member of the South African Council of Landscape Architects

This section provides a summary of the Visual Impact Assessment (Axis Landscape Architecture, 2015), as contained in **Appendix H5**.

The approach to the Visual Impact Assessment included the following:

- *The extent of the study area is limited to a radius of 5 km;*
- *The site was visited to establish a photographic record of the site, views and areas of particular visual quality and or -value;*
- *The project components and activities were described and assessed as elements that may cause visual and landscape impacts;*
- *The receiving environment was described in terms of its prevailing landscape- and visual character;*
- *Landscape- and visual receptors that may be affected by the proposed project were identified and described;*
- *The sensitivity of the landscape- and visual receptors was assessed;*
- *The severity of the landscape- and visual impacts was determined;*
- *The significance of the visual and landscape impacts was assessed; and*
- *Mitigation measures were proposed to reduce or alleviate adverse impacts.*

Landscape Character

*Landscape types are distinguished by differences in topographical features, vegetation communities and patterns, land use and human settlement pattern. The four landscape types that occur in the study area are (refer to **Figure 223**):*

- *uMkhomazi Rural Settlements;*
- *uMkhomazi Moist Grassland;*
- *Baynesfield Agricultural; and*
- *Baynesfield Hinterland Grassland.*

All four landscape types have very similar topographical characteristics but are distinguished due to the difference in land use.

uMkhomazi Rural Settlements

uMkhomazi Moist Grassland

Baynesfield Agricultural

Baynesfield Hinterland Grassland

Figure 223: Landscape Types (Axis Landscape Architecture, 2015)

Visual Quality

The visual quality was individually assessed for the four landscape types, which includes the area within 5 km from the proposed site. The evaluation is summarised in ***Table 80****.*

Table 80: Visual Quality of the Regional Landscape (Axis Landscape Architecture, 2015)

Landscape Type	Vividness	Intactness	Unity	Visual Quality
uMkhomazi Rural Settlements	3	3	3	Moderately Low
uMkhomazi Moist Grassland	4	4	4	Moderate
Baynesfield Agricultural	4	4	4	Moderate
Baynesfield Hinterland Grassland	3	3	3	Moderately Low

The evaluation scale: Very Low =1 to Very High =7

Visual Receptors

Viewer groups are a collection of viewers that are involved with similar activities and experience similar views of the proposed development. Viewer groups identified within the study area are the following:

- Residents;
- Recreational users/Tourists; and
- Motorists.

Visual Envelope

The visual envelope demarcates the extent of visual influence and includes the area within which views to the development are expected to be of concern. The visual envelope is established at 5 km. The visual influence on the proposed development further than 5km is considered insignificant and visual impacts outside this zone is negligible.

A visibility analysis was performed for the study area of the proposed development. A Digital Elevation Model (DEM) with a resolution of 90m was utilized together with GIS. As a result, all areas that are visible from the viewpoints are mapped and highlighted in a shaded colour. Conversely, the areas that are shaded are expected to have views of the proposed dam. The visibility analysis considers the worst-case scenario, using line-of-sight based on topography alone. This assists the process of identifying possible affected viewers and extent of the affected environment. An analysis of ***Figures 224 - 229*** *indicates areas of high visibility in the different distant zones.*

Landscape and Visual Impacts

The anticipated impacts are discussed under ***Section 12.20*** *in terms of the following:*

- *Landscape impacts - Loss of grassland; Alteration to existing tributaries and rivers; and Change in surface cover;*
- *Visual impacts - Residents; Recreational users/Tourists; and Motorists.*

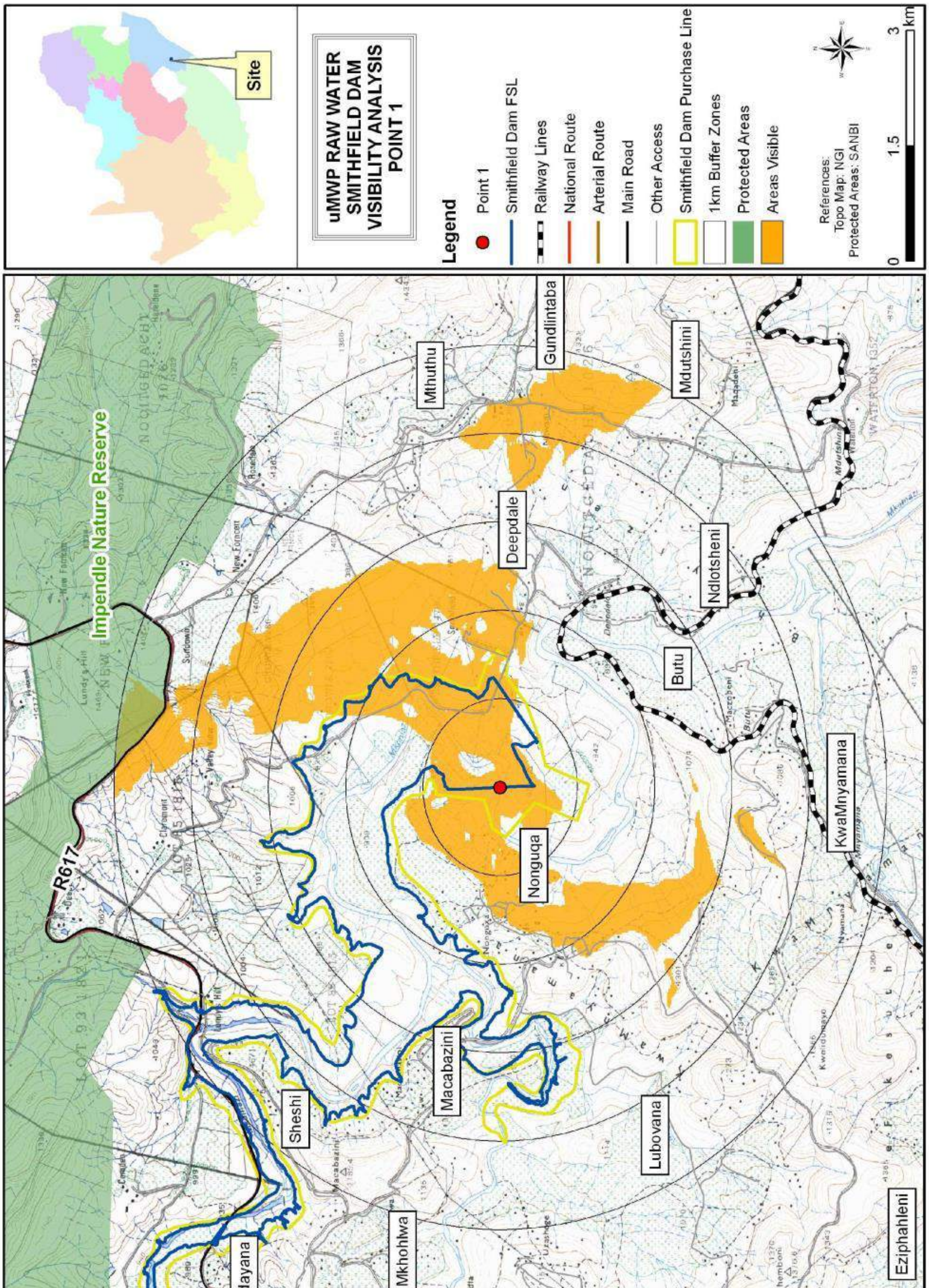


Figure 224: Visibility Analysis – Smithfield Dam Wall (Axis Landscape Architecture, 2015)

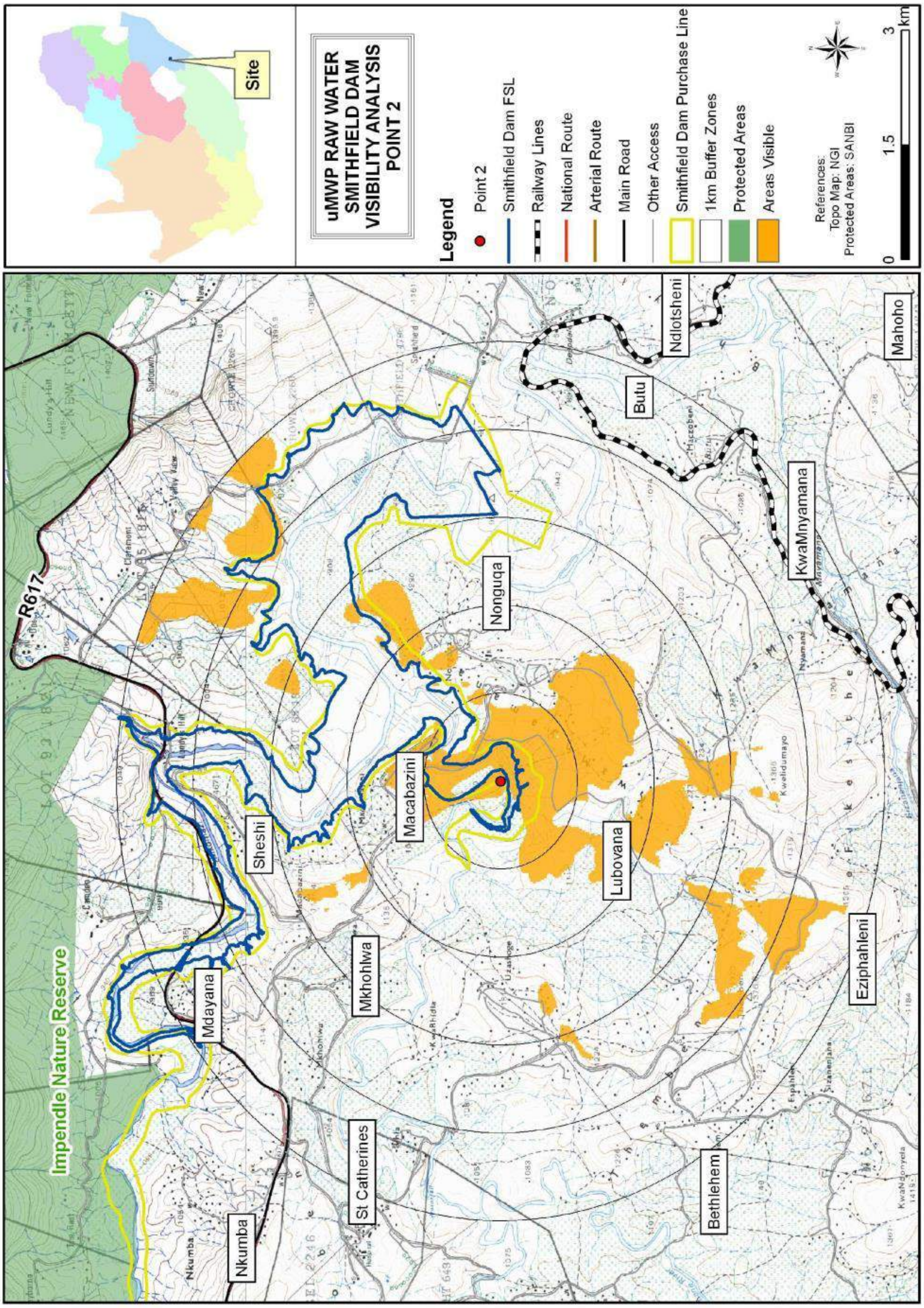


Figure 225: Visibility Analysis – Smithfield Dam (Axis Landscape Architecture, 2015)

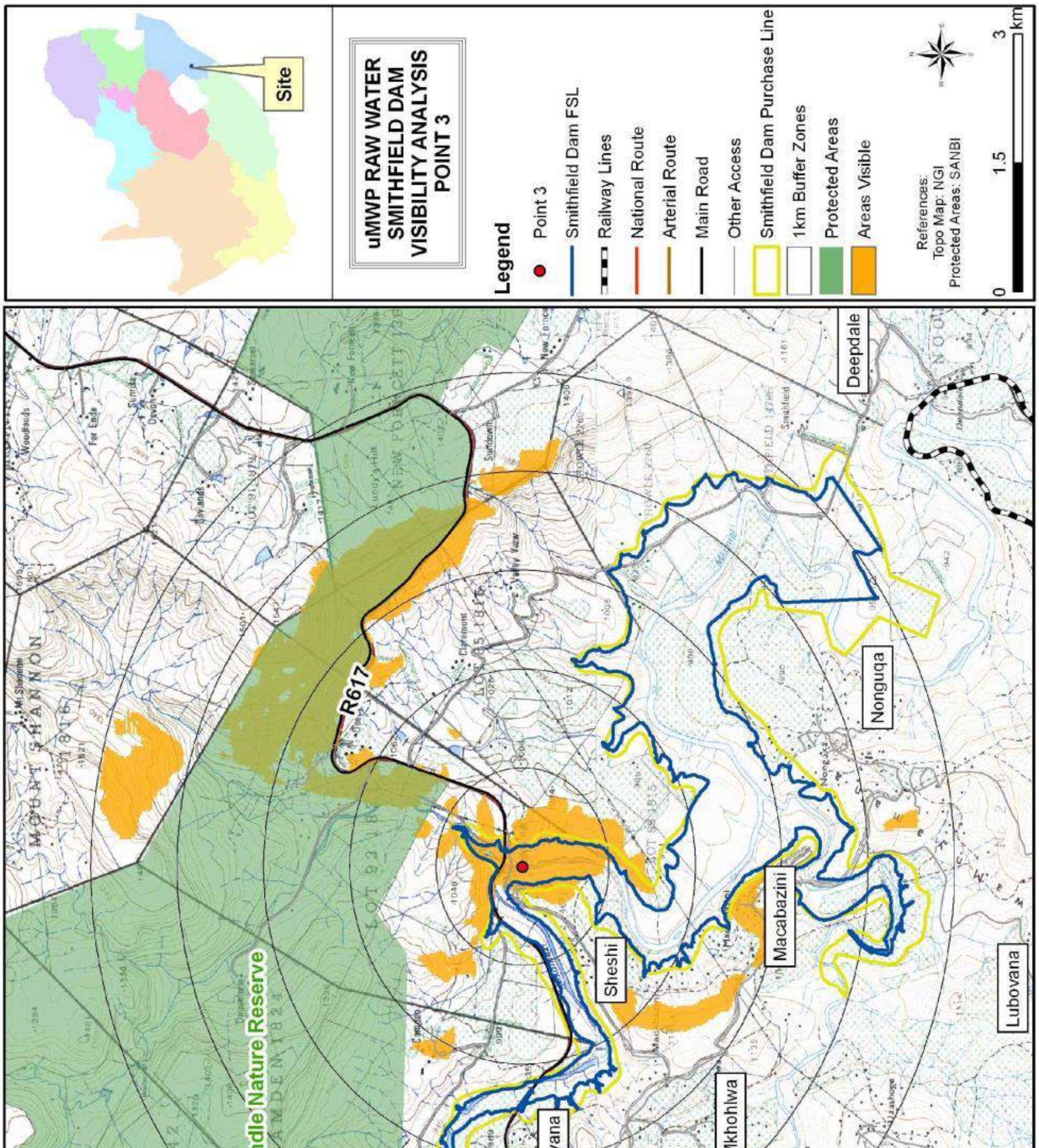


Figure 226: **Visibility Analysis – Smithfield Dam (Axis Landscape Architecture, 2015)**

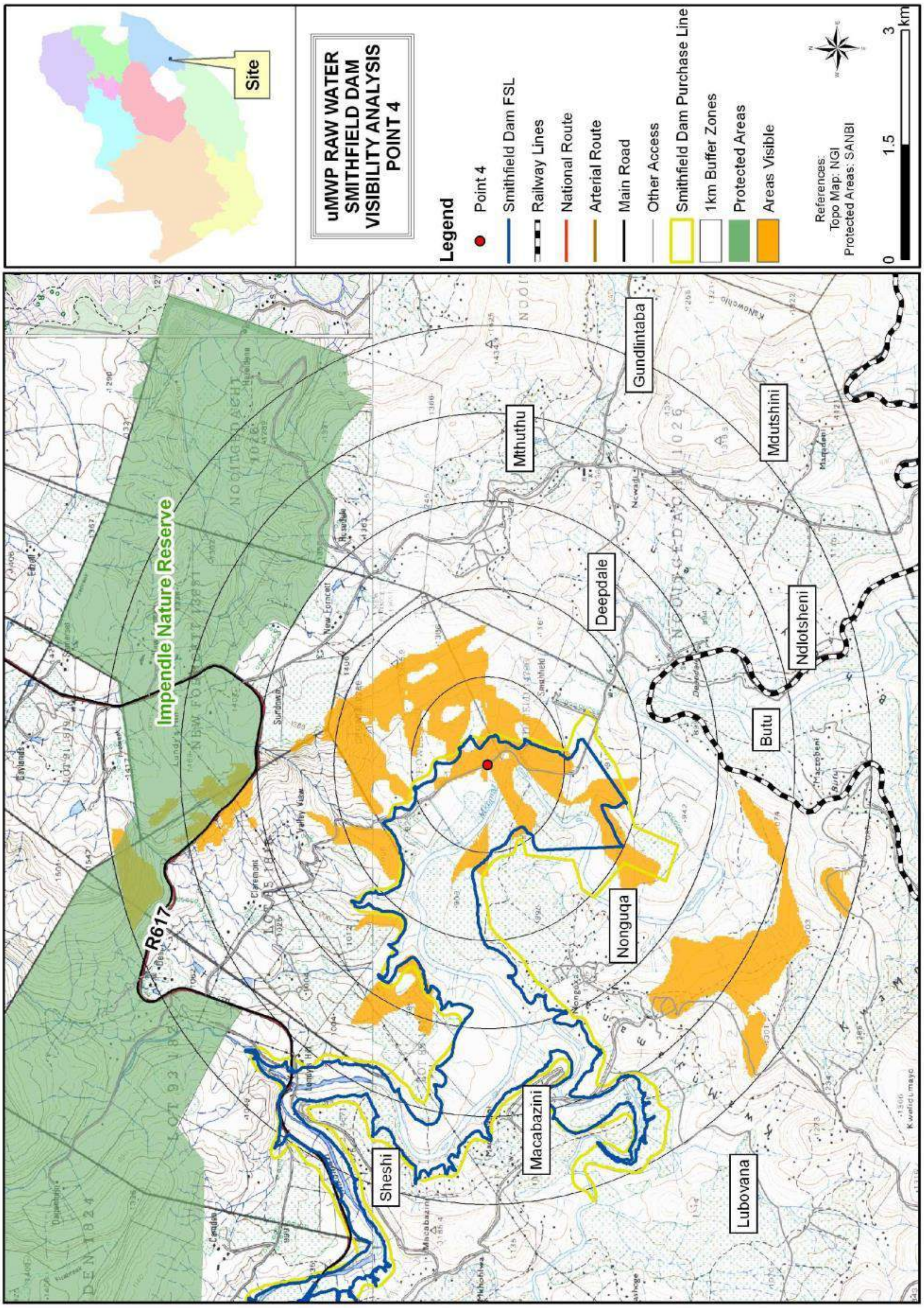


Figure 227: **Visibility Analysis – Tunnel Inlet (Axis Landscape Architecture, 2015)**

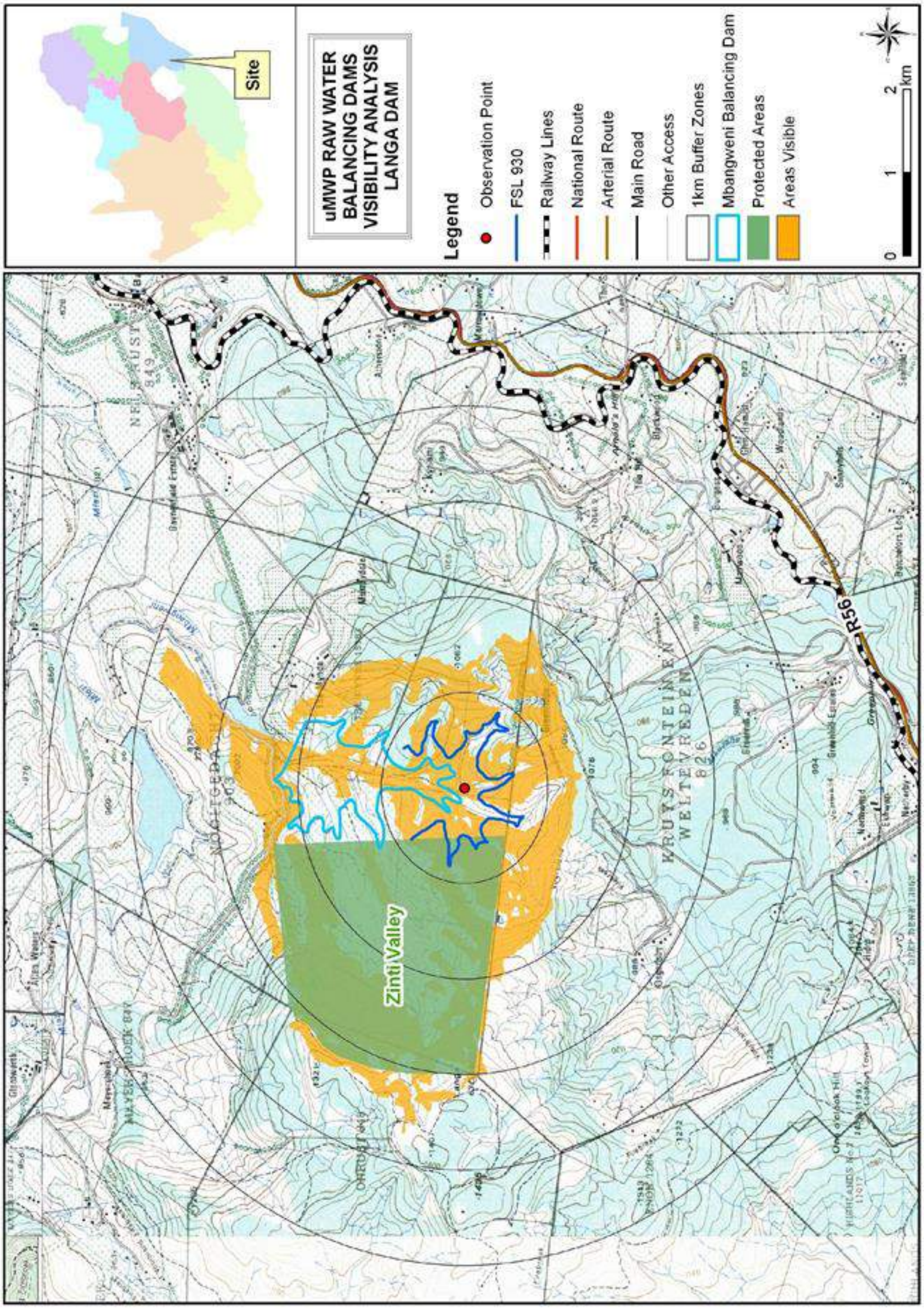


Figure 228: Visibility Analysis – Langa Balancing Dam (Axis Landscape Architecture, 2015)

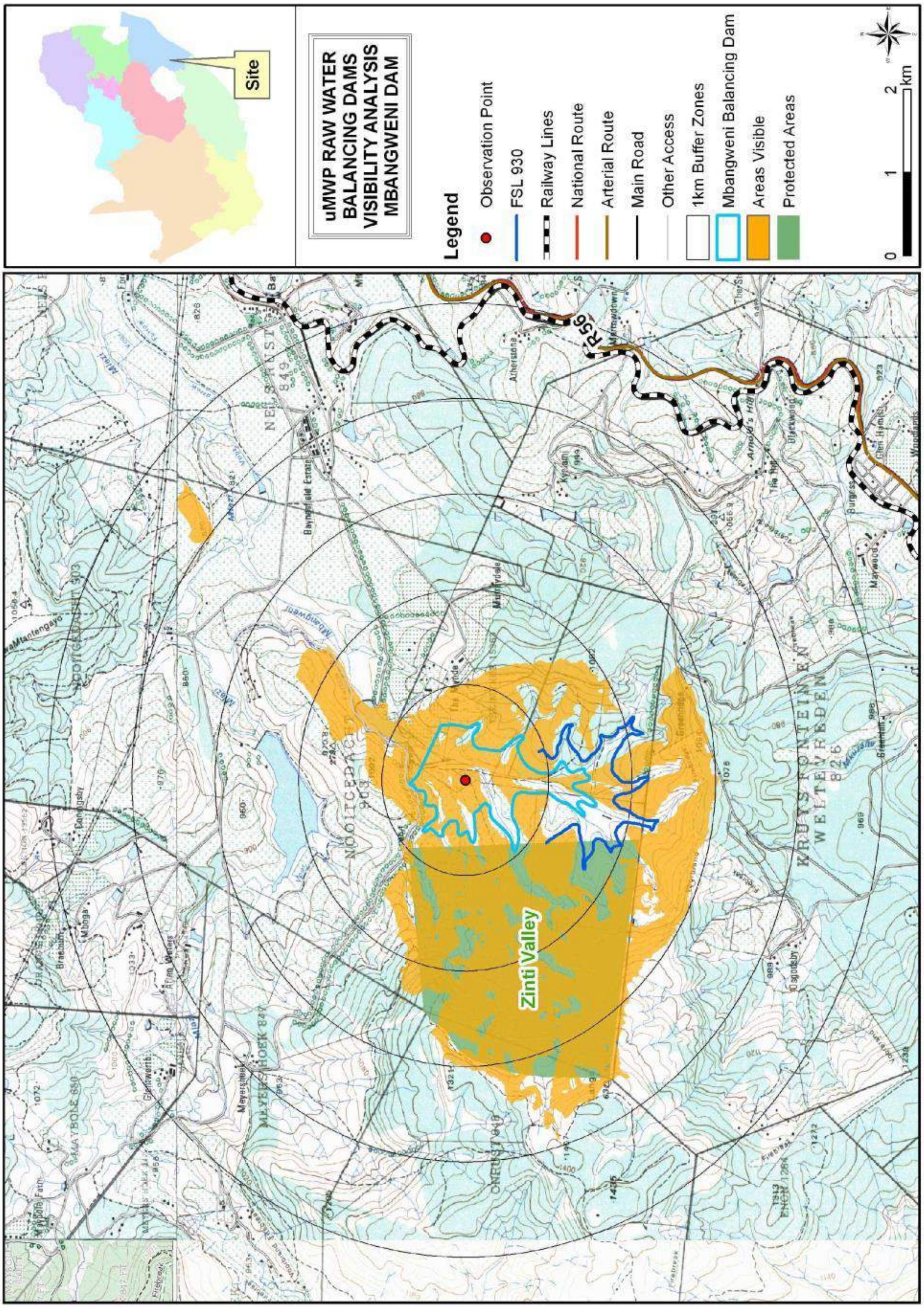


Figure 229: Visibility Analysis – Mbangweni Balancing Dam (Axis Landscape Architecture, 2015)

11.1.6 Socio-Economic Impact Assessment

The key issues and triggers identified during Scoping for the Socio-Economic Impact Assessment include:

- Local socio-economic, land utilisation and acquisition implications of the project.
- Compensation for loss of land and impacts caused by the project;
- Impacts to tourism and environmental education activities at The Baynesfield Estate Lodge;
- Loss of land through inundation and project infrastructure;
- Resettlement of dwellings in Smithfield Dam basin;
- Construction-related impacts; and
- Risk posed by land claims.

The details of the nominated specialist follow.

Specialist	
Name, qualifications and number of years' experience:	❖ Ciaran Chidley - BA (Economics); BSc Eng (Civil); MBA, 12 years ❖ Sameera Munshi - BA Hon (Econ), 4 years
Affiliation (if applicable):	International Association of Impact Assessors South Africa IAIAsa

This section provides a summary of the Socio-Economic Impact Assessment (Nemai Consulting, 2016a), as contained in **Appendix H6**.

The Socio-Economic Impact Assessment sets out the socio-economic baseline, predicts impacts and makes recommendations for mitigation. The socio-economic baseline level is based on both primary and secondary data. Primary data was collected directly from community members and traditional leaders. Secondary data was accessed through internet searches and available reports and articles, and are referenced in the text and in the reference section of this report.

The following stakeholder engagements took place:

- *Public Participation as part of the Scoping Phase;*
- *Telephonic and email questionnaires to landowners; and*

- *Site visit (interviews, meetings, door-to-door visit) with residents located in the Smithfield Dam Basin.*

Subsistence agriculture in conjunction with an informal economy is the dominant livelihood strategy for local households and communities. Subsistence agriculture is primary aimed at producing basic foods for households with any surplus food being sold at local markets.

The project has the potential to temporarily enhance the standard of living of those directly affected as well as of the population in the region as a whole in terms of employment, creation of small businesses and social development. These impacts are particularly important in an area where poverty is endemic and employment opportunities are few.

Employment is a sensitive issue and the expectations of job opportunities will be high amongst local residents. It is important to instil realistic expectations with regards to benefits from the project. Employment strategies must be transparent and should include women and youth.

The project will cause negative impacts. There will be a loss of land experienced by both the Traditional Authorities and private farmers. In the area where subsistence and commercial agriculture dominates other industries, land is highly valuable to the both types of landowners. Compensation for the loss of land, income from produce and loss of infrastructure will require adequate planning, communication and control. Negotiations must be fair and transparent at all times.

At least twenty-eight households will need to be relocated elsewhere. A fair and transparent RAP and Stakeholder Engagement Plan will be critical to mitigate the loss of assets and livelihoods. It will be critical to engage with the Ingonyama Trust Board during the relocation process. Households should not be moved to a host community belonging to another clan or Traditional Authority. Rather land should be identified within land belonging to their clan to ensure a smoother relocation process that is least disruptive to *religion and cultural practices. At all times, both those being relocated and the host community must be communicated with effectively.*

The deviation of the R617 will have significant impacts on the communities in the Smithfield Dam area as access to the R617 is cut off. The upgrade of a road to the Nonguqa area will assist in maintaining access to the area at the cost of an additional 16 km of travel. The impact of such an increase in travel will require mitigation for the costs. Improvement of internal access roads in addition to the upgrade of the road to Nonguqa is recommended to mitigate for the long-term use of these roads.

During the construction phase, there will be daily disruption to both famers and households. These impacts can be largely mitigated through measures contained in the EMPr.

Overall, this project has the potential to benefit the local community in terms of employment, job creation, empowerment of women and youth through careful mitigation strategies. In addition, the project opens up new industries such as tourism in the area that have the potential to create sustainable incomes in the area. While this project does not directly supply water connections, it is enabling infrastructure to allow for improved access to water for current and future demands. For households in the study area, this project will supply the infrastructure that will allow local government security of water. On a regional scale, the uMWP-1 scheme provides access to water for both the uMkhomazi catchment and the Umgeni Supply area. From a socio-economic perspective the project is critical to the economy and livelihoods of at local and regional scale and must be supported.

11.1.7 Social Impact Assessment

The key issues and triggers identified during Scoping for the Social Impact Assessment include:

- Loss of land through inundation and project infrastructure;
- Dependence of the local community on the reach of the uMkhomazi River that will be inundated;
- Resettlement of dwellings in Smithfield Dam basin;

- Influx of people seeking employment and associated impacts (e.g. foreign workforce, cultural conflicts, squatting, demographic changes, anti-social behaviour, and incidence of HIV/AIDS);
- Construction-related impacts; and
- Use of local road network for operation and maintenance purposes.

The details of the nominated specialist follow.

Specialist	
Name, qualifications and number of years' experience:	Neville Bews ❖ BA (Hons) (Unisa) ❖ Henley Post-Graduate certificate in Management (United Kingdom) ❖ MA (cum laude) (RAU) D. Litt et Phil (RAU) 12 years
Affiliation (if applicable):	International Association of Impact Assessors South Africa IAIAsa

This section provides a summary of the Social Impact Assessment (Dr. Neville Bews & Associates, 2016), as contained in **Appendix H7**.

Approach

Both a quantitative and qualitative methodological approach was applied during the study. A research technique referred to as triangulation, while a recognised impact assessment technique, was employed in assessing the impacts.

Social Environment

The project is situated in KZN within the following district and local municipalities:

- *uMgungundlovu District Municipality (DC22):*
  - *Mkambathini Local Municipality (KZN226) -*
    - Ward 4;
  - *Richmond Local Municipality (KZN227) -*
    - Wards 3 and 6;
- *Harry Gwala District Municipality (DC43) (previously the Sisonke DM):*
  - *Ingwe Local Municipality (KZN431) -*

- Wards 7, 8 and 10.

The social characteristics associated with each component of the project are as follows.

Smithfield Dam Basin

The area is characterised by traditional homesteads clustered within settlements and largely relying on rural subsistence agriculture. Most dwellings are located along the R617 and the main rural roads. The Smithfield Dam Basin is located on both land falling under control of the traditional authority and owned by the state.

Bulwer is the closest town to the area and the Impendle Nature Reserve is located north of the R617. The Impendle Nature Reserve is known for birding and is home to about 10 pairs of blue swallows, a species facing imminent threat of extinction in South Africa as a result of the extensive transformation of its mistbelt grassland habitat. The reserve also allows limited cattle grazing under permit.

Conveyance Infrastructure

Approximately 21km of the first section of the tunnel is located on land owned by the traditional authority and the state. This land is characterised by dwellings situated along the roads with grazing and subsistence farming occurring at the western end of the tunnel and the tunnel traversing the villages of Ncwadi and Magadini.

Balancing Dam

The remaining approximately 13km of tunnel, balancing dam and raw water pipeline is situated on privately owned land used principally for commercial farming and forestry.

The bulk of the infrastructure around the balancing dam is located on the Baynesfield Estate which is utilised for sugarcane farming, pig farming and forestry. The Baynesfield Estate markets its eco-tourism facilities for both educational and private use and has an educational facility and accommodation on the banks of the Mbangweni Dam situated on the estate. The NCT Forestry Co-operative Limited (NCT) has farmed trees on the estate stretching over an extended period in accordance with a long standing lease that they have with the estate.

Social Impact Variables

The following social impact variables are considered across the project:

- *Health and social well-being impacts;*
- *Quality of the living environment (Liveability) impacts;*
- *Economic and material well-being impacts (positive);*
- *Economic and material well-being impacts (negative);*
- *Cultural impacts;*
- *Family and community impacts;*
- *Institutional, legal, political and equity impacts; and*
- *Gender relations impacts.*

In respect of these social impacts, the most severe are related to the inundation of the Smithfield Dam Basin which will result in the displacement of approximately 28 households. These households will need to be relocated which will also have a negative impact on the host community which still needs to be identified. In addition to relocation the inundation of the Smithfield Dam Basin will result in the loss of high potential land and grazing and will affect a number of burial sites and ancestral structures which will also need to be relocated. In this regard it is important that the affected area is carefully surveyed and that a RAP is developed for the project.

During construction there will be an increase in traffic along both the R617 and R56 which will increase safety risks and add to the deterioration of these roads. In addition there will be a minor impact on settlements along these routes with the identified sensitive locations being Baynesfield Estate and the Mkheshekeni Settlement. In this regard the associated safety risks, nuisance factor and increased infrastructure deterioration will need to be carefully considered and mitigated to reduce the associated social impacts.

The issue of the road deviations will need to be carefully considered, particularly the R617 deviation which will add a further 3.5 km to the existing length of the road and the planned additional road to the Nonguqa community which adds 16 km to the travel distance of the Nonguqa community. The Sheshi Community have indicated that the R617 deviation will result in their access to the R617 being moved further from them causing them difficulties in accessing the R617 (main road). Consequently, it is important *to consider this deviation in consultation with local communities in order to explore possible solutions. This also applies in respect of both the Mdayana and Nonguqa access road deviations. The Nonguqa road deviation will add a further 16 km to the travel distance of members of Nonguqa community which is an unacceptable situation considering the hardship that this will cause this community to endure. This situation will need to be amicably resolved.*

Apart from the direct impact that these deviations will have on communities residing in the area, the Heritage Impact Assessment has also identified a heritage related impact associated with the R617 deviation in the form of a threat to a drystone wall, considered an artefact of "living history".

Conclusion and Recommendations

Various pre-feasibility investigation have indicated that uMWP-1, which entails the transfer of water from the undeveloped uMkhomazi River to the existing Integrated Mgeni WSS, is considered the most viable option to provide the large volume of water required to fulfil the long-term water needs of the Mgeni WSS. Consequently, if this, or a similar project aimed at supplementing the Mgeni WSS, was not to proceed this would place the assurance of water supply to the area at risk which in turn will have severe negative social impacts for the recipients of this water.

In addition, not only does the State have an obligation in accordance with the Bill of Rights to take adequate measures in ensuring that all citizens have access to basic housing, health care, food, water, social security, education and a healthy environment, but the right to access to water is also written into the Constitution. South Africa has a policy of recognising the human right to water at both the Constitutional and policy levels. A "no project alternative" would contradict these obligations as DWS and Umgeni Water would lose an opportunity to supplement the water resources in the area and consequently to deliver bulk potable water to the citizens of the area. Together with this lost opportunity would be the loss of a number of job opportunities, not only associated with the construction of the dams and infrastructure, but also associated with the productive potential of the scheme. For this reason the "No Project Alternative" is not considered a viable option at the social level.

11.1.8 Avifauna Study

The key issues and triggers identified during Scoping for the Avifauna Study include:

- Avian sensitivity of project area, especially due to the presence of Blue Swallows and Cranes.

The details of the nominated specialist follow.

Specialist	
Name, qualifications and number of years' experience:	Jon Smallie - Msc Env Sc – University of Witwatersrand, 13 years
Affiliation (if applicable):	South African Council for Natural Scientific Professions; Registration no. 400020/06 (Ecological Science)

This section provides a summary of the Avifauna Study (Wildskies, 2015), as contained in **Appendix H8**.

The methodology used to predict impacts in the current study was as follows:

- *Various avifaunal data sets and the micro habitats within the study area were examined to determine the likelihood of these relevant species occurring on or near the site, and the importance of the study area for these species;*
- *Sensitive areas within the proposed site, where the above impacts are likely to occur, were identified using field work, various GIS layers and Google Earth;*
- *The potential impacts of the proposed project on these species were described and evaluated; and*
- *Recommendations were made for the management and mitigation of impacts.*

*In lay terms, this study assesses which bird species could occur on site, how important they are, how important the site is for them, how the project will affect them, and how to mitigate these effects. The relevant bird populations identified as part of the study are explained in **Section 10.9.2.4**.*

*The study concluded that the project is situated in an area of generally high avifaunal sensitivity. The Avifaunal Sensitivity Map is shown in **Figure 230**. The various data sources presented in the aforementioned figure and their implications are as follows:*

- *Blue Swallow breeding areas.* *These areas are shown with red polygons. These are areas indicating congregations of Blue Swallow historic and current nest sites. The polygons to the east near the balancing dam site are by far the most important. This factor is likely to receive the highest sensitivity rating.*
- *Important Bird Areas. The entire balancing dam and raw water tunnel outlet is situated in an IBA. Since the main reason for this IBA being declared is the importance of the habitat for Blue Swallows, this factor will likely receive less importance in the final analysis than the above specific Blue Swallow breeding areas.*
- *Terrestrial Systematic Conservation Plan data. Many of these polygons were identified on the basis of Blue Swallows, with the remainder for Blue and Grey Crowned Crane.*
- *Grassland areas. These are areas of relatively pristine grassland identified during field work in addition to that already included in the Blue Swallow breeding areas and IBA. Fortunately they will mostly remain unaffected by the underground tunnel.*
- *Blue Swallow potential habitat. These areas are also loosely in agreement with some of the other above data sources.*

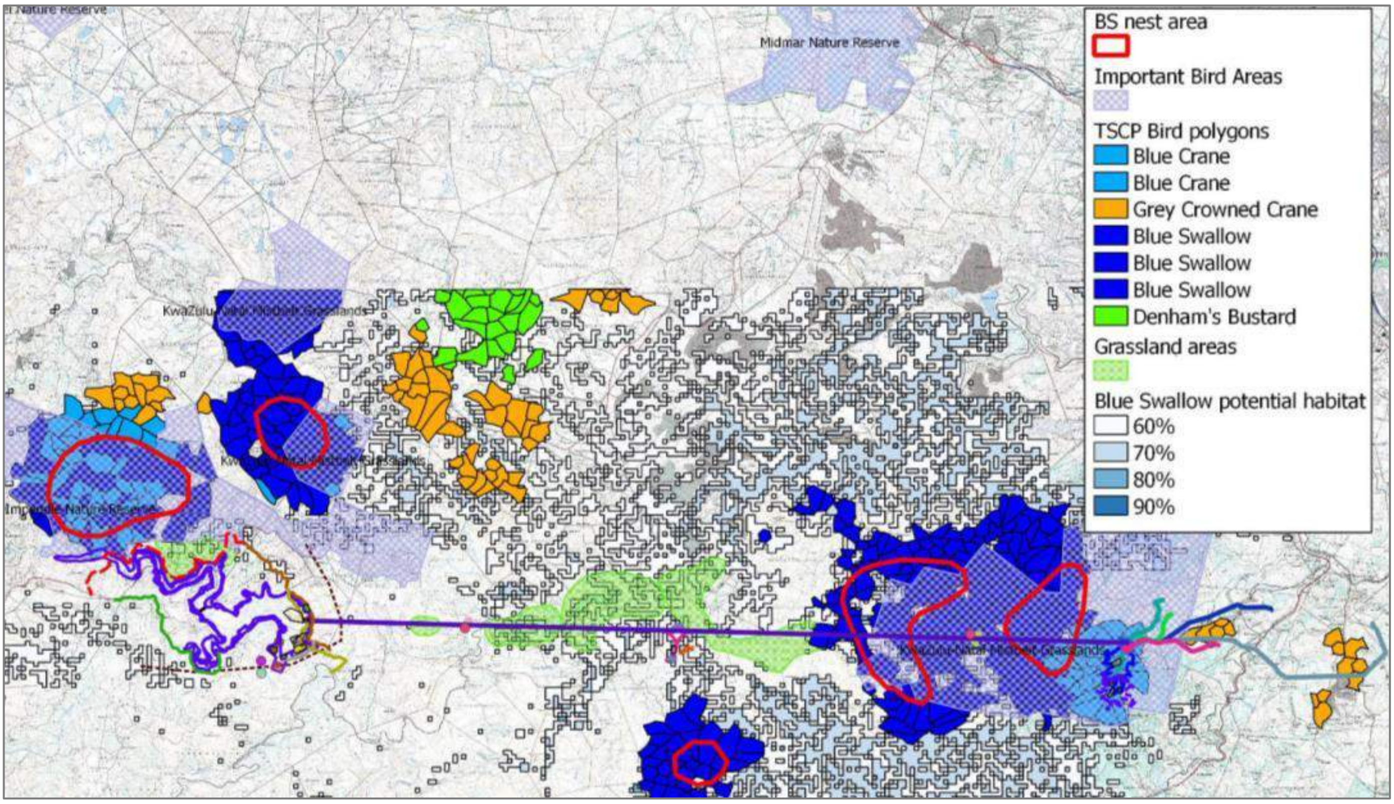


Figure 230: Preliminary avifaunal constraints map (Wildskies, 2015)

*Refer to **Section 12.10** for a discussion on the potential impacts of the project to avifauna in the study area.*

11.1.9 Relocation Framework Plan

This section provides a summary of the Relocation Framework Plan, as contained in **Appendix H11**.

The Relocation Framework Plan is intended to inform and facilitate the preparation of an RAP and to focus on some of those matters that may be very time-consuming and should be scheduled for early attention in the implementation programme. The DWS, or an Implementing Agent appointed for the project, must acquire rights to the use of land for the project before work can commence on that land. Most importantly, those rights cannot be effectively exercised before the land has been cleared of constraints or impediments to physical work commencing. A major constraint will be that all people living on or using the land must be relocated to an approved alternative locality and all the consequences of this relocation must be effectively and sustainably mitigated.

The RAP must make provision for mitigating all of the unavoidable negative impacts of project implementation on the people who are directly or indirectly affected by the project. At least the following aspects will require attention in compiling and implementing a RAP:

- Individuals and families must be relocated to new homes outside the direct physical influence of the project;
- Attention must be given to maintenance or management of close family and community networks when people are relocated;
- Graves associated with families that have been resettled must be relocated to approved new burial sites;
- Religious and other sites used for cultural ceremonies and rituals that fall within the project area must be “cleansed”, usually by a Traditional Healer, and alternative sites may have to be sanctified;
- Social services such as schools, clinics, hospitals and public buildings that are affected by the project must be relocated;
- Access by roads, streets and footpaths to homes and between communities must be reinstated;

- Water sources and pipelines for domestic use and stock watering which are located in the project area must be replaced by alternative arrangements; and
- Hazardous material such as cattle dips, stores for fertilizers and other chemicals (usually used for agricultural purposes), and soil contaminated by diesel and motor oil must be removed from the project area.

The RAP must be compiled and implemented in strict compliance with all relevant domestic legislation, the most important of which are the following:

- South African Constitution, Chapter 2, Bill of Rights, Section 24;
- South African Constitution, Chapter 2, Bill of Rights, Section 25;
- The National Environmental Management Act, Act 107 of 1998;
- The Expropriation Act, Act 63 of 1975;
- The Extension of Security of Tenure Act, Act 62 of 1997; and
- The Basic Conditions of Employment Act, Act 75 of 1997.

The RAP must also comply with policies of DWS in regards to at least the following when dealing with people, particularly when their rights may be infringed:

- Fairness and equity;
- Transparency; and
- Inclusiveness.

Best practice in compiling a RAP for relocating people who are displaced, either voluntarily or involuntarily, by an infrastructure project is to follow, where appropriate, the guidelines offered by bodies such as the World Bank and its affiliate the International Finance Corporation (IFC). The following documents are the key guidelines for the involuntarily resettlement of people such as in the case of Smithfield Dam:

- World bank Operational Policy 4.12 (OP 4.12); and
- International Finance Corporation (IFC) Performance Standard 5 on Land Acquisition and Involuntary Resettlement (IFC PS 5).

Various aspects of personal and community life are negatively affected by project-related relocations. Mitigation or compensation of these impacts can take different forms and the form most appropriate for each case is always preferred. Wherever possible mitigation should be in the form of like-for-like. Only when this is not possible should other forms of mitigation be implemented. So for instance, a dwelling and all its facilities that has to be vacated should be replaced by an equivalent dwelling on an alternative piece of land. Where crops on the land are lost this could be replaced with food or compensated in cash. The use of cash payments to mitigate the loss of physical and enduring assets should be avoided wherever possible.

All mitigation and compensation measures associated with the relocation of people from the project area must be implemented before the physical works comprising the project are commissioned. This implies that compensation in the form of annuities extending beyond the construction phase of a project are not tenable.

Stakeholder participation in detailed planning is imperative. The structures created for facilitating meaningful participation should include at least the following stakeholders and authorities:

- DWS;
- Department of Cooperative Governance and Traditional Affairs (COGTA)
- DAFF;
- DRD&LR;
- The Ingonyama Trust Board;
- Harry Gwala DM and Ingwe LM;
- Ward Councillors;
- Traditional Authorities; and
- Representatives of affected households.

Responsibility for administration of the consultative structures lies with the Developer (DWS), through the Implementing Agent, and full records of all proceedings must be prepared and maintained. The outcome of consultations with the affected parties should be in the form of Social Compacts or " Project Policies", signed off by representatives of the affected parties and by the Developer, in respect of the following:

- Relocation areas;
- Dwellings and other Buildings;
- Lands; and

- Graves.

11.2 Specialist Studies undertaken as part of the Technical Feasibility Study

11.2.1 General

A host of studies were also conducted as part of the uMWP-1 Technical Feasibility Study for the Raw Water component. Some of these studies that are of particular importance for the EIA include the following:

- Water Quality Analysis;
- Limnology Study;
- Sediment Yield Assessment;
- Geotechnical Investigation;
- Hydrological Assessment;
- Hydropower assessment;
- Economic Impact Assessment;
- Traffic Impact Assessment; and
- Potential impact of the proposed Smithfield Dam on the coastal sediment budget and shoreline stability.

Where relevant, the findings of the above technical studies were incorporated into the EIA Report particularly in terms of describing the project (**Section 9**) as well as the receiving environment (**Section 10**). Summaries of certain of these studies are included in the sub-sections to follow to provide additional context to the overall project and its environmental implications.

11.2.2 Economic Impact Assessment

A summary of the Economic Impact Assessment (DWA, 2015a) follows.

The Economic Impact Assessment reviewed the locality, the drivers of water resource demand in the catchment areas and provided an overview of the anticipated impacts of the total development from an economic perspective. Context is provided in terms of the long term development framework and legislative support for water provision in the study area.

11.2.2.1 Synopsis of the Socio-Economic Baseline

Defining the Catchments

In the socio-economic baseline of the uMkhomazi Catchment and the Umgeni Water's (UW) supply area, the following demographic and economic trends for the region become evident: the uMkhomazi Catchment area (comprising of parts of eThekwini, Vulamehlo, Impendle, Mkhambathini, Richmond, Ingwe, KwaSani, and uBuhlebezwe municipalities), while geographically large, is very sparsely settled, with only 1.9% of the KZN populous residing within the region. In contrast, the UW's supply area services 59% of all people in the province, 6.3 million people comprising of 1.6 million households.

uMkhomazi Catchment

At present, the uMkhomazi Catchment has very low rates of economic activity, with 44.3% of the working age population economically active and with 22.3% of that subgroup employed. The majority of households are considered rural (60.3%), residing in traditional dwellings and the majority of all households in the catchment (66%) utilise pit latrines, only 21.6% have either flush or chemical toilet facilities, and 33.2% of households have access to piped water in yard or dwelling.

Umgeni Water Supply Area

The UW's supply area has an economic active population of 60.4%, with 37.8% of that group employed. The majority of households (55.1%) use flush or chemical toilets; 78% households have access to piped water either inside their dwellings or inside their yard and the share of households with access to piped water on a community stand is 15% less than 200m from their dwelling, while 6.3% have access to piped water a distance greater than 200 m from their dwelling.

11.2.2.2 Proposed Project Dimensions

Economic impacts can be viewed in terms of their duration, or the stage of the lifecycle of the project that is being analysed.

Generally two phases are subjected to the economic impact assessment, the construction/development phase and the commercialisation/operational phase. The construction phase economic impact is of a more temporary duration, and has therefore a temporary effect. On the other hand, the operational phase of the project usually takes place over a long-term; hence, the impacts during this stage are of a sustainable nature.

In this project, the construction phase is articulated in two clear components: the Raw Water infrastructure (to be owned by DWS) that comprise the development of the dams, raw water pipeline and tunnel and the Potable Water infrastructure (to be owned by UW) which includes the WTW as well as potable water pipeline. Further to that, there are clearly defined refurbishment activities and common supportive activities like access roads and waste sites.

The total construction period is anticipated at 5 years, and operations are considered for the following 50 years; which includes the periods of refurbishment. Although it is anticipated that the asset lifespan exceeds 50 years; this period is used for modelling purposes.

11.2.2.3 Economic Impact Assessment

The Model

The econometric model for the study was developed using the KZN Social Accounting Matrix (SAM) updated to 2014 figures. The SAM is a comprehensive, economy-wide database that contains information about the flow of resources between economic agents in the provincial economy. The socio-economic assessment developed considers three different types of economic impact, namely direct, indirect and induced.

These levels of impact are defined as follows:

- The **direct impact** occurs when the project creates jobs and procures goods and services resulting in increased employment, production, business sales, and household income. In the case of a mega project such as a dam and water system; many of these impacts occur directly in relation to the construction site;
- The **indirect impact** occurs when the suppliers of goods and services to the proposed project experience a larger markets and the potential to expand. Indirect impacts result in an increase in job creation, Gross Domestic Product (GDP) and household income. These impacts typically accrue to the first round of spend experienced by suppliers into the direct impact zone; and
- The **induced impact** represents further shifts in spending on food, clothing, shelter and other consumer goods and services due to increased income in the directly and indirectly affected businesses. This leads to further business growth throughout the local economy. This level of impact can be best understood as the impact of additional wages entering the economy.

Measuring Impacts

The socio-economic impact of the project is measured according to the following indicators:

- **Production**: Production is defined as the process in which labour and assets are used to transform inputs of goods and services into outputs of other goods and services. The impact assessment will measure the change in production expected to result from the project.
- **GDP**: GDP refers to the market value of all final goods and services produced within a country in a given period of time. The assessment therefore measures the impact of the proposed project on the South African economy.
- **Employment created**: An employment opportunity is defined as one person employed for one year. Seasonal work is therefore not counted as an individual employment opportunity but instead combined to calculate the number of total jobs created in one year.

- **Income generated**: The income generated by the project refers to the salaries and wages earned by those employed directly in the project and the suppliers of goods and services.

Modelled Impact Outcomes

The proposed uMWP-1 will have an impact on the regional and local economies during the construction, operational and refurbishment phases. The impact during construction is considerable, yet it is not sustainable in the long-term as the construction will only last for approximately 60 months.

The operational phase is modelled on a 50 year period and therefore it is regarded as a more sustainable contribution to the domestic economy. The refurbishment phases will contribute to the overall impact during the operational phase, these are identified as discrete expenditure undertaken in single year increments over the lifespan of the assets.

Employment opportunities are counted as annual opportunities (1 person employed for a year over 10 years equals 10 employment opportunities), thus the risk of double counting during operational phase is removed, as the scheme constantly, with exception of periods of refurbishment, generates constant employment opportunities. All measured benefits are in 2014 Rm.

- Total additional production (new business sales) anticipated to be generated by the project equates to R86 661m.
- Gross domestic product is anticipated to increase by R30 305m.
- Employment opportunities present in the form of 4 280 direct employment opportunities related to construction and site operation. Of these, 110 annual opportunities are created in a permanent manner for the operation of the scheme, which equates to 5 500 employment opportunities generated in the operational phase of 50 years, that total direct employment opportunities equates to 9 670 over both construction and operation .
- Worker income is set to increase by R14bn over the modelled period. This is especially important for the uMkhomazi Catchment which has experienced high levels of migration, as population exodus in search of economic

opportunity has impacted the rural economy. The uMWP provides employment opportunities and income in a region (uMkhomazi Catchment) that is facing severe economic constraint.

- The impact assessment showed that the construction, operation and refurbishment phases of the uMWP will result in numerous positive leverage effects in the study area. The sectors in which these leverage effects will be experienced the most are as follows:
  - During the construction phase in building and construction, manufacturing and real estate and business services;
  - During the operational phase in water, manufacturing, transport and storage;
  - During the refurbishment phases in manufacturing, trade and accommodation, real estate and business services.

Economic Cost Benefit Analysis

In order to express all costs and benefits in the same monetary values, the financial analysis is undertaken over a 50 year period and held constant in 2014 Rand values. For the purposes of an Economic Cost Benefit Analysis (ECBA), land and existing infrastructure are not included and a discount rate was implemented to express future costs and benefits in current values.

The current prices were estimated using different inflators to indicate different positive and negative scenarios. The ECBA results for the costs of the scheme's development and current price analysis based on the provided water sales figures made available from uMWP: Water requirement and return flows report. Economic Costs are provided as are the GDP benefits (as a proxy of benefit to society) and the anticipated revenues from future water sales from the scheme.

The scheme is anticipated to have a net benefit of R58 370m in 2014 Rand terms, and retains a positive discounted rate for net present value rates up to 25%.

Opportunity Costs of the Scheme

Water is a critical input for all development, a key requirement for livelihoods as part of the social construct as well as an input to economic production processes. For the purpose of this assessment, the opportunity cost considered was the productive function of the supply area's economic activities as measured by economic output in gross value added terms. The assumption is that if the uMWP is not constructed then the opportunity to produce above a certain economic level will be foregone beyond that point in time that a constraint in supply is likely.

A 19 year review of economic production in KZN and the supply area in specific indicates that the average economic growth rate achieved over the period equates to an approximate 3% annual increase in gross value-added year on year.

These growth rates have been projected forward, to provide a proxy for what economic production levels could be generated on an annual basis; should all other variables (including the access to water resources) remain constant.

If 2022 is used as the critical tipping point for water scarcity in the system, then the foregone economic production, i.e. the opportunity cost to the economy from 2022 until 2044 equates to R13.3bn in constant 2005 year Rands.

This would have the consequence of foregone business sales for KZN province of R13 227 458 in 2005 Rand terms; a loss of R 1 222 866 in 2005 Rands of gross geographic production; an absolute loss of 376 055 employment opportunities over the 19 year period and a loss of income and wages of R1 717 103 in 2005 Rands.

11.2.2.4 The Affordability of Water

Water affordability is a central element to water access, as noted in the socio-economic profile, 20% of both the catchment and supply areas' households are considered below the poverty line. At present that approximately 60% of households in the uMkhomazi Catchment and 93% in the Umgeni WSS's footprint, receive water through a regional or local water scheme operated by their local municipality or another water service provider.

It is anticipated that with the increased economic activity through the uMWP investment will lead to an increase in worker income and as a result more people will be able to afford water, with supportive payment education, the creation of a willing mind-set to pay for services received could be entrenched and cost recovery could be improved.

The study has shown that additional to the availability of potable water, the uMWP development will lead to numerous positive effects which will create various leverage effects throughout the uMkhomazi study area and increase the overall wellbeing of citizens.

11.2.3 Traffic Impact Assessment

A summary of the Traffic Impact Assessment (DWA, 2015b) follows. The report is contained in **Appendix H9**.

The objectives of the Traffic Impact Assessment included:

- Determine the traffic impact during the construction and operational phases of the uMWP-1;
- Provide feasible measures to mitigate the traffic impact of the project on the surrounding road network to acceptable levels; and
- Give recommendations on how adherence to the EMPr, pertaining to traffic, may be enforced and monitored.

The study area is divided into three key activity nodes (see **Figure 231**):

1. The Smithfield node is located next to the R617, approximately 38km southwest of the Howick/Underberg interchange. This node will include the Smithfield Dam, construction of access roads and realignment of a short portion of the R617 around the impounded area.

2. The Langa node is located just south of Thornville at the Baynesfield Estate, roughly 20km south of Pietermaritzburg along the R56. This node includes the Langa Dam, WTW and the raw and potable water pipeline.
3. The Mafunze node is located about halfway between the Smithfield and Langa nodes along the tunnel route, in anticipation that the contractor would choose to use TBMs to drill the tunnel in 2 sections – one from Langa to Mafunze and another from Mafunze to Smithfield.

Specific attention was given to:

- Locations where access routes intersect with the R617 and R56;
- Possible pipeline crossing locations along the R56;
- Sensitive areas (e.g. residential settlements, schools, Baynesfield Estate) in close proximity to the routes affected by the project; and
- Deviation of existing routes around the flood lines.

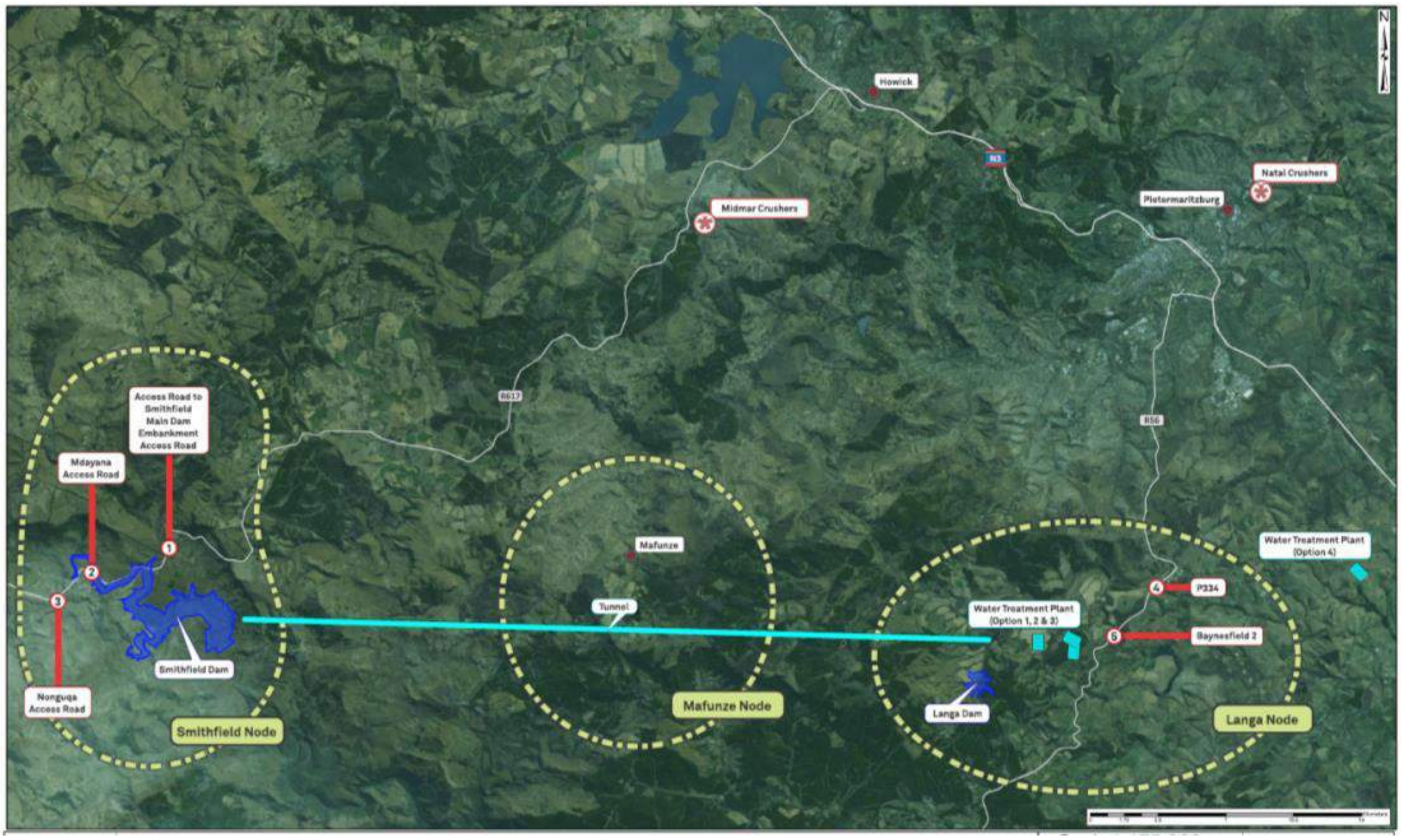


Figure 231: Traffic Impact Assessment study area (DWA, 2015b)

The findings of the investigation are contained in **Section 12.18**.

11.2.4 Impact of Smithfield Dam on Coastal Sediment Budget & Shoreline Stability

A summary of the Sediment Deposition and Impact Report (DWA, 2015d) follows (contained in **Appendix H12**).

The main objectives of this specialist study were to:

- Review the sediment yield study and to carry out a hydrodynamic modelling study of the reservoir sedimentation of the proposed Smithfield Reservoir; and
- Evaluate how the change in the fluvial sediment (sand) yield at the uMkhomazi River mouth due to the proposed Smithfield Dam, could impact the coastal sediment budget and shoreline stability.

11.2.4.1 Sediment Yield and Reservoir Sedimentation

The key findings of this study are as follows:

- The sediment yield determined by the previous Sedimentation Yield was reviewed and compared with observed sediment yields in the region. Sensitivity testing was also carried out by using the WRC (2012) method by considering the accuracy of the 10 year flood. Based on the relatively high observed sediment yields in the region, it is recommended that a 95% confidence sediment yield is used of 617 t/km^2.a for the proposed dam, which gives a mean annual sediment load of 1.27 million t/a. The sediment yields calculated in this study are similar to those of the Sedimentation Yield Study report, but the recommended sediment yield in this study is higher since it is based on a higher confidence level and agrees with regional reservoir sedimentation data. A possible future sediment yield of double the current yield due to land use change, land degradation and climate change impacts was also considered in the reservoir sedimentation analysis.
- Reservoir sedimentation of the proposed Smithfield Reservoir was carried out by using a two dimensional hydrodynamic model. In the model setup 4 sediment fractions were used based on bed sediment grading analysis from field work carried out during this study. The upstream boundary consisted of a scaled observed flow record from a nearby DWS flow gauging station U1H005 using hourly data and a sediment concentration time series for

cohesive sediments based on an adjusted discharge-sediment load rating of the Eastern Cape to obtain the correct long term sediment yield. The water levels at the dam site were used as downstream boundary in the model and were simulated by one dimensional hydrodynamic model of the reservoir mass balance, considering inflows, evaporation, rainfall, spillage and diverted flows. Reservoir sedimentation simulations were carried out for a 100 year period, with the current sediment yield of 617 t/km^2.a. A sensitivity scenario was also simulated with a smaller cohesive fraction of 11 micron (compared to the 33 micron), to evaluate the deposition patterns near the dam. The results were similar after 50 years, but after 100 years of operation the 33 micron cohesive fraction indicated slightly more sediment deposition near the dam.

The new reservoir trap efficiency is 97% and therefore only colloidal (very fine) sediment will not be deposited in the reservoir. The new Smithfield Dam full supply storage capacity (FSC) of 252 million m^3 could decrease to 208 and 161 million m^3 after 50 years, for the current sediment and possible increased future sediment yields, respectively. The simulated reservoir sedimentation therefore decreases the storage capacity by 18% and 36% for the current and future sediment yield scenarios respectively, over the 50 year period. At the current sediment yield and future possible higher sediment yield over a 100 year period, the FSC could be 163 and 87 million m^3, a decrease of 36% and 66% in the original FSC, respectively.

A scenario was also considered where the Impendle Dam is constructed in future upstream of the proposed Smithfield Dam. **Table 81** provides the Smithfield Reservoir FSC's for different sediment yield scenarios after 50 and 100 years of operation, with Impendle Dam commissioned by 2046, and without Impendle Dam. The last row in **Table 81** is the recommended scenario over 100 years of operation of Smithfield Dam, with the current yield sediment over the first 50 years and a doubled future sediment yield over the last 50 year period. With Impendle Dam commissioned by year 2046 the Smithfield Reservoir will only lose 16% of its original FSC over a 100 year period, but if Impendle Dam is not implemented 51% of the original FSC of Smithfield Dam could be lost due to sedimentation.

Table 81: Reservoir sedimentation at Smithfield Dam with and without Impendle Dam upstream of Smithfield Dam (DWA, 2015d)

Description	Unit	Smithfield Dam-with Impendle Dam (yr 2046)	Smithfield Dam-without Impendle Dam
Year of Smithfield Dam commission	year	2023	2023
New reservoir FSC	million m^3	252.0	252.0
After 50 yr: FSC, at current sediment yield	million m^3	227 (10%)*	208 (17%)
After 100 yr: FSC, at current sediment yield	million m^3	219 (13%)	163 (35%)
After 100 yr of FSC, at doubled future sediment yield, for last 50yr	million m^3	211 (16%)	124 (51%)

*Note: * percentage of original FSC loss due to sedimentation indicated in brackets*

The long term reservoir sedimentation simulations indicated possible sediment deposition at the diversion tunnel intake in the Smithfield Reservoir (no Impendle Dam). After 50 years of operation the current and possible high future sediment yield indicated sediment deposition at the intake of 0.4 and 12.8 m respectively. If the high future sediment yield is considered over a 100 year period the sediment deposition at the tunnel intake could be 28.5 m deep and at the dam wall 58.5 m deep. The actual sediment deposition could be less, however, if the high future sediment yield is only considered over the period from 50 to 100 years of operation of the dam, and if Impendle dam is constructed.

It is recommended that for scenarios without the proposed Impendle Dam:

1. The simulated 50 year reservoir sedimentation of Smithfield Dam (using a cohesive fraction size of 33 micron), for the current sediment yield, should be used to ensure that the required firm water yield of the reservoir is not affected during the first 50 years of operation.
2. As a sensitivity analysis in the water resources planning, the high sediment yield (double current yield) reservoir sedimentation assessment after 50

years should also be considered in the firm yield assessment to evaluate the firm yield reduction of Smithfield Dam.

3. While the above is typically the methodology followed in South Africa, based on international guidelines (ICOLD and World Bank) the reservoir sedimentation and operation for 100 years should also be considered in the water resources analysis, to assess whether Smithfield Dam will be feasible in the long term. The recommended sediment yield scenario is the last one in **Table 81** (bottom row).
4. Sediment control measures should be implemented in the catchment (land care programme) to limit the sediment yield increase in future.
5. Engineering measures in the dam may include a sediment bypass.

If the proposed Impendle Dam is constructed in future upstream of Smithfield Dam, land care of the catchment to prevent land degradation will remains important for the total catchment of Smithfield Dam. The recommended sediment flushing mitigation measure at the diversion tunnel intake will not be required due to the relatively small FSC storage loss of only 16% over 100 years.

11.2.4.2 Potential Impact on Coastal Sediment Budget and Shoreline Stability

The proposed Smithfield Dam is located 187 km upstream of the river mouth and the estimated total sediment yield trapped in the reservoir is 1.2 million t/a. The coastal impact of the dam is affected by the decrease in sand load at the river mouth (coarse sediment) caused by sediment trapping in the reservoir and also due to the decreased sediment transport capacity downstream of the dam with the attenuated flood peaks and fewer floods spilling at the dam. The simulated net effect of the proposed dam is a 46 000 m^3/a reduction in sand load at the mouth. The pre-dam mean sand load at the river mouth was calculated as 352 000 t/a, while the post dam sand load is calculated to be 287 000 t/a, with an estimated reduction of sand load of 74 000 t/a (a 21% reduction in sand yield on this river). The main focus is on the shoreline stretching from just south of the uMkhomazi River mouth northwards to Durban. This reduction in sand yield represents a reduction of 18% of all the inland sand load of all the rivers (from the river mouth to Durban), and a 10 % reduction in total load at Durban (river and longshore inputs combined).

It should be noted that the sediment yield has increased significantly over the past 100 years on this river due to land use changes. The sand fraction of the sediment yield is however not increased because it is related to the sediment transport capacity based on local hydraulic conditions. The main change is the fine cohesive sediment load (clay and silt) which is now much higher, but does not contribute to the sand budget to limit coastal erosion.

From the aerial photographic analyses and the topographic survey results it cannot be clearly ascertained whether there is currently a significant long-term trend in the shoreline location in the vicinity of the uMkhomazi River mouth. Horizontal shoreline variations are naturally relatively large on this exposed high energy coastline and are further subject to the effects of episodic flood derived pulses of sediment input from the larger rivers in the region. Based on the longer-term aerial photographic analyses it appears that if indeed an eroding trend were present, it would have to be quite small (<=0.3 m/a, i.e. <=15 m over 50 years) to remain undetected at this stage. However, along the Durban Bluff coastline, which is located about 31 km northeast of the uMkhomazi Mouth, the historical observed lateral erosion rate is about 1 m/a.

See further discussions in **Section 12.6.9** pertaining to potential impacts of Smithfield Dam on the coastal sediment budget.

12 IMPACT ASSESSMENT

12.1 Overview

12.1.1 General

This section focuses on the pertinent environmental impacts that could potentially be caused by the proposed uMWP-1 Raw Water during the pre-construction, construction and operational phases of the project.

Note that an 'impact' refers to the change to the environment resulting from an environmental aspect (or activity), whether desirable or undesirable. An impact may be the direct or indirect consequence of an activity.

Impacts were identified as follows:

- An appraisal of the project activities and components;
- Impacts associated with listed activities contained in GN No. R. 544, R. 545 and R. 546 of 18 June 2010, for which authorisation has been applied for;
- An assessment of the receiving biophysical, social, economic and built environment;
- Findings from specialist studies;
- Issues highlighted by environmental authorities; and
- Comments received during public participation.

12.1.2 Impacts associated with Listed Activities

As mentioned, the project requires authorisation for certain activities listed in the EIA Regulations (2010 and 2014), which serve as triggers for the environmental assessment process. The potential impacts associated with the key listed activities are broadly stated in **Table 82**.

Table 82: Potential Impacts associated with the key listed activities

Listed Activities	Potential Impact Overview
GN No. R. 544 of 18 June 2010	
9. The construction of facilities or infrastructure exceeding 1000 metres in length for the bulk transportation of water, sewage or storm water - (i) with an internal diameter of 0,36 metres or more; or	• Impacts associated with the footprint of the physical infrastructure (proposed tunnel and raw water pipeline).

Listed Activities	Potential Impact Overview
(ii) with a peak throughput of 120 litres per second or more, excluding where: a. such facilities or infrastructure are for bulk transportation of water, sewage or storm water or storm water drainage inside a road reserve; or b. where such construction will occur within urban areas but further than 32 metres from a watercourse, measured from the edge of the watercourse.	• Effects to resource quality (i.e. flow, in-stream and riparian habitat, aquatic biota and water quality) associated with traversing or working in close proximity to watercourses. • Erosion on steep slopes. • Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species). • Visual and socio-economic impacts during construction. • Traffic disruptions (road crossings, construction traffic). • Land acquisition - securing of servitude.
10. The construction of facilities or infrastructure for the transmission and distribution of electricity - (i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts; or (ii) inside urban areas or industrial complexes with a capacity of 275 kilovolts or more.	Impacts associated with the relocation of the existing power line at Smithfield Dam: • Physical footprint; • Visual impacts; • Bird collisions; • Land acquisition - securing of servitude.
11. The construction of: (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.	• Impacts associated with the footprint of the physical infrastructure within 32 m of a watercourse – main storage dam, balancing dam, gauging weir, access roads, relocated infrastructure (roads with bridges, power line), raw water pipeline, borrow areas A and B as well as quarries I and IV, spoil sites, and raw water pipeline. • Adverse effects to resource quality (i.e. flow, in-stream and riparian habitat, aquatic biota and water quality) associated with working in-stream and alongside watercourses. • Destabilisation of affected watercourses. • Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species). • Visual impacts. • Reduction in water quality of receiving watercourses due to improper management of stormwater, hazardous material and sanitation.
13. The construction of facilities or infrastructure for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 but not exceeding 500 cubic metres;	Pollution of bio-physical environment through poor practices associated with onsite storage of dangerous goods.
18. The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from (i) a watercourse; (ii) the sea; (iii) the seashore; (iv) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater- but excluding where such infilling, depositing, dredging, excavation, removal or moving 1. is for maintenance purposes undertaken in accordance with a management plan agreed to by the relevant environmental authority; or 2. occurs behind the development setback line.	• Construction activities (including bulk earthworks) to be undertaken within a watercourse for physical infrastructure - main storage dam, balancing dam, gauging weir, access roads, relocated infrastructure (roads with bridges, power line), raw water pipeline, borrow areas A and B as well as quarries I and IV, spoil sites, and raw water pipeline. • Adverse effects to resource quality (i.e. flow, in-stream and riparian habitat, aquatic biota and water quality) associated with working in-stream and alongside the watercourse. • Destabilisation of affected watercourses.
19. Any activity which requires a prospecting right or renewal thereof in terms of section 16 and 18 respectively of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).	• Impacts associated with creating the quarries and borrow areas and hauling the material. *Notes – the quarries and borrow areas are located within the Smithfield Dam and balancing dam basins, which will be inundated. At Smithfield Dam, Quarries II*
20. Any activity requiring a mining permit in terms of section 27 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) or renewal thereof.	

Listed Activities	Potential Impact Overview
	and III are located at the plunge pool and spillway approach, respectively.
22. The construction of a road, outside urban areas, (i) with a reserve wider than 13,5 meters or, (ii) where no reserve exists where the road is wider than 8 metres, or (iii) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Notice 545 of 2010.	• Impacts associated with access roads to the various sites (dam wall, outlet structure, tunnel portals, spoil areas, etc.) as well as relocation of roads that will be inundated. • Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species). • Traffic disruptions during construction. • Longer travelling distances for certain affected community members at Smithfield Dam, due to relocation of existing roads. • Impacts to watercourses at crossings.
23. The transformation of undeveloped, vacant or derelict land to – (i) residential, retail, commercial, recreational, industrial or institutional use, inside an urban area, and where the total area to be transformed is 5 hectares or more, but less than 20 hectares, or (ii) residential, retail, commercial, recreational, industrial or institutional use, outside an urban area and where the total area to be transformed is bigger than 1 hectare but less than 20 hectares; - except where such transformation takes place for linear activities. 24. The transformation of land bigger than 1000 square metres in size, to residential, retail, commercial, industrial or institutional use, where, at the time of the coming into effect of this Schedule such land was zoned open space, conservation or had an equivalent zoning.	• Clearance of large areas associated with the construction footprint, including dam wall, embankment and saddle dam at Smithfield Dam, dam wall at balancing dam, construction laydown areas, quarries and borrow pits. • Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species). • Visual impacts. • Soil destabilisation and subsequent erosion. • Proliferation of alien and invasive species. • Loss of grazing areas (Smithfield Dam). • Loss of cultivated areas and timber land (balancing dam).
26. Any process or activity identified in terms of section 53(1) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).	Potential loss of sensitive fauna and flora species.
39. The expansion of (i) canals; (ii) channels; (iii) bridges; (iv) weirs; (v) bulk storm water outlet structures; (vi) marinas; within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, where such expansion will result in an increased development footprint but excluding where such expansion will occur behind the development setback line. 40. The expansion of (i) jetties by more than 50 square metres; (ii) slipways by more than 50 square metres; (iii) buildings by more than 50 square metres; (iv) infrastructure by more than 50 square metres; within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, but excluding where such expansion will occur behind the development setback line.	• Impacts associated with the footprint of the physical infrastructure within 32 m of a watercourse – main storage dam, balancing dam, gauging weir, access roads, relocated infrastructure (roads with bridges, power line), raw water pipeline, borrow areas A and B as well as quarries I and IV, spoil sites, and raw water pipeline. • Adverse effects to resource quality (i.e. flow, in-stream and riparian habitat, aquatic biota and water quality) associated with working in-stream and alongside watercourses. • Destabilisation of affected watercourses. • Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species). • Visual impacts. • Reduction in water quality of receiving watercourses due to improper management of stormwater, hazardous material and sanitation.
47. The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre - (i) where the existing reserve is wider than 13,5 meters; or (ii) where no reserve exists, where the existing road is wider than 8 metres - excluding widening or lengthening occurring inside urban areas.	• Impacts associated with the widening or lengthening of existing roads to create access roads, and for the relocation of roads that will be inundated. • Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species). • Traffic disruptions. • Longer travelling distances for affected community at Smithfield Dam, due to relocation of existing roads. • Impacts to watercourses at crossings.
56. Phased activities for all activities listed in this Schedule, which	• Impacts associated with type of phased activities.

Listed Activities	Potential Impact Overview
commenced on or after the effective date of this Schedule, where any one phase of the activity may be below a threshold but where a combination of the phases, including expansions or extensions, will exceed a specified threshold.	• Cumulative impacts.
GN No. R. 545 of 18 June 2010	
10. The construction of facilities or infrastructure for the transfer of 50 000 cubic metres or more water per day, from and to or between any combination of the following: (i) water catchments, (ii) water treatment works; or (iii) impoundments, excluding treatment works where water is to be treated for drinking purposes.	• Reduction in volume of water available in uMkhomazi system. • Impacts to water users (including aquatic environment) downstream of Smithfield Dam. • Impacts to uMkhomazi Estuary. • Impacts to uMlaza River associated with receiving water from the uMkhomazi River, including water quality and relocation of aquatic biota. • Impacts to hydrological and sediment regimes of the uMlaza River and uMkhomazi River.
15. Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more; except where such physical alteration takes place for: (i) linear development activities; or (ii) agriculture or afforestation where activity 16 in this Schedule will apply.	• Clearance of large areas associated with the construction footprint, including dam wall, embankment and saddle dam at Smithfield Dam, dam wall at balancing dam, construction laydown areas, quarries and borrow pits. • Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species). • Visual impacts. • Soil destabilisation and subsequent erosion. • Proliferation of alien and invasive species. • Loss of grazing areas (Smithfield Dam). • Loss of cultivated areas and timber land (balancing dam).
18. The route determination of roads and design of associated physical infrastructure, including roads that have not yet been built for which routes have been determined before 03 July 2006 and which have not been authorised by a competent authority in terms of the Environmental Impact Assessment Regulations, 2006 or 2009, made under section 24(5) of the Act and published in Government Notice R385 of 2006 [if] – (i) it is a national road as defined in section 40 of the South African National Roads Agency Limited and National Roads Act, 1998 (Act 7 of 1998); (ii) it is a road administered by a provincial authority; (iii) the road reserve is wider than 30 metres; or (iv) the road will cater for more than one lane of traffic in both directions.	• Impacts associated with the relocation of the existing R617, which is administered by the KZN Department of Transport, that will be inundated. • Encroachment of the relocated road into the Impendle Nature Reserve. • Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species). • Traffic disruptions during construction. • Longer travelling distances for certain affected community members at Smithfield Dam, due to relocation of R617. • Impacts to watercourses at crossings.
19. The construction of a dam, where the highest part of the dam wall, as measured from the outside toe of the wall to the highest part of the wall, is 5 metres or higher or where the high-water mark of the dam covers an area of 10 hectares or more.	• Impacts to water users (including aquatic environment) downstream of Smithfield Dam. • Impacts to uMkhomazi Estuary. • Impacts to hydrological and sediment regimes of the uMlaza River and uMkhomazi River. • Alteration of current biophysical functioning of affected watercourses. • Interruptions to river continuum. • Impacts to migration of aquatic biota. • Socio-economic impacts associated with inundation of dam basin (e.g. relocation, movement patterns). • Relocation of exiting services and infrastructure.
20. Any activity which requires a mining right or renewal thereof as contemplated in sections 22 and 24 respectively of the Mineral and Petroleum /resources Development Act, 2002 (Act 28 of 2002).	• Impacts associated with creating the quarries and borrow areas and hauling the material. *Notes – the quarries and borrow areas are located within the Smithfield Dam and balancing dam basins, which will be inundated. At Smithfield Dam, Quarries II*
21. Any activity which requires an exploration right or renewal thereof as contemplated in sections 79 and 81 respectively of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002).	

<table>
<tr><th>Listed Activities</th><th>Potential Impact Overview</th></tr>
<tr><td></td><td>and III are located at the plunge pool and spillway approach, respectively.</td></tr>
<tr><td colspan="2"><u>GN No. R. 546 of 18 June 2010</u></td></tr>
<tr><td>2(a)(iii). The construction of reservoirs for bulk water supply with a capacity of more than 250 cubic metres.</td><td>Possible occurrence of sensitive biodiversity features at affected areas. The balancing dam is located in a potentially sensitive area.</td></tr>
<tr><td>4(a)(ii). The construction of a road wider than 4 metres with a reserve less than 13,5 metres.</td><td>Impacts associated with building access roads and re-aligning R617 to sensitive, threatened or protected ecosystems.</td></tr>
<tr><td>10(a)(ii). The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres.</td><td>Pollution of sensitive, threatened or protected ecosystems through poor practices associated with onsite storage of dangerous goods.</td></tr>
<tr><td>12. The clearance of an area of 300 square metres or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation.</td><td rowspan="3">• The clearance or inundation of large tracts of indigenous vegetation.
• Potential loss of sensitive fauna and flora species.</td></tr>
<tr><td>13. The clearance of an area of 1 hectare or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for:
1. the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), in which case the activity is regarded to be excluded from this list.
2. the undertaking of a linear activity falling below the thresholds mentioned in Listing Notice 1 in terms of GN No 544 of 2010.</td></tr>
<tr><td>14. The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for:
1. purposes of agriculture or afforestation inside areas identified in spatial instruments adopted by the competent authority for agriculture or afforestation purposes;
2. the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the activity is regarded to be excluded from this list;
3. the undertaking of a linear activity falling below the thresholds in Notice 544 of 2010.</td></tr>
<tr><td>16(a)(ii). The construction of:
(i) buildings with a footprint exceeding 10 square metres in size; or
(ii) infrastructure covering 10 square metres or more
where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.</td><td>Impacts to sensitive, threatened or protected ecosystems associated with infrastructure within watercourse(s) / within 32 m from watercourse(s), including:
• Smithfield Dam;
• Balancing dam;
• Gauging weir;
• Access roads;
• Relocated infrastructure (roads with bridges, power line); and
• Raw water pipeline.

Effects to resource quality (i.e. flow, in-stream and riparian habitat, aquatic biota and water quality) associated with working in-stream and alongside the watercourses.</td></tr>
<tr><td>19(a)(ii). The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre.</td><td>Impacts to sensitive, threatened or protected ecosystems associated with access roads to the various sites (construction and operational phases) and relocation of R617 that will be inundated.</td></tr>
<tr><td>24(a)(ii). The expansion of
1. buildings where the buildings will be expanded by 10 square metres or more in size; or
2. infrastructure where the infrastructure will be expanded by 10</td><td>Impacts to sensitive, threatened or protected ecosystems associated with upgrade of existing bridge(s) along access road(s)</td></tr>
</table>

Listed Activities	Potential Impact Overview
square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.	Effects to resource quality (i.e. flow, in-stream and riparian habitat, aquatic biota and water quality) associated with working in-stream and alongside the watercourses.
26. Phased activities for all activities listed in this Schedule and as it applies to a specific geographical area, which commenced on or after the effective date of this Schedule, where any phase of the activity may be below a threshold but where a combination of the phases, including expansions or extensions, will exceed a specified threshold.	• Impacts associated with type of phased activities. • Cumulative impacts.

12.1.3 Issues raised by Environmental Authorities and I&APs

The issues raised by authorities (both regulatory and commenting) and I&APs during meetings and contained in correspondence received to date during the execution of the EIA are captured and addressed in the Comments and Responses Report (refer to **Appendix L**).

The consolidated issues raised by I&APs during Scoping for the overall uMWP-1 Raw Water and Potable Water, as contained in the Comments and Response Report (**Appendix L**), have been succinctly grouped into the following main categories (*Note: please refer to the Comments and Response Report for a comprehensive and accurate representation of the issues raised by I&APs*):

- Alternatives-
  - Constructing of dam on one of the last free flowing rivers in KZN;
  - Alternatives to dam option;
  - Need for public participation;
  - Consideration of alternatives suggested as part of pre-feasibility studies and reasons for elimination;
  - Concern that project is presented as *fait accompli*;
  - Human, social, environmental, technical and financial considerations need to be given equal weight in the final decision for the scheme;
  - Need for more sustainable alternatives;
  - Consider off-stream reservoir;
  - Additional alternatives suggested by I&APs;
- Terrestrial ecology –
  - Avian sensitivity especially due to the presence of Blue Swallow and cranes

- Habitat for Oribi, Blue Swallow and Crowned Crane

❖ Freshwater and estuarine ecology –
  - Impacts to the uMkhomazi Estuarine Reserve;
  - Impacts to the uMlaza River;
  - Impacts of bulk water infrastructure on catchment management and health;
  - Impacts of a major in-stream dam to a free-flowing river;
  - Consideration of previous studies of the uMkhomazi River;
  - Contributions to overall catchment management;

❖ Traffic, road network and access –
  - Requirements of the KZN Department of Transport;
  - Access of contractors to the properties affected;
  - Access control onto affected properties;
  - Impacts to existing roads used by local community;
  - Roads crossing a wetland area;
  - Noise and air pollution of vehicles and traffic;
  - Stormwater management;
  - Steep gradient;
  - Risks to existing structures;
  - Risks to livestock, wildlife and public safety;
  - Crime;
  - Visual impacts;
  - Impacts to The Baynesfield Estate Lodge;

❖ Visual, air and noise impacts –
  - Loss of sense of place;
  - Impacts to tourism at The Baynesfield Estate Lodge;
  - Aesthetics, noise, light and air pollution;
  - Dust;

❖ Historical and Cultural Features –
  - Relocation of graves;

❖ Agriculture and Forestry –
  - Loss of timber land;
  - Loss of agricultural land;

- Loss of grazing land;
- Compensation;

❖ Security –
  - Risk of increase in crime due to construction;
  - Access through farms will pose security risks;
  - Concerns over labour accommodation;

❖ Socio-economic impacts –
  - Compensation;
  - Impacts to The Baynesfield Estate Lodge;
  - Relocation of households in the Smithfield Dam basin;
  - Employment opportunities;
  - Skills transfer to construction workers;
  - Benefits to local communities;
  - Bridge to connect the communities on the opposite sides of the dam;

❖ Indigenous Knowledge and Cultural Beliefs;

❖ Existing infrastructure –
  - Servitude restrictions associated with existing infrastructure;

❖ Public participation –
  - Involvement in process;
  - Suggestion of additional parties to be consulted;
  - Involvement of the community in the Bulwer area;
  - Commenting period for the Draft Scoping Report;

❖ Property –
  - Impacts to properties;
  - Servitude specifications;

❖ Water use –
  - Assurance of continued water supply to Sappi Saiccor Mill;
  - Impacts to supply of water to existing users;
  - Impacts to cost of water;
  - Interruption of water supply;
  - Ability to meet the requirements of all users;
  - Provision of water to the areas affected by the project;

  - Impacts to future water use of the Mbangweni River;
  - Impacts to a spring;
  - Impacts to the use of the uMkhomazi River for canoeing events;
  - Releases for paddling;
  - Construction of slalom and white water course at the outlet of the transfer tunnel;
  - Use of Smithfield Dam and balancing dam for recreational purposes;
  - Impacts to fishing on section of watercourse to be inundated by Smithfield Dam;
- Electrical requirements –
  - Electrical requirements of project;
  - Requirements of Eskom for the relocation of existing power lines;
- Construction methodology;
- Waste management –
  - Management of spoil material to be generated during construction;
- Project timeframe;

These issues received further attention during the investigations in the EIA phase, including the environmental and technical specialist studies.

12.1.4 Project & High Level Environmental Activities

The uMWP-1 Raw Water components, including the associated infrastructure and activities, are listed in **Table 15**.

In order to understand the impacts related to the project it is necessary to unpack the activities associated with the project life-cycle (refer to **Section 9.18**), as done in the sub-sections to follow.

12.1.4.1 Project Phase: Pre-construction

The main project activities as well as high-level environmental activities undertaken in the pre-construction phase are listed in **Table 83**.

Table 83: Activities associated with uMWP-1 Raw Water Pre-construction Phase

Project Phase: Pre-construction
Project Activities
• Undertake due diligence and optimisation studies
• Detailed engineering design
• Detailed geotechnical investigations, including geophysical investigations
• Negotiations and agreements with the affected landowners (including Ingonyama Trust, Traditional Authorities, DRD&LR, Baynesfield Trust and private landowners), tenants, occupiers of land, stakeholders and authorities
• Initiate legal process required for land acquisition
• Survey and mark construction servitude
• Survey and map topography for determination of post-construction landscape, rehabilitation and shaping (where necessary)
• Possible removal of trees within construction servitude
• Procurement process for Contractors
• Review Contractor's method statements (as relevant)
• Selective improvements of access roads to facilitate the delivery of construction plant and materials
• Arrangements for accommodation of construction workers
• The building of a site office and ablution facilities
• The harvesting of timber that will be inundated (if deemed necessary)
• Confirmation of arrangements with individual landowners / tenants / occupiers of land for managing and mitigating issues such as fencing and gate dimensions for traversing servitude, traversing patterns of livestock over servitude, access to livestock drinking points, security, opening and closing of gates and access to private property
• Confirmation of the location and condition of all buildings, assets and structures within the servitude
• Determining and documenting the road conditions for all identified haul roads
• Conduct detailed hydraulic analysis to determine the optimum positioning of the scour valves
High Level Environmental Activities
• Diligent compliance monitoring of the EMPr, environmental authorisation and other relevant environmental legislation
• Develop RAP (Smithfield Dam basin) and implement based on area of influence of the construction activities
• Undertake Phase 2 Heritage Impact Assessment and Archaeological Impact Assessment
• Commencement with RMP process by relevant DWS unit
• Conduct further investigations in terms of biodiversity offsets, based on EIA findings and recommendations
• Undertake a walk through survey of the project footprint by the relevant environmental specialists to identify sensitive environmental features
• Search, rescue and relocation of red data, protected and endangered species and medicinal plants (based on area of influence of the construction activities)
• Search, rescue and relocation of heritage resources and graves (based on area of influence of the construction activities)
• Develop environmental monitoring programme (air quality, water quality, noise, traffic, social)
• Conduct further baseline environmental studies for environmental monitoring programme

Project Phase: Pre-construction
• Barricading of sensitive environmental features (e.g. graves)
• Permits if protected trees are to be cut, disturbed, damaged, destroyed or removed
• Permits if heritage resources are to be impacted on and for the relocation of graves
• Establish Environmental Monitoring Committee (EMC)
• On-going consultation with I&APs
• Other activities as per EMPr

12.1.4.2 Project Phase: Construction

The main project activities as well as high-level environmental activities undertaken in the construction phase are listed in **Table 84**.

Table 84: Activities associated with uMWP-1 Raw Water Construction Phase

Project Phase: Construction
Project Activities
• Site establishment
• Relocation of infrastructure
• Prepare access roads
• Establish construction camps
• Bulk fuel storage
• Delivery of construction material
• Transportation of equipment, materials and personnel
• Storage and handling of material
• Construction employment
• Site clearing (as necessary)
• Excavation
• Blasting
• Tunnel excavation including TBM activities and shaft sinking operations
• River diversion for building of major storage dam and balancing dam
• Establishment and operation of crusher
• Establishment and operation of batching plant
• Establishment and operation of materials testing laboratory
• Create haul roads
• Create quarry and borrow areas
• Construction of embankments, bottom outlets, tunnel outlets, spillways
• Concrete Works
• Steel works

Project Phase: Construction
• Mechanical and Electrical Works
• Temporary river diversion for gauging weir and pipeline crossings
• Electrical supply
• Construction of spoil disposal sites
• Construction of pipeline
• Cut and cover activities
• Stockpiling (sand, crushed stone, aggregate, etc.)
• Waste and wastewater management
High Level Environmental Activities
• Diligent compliance monitoring of the EMPr, environmental authorisation and other relevant environmental legislation
• Ongoing search, rescue and relocation of red data, protected and endangered species and medicinal plants (based on area of influence of the construction activities) – permits to be in place
• Ongoing search, rescue and relocation of heritage resources and graves (based on area of influence of the construction activities) – permits to be in place
• Implement environmental monitoring programme (air quality, water quality, noise, traffic, social)
• Finalise RMP process prior to impoundment
• Develop Rehabilitation Management Plan for approval by DEA
• Reinstatement and rehabilitation of construction domain (outside of inundation areas, as necessary)
• Develop EMPr for Operational Phase for approval by DEA
• Continued implementation of RAP
• Convene EMC Meetings
• Biodiversity offset requirements, based on area of influence of the construction activities
• On-going consultation with I&APs
• Other activities as per EMPr

12.1.4.3 Project Phase: Operation

The main project activities as well as high-level environmental activities undertaken in the operational phase are listed in **Table 85**.

Table 85: Activities associated with uMWP-1 Raw Water Operational Phase

Project Phase: Operation
Project Activities
• Maintenance of infrastructure
• Operation of scheme
• Raw Water Pipeline –
• Create access track along pipeline servitude (as required)

Project Phase: Operation
• Conduct routine maintenance inspections of the project infrastructure
• Scouring of pipeline, where the water conveyed and stored within this system will be released into the receiving watercourses along the alignment from scour valves
• Undertake maintenance and repair works, where necessary
• On-going consultation with directly affected parties
• Comply with Operation and Maintenance Manual
• Adhere to Operating Rule
• Implement RMP
High Level Environmental Activities
• Erosion monitoring programme
• Firebreak management
• Control of alien invasive species (terrestrial and aquatic)
• Satisfy EWR
• Monitoring of RAP
• On-going consultation with I&APs
• Other activities as per EMPr for Operational Phase

12.1.5 *Environmental Aspects*

Environmental aspects are regarded as *those components of an organisation's activities, products and services that are likely to interact with the environment and cause an impac*t. The following environmental aspects have been identified for the proposed uMWP-1 Raw Water component, which are linked to the project activities (note that only high level aspects are provided):

Table 86: Environmental Aspects associated with uMWP-1 Raw Water Project Life-Cycle

Project Phase: Pre-construction
Environmental Aspects
• Inadequate consultation with landowners/ tenants / occupiers of land
• Inadequate environmental and compliance monitoring
• Poor construction site planning and layout
• Land occupancy by temporary buildings, provisional on-site facilities and storage areas
• Inaccurate pre-construction environmental walk through survey (including search and rescue)
• Absence of relevant permits (e.g. for protected trees, heritage resources)
• Lack of barricading of sensitive environmental features
• Poor waste management
• Absence of ablution facilities

Project Phase: Construction
Environmental Aspects
• Inadequate consultation with landowners/ tenants / occupiers of land
• Inadequate environmental and compliance monitoring
• Lack of environmental awareness creation
• Indiscriminate site clearing
• Poor site establishment
• Poor management of access and use of access roads
• Inadequate provisions for working on steep slopes
• Poor transportation practices
• Poor fencing arrangements
• Erosion
• Disruptions to existing services
• Disturbance of topsoil
• Poor management of excavations
• Inadequate storage and handling of material
• Inadequate storage and handling of hazardous material
• Poor maintenance of equipment and plant
• Poor management of labour force
• Pollution from ablution facilities
• Inadequate management of construction camp
• Poor waste management practices – hazardous and general solid, liquid
• Wastage of water
• Disturbance to landowners / tenants / occupiers of land
• Poor management of pollution generation potential
• Damage to significant flora
• Damage to significant fauna
• Influence to resource quality of the uMkhomazi River and its tributaries, as well as tributaries of the uMlaza River, from river diversions, in-stream works and activities in the riparian zones (and a buffer area of 50m)
• Environmental damage where drainage lines are crossed
• Environmental damage of sensitive areas
• Disruption of archaeological and cultural features
• Poor reinstatement and rehabilitation
• Inadequate RMP development process
• Inadequate provisions for relocation of affected community members in dam basin

Project Phase: Operation
Environmental Aspects
• Inadequate consultation with landowners/ tenants / occupiers of land

<u>Project Phase:</u> Operation
• Inadequate environmental and compliance monitoring
• Inadequate management of access, routine maintenance and maintenance works
• Inadequate management of vegetation
• Not satisfying the EWR
• Release of poor quality water
• Downstream erosion
• Inadequate RMP development process
• Inadequate provisions for relocation of affected community members in dam basin

12.1.6 <u>Potential Significant Environmental Impacts</u>

Note that it is not the intention of the impact assessment to evaluate all potential environmental impacts associated by the project's environmental aspects, but rather to focus on the potentially **<u>significant</u>** direct and indirect impacts identified during the Scoping phase and any additional issues uncovered during the EIA stage. The potential significant environmental impacts associated with the uMWP Raw Water component, as listed in **Table 87** (construction phase) and **Table 88** (operational phase), were identified through an appraisal of the following:

- The possible impacts identified and assessed as part of the Pre-feasibility Study;
- The risks identified during the Environmental Screening Investigation for uMWP-1 (DWA, 2012b);
- Project-related components and infrastructure, as well as alternatives (see **Section 9**);
- Operation of the system;
- Activities associated with the project life-cycle (i.e. pre-construction, construction, operation and decommissioning) (see **Section 9.18**);
- Nature and profile of the receiving environment and potential sensitive environmental features and attributes (see **Section 10**), which included an evaluation based on site investigations, specialist input, input from authorities and I&APs, GIS, literature review, topographical maps and aerial photography;
- Findings from specialist studies (see **Section 11**);
- Understanding of direct and indirect effects of the project as a whole;
- Input received during public participation from authorities and I&APs (see **Section 14**); and

❖ Legal and policy context (see **Section 5**).

Table 87: Potential Significant Environmental Impacts - Construction Phase

Environmental Factor	Potential Issues / Impacts	Smithfield Dam	Water Conveyance Infrastructure	Balancing Dam
Land Use	Loss of land used for subsistence agriculture and communal grazing within construction domain	✓		
	Servitude restrictions	✓	✓	✓
	Loss of cultivated land and timber land within construction domain		✓	✓
Climate	Greenhouse gas emissions	✓	✓	✓
Geology	Unsuitable geological conditions	✓	✓	✓
	Sourcing of construction material	✓		✓
	Blasting	✓	✓	✓
	Disposal of high volume of spoil material	✓	✓	✓
Topography	❖ Visual impact in river valleys ❖ Erosion of affected areas on steep slopes	✓	✓	✓
Soil	Soil erosion	✓	✓	✓
	Soil contamination	✓	✓	✓
Geohydrology	❖ High groundwater inflows ❖ Lowering of the local water table		✓	
	❖ Groundwater pollution due to spillages and poor construction practices	✓	✓	✓
Hydrology	Alteration of flow regimes	✓		✓
Water Quality	❖ Sedimentation from instream works ❖ Water quality impacts due to spillages and poor construction practices ❖ Water quality impacts caused by discharge from the tunnel (dewatering due to groundwater ingress)	✓	✓	✓
Aquatic Ecology	Disruptions to aquatic biota community due to water contamination, alteration of flow and disturbance to habitat during construction	✓	✓	✓
Riparian Habitat	Loss of riparian and instream vegetation within construction domain	✓	✓	✓
	Loss of fuelwood, medicinal and herbal plants, building material and raw products for handicrafts within construction domain	✓		
Water use	With the building of Smithfield Dam the people in the tribal areas may not be able to access the watercourse for subsistence purposes during the construction phase	✓		
Wetlands	❖ Various wetlands are affected by the project, where some wetlands will be inundated by the Smithfield Dam and balancing dam and other wetlands are traversed by infrastructure (raw water pipeline, access roads, gauging weir, power line and road deviations) ❖ Impacts to wetland characteristics	✓	✓	✓
Estuary	❖ Impacts to the uMkhomazi Estuary in terms of flow alterations, sediment regime, habitat alteration, water quality and overall ecosystem health	✓		
Terrestrial Ecology	❖ Impacts to sensitive terrestrial ecological features ❖ Potential loss of significant flora and fauna species ❖ Damage / clearance of habitat of conservation importance ❖ Proliferation of exotic vegetation	✓	✓	✓

Environmental Factor	Potential Issues / Impacts	Smithfield Dam	Water Conveyance Infrastructure	Balancing Dam
	❖ Loss of medicinal plants			
Socio-economic Environment	❖ Loss of land within construction domain ❖ Risk to livestock ❖ Nuisance from dust and noise ❖ Influx of people seeking employment and associated impacts (e.g. foreign workforce, cultural conflicts, squatting, demographic changes, anti-social behaviour, and incidence of HIV/AIDS) ❖ Land claims ❖ Safety and security ❖ Relocation of access roads ❖ Use of local road network ❖ Impacts to tourism and environmental education activities at The Baynesfield Estate Lodge ❖ Impact to visual quality and sense of place ❖ Light pollution	✓	✓	✓
Agriculture	❖ Impacts to subsistence farming undertaken within construction domain ❖ Loss of grazing land within construction domain ❖ Loss of stock watering points within construction domain	✓		
	❖ Disruptions to farming operations as a result of construction-related use of existing access roads		✓	✓
	❖ Loss of cultivated land within construction domain ❖ Loss of fertile soil through land clearance	✓	✓	✓
	❖ Loss of timber land within construction domain			✓
Air Quality	❖ Excessive dust levels ❖ Greenhouse gas emissions	✓	✓	✓
Noise & Vibration	❖ Localised increases in noise during construction ❖ Excessive vibration as a result of tunnelling and major construction activities	✓	✓	✓
Historical and Cultural Features	❖ Destruction or damage of heritage resources through construction activities ❖ Relocation of graves	✓	✓	✓
Existing Structures & Infrastructure	❖ Impoundment to affect the following – • Two sections of road R617 • High voltage Eskom power line • Access dirt roads to traditional areas • Telephone line; • Homesteads (with associated kraals and other structures)	✓		
	❖ Balancing dam options affect the following – • Section of power line • Private farm road • Access roads to cultivated areas and timber plantations • Farming-related infrastructure (e.g. irrigation pipelines)			✓
Transportation	❖ Increase in traffic on the local road networks	✓	✓	✓
	❖ Re-alignment of R617 and access roads	✓		
Solid Waste	❖ Waste generated from site preparations (e.g. plant material)	✓	✓	✓

Environmental Factor	Potential Issues / Impacts	Smithfield Dam	Water Conveyance Infrastructure	Balancing Dam
	❖ Domestic waste ❖ Surplus and used building material ❖ Hazardous waste (e.g. chemicals, oils, soil contaminated by spillages, diesel rags) ❖ Wastewater (sanitation facilities, washing of plant, operations at the batching plant, etc.) ❖ Disposal of excess spoil material (soil and rock) generated as part of the bulk earthworks			
Aesthetics	❖ Visual quality and sense of place to be adversely affected by construction activities ❖ Light pollution	✓	✓	✓
Tourism	❖ Influence to tourism potential	✓	✓	✓

Table 88: Potential Significant Environmental Impacts - Operational Phase

Environmental Factor	Potential Issues / Impacts	Smithfield Dam	Water Conveyance Infrastructure	Balancing Dam
Land Use	Servitude restrictions	✓	✓	✓
	Permanent loss of cultivated land and timber land		✓	✓
Geology	Unsuitable geological conditions	✓	✓	✓
Topography	❖ Visual impact in river valleys ❖ Erosion of affected areas on steep slopes	✓	✓	✓
Geohydrology	High groundwater inflows		✓	
	Lowering of the local water table		✓	
	Surface water and groundwater interactions	✓		✓
Hydrology	❖ Changes to seasonal flow patterns ❖ Alteration of flow regimes ❖ Quantity of water releases	✓		✓
Water Quality	❖ Impact to sediment balance in uMkhomazi and uMlaza Rivers ❖ Quality of water releases ❖ Impacts to water quality due to the physical, chemical and biological processes, sediments and nutrients being trapped in the dam basins and algal growth ❖ Possible temperature and dissolved oxygen stratification could also take place. This will impact on the downstream water quality, depending on the time and manner of release ❖ With the filling of the reservoir, the decomposition of submerged vegetation and soils can deplete the level of oxygen in the water	✓		✓
Aquatic Ecology	❖ Damming of a free-flowing river (uMkhomazi River) ❖ Alteration of current biophysical functioning of affected watercourses ❖ Loss of aquatic habitat and change to community composition ❖ Growth and spread of algae and other aquatic weeds ❖ Interruptions to river continuum ❖ Impacts to migration of aquatic biota	✓		✓
	Aquatic biota may be transferred from the donor system (uMkhomazi River) to the receiving river (uMlaza River) via the conveyance infrastructure		✓	

Environmental Factor	Potential Issues / Impacts	Smithfield Dam	Water Conveyance Infrastructure	Balancing Dam
Riparian Habitat	Loss of riparian and instream vegetation	✓	✓	✓
	Loss of fuelwood, medicinal and herbal plants, building material and raw products for handicrafts	✓		
Water use	With the damming of the uMkhomazi and uMlaza Rivers, the downstream water user requirements need to be safeguarded	✓		✓
	With the building of Smithfield Dam the people in the tribal areas may not be able to access the watercourse for subsistence purposes	✓		
Wetlands	❖ Various wetlands are affected by the project, where some wetlands will be inundated by the Smithfield Dam and balancing dam and other wetlands are traversed by infrastructure (raw water pipeline, access roads, gauging weir, power line and road deviations) ❖ Impacts to wetland characteristics	✓	✓	✓
Estuary	❖ Impacts to the uMkhomazi Estuary in terms of flow alterations, sediment regime, habitat alteration, water quality and overall ecosystem health	✓		
Coastal Environment	❖ Impact of Smithfield Dam to coastal sediment budget	✓		
Terrestrial Ecology	❖ Impacts to sensitive terrestrial ecological features ❖ Potential loss of significant flora and fauna species ❖ Proliferation of exotic vegetation ❖ Loss of medicinal plants	✓	✓	✓
Socio-economic Environment	❖ Land claims ❖ Use of local road network for operation and maintenance purposes ❖ Impact to visual quality and sense of place ❖ Light pollution	✓	✓	✓
	❖ Inundation of dwellings ❖ Dependence of the local community on the reach of the uMkhomazi River that will be inundated	✓		
Agriculture	❖ Damming of a section of the uMkhomazi River will impact on subsistence farming undertaken within the FSL on tribal and state-owned land. ❖ Loss of grazing land. Could place additional pressure on the remaining grazing resources. ❖ Loss of stock watering points along the affected reaches of the uMkhomazi and Luhane Rivers. If the dam is to be fenced off, then alternative watering points would need to be established for livestock.	✓		
	❖ Permanent loss of cultivated land	✓	✓	✓
	❖ Permanent loss of timber land			✓
Noise	❖ Noise from hydropower plant	✓	✓	✓
Historical and Cultural Features	❖ Inundation of heritage resources	✓		✓
Existing Structures & Infrastructure	❖ Impoundment to affect the following – • Two sections of road R617 • High voltage Eskom power line • Access dirt roads to traditional areas • Telephone line; • Homesteads (with associated kraals and other	✓		

Environmental Factor	Potential Issues / Impacts	Smithfield Dam	Water Conveyance Infrastructure	Balancing Dam
	structures)			
	❖ Balancing dam options affect the following – • Section of power line • Private farm road • Access roads to cultivated areas and timber plantations • Farming-related infrastructure (e.g. irrigation pipelines)			✓
Transportation	❖ Re-alignment of R617 and access roads	✓		
Aesthetics	❖ Visual quality and sense of place could be adversely affected	✓	✓	✓

The cumulative impacts are discussed in **Sections 12.23**.

The findings of the specialists are of particular importance in terms of understanding the impacts of the project and managing these during the project life-cycle, as these studies focused on the significant environmental issues identified during the execution of the EIA. As can be seen from the various impact assessments performed by the specialists, there are a host of cross-cutting impacts that are addressed in a number of these studies, with particular reference to the visual, social and economic effects of the project. The mitigation measures proposed by the specialists for these similar types of impacts are regarded as complementary and they are aligned with best practices and principles.

12.1.7 Impact Assessment Methodology

The impacts and the proposed management thereof are first discussed on a qualitative level and thereafter quantitatively assessed by evaluating the nature, extent, magnitude, duration, probability and ultimately the significance of the impacts (refer to methodology provided in **Table 89**). Where applicable, the impact assessments and significance ratings provided by the respective specialists are included. The assessment considers impacts before and after mitigation, where in the latter instance the residual impact following the application of the mitigation measures is evaluated.

In the case of the specialist studies, some of the impact assessment methodologies deviated from the approach shown in **Table 89**. However, the quantitative basis for these specialist evaluations of the impacts to specific environmental features still satisfied the intention of the EIA.

Table 89: Quantitative Impact Assessment Methodology

Nature (/Status)	The project could have the following impacts to the environment: • Positive; • Negative; or • Neutral.
Extent	• Local - extend to the site and its immediate surroundings. • Regional - impact on the region but within the province. • National - impact on an interprovincial scale. • International - impact outside of South Africa.
Magnitude	Degree to which impact may cause irreplaceable loss of resources. • Low - natural and social functions and processes are not affected or minimally affected. • Medium - affected environment is notably altered; natural and social functions and processes continue albeit in a modified way. • High - natural or social functions or processes could be substantially affected or altered to the extent that they could temporarily or permanently cease.
Duration	• Short term - 0-5 years. • Medium term - 5-11 years. • Long term - impact ceases after the operational life cycle of the activity either because of natural processes or by human intervention. • Permanent - mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.
Probability	• Almost certain - the event is expected to occur in most circumstances. • Likely - the event will probably occur in most circumstances. • Moderate - the event should occur at some time. • Unlikely - the event could occur at some time. • Rare/Remote - the event may occur only in exceptional circumstances.
Significance	Provides an overall impression of an impact's importance, and the degree to which it can be mitigated. The range for significance ratings is as follows- 0 - Impact will not affect the environment. No mitigation necessary. 1- No impact after mitigation. 2- Residual impact after mitigation / some loss of populations and habitats of non-threatened species. 3- Impact cannot be mitigated / exceeds legal or regulatory standard / increases level of risk to public health / extinction of biological species, loss of genetic diversity, rare or endangered species, critical habitat.

12.1.8 Impact Mitigation

12.1.8.1 Mitigation Hierarchy

Impacts are to be managed by assigning suitable mitigation measures. According to DEAT (2006), the objectives of mitigation are to:

- Find more environmentally sound ways of executing an activity;
- Enhance the environmental benefits of a proposed activity;

- ❖ Avoid, minimise or remedy negative impacts; and
- ❖ Ensure that residual negative impacts are within acceptable levels.

Mitigation should strive to abide by the following hierarchy – (1) prevent or avoid the impact; (2) reduce or minimise the impact; (3) rectify the impact by reinstatement and rehabilitation (or remediation) to restore the affected environment; and/or (4) compensate for the impact by replacing or providing substitute resources or environment(s).

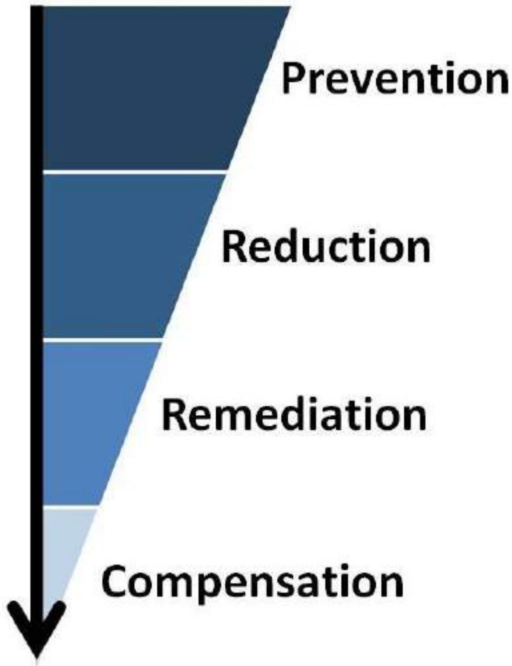


Figure 232: Mitigation Hierarchy

The proposed mitigation of the impacts associated with uMWP-1 Raw Water includes specific measures identified by the technical team (including engineering solutions) and environmental specialists, stipulations of environmental authorities and environmental best practices.

Note that the mitigation measures in the subsequent sections are not intended to be exhaustive, but rather focus on the potentially significant impacts identified.

The EMPr (contained in **Appendix I**) provides a comprehensive list of mitigation measures for specific elements of the project, which extends beyond the impacts evaluated in the body of the EIA Report.

12.1.8.2 EMPr Framework

An EMPr represents a detailed plan of action prepared to ensure that recommendations for enhancing positive impacts and/or limiting or preventing negative environmental impacts are implemented during the life-cycle of a project.

Box 2:	Overview of an EMPr

The EMPrs aim to satisfy the requirements stipulated in Section 24N of NEMA and Appendix 4 of GN No. R982 (4 December 2014).

The scope of the uMWP-1 EMPrs are as follows:

- Establish management objectives during the project life-cycle in order to enhance benefits and minimise adverse environmental impacts;
- Provide targets for management objectives, in terms of desired performance;
- Describe actions required to achieve management objectives;
- Outline institutional structures and roles required to implement the EMPr;
- Provide legislative framework; and
- Description of requirements for record keeping, reporting, review, auditing and updating of the EMPr.

All liability for the implementation of the EMPr (as well as the EIA findings and environmental authorisation) lies with the project proponent (i.e. DWS).

Due to the extent of the overall project, the EMPr shown in **Table 90** (contained in **Appendix I**) was developed to deal with the various key components of the project. Note that the Operational EMPr will be developed in the future.

Table 90: Scope of EMPr

Project Life-cycle	Description	Responsibility - Implementation
Pre-construction phase	Managing of impacts associated with those activities (and related environmental aspects) that take place prior to construction of the project infrastructure.	DWS
Construction phase	Managing of impacts associated with those activities (and related environmental aspects) that take place as part of the construction of the project infrastructure.	DWS

The following considerations and assumptions accompany the EMPr:

❖ The EMPr is guided by the following principles (based on Lochner, 2005) –

- **Continuous improvement -** The project proponent (or implementing organisation) should be committed to review and to continually improve environmental management, with the objective of improving overall environmental performance;
- **Broad level of commitment -** A broad level of commitment is required from all levels of management as well as the workforce in order for the implementation of the EMPr to be successful and effective;
- **Flexible and responsive -** The implementation of the EMPr needs to be responsive to new and changing circumstances. The EMPr is a dynamic "living" document that will need to be updated regularly throughout the duration of the project life-cycle.

- Compliance with the EMPr must be audited in terms of the requirements specified in the EIA Regulations.
- Any changes to the EMPr must be submitted to DEA for acceptance. In accordance with Regulation 37 of GN No. R. 543 (18 June 2010), the Environmental Authorisation (if granted) will specify the requirements for amending or updating the EMPr.
- The EMPr provides the framework for the overarching environmental management requirements for the project life-cycle. Following detailed design and planning, the EMPr may need to be revised to render the management actions more explicit and accurate to the final project specifications.
- The EMPr will be linked to the project's overall Environmental Management System (EMS) (if applicable), where the EMS constitutes an iterative process that aims achieve continuous improvement and enhanced environmental performance.
- Although every effort has been made to ensure that the scope and level of detail of the EMPr are tailored to the level of environmental risk (i.e. type and scale of activity and the sensitivity of the affected environment) and the project- and site-specific conditions, certain of the environmental management requirements within the EMPr may be regarded as generic to make provision for activities that may take place as part of the overall project.

It is recommended that the following management plans be developed to supplement the provisions in the EMPr (if relevant):

1. Relocation Action Plan (RAP) for Smithfield Dam, which needs to make provision for the following (amongst others) –
   a. Build on the Relocation Framework Plan;
   b. Incorporate findings of the Socio-economic Survey;
   c. Incorporate mitigation measures included in the Social Impact Assessment and Socio-Economic Impact Assessment;
   d. Satisfy the requirements of the Ingonyama Trust Board, Traditional Authorities, COGTA, Harry Gwala DM and Ingwe LM;
2. Smithfield Dam Impoundment EMPr, which needs to make provision for the following (amongst others) –

   a. Dam safety management;
   b. Water quality management;
   c. Rescuing stranded animals;
   d. EWR releases;
   e. Managing impacts to land use and biodiversity in the dam basin;
3. Relocation and decommissioning of services, such as –
   a. Buildings;
   b. Electricity supply lines;
   c. Fences;
   d. Telephone lines;
   e. Pump stations and pipelines;
   f. Domestic waste water and sewage disposal facilities;
   g. Stock dipping tanks;
   h. Slurry ponds and feedlots; and
   i. Diesel storage tanks.
4. Balancing Dam Impoundment EMPr, which needs to make provision for the items listed above;
5. Rehabilitation Management Plan, which will include additional measures identified during construction to supplement the reinstatement and rehabilitation provisions included in the EMPr for the construction phase; and
6. Operational EMPr, which will complement the Operation and Maintenance Manual and needs to make provision for the following (amongst others) –
   a. Dam safety management;
   b. Operational Rules;
   c. Erosion management;
   d. Shoreline management;
   e. Access management;
   f. Ongoing engagement with I&APs;
   g. Control of alien invasive species (terrestrial and aquatic);
   h. Firebreak management;
   i. Biodiversity management; and

j. Managing specific impacts, such as the transfer of alien and invasive aquatic species from the donor system (uMkhomazi River) to the receiving river (uMlaza River) via the conveyance infrastructure.

12.2 Land Use

12.2.1 Smithfield Dam

Land is required for constructing the selected scheme. Both title deed and tribal land will need to be acquired for the project. Refer to **Section 9.14** for an explanation on the land acquisition. The estimated area of land that will be required for Smithfield Dam is 1 487.0 ha, with accompanying loss of land used for subsistence agriculture and communal grazing. All structures located within the buffer zone will also need to be relocated (seek approvals for reburial of graves). In addition, the estimated area of land that will be required for the proposed gauging weir is 18.2 ha. The proposed width of the servitudes for the access roads is 12 m.

Impacts associated with land use were also indirectly assessed as part of the specialist studies (e.g. Agricultural Impact Assessment, Socio-economic Impact Assessment and Social Impact Assessment).

12.2.2 Water Conveyance Infrastructure

The proposed servitudes for the Water Conveyance Infrastructure are as follows:

- The proposed servitude for the tunnel is 24 m wide. The estimated area of the servitude that will be required for the tunnel, which is 32.5 km long, is 78 ha. An additional area of 10 ha was included for the inlet and outlet portal areas;
- The proposed servitude widths for the raw water pipelines are as follows –
  - Pipeline 1 – Tunnel outlet to proposed WTW = 10 m wide;
  - Pipeline 2 – Langa Balancing Dam to pipeline 1 = 9 m wide; and
- The proposed width of the servitudes for the access roads is 12 m.

There are no direct land use impacts associated with the tunnel, except at portals and shafts. The tunnel outlet waste disposal site at Baynesfield Estate may result in the loss of cultivated land, unless the option for the disposal of spoil in the dam wall is pursued.

Sections of the raw water pipeline routes traverse cultivated land and timber plantations with possible disturbances during the construction phase. Sections of the raw water pipeline route to WTW Option 2 passes residential dwellings and disturbances will be experienced during the construction phase. Possible minor realignments of this route may be considered to minimise these impacts. The land which is occupied by the servitude will have restricted land use, in order to maintain the integrity of the pipeline and ensure public safety. No permanent or temporary structures will be allowed within the servitude. In addition, no trees, large bushes or deep-rooted plants will be allowed. Non-obtrusive farming practices will be allowed following consultation with DWS and Umgeni Water.

The hydropower plant on the conveyance infrastructure may impact on cultivated land or forest plantation, depending on the location of the WTW.

The Baynesfield Estate Lodge is located next to the Mbangweni Dam and it offers tourist accommodation, recreational fishing on the dam and environmental education opportunities. To mitigate impacts to the Baynesfield Estate Lodge during the construction phase it is recommended that this facility be recreated at Baynesfield Dam. The existing Baynesfield Estate Lodge could be leased out to the construction team and then reinstated (as necessary) after the construction period for continued future use.

12.2.3 Balancing Dam

Both options for the balancing dam will inundate cultivated land as well as forestry plantations. The estimated area of land that will be required for Langa Balancing Dam is 117.2 ha.

Recreational use of the balancing dam will need to be established in consultation with the authorities, stakeholders and I&APs as part of a RMP process prior to impoundment of the basins.

12.2.4 *Impact Assessment*

Environmental Feature	1. Land Use
Relevant Alternatives & Activities	Smithfield Dam and associated infrastructure; Water Conveyance Infrastructure; Balancing Dam
Project life-cycle	Construction & operational phases
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Land acquisition and servitude restrictions	1.1. Engage and negotiate with affected landowners, including – a. Smithfield Dam - DRD&LR, Ingonyama Trust Board and Traditional Authorities; b. Water Conveyance Infrastructure (western side) - DRD&LR, Ingonyama Trust Board and Traditional Authorities c. Water Conveyance Infrastructure (eastern side) – private landowners and Baynesfield Trust; d. Balancing Dam - Baynesfield Trust. 1.2. DWS will need to conform to all its legal obligations as part of the acquisition of land for the construction and operation of the project.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	high	permanent	almost certain	2
After Mitigation	-	local	low	permanent	almost certain	1

Environmental Feature	2. Land Use
Relevant Alternatives & Activities	Smithfield Dam and associated infrastructure
Project life-cycle	Construction & operational phases
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Loss of land used for subsistence agriculture and communal grazing	2.1. Control access to construction domain. 2.2. Engage with DRD&LR, Ingonyama Trust Board, Traditional Authorities and affected parties as part of RAP. 2.3. RAP to consider the current use of land within the basin and to identify suitable mitigation measures.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	high	permanent	almost certain	2
After Mitigation	-	local	low	permanent	almost certain	1

Environmental Feature	3. Land Use
Relevant Alternatives & Activities	Smithfield Dam; Balancing Dam
Project life-cycle	Operational phases
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Access to dam and shoreline area	3.1. RMP to consider the future access to the dam and shoreline.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	high	permanent	almost certain	2
After Mitigation	-	local	low	permanent	almost certain	1

12.3 Climate

12.3.1 Smithfield Dam and Balancing Dam

Smithfield Dam and the balancing dam will have larger surface areas than the original river channels on the uMkhomazi and uMlaza Rivers, respectively, which will become inundated. This will lead to an increase in evaporation.

Particularly Smithfield Dam could also cause potential changes in the micro-climate of the area surrounding the reservoir. Changes to the microclimate are the result of the changes to the energy balance due to the presence of the water body, which has greater heat capacity than the ground and absorbs greater latent heat because of the increase of evaporation. Although, in the EIA conducted for the Mooi-Mgeni River Transfer Scheme Phase 2, specialists were of the opinion that the proposed Spring Grove Dam (surface area of approximately 10.3 km^2) would not likely have an impact on the microclimate of the area, except for an approximate band of 100 m around the dam, and localised impacts could include changing local wind patterns and nocturnal temperature inversions (DWAF, 2009). A Kariba Dam Case Study provides evidence that a dam the size of Kariba (maximum surface area 5 577 km^2) did not have a significant impact on either the local or the regional climate.

The dam could contribute to greenhouse gas emissions, where inundated plant material that decays in an anaerobic environment will release methane and carbon dioxide. Some of the main parameters/factors affecting greenhouse gas production from dams include (http://www.hydropower.org/iha/development/ghg/faq.html):

- Shape of the reservoir;
- Water depth;
- Water temperature;
- Climate and weather conditions;
- How much carbon and/or plant life is in the water;
- The predominant soil types in the watershed;
- How long the water stays in the reservoir; and
- Age of the reservoir.

Conversely, dams can also sequester large volumes of carbon (Dean and Gorham, 1998), which is a positive contribution towards managing climate change.

As part of the Aquatic Ecology Study undertaken for the EIA for the De Hoop Dam (DWAF, 2005), it was suggested that the natural pre-impoundment carbon fluxes be quantified in order to establish the total contribution of the area to be inundated to potential climate change. The same could apply for the proposed Smithfield Dam and balancing dam, where the outcome of a similar assessment should guide the decision on removing all large trees within the basins. However, it should be noted that trees within the Smithfield Dam basin occur primarily within the riparian zone of the uMkhomazi River and its tributaries and the basin is thus not densely vegetated. At the balancing dam sites sections of timber plantations will be inundated and the removal of the trees by NCT Forestry Co-operative Limited, who currently lease this land from the Baynesfield Trust, will probably take place prior to project implementation.

To establish the net greenhouse gas footprint of Smithfield Dam, it is also recommended that the greenhouse gas emissions from the dam following impoundment be monitored to determine the difference between the emissions with and without the reservoir. This must be documented and the lessons learnt must provide guidance for managing greenhouse gas emissions for future DWS dams. It is suggested that these future studies be conducted by the Water Research Commission.

As part of the Technical Feasibility Study the possible impacts of climate change on the proposed Smithfield Dam were assessed at a desktop level, based on available stream flow scenarios and results from previous studies (DWS, 2015c). The investigation involved two separate components, namely (i) to assess the flood design capacity of the dam to accommodate future flood peaks; and (ii) to assess the possible impact of climate change on the water supply potential (or "yield") of the dam. The outcomes and conclusions of the investigation can be summarised as follows:

- The design stream flow and magnitude of flood peaks at the Smithfield Dam site are projected to increase by approximately 30% in the Intermediate Future (2046 to 2065);

- The projected increase of 30% requires a non-overspill crest level of 935.8 m. This is well within the originally proposed level of 936.0 m (which included a 1.0 m allowance for unknown climate change impacts and possible embankment settlement);
- While the projected impact of climate change on yield produced a wide range of results, from a decrease of 15% to an increase of 20%, the majority of scenarios fell within the +/- 10% range; and
- Based on the above outcome it can be concluded that, in the Intermediate Future, climate change is unlikely to have a significant impact on the yield of Smithfield Dam.

The operating rules ensure that local users and, specifically, the EWR are supplied first (i.e. before transfers to the Integrated Mgeni WSS).

12.3.2 Impact Assessment

Environmental Feature	**4. Climate**
Relevant Alternatives & Activities	**Smithfield Dam & Balancing Dam - dam basin inundation**
Project life-cycle	**Construction & operational phases**
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Greenhouse gas emissions. Contributions to global warming.	4.1. Quantify natural pre-impoundment carbon fluxes. Determine de-bushing requirements. 4.2. Monitoring of post-impoundment greenhouse gas emissions. 4.3. Employ the UNESCO *GHG Measurement Guidelines for Freshwater Reservoirs* (or other acceptable best practice) to determine the dam's greenhouse gas footprint. 4.4. Clear large trees within the dam impoundment. Where possible, woody material can be provided to local communities for use as firewood. 4.5. Materials with a high recycled content should be used where possible and the re-use of site materials should be considered. 4.6. The operational performance of accommodation facilities on site should be considered so to maximise the efficient use of energy and water. 4.7. Suitable training should be provided to operators to ensure that they maximise the efficiency of the plant and idling is reduced. 4.8. In terms of transportation of workers and staff, collective transportation arrangements should be made to reduce individual car journeys. 4.9. All vehicles used during the project should be properly maintained and in good working order.

	+/- Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Before Mitigation	-	regional	unknown	medium-term	likely	unknown
After Mitigation	-	regional	unknown	medium-term	likely	unknown

12.4 Geology & Soils

12.4.1 Smithfield Dam and Balancing Dam

The construction of Smithfield Dam and the balancing dam will require suitable geological foundation conditions, which were confirmed through the geotechnical studies.

The impounding of water adds a significant weight to the area and weak geological stresses could be exacerbated. The Probabilistic Seismic Hazard Analysis found that the site of the future Smithfield Dam is rated as low risk.

Construction material will need to be sourced from quarries and borrow areas near the Smithfield Dam and balancing dam sites. Such extraction could result in a variety of environmental impacts including visual impacts, loss of habitat, noise and dust to local communities and wildlife. Where possible, the quarries and borrow areas are situated within the dam basins to manage the permanent impacts.

Suitable mitigation measures are contained in the EMPr to manage the impacts associates with creating and operating the quarries and borrow areas. The quarries and borrow areas that fall within the dam basins and which will be inundated will not be rehabilitated. Excess inert material will also be spoilt within the dam basins.

Blasting will be required, based on geotechnical conditions encountered. All blasting will comply with the relevant legislation and SANS stipulations. Specific mitigation measures are contained in the EMPr, including the use of blast mats to safeguard against fly-rock, and the protection of property and accompanying monitoring practices.

12.4.2 Water Conveyance Infrastructure

Available geotechnical information indicates that tunnelling conditions should generally be favourable, but that the potential for high groundwater inflows exist, particularly at dolerite contact zones. The tunnel may be fully concrete lined to manage water ingress, which needs to be confirmed as part of the final design.

Excess spoil material (soil and rock) will be generated as part of the bulk earthworks associated with the construction phase of the project. In particular, large volumes of excavated material will be produced during the tunnel boring exercise, which will be removed from the inlet, central and outlet portals. Rock will consist of shale and dolerite and when covered these materials do not deteriorate. This spoil material will be hauled and dumped at new disposal sites that will be created at the inlet and central portals of the tunnel, or will be used in the construction of the dam wall of the balancing dam.

Any additional spoil material generated during the construction period may also be disposed of at these sites. Where possible, suitable excess material that will be generated by earthworks may be re-used in the construction process (e.g. building of the embankment, coffer dams, roads, etc.). Dolerite material excavated from the river diversion infrastructure such as from the inlet portal, outlet portal and tunnels, will be used as construction material for the Smithfield Dam main embankment.

The spoil sites will only be operational for the construction period of uMWP-1 and will be rehabilitated afterwards through shaping, application of topsoil and planting of indigenous vegetation.

12.4.3 General

During the construction phase large areas will be cleared of vegetation, which may lead to soil erosion. In areas with steep terrain erosion could take place in the absence of suitable stormwater management and stabilisation of the cut and fill areas. The EMPr includes suitable stormwater management measures to prevent the occurrence of erosion.

Soil may be polluted by poor storage of construction material, spillages and inadequate housekeeping practices. Specific mitigation measures are contained in the EMPr, where the primary objective is the effective and safe management of materials on site, in order to minimise the impact of these materials on the biophysical environment. The same objective applies to the correct management and handling of hazardous substances (e.g. fuel).

12.4.4 Impact Assessment

Consider findings from geotechnical investigations during project design phase and incorporate mitigation measures (as relevant).

Environmental Feature	**5. Geology & Soils**
Relevant Alternatives & Activities	**Smithfield Dam and associated infrastructure; Water Conveyance Infrastructure; Balancing Dam**
Project life-cycle	**Construction & operational phases**
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Soil erosion on steep slopes.	5.1. Stabilisation of cleared areas to prevent and control erosion. The method chosen (e.g. watering, planting, retaining structures, commercial anti-erosion compounds) will be selected according to the site specific conditions. Drainage management should also be implemented to ensure the minimization of potential erosion. 5.2. Acceptable reinstatement and rehabilitation of areas outside of FSL to prevent erosion during operation phase. 5.3. Install suitable buttressing to prevent future erosion of the structures of the watercourses affected by construction, if required. 5.4. Monitoring to be conducted to detect erosion (e.g. steep sections along access roads and pipeline, crossing of drainage lines, tie-ins at river banks, spillways, stilling basin, etc.).

	+/- Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Before Mitigation	-	local	medium-high	short-long	likely	2
After Mitigation	-	local	low	short-term	unlikely	1

Environmental Feature	**6. Geology & Soils**
Relevant Alternatives & Activities	**Smithfield Dam and balancing dam – quarries and borrow areas**
Project life-cycle	**Construction phases**
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Impacts associated with creating and operating quarries and borrow areas	6.1. Remove, stockpile and preserve topsoil for re-use during rehabilitation. 6.2. Implement suitable stormwater management measures at borrow pits / quarries. 6.3. No direct discharge of sediment laden water without treatment. 6.4. Manage dangerous conditions (e.g. steep slopes, loose and unstable material). 6.5. All borrow pits and quarries situated outside of the dam basin to be created, operated and rehabilitated in accordance with the Environmental Management Plan, as authorised by the Department of Mineral Resources.

	+/- Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Before Mitigation	-	local	high	short-term	almost certain	2
After Mitigation	-	local	low	short-term	moderate	1

12.5 Groundwater

12.5.1 Smithfield Dam and Balancing Dam

Surface water and groundwater interactions have been taken into account from a regional perspective when determining the hydrology of the river catchment. Furthermore, the water table of the proposed Smithfield Dam and Langa Balancing Dam were considered during the geotechnical investigations when assessing the foundation conditions for these dams.

In the surrounding area and downstream of reservoirs, groundwater levels generally rise due to damming, increased infiltration and rise of the hydraulic base level. In the long term, a reservoir bed could be sealed by the deposition of fine sediments, infiltration may decrease and the groundwater level may fall again.

12.5.2 Water Conveyance Infrastructure

There is potential for high groundwater inflows during the tunnelling exercise, particularly at dolerite contact zones. In addition, there is a possibility of temporarily lowering the local water table along the tunnel, depending on the geohydrological conditions encountered.

The following information, which pertains to the effects of the tunnel to the groundwater regime, is contained in the Feasibility Design Report (DWA, 2014e):

- The construction of the tunnel would entail:
  - Boring or drilling and blasting of rock, opening of impermeable rock and weathered rock contacts where water is expected to be encountered;
  - Immediate sealing of areas where excessive groundwater is encountered by grouting of rock or providing mass concrete plugs where necessary;
  - Concrete lining of the full length of the tunnel; and
  - Conveyance of excessive seepage water and discharging this water in a controlled manner into a watercourse. This water will need to be analysed and treated to an acceptable quality prior to discharge.
- During operation the lined tunnel will convey water under pressure. No groundwater is expected to be added to the water conveyed from Smithfield Dam. It may, however,

be necessary to pipe groundwater behind the liners from high fractured and leaking zones through a separate pipe system for discharge into a watercourse.

- As the geotechnical investigations (sampling and logging of boreholes) carried out during the feasibility design stage are still limited to 4 to 6 holes to the tunnel over a 32.5 km long stretch it is not possible to project the quantity of expected seepage into the tunnel area. Normally this rate is very small and compared to the total mass of rock and groundwater on top of a 32.5 km long and ± 400 m deep mountain area the expected seepage of say 3 l/s is small and insignificant and is expected not to impact significantly on the ground water head. It is also expected that this small rate will not impact the yield of boreholes which may only be 60 m to 100 m deep at some locations in this rock mass.
- Furthermore, the shales are horizontally layered which directs water to flow horizontally. Vertical flow will occur at fractured zones only. The dolerites of which the extend is expected to be up to 40% of the tunnel line, is normally water tight except at contact zones with shales and/ or vertical joints or fractures. A very low number of these features were projected from surface geological mapping and extrapolation done during the geotechnical investigations.
- High fluoride water was encountered in one borehole at 60 m depth during investigations. This location is more than 400 m away from the tunnel. This necessitates that groundwater encountered during the construction of the uMkhomazi – uMlaza Tunnel must be evaluated for contaminates. Should the quality of the groundwater be inadequate for direct discharge into natural watercourses, it must be treated prior to discharge.
- It is therefore concluded that:
  - Minimum and insignificant effects on the groundwater and therefore yields of boreholes of owners on the mountains on the tunnel route can be expected.
  - The highest risk of encountering insignificant effects on groundwater is during construction in times at the boring head. However, grouting will be done immediately from the second “train truck” behind the bore of the TBM and a liner will be placed from the “third truck” – in a small time span. It is expected that the rate of seepage will be limited and managed during the construction process and very limited quantities will be flowing from the groundwater regime during the operational phase of the project.

12.5.3 General

Groundwater may be impacted by the project as follows:

- Potential disturbance of the aquifer from blasting;
- Possible intersection of acquirers during excavation;
- Potential contamination of groundwater during the construction stage; and
- Appropriate management required of shallow groundwater at river crossings and waterlogged areas, which will include the suitable dewatering of excavations.

12.5.4 Impact Assessment

Environmental Feature	7. Groundwater
Relevant Alternatives & Activities	Tunnel
Project life-cycle	Construction & operational phases
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Dewatering as a result of groundwater inflows during tunnelling	7.1. Sealing of areas where excessive groundwater is encountered by grouting of rock or providing mass concrete plugs where necessary. 7.2. Concrete lining of the full length of the tunnel. 7.3. Consider findings from geotechnical investigations during project design phase and incorporate mitigation measures (as relevant). 7.4. Geohydrological modelling and monitoring.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	high	long-term	unlikely	2
After Mitigation	-	local	low	short-term	unlikely	1

Environmental Feature	8. Groundwater
Relevant Alternatives & Activities	Tunnel
Project life-cycle	Construction phase
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Water quality impacts caused by discharge from the tunnel (dewatering due to groundwater ingress)	8.1. Convey and discharge excessive seepage water in a controlled manner. 8.2. Analyse and treat (as necessary) seepage water to an acceptable quality prior to discharge. 8.3. Seek relevant environmental approvals for discharge. 8.4. Prevent erosion and siltation as a result of the discharge. 8.5. Consider findings from geotechnical investigations during project design phase and incorporate mitigation measures (as relevant).

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	high	long-term	unlikely	2
After Mitigation	-	local	low	short-term	unlikely	1

Environmental Feature	9. Groundwater
Relevant Alternatives & Activities	All infrastructure that will affect watercourses
Project life-cycle	Construction phase
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Contamination of groundwater by poor construction practices.	9.1. Suitable protection of groundwater during excavations. Implement mitigation measures suggested as part of the geotechnical investigations for managing groundwater. 9.2. All storage tanks containing hazardous materials must be placed in bunded containment areas with impermeable surfaces. The bunded area must be able to contain 110% of the total volume of the stored hazardous material. 9.3. Reduce sediment loads in water from dewatering operations. All dewatering should be done through temporary sediment traps (e.g. constructed out of geo-textiles and hay bales).

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	high	long-term	unlikely	2
After Mitigation	-	local	low	short-term	unlikely	1

12.6 Surface Water

12.6.1 General

For the discussion to follow “watercourses” are considered as rivers, streams, natural channels (perennial and seasonal), wetlands and dams.

Activities linked with the construction and operational phases can cause significant adverse impacts to the “resource quality” of the affected watercourses, which is defined by the National Water Act (Act No. 36 of 1998) as the following:

- Quantity, pattern, timing, water level and assurance of in-stream **flow**;
- **Water quality**, including physical, chemical and biological characteristics of the water;
- Character and condition of the in-stream and riparian **habitat**; and
- Characteristics, condition and distribution of the **aquatic biota**.

12.6.2 Water Use

12.6.2.1 General

Water uses associated with the project include storing and taking water, impeding and diverting flow and altering the bed, banks, course and characteristics of the watercourse (associated with the construction activities that encroach upon the regulated area of a watercourse - i.e. 1:100 year floodline / delineated riparian or wetland habitats). Water Use Authorisation will be required for the aforementioned activities in terms of Section 21 of the National Water Act (Act No. 36 of 1998). In accordance with Section 27 of this Act, the following factors need to be taken into consideration by DWS before an authorisation may be issued:

1. Existing lawful water uses;
2. The need to redress the results of past racial and gender discrimination;
3. Efficient and beneficial use of water in the public interest;
4. The socio-economic impact of the water use or uses if authorised; or of the failure to authorise the water use or uses;
5. Any catchment management strategy applicable to the relevant water resource;
6. The likely effect of the water use to be authorised on the water resource and on other water users;
7. The class and the resource quality objectives of the water resource;
8. Investments already made and to be made by the water user in respect of the water use in question;
9. The strategic importance of the water use to be authorised;
10. The quality of water in the water resource which may be required for the Reserve and for meeting international obligations; and
11. The probable duration of any undertaking for which a water use is to be authorised.

As a positive impact, the intention of the uMWP-1 is to meet long-term water requirements of the Mgeni system in order to satisfy the demands of the water users.

As part of the planning of the transfer scheme, all historical, current and future water requirements for all water use sectors within the uMkhomazi and upper uMlaza River catchments were factored into the calculations, where these sectors include domestic (urban and rural), irrigation, industrial and stock watering, as well as streamflow reductions such as commercial forestry, dry-land sugarcane and invasive alien plants. With the damming of the uMkhomazi and uMlaza Rivers, the downstream water user requirements need to be safeguarded.

12.6.2.2 Smithfield Dam and Balancing Dam

The NWA makes provision for DWS to explore the recreational use of a Government Water Works. This is achieved through a RMP, which serves as the tool used by DWS to determine and gazette the sustainable and equitable use and management of the water surface and state-owned land during the operational phase of a dam. Recreational use of Smithfield Dam and the balancing dam will need to be established in consultation with the authorities, stakeholders and I&APs as part of a RMP process prior to the impoundment of these basins.

Smithfield Dam may be associated with various future uses, which include:

- First and foremost, it will form part of a transfer scheme and no other use may jeopardise this primary objective;
- There may be an expectation by the local community to obtain water from this dam for domestic and agricultural (irrigation and stock watering) use;
- Aquaculture may be pursued at the dam, which would need to be investigated further. Factors to consider will include beneficiaries (e.g. communities surrounding Smithfield Dam), management responsibilities, fish species to be harvested, infrastructure, and operational requirements. This could also form part of the RMP for Smithfield Dam; and
- Sustainable and equitable use for recreational purposes, as established through a RMP process. Based on the surrounding land use, access provisions and receiving environment, it is expected that recreational use by the public could be viable.

With the building of Smithfield Dam the people in the surrounding rural area may not be able to access the watercourse for subsistence purposes (e.g. domestic use and livestock watering), as the dam may be fenced off. In addition, households reliant on water abstraction directly from the watercourse that is to be impounded may need to walk further to access water. Access to the dam will receive detailed attention as part of the RMP development process, which will include public participation and direct engagement with the Traditional Authorities. As part of the feasibility study for the proposed Smithfield Dam, a desktop-level study was carried out to ascertain the current water sources being used by the communities surrounding the dam, as well as the possibility of feasibly supplying these communities from Smithfield Dam in the future. As a result, the proposed Smithfield Dam local water supply scheme was designed (refer to **Section 3.5**). Note that a separate EIA will be conducted for the Smithfield Dam local water supply scheme.

Various encumbrances exist with allowing public access to the balancing dam, which include:

- The balancing dam will be surrounded by private land;
- The access road to the balancing dam is used by private landowners;
- There is a general lack of space to allow for facilities associated with public access (e.g. parking, ablution); and
- Any public access to the balancing dam may cause a nuisance to surrounding landowners.

Opposition to allowing public access to the balancing dam was expressed during the public meeting that was held on 23 October 2013. However, the Baynesfield Estate has conveyed an interest in using the balancing dam for eco-tourism purposes. It is noted that any private entity that pursues commercial benefits from a state asset (such as the dam) will need to adhere to the National Treasury Regulations in respect of and Public Private Partnerships (15 March 2005). The requisite agreement will also need to be in place between DWS and the Baynesfield Estate.

12.6.2.3 Impact Assessment

Environmental Feature	10. Surface Water - Water Use
Relevant Alternatives & Activities	Smithfield Dam & Balancing Dam - measured water releases
Project life-cycle	Construction & operational phases
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Impacts to lawfully entitled water users	10.1. Manage water quality during construction. 10.2. Existing water use entitlements not to be affected. 10.3. Compliance with DWS operating rules. 10.4. Water quality and quantity released from Smithfield Dam and the balancing dam will need to satisfy the EWR for both the affected rivers and the uMkhomazi Estuary.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	regional	medium-high	permanent	almost certain	3
After Mitigation	neutral	-	-	-	-	-

Environmental Feature	11. Surface Water - Water Use
Relevant Alternatives & Activities	Smithfield Dam & Balancing Dam
Project life-cycle	Operational phase
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Access to dam and shoreline area – recreational purposes, livestock watering, etc.	11.1. RAP to consider current water access requirements at Smithfield Dam. 11.2. RMP to consider the future access to and use of the dam and shoreline.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	high	long-term	moderate	2
After Mitigation	+	regional	medium	long-term	moderate	1

12.6.3 Water Quality

12.6.3.1 General

During the construction phase, potential contamination of surface water could occur through:

- Sedimentation from working within and alongside the watercourse;
- Diffuse pollution from spillages, silt-laden runoff from disturbed areas, and improper practices (e.g. poor management of waste water, inadequate storage and housekeeping practices, and inadequate disposal of solid waste);
- Discharge from the tunnel (dewatering due to groundwater ingress); and
- Dewatering without filtering of sediments.

The water quality impacts during the construction phase will be managed by employing environmental best practises that will be contained in the EMPr.

12.6.3.2 Smithfield Dam and Balancing Dam

Water quality considerations for the operational phase of the proposed Smithfield Dam and balancing dam include:

- Potential impacts to water quality could result due to the physical, chemical and biological processes, sediments and nutrients being trapped in the dam basins and algal growth;
- Possible temperature and dissolved oxygen stratification could also take place. This will impact on the downstream water quality, depending on the time and manner of release; and
- With the filling of the reservoir, the decomposition of submerged vegetation and soils can deplete the level of oxygen in the water.

These potential impacts (amongst others) were evaluated as part of a Water Quality Assessment (Umgeni Water, 2013), which included the following key findings:

- Dam processes such as sedimentation of suspended material, biological processing of nutrients, predation and natural mortality of potential pathogens, and ultra-violet light disinfection are anticipated to improve surface water quality between the uMkhomazi Smithfield inflow and the proposed Smithfield Dam wall. Significant improvements will thus occur in recorded concentrations of suspended materials and the bacteriological quality of the river water, despite relatively short impoundment residence times.
- The anticipated trophic status of the proposed Smithfield Dam is mesotrophic - moderately enriched with nutrients, with occasional blooms of nuisance algal species.
- The Smithfield Dam is likely to stratify thermally during summer (from October), with dam turnover (destratification) occurring around April, dependent on air temperatures and impoundment drawdown.

- In order to allow abstraction from the aerobic zone as well as abstraction when the proposed Smithfield impoundment is significantly drawn-down, it is recommended that a number of abstraction levels are constructed at the intake tower to the tunnel.
- A dam scour is recommended to be constructed to be able to release dam bottom water during high summer inflows. Sleeve valves with dispersers are recommended to oxygenate the water used for environmental releases.
- Spilling is the recommended release mechanism when algal numbers are high and water levels permit. Water from the abstraction levels are recommended to be able to be used for downstream environmental releases, and it is recommended that combination spill - scour releases are managed to minimise the impact on downstream aquatic life. As far as possible, water for environmental flows is recommended to be distributed according to the natural flow patterns. The scour should be big enough to emulate natural flood events downstream.
- Water quality and biological monitoring is recommended during the pre-construction, construction and operational phase of the proposed Smithfield Dam and the balancing dam to assess impacts on the environment, and to optimise dam management as well as raw water quality for treatment.

The outlet works at Smithfield Dam will release water into the uMkhomazi River for environmental requirements and in the case of emergency drawdown conditions. The EWR downstream of Smithfield Dam was determined from the daily flows as measured at gauging weir U1H005. To ensure the impact of the dam and its management on the downstream aquatic environment is minimised, four intake levels are recommended. Due to temperature and stratification compliance, the first two intake levels will be used for the majority of the time for EWR releases. Two intakes are required at the bottom intake level to accommodate emergency drawdown conditions.

A double one level draw-off pipe intake system in an intake tower and bottom outlet would facilitate water to fill the balancing dam from Smithfield Dam under gravitation, as well as to make releases in support of downstream ecological water requirements and water supply when required.

Other potential water quality issues related to the operation and maintenance of dams include sedimentation from shoreline or streambank erosion. In addition, the dam wall will trap sediment. A lack of sediment in the water may result in increased scouring and erosion of river beds and banks downstream. See further discussion under **Section 12.6.9**.

See other impacts related to water quality under **Section 12.6.6**, based on findings from Aquatic Impact Assessment.

12.6.3.3 Impact Assessment

Environmental Feature	**12. Surface Water - Water Quality**
Relevant Alternatives & Activities	**All components and associated infrastructure; activities undertaken in-stream, alongside watercourses and within construction domain**
Project life-cycle	**Construction phase**
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Contamination of surface water through sedimentation from in-stream works, silt-laden runoff from disturbed areas, and improper practices (e.g. poor management of waste water and disposal of solid waste).	12.1. Conduct water quality monitoring (baseline and during construction) at suitable up- and downstream sites on – ○ uMkhomazi River (Smithfield Dam and gauging weir); ○ Mbangweni River (balancing dam); ○ Major watercourses affected by project infrastructure (e.g. raw water pipeline, roads, etc.) (as necessary). 12.2. All diffuse pollution sources to be managed to prevent pollution of the watercourses in the project area. 12.3. Storage area and ablution facilities to be located 50m from edge of riparian habitat. 12.4. Where necessary, install in-stream silt traps during construction within the watercourse channel and along the riparian habitat. The style of silt trap will depend on materials used and the water movement patterns. 12.5. Implement suitable stormwater measures during construction to manage ingress of runoff into watercourses. 12.6. Ensure proper storage of material (including fuel, paint) that could cause water pollution. Ensure proper storage and careful handling of hazardous substances with spill prevention materials at hand. 12.7. Reduce sediment loads in water from dewatering operations. All dewatering should be done through temporary sediment traps (e.g. constructed out of geo-textiles and hay bales).

	+/- Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Before Mitigation	-	local	medium-high	short-term	likely	3
After Mitigation	-	local	low	short-term	moderate	1

Environmental Feature	13. Surface Water - Water Quality
Relevant Alternatives & Activities	Smithfield Dam & Balancing Dam - measured water releases
Project life-cycle	Operational phase
Potential Aspects & Impacts	Proposed Management Objectives / Mitigation Measures
Impacts to water quality in the uMkhomazi and Mbangweni Rivers due to releases from the dams	13.1. Releases based on DWS operating rules – ensure that optimal water quality is achieved during releases from the dams. 13.2. Smithfield Dam will have a multiple level intake tower to ensure good quality water is release to the downstream environment. 13.3. Water quality and quantity released from Smithfield Dam and the balancing dam will need to satisfy the EWR for both the affected rivers and the uMkhomazi Estuary. 13.4. Conduct water quality monitoring to determine the impacts to the uMkhomazi and Mbangweni Rivers as a result of water releases.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	medium-high	short-term	likely	3
After Mitigation	-	local	low	short-term	moderate	1

12.6.4 Hydrology

12.6.4.1 General

Watercourses will be affected by the following uMWP-1 Raw Water infrastructure:

- Smithfield Dam;
- Saddle dam;
- Balancing Dam;
- Options 1 and 3 for the power line deviation;
- Various Access roads;
- Deviation of the R617;
- Borrow areas A and B as well as quarries I and IV at Smithfield Dam;
- Quarry and borrow area at the balancing dam;
- Spoil sites at tunnel inlet and central portals;
- The alternative raw water pipeline routes; and
- Gauging weir sites.

The Contractor will prepare detailed method statements on how the river diversions will be undertaken to accommodate the construction of the above-mentioned project infrastructure. Best practices to manage the flow of the rivers to be affected by the diversions are included in the EMPr.

The Rehabilitation Management Plan will make provision for reinstating the affected watercourses and preventing future erosion, as required. Rehabilitation measures are also included in the EMPr.

12.6.4.2 Smithfield Dam and Balancing Dam

Major diversions will be required to allow for the construction of Smithfield Dam (refer to **Section 9.3.5**) and the balancing dam (refer to **Section 9.6.2**). The purpose of river diversion is to enable construction, especially in the river section, while accommodating the river flows and possible floods at an acceptable risk of delays and damages.

Smithfield Dam and the balancing dam will change the seasonal flow patterns and alter the flow regimes in the uMkhomazi and Mbangweni Rivers, respectively, from flowing (lotic) to still (lentic) systems. The nature of the impact to the flows in the affected watercourses will depend on the design and operating regime of the dams. As discussed in **Section 12.6.3.2**, provision is made for releases from these dams to satisfy the EWR of the affected watercourses and the uMkhomazi Estuary.

12.6.4.3 Impact Assessment

Environmental Feature	**14. Surface Water - Hydrology**
Relevant Alternatives & Activities	**All infrastructure that will affect watercourses**
Project life-cycle	**Construction phase**
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Impacts to watercourses from temporary diversions	14.1. Minimise influence to downstream flow regime when diverting and impeding flow for cofferdams, temporary river crossings or for any other purposes. 14.2. Prevent possible erosion caused by temporary in-stream diversion. Install suitable buttressing / stabilisation structures to prevent future erosion, if required. 14.3. Select most appropriate crossing point based on geotechnical conditions, sensitivity of riparian habitat (e.g. protected trees, large trees that afford bank stabilisation) and in-stream habitat, depending on technical feasibility. 14.4. Adequate rehabilitation and reinstatements of affected watercourses.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	high	short-term	almost certain	2
After Mitigation	-	local	low	short-term	moderate	1

Environmental Feature	15. Surface Water - Hydrology
Relevant Alternatives & Activities	Smithfield Dam & Balancing Dam - measured water releases
Project life-cycle	Operational phase
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Impacts to flow regime in the uMkhomazi and Mbangweni Rivers during the operation of the Smithfield Dam and balancing dam, respectively	15.1. Compliance with DWS operating rules. 15.2. Water quality and quantity released from Smithfield Dam and the balancing dam will need to satisfy the EWR for both the affected rivers and the uMkhomazi Estuary

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	regional	high	short-term	almost certain	3
After Mitigation	-	regional	medium	short-term	moderate	1

12.6.5 EWR & Operational Scenarios

An extract from the Determination of Water Resource Classes – River Ecological Consequences of Operational Scenarios (DWS, 2014a), which formed part of the Comprehensive Reserve determination, follows.

The details of the EWR sites that were selected as part of the Reserve Determination for the uMkhomazi River are provided in **Section 10.8.4.2**. The impacts of the following operational scenarios in the uMkhomazi River system were assessed at the EWR sites:

1. uMWP-1;
2. Bulwer Water Supply Scheme; and
3. Ngwadini Off-Channel Dam (OCD).

Each scenario and its associated variables are described in **Table 91**.

Table 91: Operational scenarios assessed as part of Comprehensive Reserve determination (DWS, 2014a)

Scenario	Description & Purpose
Scenario MK1: Present Day	Present state - unchanged
Scenario MK2: Ultimate Development, uMWP-1 and Ngwadini OCD (No MWP Support)	The purpose of this scenario is to determine the system yield prior to the implementation of the EWRs and to assess the flows at the selected two EWR sites (Mk_I_EWR2 and Mk_I_EWR3). The Sc MK2 analysis was based on the following assumptions: • Catchment development was set to reflect the ultimate development level (2040); • The MWP was implemented with Smithfield Dam operated at its Historic

Scenario	Description & Purpose
	Firm Yield (HFY); • Ngwadini OCD implemented with no support from Smithfield Dam and operated at its HFY; • EWRs not implemented; • Modelling of Bulwer Water Supply and Sanitation (WSS), SAPPI-SAICCOR and main stem irrigators.
Scenario MK21, MK22, MK23: Ultimate Development, REC EWR (Mk_I_EWR2), MWP and Ngwadini OCD (No MWP Support)	These scenarios were based on Sc MK2 where the flows at the EWR sites were assessed for the following EWR flows: • Total flow EWRs (Mk_I_EWR2) set to achieve the REC (Sc MK21); • Low flow EWRs (Mk_I_EWR2) set to achieve the REC (Sc MK22); • Total Flows for January, February, March and Low Flows remaining months (Mk_I_EWR2) set to achieve the REC (Sc MK23). The purpose of these scenarios was to determine to what degree the total flow, low flow and the in between flow EWRs together with the dam spills and tributary inflows from the dam will achieve the REC at Mk_I_EWR2. The HFYs of Smithfield and Ngwadini were also assessed to determine the affect of implementing the EWR. The 'cost' of releasing an EWR from the future Smithfield Dam can then be determined as an impact on the current socio-economics.
Scenario MK31, MK32, MK33: Ultimate Development, REC EWR (Mk_I_EWR3), MWP and Ngwadini OCD (No MWP Support)	These scenarios are based on Sc MK2 where the flows at the EWR sites will be assessed for the following EWR flows: • Total flow EWRs (Mk_I_EWR3) set to achieve the REC (Sc MK31); • Low flow EWRs (Mk_I_EWR3) set to achieve the REC (Sc MK32); • Total flows for January, February, March and low flows remaining months (Mk_I_EWR3) set to achieve the REC (Sc MK33). The purpose of these scenarios is to determine to what degree the total flow, low flow and the in between flow EWRs together with the dam spills and tributary inflows from the dam will achieve the REC at Mk_I_EWR3. The HFYs of Smithfield and Ngwadini were also assessed to determine the affect of implementing the EWR. The 'cost' of releasing an EWR from the future Smithfield Dam can also be determined as an impact on the current socio-economics.
Scenario MK4: Ultimate Development, MWP and Ngwadini OCD (No EWR releases)	This scenario is based on Sc MK2 with the only change being that the Ngwadini OCD was configured in the WRYM in such a way that support is provided from Smithfield Dam. The strategy adopted for the assessment of Sc MK4, was firstly to determine the HFY for Ngwadini Dam and secondly to determine the HFY for Smithfield Dam whilst Ngwadini is operated at its HFY. The system was finally run with both dams operated at their respective HFYs to get the final simulated flows for Sc MK4. The purpose of this scenario is to assess the flows at the EWR sites for the ultimate development level with MWP and Ngwadini OCD (with support provided from Smithfield Dam) in place. The HFYs of Smithfield and Ngwadini were assessed to determine the affect of implementing the EWR. The 'cost' of releasing an EWR from the future Smithfield Dam can also be determined as an impact on the current socio-economics.
Scenario MK41, MK42: Ultimate Development, REC EWR (Site 2), MWP and Ngwadini OCD (With MWP Support)	These scenarios are based on Sc MK4 and the flows at the EWR sites were assessed for the following EWR flows: • Total flow EWRs (Site 2) set to achieve the REC (Sc MK41); • Low flow EWRs (Site 2) set to achieve the REC (Sc MK42). The purpose of these scenarios is to determine to what degree the total flow and low flow EWRs (Mk_I_EWR2) together with the dam spills and tributary inflows from the dam will achieve the REC at the EWR sites.
Scenario MK21b:	This scenario is based on Sc MK21, with 20Ml/day of treated wastewater

Scenario	Description & Purpose
Ultimate Wastewater Scenario, discharge into the estuary	discharge into the estuary. The assumption was that nutrient removal is in accordance with conventional treatment methods.

The ranking of the scenarios at each site in terms of how successful the scenarios are in meeting the Recommended Ecological Category (REC) is provided in **Figure 233**. The ranking shows that Sc MK2 and 4 are the lowest in the ranking order at all sites and significantly lower than the other scenarios. This is because Sc MK2 and 4 includes Smithfield Dam with no EWRs. All the rest of the scenarios still maintain the EcoStatus of a C at Mk_I_EWR1 but do not achieve the REC (PES). The major problem at Mk_I_EWR 1 is that the site is close to the dam and therefore only received the water being released from the dam or spills. As the river acts as a conduit to convey water from the dam down the system, the main reasons for not achieving the REC (PES) is the increased (above natural) and unseasonal base flows as well as the decrease in floods.

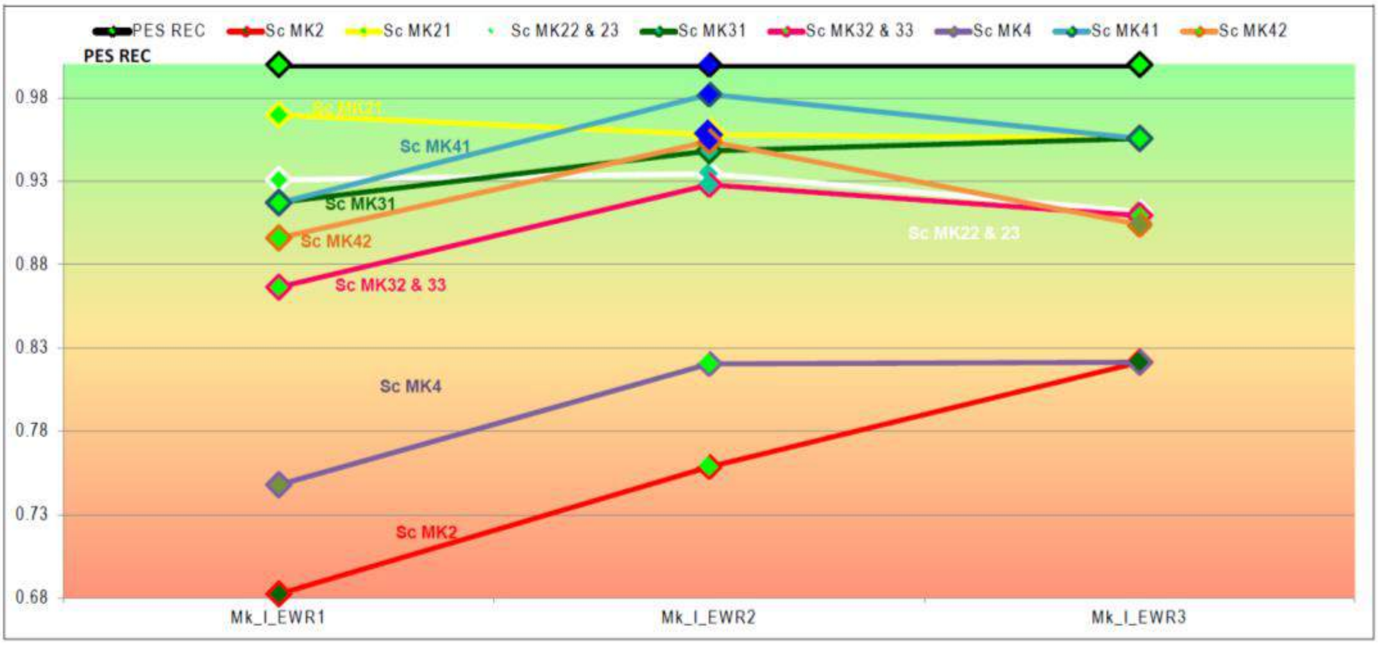


Figure 233: uMkhomazi River: Ranking of scenarios at each EWR site (DWS, 2014a)

As one moves further downstream of the dam, the impacts become less pronounced. At Mk_I_EWR 2, tributary inflows mitigate some of the impacts of the unseasonal flows and the lack of floods. However the main users are downstream of Mk_I_EWR 2, and therefore the impacts are still felt to some degree. Sc MK 21, 41 and 42 still maintain the EcoStatus of a B with Sc MK41 being the better scenario. At Mk_I_EWR3 Sc MK21, 41 and 31 maintains the C EcoStatus and are the best scenarios, although it also does not achieve all the ecological objectives.

The process to determine an integrated ranking of the different scenarios is described below. The first step was to determine the relative importance of the different EWR sites. The site weight (following table) indicates that Mk_I_ EWR 3 carries the highest weight due to the longer river distance which the scenario consequences are relevant for. The importance of Mk_I_EWR 2 is slightly lower due to the shorter distance it represents, which is offset in the higher ecological importance and presence in a protected area. Mk_I_EWR 1 will have a much lower weight, largely because the scenario consequences are only applicable to 14 km of the total length of river. The weights are provided below. The weight is based on the conversion of the PES and EIS to numerical values to determine the normalised weight.

Table 92: Weights allocated to EWR sites relative to each other (DWS, 2014a)

EWR site	PES	EIS	Locality in protected areas (0 - 5)	Distance	Normalised Weight
EWR 1	C	*Moderate*	*1*	*0.08*	0.22
EWR 2	B	*High*	*3*	*0.32*	0.37
EWR 3	C	*Moderate*	*1*	*0.6*	0.41

The weight is applied to the ranking value for each scenario at each EWR site and this provides an integrated score and ranking for the operational scenarios of the uMkhomazi system. The ranking of '1' refers to the REC and the rest of the ranking illustrate the degree to which the scenarios meet the REC. The results are provided below after the weights have been taken into account, and shown in **Figure 234**.

Table 93: Ranking value for each scenario resulting in an integrated score and ranking (DWS, 2014a)

EWR	PES	REC	Sc MK2	Sc MK21	Sc MK22	Sc MK23	Sc MK31	Sc MK32	Sc MK33	Sc MK4	Sc MK41	Sc MK42
Mk_I_EWR1	*0.22*	*0.22*	*0.15*	*0.21*	*0.21*	*0.21*	*0.20*	*0.19*	*0.19*	*0.17*	*0.20*	*0.20*
Mk_I_EWR2	*0.37*	*0.37*	*0.28*	*0.35*	*0.35*	*0.35*	*0.35*	*0.34*	*0.34*	*0.30*	*0.36*	*0.35*
Mk_I_EWR3	*0.41*	*0.41*	*0.34*	*0.39*	*0.37*	*0.37*	*0.39*	*0.37*	*0.37*	*0.34*	*0.39*	*0.37*
	1.00	*1.00*	*0.77*	*0.96*	*0.92*	*0.92*	*0.94*	*0.91*	*0.91*	*0.80*	*0.96*	*0.92*

Sc MK 21 and 41 are the best options as they are the closest to meeting the ecological objectives. Both these scenarios include the total EWR flows and the impacts are mostly due to the impacts on the dam itself, such as the barrier effect, impact on larger frequency of floods and largely due to the increased (above natural) base flows.

The target flows to be released from Smithfield Dam to meet the EWR, as determined during the Technical Feasibility Study, are discussed in **Section 9.3.3.2**.

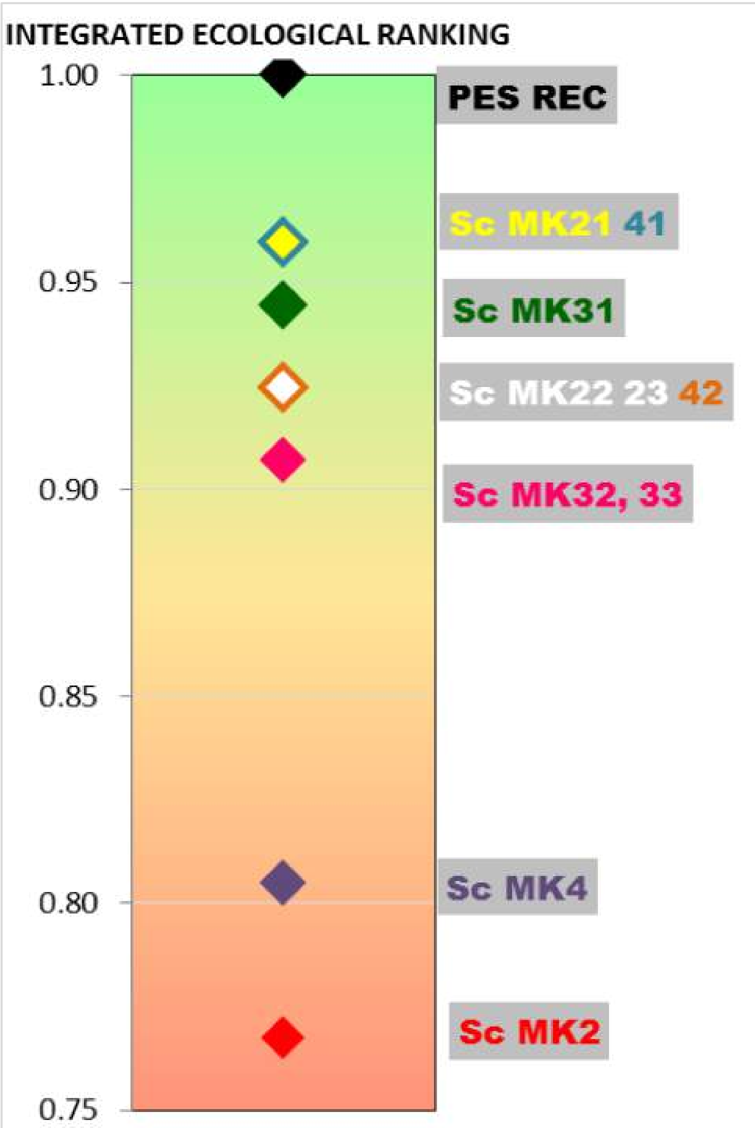


Figure 234: Integrated ecological ranking of scenarios on uMkhomazi River (DWS, 2014a)

A separate quantitative impact assessment is not included due to the evaluation that was already undertaken as part of the Comprehensive Reserve determination.

12.6.6 Aquatic Ecology

12.6.6.1 Pre-Construction & Construction Phase

The nature of the development is such that large scale and total habitat transformation, making the ecological impacts, of a permanent and significant nature for certain aspects (loss of riparian habitat and loss of wetland habitat due to inundation). Many of the other impacts can be significantly reduced through the implementation of mitigation measures.

Aquatic habitat features

Physical destruction of aquatic habitat will be a feature of the proposed development activities. This is applicable within the direct construction footprint of the proposed infrastructure. Aquatic habitat will also be transformed through the drowning out of running (lotic) habitat. The river reach includes a relatively high amount of running water habitat that includes a wide diversity of flow depth classes and substrates. Riffle and run habitat types with underlying substrates of cobbles, stones and gravel are regarded as the most productive aquatic habitat units. These habitat types are utilised as spawning beds due to the high flow through and resulting aeration of the substrate. Aquatic macro-invertebrates also readily utilise this habitat for much the same reason. Some fish species (e.g. yellowfish) utilise this habitat type for spawning purposes, but other species such as *Amphilius natalensis* (Natal stargazer catfish) inhabit this habitat type. Loss of this habitat type through drowning out will displace this species, deplete a large area utilised for breeding purposes and also displace aquatic invertebrates, making for a less productive system in general.

Impacts on water quality emanating from contaminants potentially entering the system from accidental spillages will displace ecologically sensitive aquatic biota from the system. This will impact on the short to medium-term conservation of aquatic resources if contained. Contamination of the water resources will also impact the local people who are reliant on the water for agriculture, livestock watering, household use and consumption.

Riparian vegetation

Approximately 135 ha of riparian habitat will be inundated following the construction of the proposed Smithfield Dam. The destruction of riparian habitat will decrease the filtration capacity of surface water runoff, effectively leading to increased contamination of the aquatic resources. Destruction of riparian habitat will also reduce the habitat availability for riparian-dependent species, which will be displaced.

Soil features

Soil erosion emanating from disturbed areas and soil stockpiles could enter the aquatic system and effectively smother the aquatic habitat. This will displace faunal biota from those areas that are transformed through this impact. This feature can be easily mitigated.

Trenching through wetlands

Wetland functionality is largely governed by a perched water table that occurs due to the stratification characteristics of the underlying soils. Retention of wetland functionality through the preservation of lateral water movement through the soils is dependent on correct soil layering and profiling. Therefore any soil that is removed for trenching purposes must be stored in their respective layers and returned to the excavation in reverse order. The soils must be stored outside of the wetland and buffer zones in order not to smother established wetland vegetation.

Adequate site reinstatement must be implemented in order to abate the formation of erosion through modification of the surface water hydrology. Silt traps and fencing should be used in areas of steeper topography. The movement of heavy machinery within wetland zones should be limited to only single access roadways. Upon completion of the construction phase, this roadway should be ripped and/or disk ploughed to loosen the compacted soils and to allow for the establishment of vegetation within the affected areas. Indiscriminate habitat destruction should be avoided and the construction footprint, including service and support areas should be kept to a minimum.

Wetland habitat

Loss of wetland habitat constitutes one of the most profound ecological impacts associated with the proposed development.

- Smithfield Dam - Approximately 55 ha of natural valley bottom and floodplain wetlands will be inundated by the proposed construction of Smithfield Dam. These wetlands are generally closely associated with the main watercourse and function in natural or near-natural states. Functions of these wetlands include providing the watercourse with a source of water, flood attenuation and flood control for the main watercourse, and provision of habitat to a host of biodiversity that are reliant on the habitat unit. Permanent inundation of this habitat unit will destroy riparian floral species and displace faunal biodiversity that inhabit the unit. It should be noted, however, that the wetland units associated with the banks of the uMkhomazi River are subject to frequent seasonal flooding and therefore are inundated for a period of the year, which will naturally displace faunal biodiversity as well as some floral species that inhabit it. The flood attenuation capacity that is presently provided by the floodplains and riparian zones of the river will be substituted by the impoundment and the associated flood management of the system with controlled releases from the dam. The wetlands within the area do support ecologically sensitive species and a host of biodiversity, which will be lost with the permanent inundation of the system. Fringing emergent vegetation will establish along the banks of the impoundment that will provide habitat to some species, but to a limited extent in relation to under natural conditions. This will have a profound ecological impact that cannot be mitigated for on site, and offset mitigation measures should be considered.

- Langa and Mbangweni Balancing Dams - Approximately 90 ha of wetland habitat will be inundated by the development of Langa and Mbangweni Balancing Dams. The wetland units associated with this area are dominated by channelled and unchannelled valley-bottom wetlands, with emergent vegetation (reedbeds) dominating the floral community structures. This provides valuable habitat for a host of biodiversity, including ecologically sensitive species. These wetland units occur high up within the catchment area, making flood events relatively rare. Natural displacement of the species due to flood conditions is therefore rare. These wetland units therefore support a permanent community of wetland-dependent species, which adds to the significance of the overall ecological impact of permanently inundating the area. For both of the proposed dam construction areas, the most significant impacts will be of destruction of habitat that would otherwise support biodiversity.

Aquatic habitat features

Impacts on water quality emanating from contaminants potentially entering the system from accidental spillages will displace ecologically sensitive aquatic biota from the system. This will impact on the short to medium-term conservation of aquatic resources if contained. Contamination of the water resources will affect the local people who are reliant on the water for agriculture, livestock watering, household use and consumption.

12.6.6.2 Operational Phase

Smithfield Dam and the balancing dam will transform the affected watercourses from free-flowing river ecosystems to reservoir habitats, with accompanying changes in temperature, chemical composition, dissolved oxygen levels and the physical properties.

The potential changes to flow patterns arising from the damming of the uMkhomazi and uMlaza Rivers may influence the current biophysical functioning of these watercourses. The influence to the natural cycles in the rivers (e.g. elimination of natural flooding) will also impact on the downstream ecosystems.

The impoundments (Smithfield and Langa) will result in the loss of habitat for aquatic biota within the inundation zones, including rapids and riffles, as well as marginal and instream vegetation. Species specifically adapted to flowing water environments will be displaced. Species that utilise flowing water habitats for spawning and feeding will also be displaces and their breeding success will be impacted. Habitat specialist fish species such as *Amphilius natalensis* and invertebrate families of Heptageniidae, Perlidae, Leptophlebiidae, Tricorythidae and others will also be displaced. Fish species, such as *Labeobarbus natalensis* that spawns in gravel and cobble beds within flowing water habitats will lose breeding potential, which will ultimately reduce population numbers and vigour.

The trapping of sediments and nutrients behind the dams could cause the growth and spread of algae and other aquatic weeds. Further, due to lack of movement, water in the reservoir becomes stagnant, resulting in loss of oxygen. Ultimately, this cycle can reduce the number of organisms living in the reservoirs.

The dams will trap sediments, which are critical for maintaining physical processes and habitats downstream of the dam. The downstream rivers, which are deprived of sediment load, may seeks to recapture it by eroding the river bed and banks In addition, the dams will also hold back debris (leaves, twigs, branches, trees, organic remains of dead animals) which provides food and micro-habitat for aquatic biota.

A dam wall on the uMkhomazi River and upper uMlaza River, as well and the proposed gauging weir structure will act as barriers that will prevent the up- and downstream movement of aquatic biota. The dams will also lead to the fragmentation of the affected rivers, where the interconnected relationship of the system could be adversely influenced. Fragmentation of riverine habitat is regarded as one of the leading causes of fish population declines worldwide. The uMkhomazi River represents one of the few watercourses within South Africa that is regarded as being open, without any major impoundments. Being regarded as a coastal river on the eastern seaboard, it is an important inland conduit to eels (*Anguilla* spp) that breed out at sea, migrate into freshwater environments to attain maturity and then migrate back out to sea to breed again. Access to suitable inland freshwater habitat is therefore vital to the successful completion of their life cycle. Fragmentation of habitat will inhibit this freedom of movement and a significant decline in eel population will result. In depth discussion were held between project managers, engineers and ecologists where the feasibility of implementing a fishway to overcome the barrier posed by Smithfield Dam was discussed. After exploring various options and alternatives, it was concluded that the implementation of a fishway was not economically viable and was also inhibited by various technical, operational and topographical constraints.

Severe changes in the natural flow pattern, as well as 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.

Aquatic biota may be transferred from the donor system (uMkhomazi River) to the receiving river (uMlaza River) via the conveyance infrastructure. During the operation phase, alien angling fish (e.g. bass) may be introduced to Smithfield Dam if permission is granted to utilise the impoundment for recreational purposes. If these species are transferred to the uMlaza River the local fish population will be adversely affected. Specific measures need to be included in the Operational EMPr and RMP to mitigate these impacts.

According to Net *et al.* (2011), where free-flowing rivers have to be dammed, there are some measures that can be implemented to mitigate the worst effects of these dams which include:

- Undertaking comprehensive environmental flow assessments prior to dam construction to understand and mitigate the consequences of the dam on the social, economic and ecological environments;
- Designing dams that allow for environmental flow releases; and
- Constructing passages for fish to by-pass the dam wall.

The Reserve requirements will ultimately feed into the licensing process of DWS and the operation of the system.

A waterfall that is located on the Luhane River (refer to **Figures 235**) will become inundated by Smithfield Dam. This waterfall is a natural feature that presents an absolute migratory barrier to aquatic biota. A small distance upstream of this waterfall is an artificial weir, which is presumably a weir that was constructed to provide a water abstraction point. The Luhane River within this area has therefore limited ecological value in terms of providing habitat and refuge for fish species due to these two features.

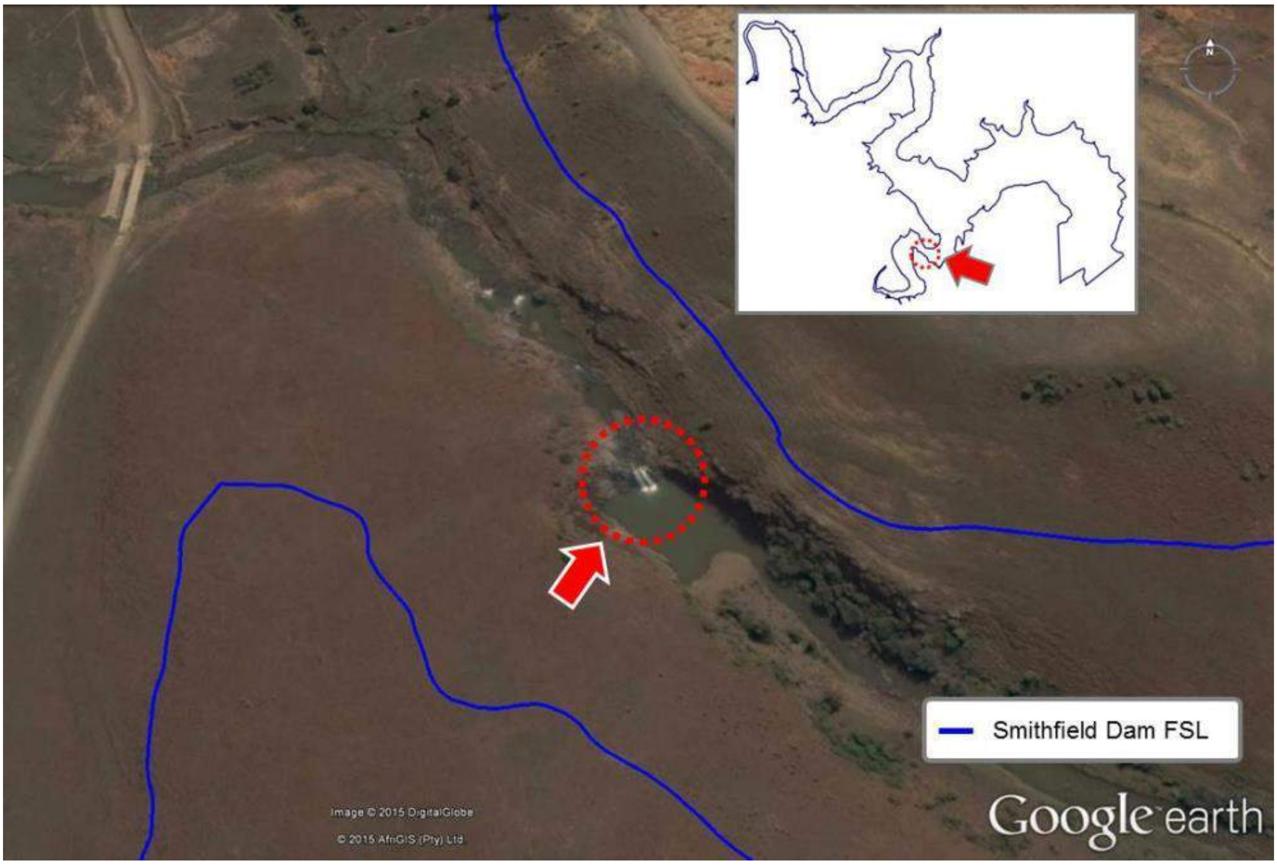


Figure 235: Waterfall on Luhane River

12.6.6.1 Impact Assessment

The information to follow was extracted from the Aquatic Impact Assessment (Enviross, 2016).

Table 94: Smithfield Dam and associated infrastructure: Impact significance ratings - preconstruction and construction phases (Enviross, 2016)

<table>
<tr><th colspan="10">PRE-CONSTRUCTION AND CONSTRUCTION PHASE</th></tr>
<tr><th>Activity</th><th>Nature of Impact</th><th>Impact type</th><th>Extent</th><th>Duration</th><th>Potential Intensity</th><th>Likeli-hood</th><th>Rating</th><th>Mitigation*</th><th>Interpretation</th></tr>
<tr><td rowspan="3">Destruction of aquatic habitat as a direct consequence of the infrastructure construction footprint.</td><td>Direct Impact:</td><td>Existing</td><td>2</td><td>4</td><td>4</td><td>1</td><td>10 - HIGH</td><td rowspan="3">Impact of this nature is an inevitable consequence of the proposed development. Recommended mitigation is to limit the impact footprint to as small an area as possible and that no indiscriminate destruction outside of the infrastructure footprint be allowed.</td><td>The impact during the construction phase will be larger than the actual infrastructure footprint as construction support areas are required to facilitate the construction process (storage yards, access roadways, etc.).</td></tr>
<tr><td rowspan="2">Aquatic habitat will be destroyed within the local area to accommodate the dam wall infrastructure as well as construction support areas established within the watercourse.</td><td>Cumulative</td><td>1</td><td>4</td><td>4</td><td>1</td><td>9 – MOD</td><td>Cumulative impacts are low as the uMkhomazi River falls within a rural region where infrastructure development is at a minimum.</td></tr>
<tr><td>Residual</td><td>1</td><td>4</td><td>4</td><td>1</td><td>9 – MOD</td><td>Residual impacts will remain, but will diminish as the impact area re-vegetates and soils stabilise. A degree of residual effects will always remain.</td></tr>
<tr><td rowspan="3">Clearing of riparian vegetation to accommodate access to the site and clearing of construction footprint.</td><td>Direct Impact:</td><td>Existing</td><td>2</td><td>1</td><td>2</td><td>1</td><td>5 - MOD</td><td rowspan="3">With appropriate mitigation this impact can be short-lived, limited in extent and easily rehabilitated.
Limit the footprint to only areas necessary for the construction process;
Utilise single access roads only;
Avoid indiscriminate destruction of riparian habitat.</td><td>Rivers within the area suffer limited transformation of the riparian zones already.</td></tr>
<tr><td rowspan="2">Riparian vegetation will have to be removed to allow access for heavy earthmoving equipment, vehicles, etc.</td><td>Cumulative</td><td>2</td><td>2</td><td>2</td><td>1</td><td>6 - MOD</td><td>Cumulative loss of riparian habitat is limited due to rural setting of the region.</td></tr>
<tr><td>Residual</td><td>1</td><td>1</td><td>1</td><td>0.5</td><td>2 - LOW</td><td>With mitigation the impacts to the riparian zones can be minimised and rehabilitated with limited residual impacts remaining.</td></tr>
<tr><td rowspan="3">Establishment of construction camps and/or yards within riparian zones.</td><td>Direct Impact:</td><td>Existing</td><td>2</td><td>1</td><td>1</td><td>0.5</td><td>2 - LOW</td><td rowspan="3">Storage of materials, vehicles and equipment must not be allowed within the riparian zones.</td><td>This is thought to be very limited as construction camps should be placed outside of the riparian zones.</td></tr>
<tr><td rowspan="2">A footprint area within the riparian zones will be utilised for activities related to the construction further than the immediate footprint of the dam wall (work areas and other supporting services for the construction processes).</td><td>Cumulative</td><td>2</td><td>1</td><td>1</td><td>0.5</td><td>2 - LOW</td><td>Cumulative loss of riparian habitat is limited due to rural setting of the region.</td></tr>
<tr><td>Residual</td><td>1</td><td>1</td><td>1</td><td>0.2</td><td>1 - LOW</td><td>With mitigation the impacts to the riparian zones can be minimised and rehabilitated with little to no residual impacts remaining.</td></tr>
</table>

PRE-CONSTRUCTION AND CONSTRUCTION PHASE									
Activity	**Nature of Impact**	**Impact type**	**Extent**	**Duration**	**Potential Intensity**	**Likeli-hood**	**Rating**	**Mitigation***	**Interpretation**
Impacts to surface water quality	Direct Impact:	Existing	3	4	4	0.75	8.25 - MOD	Active soil erosion management to be implemented throughout all phases of the development; Proper site reinstatement must take place to abate the formation of erosion; Proper servicing of all equipment to ensure no fluid leaks; Stored fuel to be adequately bunded and stored outside of area that could impact surface waters should leakages occur; Contaminated soils must be removed immediately and dumped at a registered disposal site.	Impacts to water quality will occur unless mitigation measures are in place. Simple mitigation measures could ensure that impacts can be negated.
	Disturbances of soils will lead to increase in turbidity and general degradation of water quality; Fuel leaks from equipment will impact water quality within the area.	Cumulative	3	2	2	0.5	6 - MOD		Degradation of water quality is a world-wide feature induced by anthropogenic activities.
		Residual	1	1	2	0.5	2 - LOW		Little to no residual impacts to water quality should occur if mitigation measures are properly implemented.
Blasting of bedrock and deep excavations to facilitate construction of the dam wall and other infrastructure.	Direct Impact:	Existing	1	1	2	1	4 - MOD	Blasting to take place during the low flow season only when no active fish migrations occur. A high congregation of fish below the weir will mean a greater impact to the fish population.	Blasting of bedrock will destroy substrate of the river and associated habitat features.
	Excavations (possibly facilitated by blasting) to located suitable foundation material is required prior to construction of the dam wall and associated infrastructure.	Cumulative	1	1	1	0.5	2 - LOW		Bed modification of rivers within the area is not thought to be a significant cumulative loss.
		Residual	1	1	1	0.2	1 - LOW		Limited to no residual impact should remain from this activity.
Diversion of watercourse to accommodate construction activities.	Direct Impact:	Existing	2	1	1	1	4 - MOD	This should be done during the low flow season to safeguard against erosion potential and outside of the breeding season of riverine biota.	Removal of existing instream infrastructure will require invasive use of heavy machinery within the watercourse.
	Coffer dams will have to be established within the active watercourse to allow for safe work conditions and to allow heavy machinery access to the existing weirs.	Cumulative	2	1	1	0.5	2 - LOW		Active construction of structures within active watercourses within the area is not a regular occurrence.
		Residual	1	1	1	0.2	1 - LOW		These are temporary features of the proposed development activities that will leave little to no residual impacts once rehabilitation measures have been implemented.

Table 95: Diversion of R617: Impact significance ratings pertaining to preconstruction and construction phases (Enviross, 2016)

PRE-CONSTRUCTION AND CONSTRUCTION PHASE									
Activity	**Nature of Impact**	**Impact type**	**Extent**	**Duration**	**Potential Intensity**	**Likeli-hood**	**Rating**	**Mitigation***	**Interpretation**
Excavations within wetland habitat to located suitable foundation material, backfilling and compaction for stabilisation of the road	Direct Impact:	Existing	2	1	2	1	5 - MOD	With appropriate mitigation this impact can be short-lived, limited in extent and easily rehabilitated. Limit the footprint to only areas necessary for the construction process; Allow for adequate flow beneath the roadway that retains the spreading of the water across the width of the wetland unit. Utilise single access roads only; Avoid indiscriminate destruction of wetland habitat.	Rivers within the area suffer some transformation of the riparian zones already.
	Wetland habitat units will be crossed to facilitate the construction of the proposed deviation of the R617.	Cumulative	2	2	2	1	6 - MOD		Cumulative loss of riparian habitat is ongoing within the area as more habitat is lost to accommodate land use.
		Residual	1	1	1	0.5	2 - LOW		With mitigation the impacts to the wetland zones can be minimised and rehabilitated with limited residual impacts remaining.
Stripping of wetland and riparian vegetation	Direct Impact:	Existing	2	1	1	0.5	2 - LOW	Storage of materials, vehicles and equipment must not be allowed within the riparian zones.	Rivers within the area suffer some transformation of the riparian zones already.
	A footprint area within the riparian zones will be utilised for activities related to the construction further than the immediate footprint of the dam wall (work areas and other supporting services for the construction processes).	Cumulative	2	1	1	0.5	2 - LOW		Cumulative loss of riparian habitat is ongoing within the area as more habitat is lost to accommodate land use.
		Residual	1	1	1	0.2	1 - LOW		With mitigation the impacts to the riparian zones can be minimised and rehabilitated with little to no residual impacts remaining.
Channelling surface water runoff through culverts beneath roadway.	Direct Impact:	Existing	2	1	1	1	4 - MOD	Sufficient culvert size and numbers should be utilised to allow for the natural spreading of surface water across the entire width of the wetland unit.	Restricting the water flow will increase the velocity and scouring potential of flowing water. This will create erosion of the watercourse.
	Culverts will typically be utilised to drain surface water beneath the roadway. This will channel the water, increase its velocity and scouring potential to aggravate erosion.	Cumulative	2	1	1	0.5	2 - LOW		This is a problem throughout much of the country where inadequate culvert clearance us catered for, which has created erosion of the watercourse along the outfall side.
		Residual	1	1	1	0.2	1 - LOW		If done appropriately, little to no residual impact should remain.

Table 96: Balancing dams and associated infrastructure: Impact significance ratings preconstruction and construction phases (Enviross, 2016)

PRECONSTRUCTION AND CONSTRUCTION PHASE									
Activity	**Nature of Impact**	**Impact type**	**Extent**	**Duration**	**Potential Intensity**	**Likeli-hood**	**Rating**	**Mitigation**	**Interpretation**
Destruction of wetland habitat	Direct Impact:	Existing	3	1	4	0.75	6 - MOD	The extent of the construction footprint needs to be limited to as small an area as possible, especially downstream of the infrastructure (outside of the inundation area). Areas located downstream of the proposed wall site should be prioritized as ecologically sensitive features as this need to retain its ecological integrity as a wetland system. The construction footprint could possible encroach to within upstream areas of the watercourse, where the habitat will become inundated once the construction is completed. The substrates removed from the watercourse should be stored in their respective layering and reinstated in reverse order to maintain soil stratification (if applicable). Adequate landscaping of the watercourse should take place in order to resemble the original state of the watercourse. All rubble and surplus concrete and reinforcing steel, etc must be removed from the site. Nothing should be stored (equipment, topsoil, building materials, rubble) within the wetland zones. Coffer dams to be removed and the affected areas within the watercourse to be reinstated to the former state.	Construction of the dam walls within the wetland area will impact the ecological integrity of the system.
	Wetland habitat will be destroyed to accommodate the construction of the dam walls and associated infrastructure.	Cumulative	2	1	4	0.75	5 - MOD		There are small-scale weirs and dams along the watercourse but not to the scale that is being proposed.
		Residual	1	1	2	0.5	2 - LOW		The direct infrastructure footprint downstream of the proposed dam wall sites can be mitigated to restore a degree of functionality.
Impacts to surface water quality	Direct Impact:	Existing	3	2	2	0.5	4 - MOD	Active soil erosion management to be implemented throughout all phases of the development; Proper site reinstatement must take place to abate the formation of erosion; Proper servicing of all equipment to ensure no fluid leaks; Stored fuel to be adequately bunded and stored outside of area that could impact surface waters should leakages occur; Contaminated soils must be removed immediately and dumped at a registered disposal site.	Impacts to water quality will occur unless mitigation measures are in place. Simple mitigation measures could ensure that impacts can be negated.
	Disturbances of soils will lead to increase in turbidity and general degradation of water quality; Fuel leaks from equipment will impact water quality within the area.	Cumulative	4	4	4	0.75	9 - MOD		Degradation of water quality is a world-wide feature induced by anthropogenic activities.
		Residual	1	1	1	0.1	0 - LOW		Little to no residual impacts to water quality should occur if mitigation measures are properly implemented.
Construction of access roadways that may lead to erosion	Direct Impact:	Existing	3	4	4	0.75	8.25 - MOD	Active erosion measures should be implemented within the road reserves to abate the effects of surface water runoff and associated erosion; Making use of exiting roadways is recommended wherever possible.	Without adequate management, stormwater runoff will carry silts toward local watercourses.
	Construction of roads requires stripping of vegetation and topsoil and the importation of aggregates to stabilise the road surface. If the road remains gravel then runoff will carry silts toward local watercourses	Cumulative	3	2	2	0.5	6 - MOD		Informal gravel roads and agriculture occur within the local catchments, making the cumulative impact of siltation of the watercourses relatively high.
		Residual	1	1	2	0.5	2 - LOW		This impact can be readily mitigated that will result in little residual impacts remaining.

Table 97: Smithfield Dam: Impact significance ratings - operational phase (Enviross, 2016)

OPERATIONAL PHASE									
Activity	**Nature of Impact**	**Impact type**	**Extent**	**Duration**	**Potential Intensity**	**Likeli-hood**	**Rating**	**Mitigation**	**Interpretation**
Establishing an instream migratory barrier (habitat fragmentation).	Direct Impact:	Existing	3	4	8	1	15 - HIGH	Discussions and workshops were held between the project managers, ecologists and engineers for the project where various options for the implementation of fish bypass or fishways were explored in detail. It was concluded that making provision for a fishway at Smithfield Dam is non-feasible due to expense, technical and topographical constraints. *Investigate the feasibility of trap-and-haul or selectively catching appropriate fish species downstream of Smithfield Dam and physically transporting and releasing these fish upstream of the dam wall, which may serve as a more practicable option than a fishway.*	The uMkhomazi River at present is one of the very few rivers remaining within South Africa that does not have any major impoundments along its watercourse.
	Inhibition of migratory freedom of fish will lead to lowered breeding potential and population vigour; depletion of genet pool and reduction of available habitat; The construction of Smithfield Dam will cut off access to inland waters for Anguillid eels, which will be unable to complete part of its lifecycle.	Cumulative	3	4	8	1	15 - HIGH		River fragmentation is regarded as one of the leading causes of fish population declines worldwide.
		Residual	3	4	8	1	15 - HIGH		A residual impact will remain and the fish populations will be impacted, especially eels that will not be able to complete a stage of their life cycle. This is, however, not absolute as habitat between this barrier and the ocean will remain that could be utilised by these species to complete their life cycle.
Reduction of flow through the river system will affect the overall ecological integrity of the system.	Direct Impact:	Existing	3	4	8	1	15 - HIGH	Observation of the recommended ecological flow requirements (EFR) for the system will ensure maintenance of system health.	By not observing the EFR volumes and flow regimes for the system, overall biological integrity will suffer and the resource will degrade.
	Reduction of the ecological flow volumes will lead to degradation of channel maintenance, depletion and degradation of available aquatic habitat and will degrade the overall ecological integrity of the system.	Cumulative	3	4	8	1	15 - HIGH		Depletion of water volume within rivers without adequate provision for EFR volumes leads to unnatural flow regimes and seasonality that will negatively impact aquatic-dependent biota.
		Residual	1	1	2	0.5	2 - LOW		Biological integrity of the system can be maintained by observing the EFR volumes and flow regimes.
Drowning out of productive riverine habitat.	Direct Impact:	Existing	1	4	16	1	21	This is an inevitable feature of the proposed development activities that cannot be effectively mitigated for.	The drowning out of productive aquatic habitat will occur as a consequence of the proposed development of Smithfield Dam.
	Running water habitat units (riffles and runs associated with cobble and gravel beds) will be lost as the riverine habitat is	Cumulative	2	4	16	1	22		Drowning out of riverine habitat due to impoundments has occurred along all major watercourses throughout the world.

OPERATIONAL PHASE									
Activity	**Nature of Impact**	**Impact type**	**Extent**	**Duration**	**Potential Intensity**	**Likeli-hood**	**Rating**	**Mitigation**	**Interpretation**
	transformed to a standing water environment.	Residual	1	4	16	1	21		This impact will remain for the lifespan of the dam.
Loss of riparian habitat following inundation of the valley.	Direct Impact:	Existing	1	4	4	1	9 – MOD	This impact is an inevitable feature of the proposed development activities and cannot be mitigated for on site. Offset mitigation measures should be considered that could focus on improving the catchment management of the system in terms of erosion control and/or education of local people on more sustainable agricultural methods that could ultimately improve erosion management within the catchment area. Any new riparian vegetation that will establish should be protected from the impacts of grazing and resource harvesting.	Loss of riparian habitat is an inevitable feature of the project.
	The construction of Smithfield Dam will inundate the river valley and lead to a substantial loss of riparian vegetation and habitat that is considered to be in good ecological integrity.	Cumulative	2	4	4	1	10 - HIGH		Riparian habitat loss is a feature throughout the country that is in need of attention.
		Residual	1	4	4	1	9 - MOD		Riparian zones with specific riparian vegetation will eventually establish along the periphery of the inundated area and will assume functionality, which will reduce the residual impacts.
Exotic vegetation encroachment	Direct Impact:	Existing	3	3	4	0.75	8 - MOD	Exotic vegetation to be controlled and future recruitment to be managed appropriately.	The recruitment of alien invasive vegetation will be enhanced following site disturbances.
	Disturbance of soils will enhance potential for invasion of exotic vegetation.	Cumulative	4	3	4	0.75	8 - MOD		Alien vegetation encroachment within riparian zones is a national concern.
		Residual	1	2	1	0.1	0 - LOW		Appropriate mitigation measures and follow-up control will negate this impact.

Table 98: Balancing Dams: Impact significance ratings - operational phase (Enviross, 2016)

OPERATIONAL PHASE									
Activity	**Nature of Impact**	**Impact type**	**Extent**	**Duration**	**Potential Intensity**	**Likeli-hood**	**Rating**	**Mitigation**	**Interpretation**
Establishing an instream migratory barrier (habitat fragmentation).	Direct Impact:	Existing	1	4	16	1	21	No mitigation measures are thought necessary to abate this impact.	There is an existing issue of river fragmentation through the existing weirs.
	This is not thought to be a significant impact due to the spatial setting of the proposed dams, which are located high up within the catchment area. The watercourses associated with the proposed development are also not conducive to supporting largescale migratory activity.	Cumulative	2	4	16	1	22		Numerous instream barriers occur along the watercourses within the area.
		Residual	1	4	16	1	21		A residual impact will remain and the fish populations will be impacted.
Drowning out of wetland habitat.	Direct Impact:	Existing	1	4	4	1	9 – MOD	This is an impact that cannot be mitigated for. Offset mitigation measures should be considered to offset the ecological impacts emanating from this feature.	Loss of wetland habitat will be an inevitable consequence of the proposed development activities.
	Inundation of the valley resulting from the establishment of the dams will drown out wetland habitat and transform it to an aquatic environment.	Cumulative	2	4	4	1	10 - HIGH		Some instream barriers and weirs do occur within the local catchment area, which adds to the cumulative impact.
		Residual	1	4	4	1	9 - MOD		This will remain as a residual impact, however, peripheral vegetation will establish that will see a small degree of mitigation.
Exotic vegetation encroachment	Direct Impact:	Existing	3	3	4	0.75	8 - MOD	Exotic vegetation to be controlled and future recruitment to be managed appropriately.	The recruitment of alien invasive vegetation will be enhanced following site disturbances.
	Disturbance of soils will enhance potential for invasion of exotic vegetation.	Cumulative	4	3	4	0.75	8 - MOD		Alien vegetation encroachment within riparian zones is a national concern.
		Residual	1	2	1	0.1	0 - LOW		Appropriate mitigation measures and follow-up control will negate this impact.

12.6.7 *Aquatic Weeds*

12.6.7.1 General

Smithfield Dam and the balancing dam may create conditions that are favourable for the proliferation of aquatic weeds. Water is these impoundments will be stagnant (as opposed to the free-flowing rivers), which traps sediments and nutrients that may result in the undesirable growth and spread of algae and aquatic weeds.

Impacts associated with high infestations of aquatic weeds include:

- Degrading aquatic ecosystems and threatening biodiversity;
- Causing foul taste and odours of drinking water supplies;
- Increasing costs of water purification;
- Causing stunting of fish populations and fish kills due to decomposition;
- Causing water loss due to evapotranspiration from floating or emergent species;
- Catching debris and sediment hastening the filling in of water bodies;
- Providing habitat for disease vectors such as mosquitoes;
- Producing and releasing toxins into the water;
- Lowering aesthetic appeal of a waterbody;
- Reducing access of wildlife; and
- Monetary losses due to control efforts.

The habitat and the type of aquatic weed flora influence the technique of weed control. Aquatic weeds can be brought under control to manageable limits by various methods, which are broadly categorised under the following:

- Physical or mechanical methods;
- Biological methods;
- Chemical methods; and
- Cultural and physiological methods.

12.6.7.2 Impact Assessment

Environmental Feature	16. Surface Water – Aquatic Weeds
Relevant Alternatives & Activities	Smithfield Dam & Balancing Dam
Project life-cycle	Operational phase
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Proliferation of aquatic weeds	19.1. Develop eradication programme for aquatic alien invasive species (aquatic and terrestrial) as part of Operational EMPr. 19.2. Prevent introduction of aquatic alien invasive species by vessels. Construction of Wash Bay, provision of spray tanks, herbicides and training of Wash Bay Officer. To be considered further as part of RMP and Operational EMPr.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	regional	medium	long-term	moderate	2
After Mitigation	-	regional	medium	long-term	moderate	1

12.6.8 <u>Sediment Regime</u>

12.6.8.1 Degradation of River Channel

The dam walls (Smithfield Dam and balancing dam) will trap sediment and could starve the rivers downstream of their normal sediment load. A lack of sediment in the water may result in increased scouring and erosion of river beds and banks downstream. The extent of this erosion is dependent on the amount in which the flow has been regulated. In the case of Smithfield Dam the releases will aim to satisfy the EWR. This form of erosion becomes less pronounced with distance downstream due to non-regulated tributaries making contributions to sediment load in the main stem, along with material derived from erosion of the channel boundary. Reduced sediments could also impact on sand winning operations that occur further downstream on the uMkhomazi River.

An OCS dam was not considered viable, as explained in **Section 9.15.1**.

12.6.8.2 Impact on Coastal Sediment Budget

Smithfield Dam can impact on the coastal sediment budget. An extract from the Sediment Deposition and Impact Report (DWA, 2015d) follows.

It is clear that the proposed dam on the uMkhomazi River will possibly have a significant and long-term effect on the coastal sediment budget due to the relatively large volume of sediment (sand) that will not reach the river mouth due to sediment deposition in the reservoir and due to the reduced sediment transport capacity downstream of the dam. It is however possible to mitigate and limit the impact of the dam by implementing a combination of measures (see below). The impact in terms of net coastal erosion will be most noticeable in the first 10 km to the north of the mouth of the river, but even in this area it may be a decade or more before the impact is clearly apparent. However, in the long-term the impact (although initially insignificant), will gradually spread further north and is likely to eventually even result in a reduction of the longshore sand supply to the Durban Bluff area. Numerical shoreline modelling (1D) could be employed to quantify potential erosion impacts in the medium-term The estimated sea level rise due to climate change could be 0.5 m in about 60 years' time, with an associated 50 m potential lateral erosion of the beach. The effect of sea level rise on coastal erosion will probably become significant from year 2040. The lateral erosion rate due to sea level rise could be on average 0.83 m/a (not linear in reality), while the historical observed lateral erosion rate is 1 m/a along the Durban Bluff. Climate change by year 2075 could therefore almost double the current rate of lateral erosion of the beaches. The proposed Smithfield Dam has an estimated 10 % long term impact (reduction) of the total longshore sediment load at Durban, which is likely to increase the current rate of coastal erosion.

If major dam developments on the uMkhomazi River are inevitable, then the potential impacts in terms of reduced fluvial sand supply to the coast could be mitigated by:

- The current impact of sand mining on the uMkhomazi River is as large as the impact on the sand yield of the proposed Smithfield Dam. It is recommended to establish the status quo of sand mining in the uMkhomazi catchment, including illegal/unpermitted mining to quantify the extent of the problem. It is proposed that firstly existing illegal sand mining south of Durban should be prevented.

- In general future legal sand mining south of Durban should also be limited. As alternative to the current sources of alluvial river bed sediment, suitable sand sources at the coast could be identified, such as historical beach zones (geologic deposits) currently located inland near the coast, possible quarries, from the Smithfield Reservoir or upstream on the river (but this is relatively far from the coast), and possibly from alluvial river floodplains above the 200 year flood levels,
- Coastal control of development could possibly be improved to limit erosion (by not removing coastal dunes, etc.).
- Increase the sand load at the mouth by adding a sand bypass tunnel at the Smithfield Dam. A 5.1 km concrete lined tunnel length is required. Flushing of sediment will be carried out during floods and the firm yield of the dam could decrease slightly due to the flushing operation.
- A beach nourishment programme is possible, but requires a suitable off-shore source of coarse sand and dredging cost will be expensive. Critical zones along the beach could be targeted or general dredge disposal could be done to increase the available sediment for longshore transport.
- Coarse sediment bypassing of the Smithfield Dam by bypass tunnel is possible to limit the impacts of the dam on the downstream river morphology and on the sediment loads at the river mouth. A 5.1 km tunnel is required with diameter of 7.0 m to 8.3 m (if concrete lined), to bypass the frequent floods such as the 2 year and 5 year floods, respectively. At the tunnel intake a weir is required in the upper reservoir, with a height of about 12 m.

The proposed order of further investigation of the above measures to limit the environmental impact of the reduction in available sand resources on coastal erosion south of Durban is to address sand mining and control of development first, followed by the bypass tunnel at the dam (if deemed to be feasible).

An authorities meeting was convened on 2 March 2016 to discuss the potential impact of the proposed Smithfield Dam on the coastal sediment budget and shoreline stability (refer to minutes contained in **Appendix H12**). Some of the key outcomes of this meeting, which also serve as a way forward regarding this matter, include the following:

- Targets to be established in terms of the volume of sediment that should be made available from the system. This requires further input from the relevant stakeholders and specialists.
- Further investigations must include a detailed understanding of the current state of the sediment regime as well as establishing a monitoring programme.
- Most likely a host of interventions will need to be explored by the mandated authorities (including DEA, DWS, KZN DEDTEA, EKZNW, DMR, eThekwini Municipality, etc.).

12.6.8.3 Impact Assessment

A likely assessment of the impacts of Smithfield Dam on sand yield and coastal sediment budget, based on the Sediment Deposition and Impact Report (DWA, 2015d), follows.

Extent	Site specific At the facility constructed/ operated.	Local Limited to within a 15km radius	Regional (100km radius)	National	International
			✓		
Duration	Very Short Term 3 days	Short term 3 days – 1 year	Medium term 1 - 5 years	Long term 5 – 20 years	Permanent > 20 years (life of dam)
					✓
Intensity/ Magnitude	No lasting effect No environmental functions and processes are affected	Minor effects The environment functions, but in a modified manner	Moderate effects Environmental functions and processes are altered to such extent that they temporarily cease	Serious effects Environmental functions and processes are altered to such extent that they permanently cease	
		✓			

Status of the impact	Negative
Degree of confidence in predictions:	Medium
Significance	High

12.7 Estuary

12.7.1 General

Smithfield Dam is in excess of 170km (along the uMkhomazi River) to the north-west of the estuary. Nonetheless, the uMWP-1 may influence the uMkhomazi Estuary in terms of flow alterations, sediment regime, habitat alteration, water quality and overall ecosystem health.

According to the Pre-feasibility Study (DWAF, 1999d), the uMkhomazi 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 KZN 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 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.

According to the Pre-feasibility Study (DWAF, 1999d), 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.

12.7.2 Ecological Categories associated with Scenarios

An extract from the Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu WMA: Volume 7a: Recommended Water Resource Classes for the Umkhomazi (U1) and Mvoti (U4) River Systems (DWS, 2014b) follows.

The individual Estuarine Health Index (EHI) scores, as well as the corresponding Ecological Categories (ECs) under different operational scenarios (as discussed in **Section 12.6.5**) are provided below and shown in **Figure 236**.

The estuary is currently in a C Category. Under Scenario Group B (Sc MK21 and MK42) and Group C (Sc MK22, MK23, MK43) the uMkhomazi Estuary will decline slightly in health, as a result of more closed mouth conditions, but is expected to remain in a C Category. While, under Scenario Group A (Sc MK2,4), D (Sc MK31) and E (Sc MK32, MK33) the estuary will deteriorate further in health by about 14%, 8% and 9% respectively as a result of increase closed mouth conditions. See explanations of scenarios in **Table 91**.

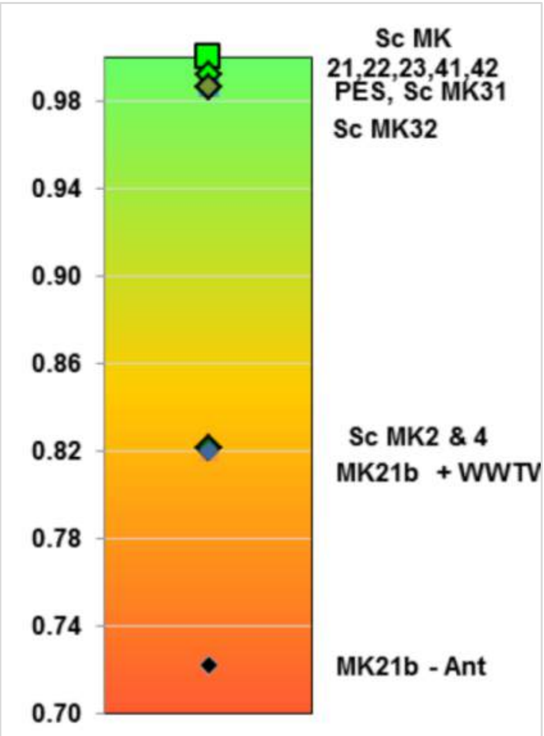


Figure 236: uMkhomazi Estuary: Ranking of scenarios (DWS, 2014b)

For the uMkhomazi Estuary, none of the scenarios achieved the REC of a B Category. Therefore, Scenario H (Group B (Sc MK21 and MK42)) in conjunction with a number of management interventions) is the recommended ecological flow scenario. Scenario Group C (Sc MK22, MK23 and MK43) will also achieve the REC. The following management interventions are required to achieve the uMkhomazi REC:

- Remove sand mining from the upper reaches below the Sappi Weir to increase natural function, i.e. restore intertidal area;
- Restoration of vegetation in the upper reaches and along the northern bank in the middle and lower reaches, e.g. remove alien vegetation and allow disturbed land to revert to natural land cover (is already on upwards trajectory);
- Curb recreational activities in the lower reaches through zonation and improved compliance;
- Reduce/remove castnetting in the mouth area through estuary zonation or increased compliance; and
- Relocate upstream, or remove, the Sappi Weir to restore upper 15% of the estuary.

Since these scenarios include the construction of a new dam, this is seen as a medium to long term recommendation. In the short term, a combination of the PES and the REC will be recommended. The improvements required to meet the REC are mostly non-flow related measures. The non-flow related (or anthropogenic) measures required to improve the estuary (apart from the removal or changing of the SAPPI weir location) can be applied and should improve the estuary to a B/C

A separate quantitative impact assessment is not included due to the evaluation that was already undertaken as part of the Comprehensive Reserve determination.

12.8 Flora

12.8.1 General

Vegetation will be lost in areas that are to be cleared for the project infrastructure, as well as in the inundation areas of Smithfield Dam and the balancing dam. The potential loss of significant flora species may occur. Refer to the findings of the Terrestrial Ecological Impact Assessment in **Section 11.1.1**.

Clearing of vegetation for construction purposes may result in the proliferation of exotic vegetation, which could spread beyond the construction domain. These potential impacts will be managed through suitable rehabilitation and eradication methods contained in the EMPr.

It is recommended that search, rescue and relocation be conducted taking into consideration red data, protected and endangered flora and fauna species, and medicinal plants. In this regard, attention will be given to the following species of conservation importance: *Merwilla plumbea* (Wild squill), *Bowkeria verticillata* (Natal shell-flower bush), *Hypoxis hemerocallidea* (Star flower/African potato) and *Boophane disticha* (Century plant). For flora species, the following factors need to be considered (amongst others):

- Detailed plan of action (including timeframes, methodology and costs);
- Site investigations;
- Consultation with authorities and stakeholders;
- Marking of species to be relocated;
- Applying for permits;
- Identification of suitable areas for relocation;
- Aftercare; and
- Monitoring (including targets and indicators to measure success).

The following permits may need to be acquired:

- Permit from DAFF in terms of the National Forests Act (No. 84 of 1998) if protected trees are to be cut, disturbed, damaged, destroyed or removed; and
- Permit from EKZNW for the relocation of species protected under the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) and Natal Nature Conservation Ordinance (15 of 1974).

Consideration must be given whether the dam basins (Smithfield Dam and balancing dam) will be selectively de-bushed up to a predetermined level below the FSL, based on the following criteria (DWAF, 2008):

- Viability of commercial harvesting;
- Need of Traditional Authority and rural dwellers to harvest medicinal plants, firewood, etc.;
- Potential adverse impacts to water quality (including levels of dissolved oxygen) due to the decomposition of flooded vegetation; and
- Potential future use of impoundment, where the existing vegetation will pose dangerous obstacles.

The establishment of trees within the pipeline servitude will not be allowed as roots may compromise the stability of the pipeline.

12.8.2 Impact Assessment

<table>
<tr><th>Environmental Feature</th><th colspan="2">17. Flora</th></tr>
<tr><td>Relevant Alternatives & Activities</td><td colspan="2">All project components and associated activities located in sensitive terrestrial ecological areas</td></tr>
<tr><td>Project life-cycle</td><td colspan="2">Pre-construction, construction & operational phases</td></tr>
<tr><td>Potential Impact</td><td colspan="2">Proposed Management Objectives / Mitigation Measures</td></tr>
<tr><td>Loss of vegetation of conservation significance through construction activities and inundation.</td><td>17.1.
17.2.
17.3.
17.4.</td><td>Search, rescue and relocation of red data, protected and endangered species and medicinal plants.
All relevant approvals to be obtained prior to relocation of red data, protected and endangered flora species and medicinal plants.
Any protected plants or trees in proximity to construction areas that will remain, should be clearly marked and must not be disturbed.
Adequate re-instatement and rehabilitation of areas disturbed by the construction activities – relevant to disturbed areas outside of dam basins and areas to be utilised for operational purposes.</td></tr>
<tr><td>Loss of topsoil</td><td>17.5.</td><td>During site preparation, topsoil and subsoil are to be stripped separately from each other and must be stored separately from spoil material for use in the rehabilitation phase. It should be protected from wind and rain, as well as contamination from diesel, concrete or wastewater.</td></tr>
<tr><td>Proliferation of exotic vegetation in disturbed areas</td><td>17.6.
17.7.</td><td>Control of alien invasive species and noxious weeds for areas disturbed by the construction activities, in accordance with the requirements of the Conservation of Agricultural Resources Act (No. 43 of 1983) and GN No. R. 598 (Alien and Invasive Species Regulations, 2014) in terms of the National Environmental Management: Biodiversity Act (No. 10 of 2004). Eradication method to be approved by the Project Manager.
Implement a monitoring programme for eradication of alien invasive plants and noxious weeds.</td></tr>
<tr><td>Soil erosion due to exposed soils</td><td>17.8.</td><td>During and after construction, there should be regular monitoring of soil erosion due to exposed soils and any problems observed should be rectified as soon as possible using the appropriate erosion control structures and a revegetation techniques.</td></tr>
<tr><td>Loss of medicinal plants and firewood</td><td>17.9.
17.10.
17.11.</td><td>Search, rescue and relocationto include medicinal plants.
Trees felled should be made available to the local surrounding community, as far as practical.
No trees to be felled for fuel purposes.</td></tr>
<tr><td>Soil contamination and vegetation disturbance due to fuel and chemical spills.</td><td>17.12.
17.13.
17.14.
17.15.</td><td>Employ on site personnel responsible for preventing and controlling potential soil pollution through fuel and oil leaks and spills.
Natural water bodies must not be used to wash out construction vehicles, concrete mixers, or for domestic ablutions.
Make sure construction vehicles are maintained and serviced to prevent oil and fuel leaks.
Emergency on-site maintenance should be done over appropriate drip trays and all oil or fuel must be disposed of according to waste regulations. Drip-trays must be placed under vehicles and equipment when not in use.</td></tr>
<tr><td>Damage to plant life outside of the proposed development areas.</td><td>17.16.</td><td>Construction activities should be restricted to the development footprint area. All workers must be trained before construction commences.</td></tr>
</table>

Rehabilitation of site after construction	17.17. Bare surfaces should be grassed as soon as possible after construction to minimise time of exposure. Locally occurring, indigenous runner grasses should be used. 17.18. All re-seeding activities will be undertaken at the end of the dry season (middle to end September) to ensure optimal conditions for germination and rapid vegetation establishment. 17.19. The rehabilitated and seeded areas must be harrowed after spreading the topsoil and fertilizer uniformly. 17.20. Inspect rehabilitated area at three monthly intervals during the first and second growing season to determine the efficacy of rehabilitation measures. 17.21. Take appropriate remedial action where vegetation establishment has not been successful or erosion is evident. 17.22. Only locally indigenous vegetation is to be used for rehabilitation.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	high	long-term	almost certain	3
After Mitigation	-	local	low	long-term	moderate	1

12.9 Fauna - General

Permanent inundation caused by the reservoirs (Smithfield Dam and balancing dam) will flood terrestrial habitat within the basin and the riparian zone, and will affected ecosystem connectivity. Depending on whether the basin will be de-bushed, certain slower moving animals may drown with the onset on inundation. Further ecosystem disruption may occur downstream of the dam wall along the tributary’s banks (riparian area), which are usually associated with rich biodiversity.

Natural habitats will also be lost where clearing is done within the construction areas, especially along the wetlands, grasslands and riparian vegetation. Fauna could also be adversely affected through construction-related activities (noise, illegal poaching, and pollution of the biophysical environment). It is expected that sensitive fauna will move away from the area during the construction area phase.

Search, rescue and relocation needs to be conducted taking into consideration red data, protected and endangered fauna species (amongst others). All relocations will need to comply with the requirements of EKZNW, in terms of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) and Natal Nature Conservation Ordinance (15 of 1974).

The EMPr includes measures to manage the potential adverse impacts to fauna associated with the construction activities.

12.9.1 *Impact Assessment*

Environmental Feature	18. Fauna
Relevant Alternatives & Activities	**All project components and associated activities located in sensitive terrestrial ecological areas**
Project life-cycle	**Pre-construction, construction & operational phases**
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Loss of habitat and animals of conservation significance through construction activities or inundation.	18.1. Search, rescue and relocation of red data, protected and endangered species. 18.2. Stringent and dedicated control of poaching. No fishing allowed. No wilful harm to any animals, unless a direct threat is posed to a worker's health or safety.
Loss of livestock.	18.3. Proper access control to be maintained to prevent livestock from accessing construction areas.
Disturbance of animals found on site during construction.	18.4. Faunal species encountered during construction and which are at risk of being harmed or self-injury should be removed from the immediate site and relocated to an adjacent, suitable area. 18.5. Captured animals to be safely released to a similar representative habitat. 18.6. In order to prevent fauna falling into excavations suitably designed barriers or covers need to be used when excavated pits remain open. 18.7. Proper access control to be maintained to prevent livestock from accessing construction areas.
Habitat lost during clearing for the construction works.	18.8. During site preparation, special care must be taken during the clearing of the works area to minimise damage or disturbance of roosting and nesting sites.
Habitat fragmentation and reduction of ecological functioning.	18.9. Where possible, the construction activities should be restricted to one area at a time as this will give the smaller mammals and reptiles a chance to weather the disturbance in an undisturbed zone close to their natural territories.
Noise disturbances and vibrations during blasting.	18.10. Red data mammal species such as Oribi could be affected and displaced by vibrations. Undertake controlled blasting.
Rehabilitation of the site after construction activities	18.11. As much vegetation growth as possible should be promoted within the proposed development site in order to protect soils and to reduce the percentage of the surface area which is left as bare ground. In this regard special mention is made of the need to use indigenous vegetation species as the first choice during landscaping.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	high	long-term	likely	3
After Mitigation	-	local	low	long-term	unlikely	1

12.10 Avifauna

12.10.1 General

Findings from the Avifauna Study (Wildskies, 2015) follow.

This project is situated in an area of generally high avifaunal sensitivity, as discussed in **Section 11.1.8**. Further In particular the following aspects require careful consideration:

- The construction of the deviation of the R617 road will pose a risk to avifauna in the Impendle Nature Reserve and Important Bird Area during construction, and will remove a certain amount of natural habitat. The habitat alteration is inevitable and cannot be mitigated significantly. We recommend at least a formal consultation of BirdLife South Africa (with respect to the Important Bird Area) and Ezemvelo KwaZulu-Natal Wildlife with respect to the Nature Reserve. The risk of disturbance of breeding birds in the reserve, particularly Blue Swallows, during construction of the road is high. We recommend that more details regarding the noise created by these activities be made available and that this aspect be discussed further. Since construction associated disturbance of Blue Swallows breeding is a common high risk aspect for this project (see below), we recommend additional study into this particular aspect.
- The drilling and excavation of the tunnel (inlets) poses a high risk to Blue Swallows breeding above on the surface. Again we recommend that more details regarding the noise created by these activities be made available and that this aspect be discussed further. At this stage we recommend that no drilling be undertaken during the Blue Swallows breeding season (September to March – exact dates to be confirmed by specialist during the relevant seasons). Since construction associated disturbance of Blue Swallows breeding is a common high risk aspect for this project, we recommend additional study into this particular aspect.
- The construction of the balancing dam and associated infrastructure is in a sensitive area for avifauna. Blue Swallow is the primary bird species of concern since there are so few breeding pairs left in South Africa, and it is a species known to be susceptible to disturbance. This project is also sited in a core area for the species. Once again, although some habitat will be destroyed by the construction activities and dam inundation, the greater concern is the disturbance of breeding Blue Swallows. We

recommend that no construction takes place during the Blue Swallows breeding season (September to March – exact dates to be confirmed by specialist during the relevant seasons).

In the avifauna specialist's opinion, there are several aspects of this project for which more technical detail and discussion is required before this report can be finalised. These discussions may prompt more focused studies, such as into the Blue Swallow's likely sensitivity to noise and vibration and acceptable parameters for this.

12.10.2 Impact Assessment

Environmental Feature	**19. Avifauna**
Relevant Alternatives & Activities	**All project components and associated activities located in sensitive avifauna areas**
Project life-cycle	**Construction and operational phases**
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Habitat destruction during construction of proposed development	19.1. Conduct thorough avifaunal walk through of all project components prior to construction, to identify any areas of particularly high sensitivity and requiring management during construction. This will include the identification of any sensitive bird species breeding sites and the development of case specific management measures for these sites. 19.2. At the balancing dam it is recommended further formal consultation with EKZNW be undertaken on this specific point. It is recommended that the option of offsets be discussed as a management measure for both the habitat destruction and disturbance impacts on the Blue Swallow. 19.3. BirdLife SA and EZKZW to be consulted formally about the acceptability of the R617 road deviation taking place in the Impendle Important Bird Area and Nature Reserve respectively. 19.4. Technical information on the extent to which road construction will increase ambient noise levels in the area – noise and vibration monitoring programme to include avifauna sensitivity.

Project component	Management Measures	+/- impact	Extent	Magnitude	Duration	Probability	Significance
Smithfield dam	Before mitigation	-	Regional	Medium	Permanent	Almost certain	2*
	After mitigation	-	Regional	Medium	Permanent	Almost certain	2*
Balancing dam & associated infrastructure	Before mitigation	-	Regional	High	Permanent	Almost certain	3*
	After mitigation	-	Regional	High	Permanent	Almost certain	3*
Raw water conveyance tunnel	Before mitigation	-	Regional	Low	Permanent	Almost certain	1
	After mitigation	-	Regional	Low	Permanent	Almost certain	1
Road infrastructure, borrow pits, quarries, power lines & other minor components	Before mitigation	-	Regional	High for R617 deviation	Permanent	Almost certain	3*
	After mitigation	-	Regional	High for R617 deviation	Permanent	Almost certain	3*

* For those impacts that remain significant after mitigation a noise and vibration monitoring programme is required which needs to include the following:

- Conduct thorough avifaunal walk through of all project components prior to construction, to identify any areas of particularly high sensitivity and requiring management during construction;
- Engage further with EKZNW and BirdLife SA, EWT and other relevant parties;
- Establish baseline noise and vibration values in sensitive avifauna areas;
- Active monitoring of Blue Swallow nests in the project area for the remainder of the project life-cycle (as deemed necessary);
- Determine appropriate noise and vibration thresholds and areas of influence (impact area) to prevent disturbances to sensitive species; and
- Identify mitigation measures to attenuate noise and vibration to supplement those measures included in the EMPr.

Environmental Feature	20. Avifauna
Relevant Alternatives & Activities	All project components and associated activities located in sensitive avifauna areas
Project life-cycle	Construction and operational phases
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Disturbance of birds during the construction & operation of proposed development	20.1. Conduct thorough avifaunal walk through of all project components prior to construction, to identify any areas of particularly high sensitivity and requiring management during construction. This will include the identification of any sensitive bird species breeding sites and the development of case specific management measures for these sites. 20.2. No construction activities should take place at the balancing dam during Blue Swallow breeding season (typically September to March, but exact dates to be confirmed by avifaunal specialist in relevant season). 20.3. No tunnel drilling activities or surface construction activities should take place in the easternmost 15km of the tunnel route during Blue Swallow breeding season (typically September to March, but exact dates to be confirmed by avifaunal specialist in relevant season). 20.4. BirdLife SA and EZKZW to be consulted formally about the acceptability of the R617 road deviation taking place in the Impendle Important Bird Area and Nature Reserve respectively. 20.5. Investigate extent to which road construction will increase ambient noise levels in the Impendle Important Bird Area and Nature Reserve.

Project component	Management Measures	+/- impact	Extent	Magnitude	Duration	Probability	Significance
Smithfield dam	Before mitigation	-	Local	Low	Short term	Moderate	1
	After mitigation	-	Local	Low	Short term	Moderate	1
Balancing dam & associated infrastructure	Before mitigation	-	International – Blue Swallow is a migrant critically endangered species	High	Short term	Likely	3

Project component	Management Measures	+/- impact	Extent	Magnitude	Duration	Probability	Significance
	After mitigation	-	International – Blue Swallow is a migrant critically endangered species	Low	Short term	Unlikely	1
Raw water conveyance tunnel	Before mitigation	-	International – Blue Swallow is a migrant critically endangered species	High	Short term	Likely	3
	After mitigation	-	International – Blue Swallow is a migrant critically endangered species	Low	Short term	Unlikely	1
Road infrastructure, borrow pits, quarries, power lines & other minor components	Before mitigation	-	Local	Low	Short term	Moderate	2
	After mitigation	-	Local	Low	Short term	Moderate	1

Environmental Feature	**21. Avifauna**
Relevant Alternatives & Activities	**All project components and associated activities located in sensitive avifauna areas**
Project life-cycle	**Construction and operational phases**
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Electrocutions & collision of birds on overhead power lines	21.1. Use only a bird (including vulture) friendly Eskom approved pylon structure may be used with any construction of new overhead line. This must include at least 2 000mm phase-phase and phase-earth clearance to allow safe perching of Cape Vultures and large eagles. If a monopole structure is used a Bird Perch must be fitted on every pole top to provide safe perching area for large birds above dangerous hardware. 21.2. Conduct a thorough avifaunal walk through prior to construction to identify those sections of power line posing a bird collision risk. These sections of power line will need to be installed with a suitable Eskom approved line marking device in order to make it more visible to birds. On 88kV lines these are typically installed on the earth wire. These should be installed at a maximum of 10m spacing, for the entire length of the span (not only the middle 60% as previously believed), and light and dark colour devices should be alternated in order to provide contrast against both dark and light backgrounds. It will be Eskom's responsibility to ensure that these devices remain intact and effective for the power lines full lifespan. Any defective devices must be replaced timeously.

Project component	Management Measures	+/- impact	Extent	Magnitude	Duration	Probability	Significance
Overhead power line deviation at Smithfield dam	Before mitigation	-	Local	High	Permanent	Likely	2
	After mitigation	-	Local	Low	Permanent	Unlikely	1

12.11 Biodiversity Offsets

12.11.1 Terrestrial Ecological Impact Assessment

Various Biodiversity Offset Guidelines were reviewed as part of the Terrestrial Ecological Impact Assessment. Although isolated portions of the Smithfield Dam basin fall within CBA 2, which are associated with high biodiversity, the majority of the inundated areas and footprint of the physical infrastructure are areas which have been transformed through agricultural activities, gravel roads, alien plant species, weeds and exotic plants. Portions of the balancing dam options which fall within CBA1 have been transformed through maize fields and pine plantations. It is expected that similar habitat as is encountered within the dam basin is readily available in the greater area (characterised by a rural landscape) to allow for the habitation of relocated species, without resulting in competition with similar species for resources (depending on the conditions of the receiving habitat).

12.11.2 Aquatic Impact Assessment

The overall loss of wetland and riparian habitat due to inundation of the valleys following construction of the dams has been quantified and mapped. Approximately 135 ha of riparian vegetation and 55 ha of wetland habitat will be lost with the construction of Smithfield Dam. Approximately 44 ha and 59 ha of wetland habitat will become inundated with the completion of Langa and Mbangweni Balancing Dams, respectively. In addition, the Smithfield Dam FSL inundates approximately 17 km of the uMkhomazi River (main stem).

The study recommended that offset mitigation measures be considered to compensate for the inevitable loss of ecologically important aquatic habitat. This should consider improving catchment management in the form of erosion management or education of local subsistence farmers that may result in a more sustainable use of the resources.

12.11.3 Ecological Infrastructure

Ecological Infrastructure is the functioning ecosystems, within landscapes, that provide environmental services which contribute positively to the economy and human welfare.

Ecological Infrastructure is the nature-based equivalent of built or hard infrastructure, and can be just as important for providing services and underpinning socio-economic development. Ecological infrastructure does this by providing cost effective, long-term solutions to service delivery that can supplement, and sometimes even substitute, built infrastructure solutions. Ecological Infrastructure includes healthy mountain catchments, rivers, wetlands, coastal dunes, and nodes and corridors of natural habitat, which together form a network of interconnected structural elements in the landscape.

The goods and services provided by aquatic ecosystems include:

- Improve water quality through filtering and purifying water, trapping sediment, controlling erosion (thereby minimising excessive sedimentation) and recharging aquifers;
- Increase water quantity through storing flood waters and supporting stream base flow during the dry season;
- Provide a wildlife habitat for amphibians, birds, fish and mammals for all or portions of their life cycles;
- Provide water for agricultural, industrial and domestic use;
- Attenuate and regulate floods;
- Provide food and medicinal plants;
- Transport and / or purify biodegradable wastes;
- Support tourism, recreational and cultural use; and
- Enhance property values

The identification and mapping of ecological infrastructure within KZN is currently in its infancy and requires input from a number of sectors and levels of government (EKZNW, 2014c). There are a range of ecological infrastructure categories that need to be considered, but initial focus has been placed on water production areas due to its importance within the biodiversity social and economic sectors, and the fact that South Africa is a water scarce country.

It is recommended that the promotion of ecological infrastructure be taken forward as part of biodiversity offset for uMWP-1. An example of a critical intervention to support ecological infrastructure is the rehabilitation of eroded areas and reinstatement of suitable ground cover in the uMkhomazi catchment.

12.11.4 Extension of the Impendle Nature Reserve

During a meeting held with EKZNW on 16 March 2015, the following matters were discussed (amongst others):

- The possibility of extending the boundary of the Impendle Nature Reserve to include Smithfield Dam was identified as unfeasible due to maintenance problems, liability issues and high risk of roadkills along the deviated R617; and
- EKZNW suggested that land under the Protected Area Expansion Programme that is representative of the Impendle Nature Reserve be considered further for biodiversity offsets. Land adjacent to the reserve could also be considered.

12.12 Agriculture

12.12.1 General

From the Scoping exercise the following impacts in terms of agriculture in the study area where identified:

- Smithfield Dam:
  - Damming of a section of the uMkhomazi River will impact on subsistence farming undertaken within the FSL on Traditional Authority and state-owned land.
  - The loss of grazing land by the impoundment may place additional pressure on the remaining grazing resources.
  - Many local households in the Traditional Authority area keep cattle and goats. Livestock currently have access to the uMkhomazi and Luhane Rivers for drinking purposes. If the dam is to be fenced off, then alternative watering points would need to be established for livestock.
- Raw Water Conveyance Infrastructure:
  - The raw water pipeline route options traverse cultivated land and forestry plantations. Impacts during construction (clearing within the temporary servitude) and operational phase (permanent servitude restrictions) will need to be assessed. It is anticipated that agricultural practices will be able to proceed on top of the raw water pipeline within the servitude, with certain limitations that need to be confirmed.

- Disruptions to farming operations as a result of construction-related use of access roads in the Baynesfield area need to be clearly understood and mitigated.

❖ Balancing Dam:
- The balancing dam affects a portion of cultivated land on the Baynesfield Estate as well timber land that is leased to NCT Forestry Co-operative Limited.
- Disruptions to farming operations as a result of construction-related use of access roads in the Baynesfield area.

The RMP will need to determine future access to the dam for livestock watering and obtaining water for subsistence agriculture.

NCT Forestry Co-operative Limited noted the following concerns with regards to the possible loss of timber land by the project:

❖ *Permitted timber land cannot be replaced in the Umlaas River catchment;*

❖ *The land in question is not only prime timber land but is also suitable as prime agricultural land;*

❖ *NCT lease the said timber area from Baynesfield Estate and as lessee's of the area which has attracted large costs over the years, forecast have been done without taking the loss of timber areas into consideration. This would also have an effect on the lease agreement with Baynesfield Estate; and*

❖ *Forestry land is already under threat from many other different aspects such as power lines, environmental organizations, water projects, roads etc. any loss of timber land is a further loss to the industry.*

The findings from the Agricultural Impact Assessment (Index, 2015) follow.

12.12.2 Smithfield Dam

Land to be inundated by basin

Arable land is mostly located on the western portion of Crowle and along the river on Lot 85. The survey shows that only small portions are now cultivated. Nevertheless, previously cultivated land was also delineated and included in the assessment.

An annual income of R1,67 million is projected for the inundated land of Smithfield Dam. The full financial impact is the capitalised loss over time.

The grazing land that will be inundated is sufficient for 177 LSU.

- The loss cannot be mitigated against. Communal grazing land south of the river is already overstocked. It will require similar grazing land elsewhere.
- Fodder can be produced under irrigation below the dam wall as an alternative to natural veld.

The overall agricultural impact at Smithfield Dam is as follows:

- Loss of 228 hectare high potential arable land -
  - Significance on local community – highly negative (irreplaceable);
  - Significance on regional level – low;
- Loss of 177 LSU grazing -
  - Significance on local community – high (irreplaceable); and
  - Significance on regional level – low.

The RAP must consider the current use of land within the basin, including grazing and agriculture, and identify suitable mitigation measures.

Eskom transmission line

Option 1 will reroute approximately 350 metres, which is across the river. The line will affect 350 metres during construction. The pylons can be positioned so that there will not be a permanent impact on the arable land. Construction will likely last for 2 months, during which grazing will be affected. The impact area is expected to be 30 metres wide – for the 350 metres line, approximately 1 050 m^2 will be affected.

Option 2 will be 15,6 km deviation to get around the dam; 1,2 km arable land will be affected. The effect will be for the duration of construction, which is likely for less than 2 months. If a 30 metres wide strip along the route of the line is impacted, then 40 hectares of grazing and 3,6 hectares of arable land will be affected for a period of 2 months. In addition, the area of the pylon will be permanently affected.

The estimated financial impact is a loss of R28,67 for Option 1 and R12 673 for Option 2 that is limited to the period of construction. *Note that this impact will not necessarily be realised given the rural state of the affected area and the substantive nature of agriculture that is practiced by the community in the traditional area.*

The overall agricultural impact associated with the Eskom transmission line is as follows:

- Temporary loss of high potential arable land -
  - Significance on local community – low;
  - Significance on regional level – low;
- Temporary loss of grazing:
  - Significance on local community – low; and
  - Significance on regional level – low.

Gauging weir

The gauging weirs in both instances are located on the river bank with no potential land use that should be considered. The impact on agriculture is minimal, and will only be for the period that construction takes place. It is not foreseen that dust or any biological factor will influence farming income.

Quarries and borrow areas

The borrow areas will be inundated once the dam is built, and therefore, has no impact on farming. Quarries I and IV are within the dam's buffer zone or will be inundated and will also have no impact on farming.

During construction, however, dust may impact on farming by reducing the carrying capacity of the veld. This can be mitigated by instituting dust suppression measures.

12.12.3 Raw Water Conveyance Infrastructure

Tunnel

The tunnel will have no impact on agriculture. There are, however, impacts at the inlet, central and outlet portals.

Inlet portal

The tunnel inlet portal will be below the buffer zone of the dam and therefore, will have no additional impact on farming. It is also low potential arable land and is only suitable for grazing.

Central portal

A portion of the main tunnel in the vicinity of the central access will be enlarged to a 7,5 m span to facilitate the assembly and dismantling of the TBM. This enlargement will be required over a length of 40 to 50 m. This area will also be utilised for the storage of conveyor belting, pre-cast lining segments, ventilation ducts and services. The central portal will impact on 0,5 hectares of forestry and 4,9 hectares of grazing (at 3 ha/LSU, this is 1,63 livestock units).

Outlet portal

Approximately 7,3 hectares of grazing will be lost at the tunnel outlet. The soil potential of this portion is low and is not arable.

It is estimated that R12 389 will be lost per year for the period that construction takes place.

Spoil site – tunnel outlet

If the spoil material is not disposed of in the building of the balancing dam's wall the disposal area will affect 9,6 ha of high potential land that is currently used for crop production.

Raw Water Pipeline

It is assumed that a total width of 30 metres along the pipeline route will be impacted on for the period that construction takes pace and that the period of construction will be 3 months. It is further assumed that where the pipe is installed, crops will not be planted that season. Plantations will be harvested before construction takes place and then re-established the following year.

Agricultural impacts associated with the raw water pipeline include:

- Temporary loss of high potential arable land -
  - Significance on local community – low (temporary loss of income);
  - Significance on regional level – low (temporary loss of income);
- Temporary loss of grazing -
  - Significance on local community – low; and
  - Significance on regional level – low.

12.12.4 Balancing Dam

General

There are two options:

- Mbangweni Dam will cover 185 ha of mostly high potential land on a highly productive farm.
- Langa Dam will cover 144 ha, covering medium potential land on the south western portion, while the rest is highly productive.

Road – Balancing Dam

Two routes are proposed, both follow existing alignments. Option 2 deviates for approximately 134 m to cross a small watercourse. This rerouting will have a temporary impact for as long as the old road will need to return to its natural state. The road is approximately 15 metres wide (road and verge).

The total area affected will, therefore, be 0,2 hectares (2 010 m^2). The impact on farming will be minimal.

Quarries & borrow areas

The quarry and borrow areas will be inundated if Langa Dam is chosen, and will therefore, have no impact on farming. In the case that Mbangweni Balancing Dam is built, the quarry will be partially submerged when the dam is full.

During construction, however, dust may impact on farming by reducing the carrying capacity of the veld. This can be mitigated by instituting dust suppression measures.

12.12.5 Summary

The main impact on agriculture is the loss of high potential land and of grazing land. In the case of high potential land, on a national level, it is irreplaceable. On a local level, it can be replaced by buying new land and then making it available to the person experiencing the loss. For land owners with title to the land, this is easily achieved, but where the land is communal, the problem is more complex.

The grazing land along the right side of the river at Smithfield Dam is communal, and even the stubble on the arable land is collectively used during the off-season. Because the land is already overgrazed, the net effect will be that less animals can be kept by the affected community.

In essence, the loss of high potential arable land cannot be mitigated, but the loss on income to the land users can be, by compensating them for the loss of income. For this reason, the impact assessment focussed on the financial implications of the development.

12.12.6 Impact Assessment

General

- The loss of cultivated land on Baynesfield Estate needs to be considered in terms of the impact to the current agricultural operations and the provision of feed for the piggery. Compensation measures will need to be evaluated in close consultation with the affected parties.
- The RMP will need to determine future access to the dam for livestock watering and obtaining water for subsistence agriculture.
- Loss of land used for timber plantation by NCT Forestry Co-operative Limited. DWS to investigate providing an entitlement to this party for undertaking forestry for the same are lost in another suitable area.

Specialist Study

The tables to follow were extracted from the Agricultural Impact Assessment (Index, 2015).

Table 99: Agricultural Impact Assessment (Index, 2015)

	Potential impact	Proposed Management Objectives / Mitigation Measures	Extent	Magnitude	Duration	Probability	Significance	Area lost	Annual value of loss	Value of loss (short term)
1	**INUNADATION DUE TO DAM CONSTRUCTION**									
1.1	**Loss of high potential arable land**									
	Before mitigation	Loss of farming land	Local	High	Permanent	Certain	3	228	R 761 064	R 761 064
	After mitigation	Mitigation in terms of loss of a resource is not possible. It will only impact other people if land outside is obtained. As far is the affected party is concerned, there are three options: 1) Purchase land to replace the loss. 2) Compensate the land used annually for the loss in income, and 3) negotiate a lump sum to compensate for the income					3			
1.2	**Loss of grazing land**									
	Before mitigation	Loss of grazing land (177lsu)	Local	High	Permanent	Certain	3	630	R 913 851	R 913 851
	After mitigation	Mitigation in terms of loss of a resource is not possible. It will only impact other people if land outside is obtained. As far is the affected party is concerned, there are three options: 1) Purchase land to replace the loss. 2) Compensate the land used annually for the loss in income, and 3) negotiate a lump sum to compensate for the income					3			
2	**CONSTRUCTION OF THE ESCOM TRANSMISSION LINE**									
2.1	**Loss of high potential arable land**									
	Before mitigation									
	Option 1	No land will be lost	Local	Low	Short term	Certain	0	0		
	Option 2	Approximately 3,6 hectares will be influenced for the construction period of probably less than 2 months.	Local	Low	Short term	Certain	1	3.6ha	R 0	R 1 202
	After mitigation									
	Option 1	Keep the construction period as short as possible	Local	Low	Short term	Certain	0			

	Potential impact	Proposed Management Objectives / Mitigation Measures	Extent	Magnitude	Duration	Probability	Significance	Area lost	Annual value of loss	Value of loss (short term)
	Option 2	Keep the construction period as short as possible	Local	Low	Short term	Certain	1			
2.2	**Loss of grazing land**									
	Before mitigation									
	Option 1	Less than 0,1 ha will be influenced for the construction period of probably less than 2 months.	Local	Low	Short term	Certain	0	0.1ha	R 29	R 29
	Option 2	Approximately 40 hectares will be influenced for the construction period of probably less than 2 months. Only the area on which the pylon stands will be lost permanently.	Local	Low	Short term	Certain	3	40 short term	R 0	R 11 471
	After mitigation									
	Option 1	Keep the construction period as short as possible	Local	Low	Short term	Certain	0			
	Option 2	Keep the construction period as short as possible	Local	Low	Short term	Certain	3			
3	**CONSTRUCTION OF THE GAUGING WEIR**									
3.1	**Loss of high potential arable land**									
	Before mitigation	Loss of farming land	Local	None	Short term	Certain	0	0	R 0	R 0
	After mitigation						0	0		R 0
3.2	**Loss of grazing land**									
	Before mitigation	Loss of grazing	Local	None	Short term	Certain	0	0	R 0	R 0
	After mitigation						0	0	R 0	R 0
4	**RAW WATER PIPELINE**									
4.1	**Loss of high potential arable land***									
	Before mitigation									
	Option 1	Loss of income during the construction period	Local	Low	Short term	Certain	3	12.1		R 249 491
	Option 2	Loss of income during the construction period	Local	Low	Short term	Certain	3	15.6		R 190 130
	Option 3	Loss of income during the construction period	Local	Low	Short term	Certain	3	32.9		R 369 384

	Potential impact	Proposed Management Objectives / Mitigation Measures	Extent	Magnitude	Duration	Probability	Significance	Area lost	Annual value of loss	Value of loss (short term)
	After mitigation									
	Option 1	No mitigation possible	Local	Low	Short term	Certain	2	12.1		R 249 491
	Option 2	No mitigation possible	Local	Low	Short term	Certain	2	15.6		R 190 130
	Option 3	No mitigation possible	Local	Low	Short term	Certain	2	32.9		R 369 384
4.2	**Loss of grazing land**									
	Before mitigation									
	Option 1	Loss of income during the construction period	Local	Low	Short term	Certain	3	5.3		R 9 067
	Option 2	Loss of income during the construction period	Local	Low	Short term	Certain	3	6.7		R 11 467
	Option 3	Loss of income during the construction period	Local	Low	Short term	Certain	3	6.9		R 11 867
	After mitigation									
	Option 1	Compensate the land owner for the loss of income	Local	Low	Short term	Certain	2	5.3		R 9 067
	Option 2	Compensate the land owner for the loss of income	Local	Low	Short term	Certain	2	6.7		R 11 467
	Option 3	Compensate the land owner for the loss of income	Local	Low	Short term	Certain	2	6.9		R 11 867
5	**WASTE DISPOSAL TUNNEL OUTLET**									
5.1	**Loss of high potential arable land**	Disposal site will be inundated. The impact is discussed under the Balancing Dam. There is no additional impact.								
5.1	**Loss of grazing land**	Disposal site will be inundated. The impact is discussed under the Balancing Dam. There is no additional impact.								
6	**BALANCING DAM**									
6.1	**Loss of high potential arable land**									
	Before mitigation									
	Option 1 (Mbangweni)	It will cover 185 hectare on mostly high potential land in is on a highly productive farm.	Local	High	Permanent	Certain	3	100.7	R 2 620 602	
	Option 2 (Langa)	It will cover 144 hectares. The land on the south western portion is medium potential land, while the rest is highly productive.	Local	High	Permanent	Certain	3	80.7	R 2 604 419	

	Potential impact	Proposed Management Objectives / Mitigation Measures	Extent	Magnitude	Duration	Probability	Significance	Area lost	Annual value of loss	Value of loss (short term)
	After mitigation									
	Option 1	Mitigation in terms of loss of a resource is not possible. It will only impact other people if land outside is obtained. As far is the affected party is concerned, there are three options: 1) Purchase land to replace the loss. 2) Compensate the land used annually for the loss in income, and 3) negotiate a lump sum to compensate for the income	Local	High	Permanent	Certain	3			
	Option 2	Mitigation in terms of loss of a resource is not possible. It will only impact other people if land outside is obtained. As far is the affected party is concerned, there are three options: 1) Purchase land to replace the loss. 2) Compensate the land used annually for the loss in income, and 3) negotiate a lump sum to compensate for the income	Local	High	Permanent	Certain	3			
6.2	**Loss of grazing land**									
	Before mitigation									
	Option 1		Local	High	Permanent	Certain	3	84.2	R 144 863	
	Option 2		Local	High	Permanent	Certain	3	63.8	R 109 795	
	After mitigation									
	Option 1	Mitigation in terms of loss of a resource is not possible. It will only impact other people if land outside is obtained. As far is the affected party is concerned, there are three options: 1) Purchase land to replace the loss. 2) Compensate the land used annually for the loss in income, and 3) negotiate a lump sum to compensate for the income	Local	High	Permanent	Certain	3			

	Potential impact	Proposed Management Objectives / Mitigation Measures	Extent	Magnitude	Duration	Probability	Significance	Area lost	Annual value of loss	Value of loss (short term)
	Option 2	Mitigation in terms of loss of a resource is not possible. It will only impact other people if land outside is obtained. As far is the affected party is concerned, there are three options: 1) Purchase land to replace the loss. 2) Compensate the land used annually for the loss in income, and 3) negotiate a lump sum to compensate for the income	Local	High	Permanent	Certain	3			
7	**ROAD TO THE BALANCING DAM**									
7.1	Loss of farming land	Two routes are proposed, both follows existing alignments. Option 2 will have to deviate for approximately 134 metres to cross a small watercourse. This rerouting will have a temporary impact for as long as the old road will need to return to its natural state. The road is approximately 15 metres wide (road and verge).	Local	High	Permanent	Certain	3	0.2		
8	**QUARRIES AND BORROW AREAS**									
	Option 1 (Mbangweni)	The quarry will be submerged when the dam is full. No additional impact in addition to the construction of the Balancing dam								
	Option 2 (Langa)	The quarry will be submerged when the dam is full. No additional impact in addition to the construction of the Balancing dam								

** If construction takes place during the growing season*

12.13 Historical and Cultural Features

12.13.1 General

The project could impact on heritage and cultural features as follows:

- Destruction or damage of heritage resources through construction activities; and
- Inundation of heritage resources at Smithfield Dam and the balancing dam.

A Phase 1 Heritage Impact Assessment was conducted in accordance with the KZN Heritage Act (Act No. 04 of 2008). The heritage and cultural resources identified as part of this study are discussed in **Sections 10.16** and **11.1.3**. A Heritage Management Plan for the uMWP-1 Raw Water component was developed by Beater & Prins (2015), which is contained in **Appendix H4**. Mitigation measures for heritage resources are also included in the EMPr.

12.13.2 Impact Assessment

Environmental Feature	**22. Cultural heritage**
Relevant Alternatives & Activities	**Smithfield Dam**
Project life-cycle	**Pre-Construction phase**
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Destruction or damage to cultural heritage sites including structures older than 60 years, traditional graves, LIA sites, etc.	22.1. During construction, if any heritage resources are found (chance finds) the following protocol must be followed: • All work must stop in the vicinity of the find. • The Contractor or ECO must be informed and the find barricaded off to prevent further interference or damage. • Amafa must be informed and a registered heritage specialist must be appointed to undertake an assessment of the find. • Depending of what is found and the significance thereof, the specialist will advise on the way forward. • If the resource needs to be removed/altered/destroyed then the necessary permit/s must be obtained from Amafa. • Only once the specialist gives the go-ahead can work commence in the area. • Under no circumstance can heritage material be destroyed or removed from the site. • Should any remains be found that could potentially be human remains then the SAPS must be contacted.

	+/- Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Before Mitigation	-	Regional	Medium	Permanent	Almost certain	3
After Mitigation	-	Regional	Medium	Permanent	Likely	3

Potential Aspects & Impacts	Proposed Management Objectives / Mitigation Measures
Inundation of Deepdale Bridge	22.2. The bridge is one of the few examples of the early transportation network within KZN. It is recommended that the bridge is not inundated. If this this not possible, then a complete photographic and historic record of the bridge must take place prior to inundation. A permit must be obtained from Amafa in accordance with Regulation 2 of the 2012 Heritage Regulations (as attached) prior to inundation

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	Regional	Medium	Permanent	Almost certain	3
After Mitigation	-	Regional	Medium	Permanent	Likely	3

Potential Aspects & Impacts	Proposed Management Objectives / Mitigation Measures
Inundation of graves in traditional burial places and those not located in formal cemeteries	22.3. A Phase 2 assessment is recommended where the exact location of all graves to be removed is determined as well as the identification of unidentified archaeological sites including rock art sites 22.4. Permits must be obtained from Amafa prior to the relocation of the graves and the process required by Regulation 4 of the Heritage Regulations must be adhered to including consultation with family members, the affected community and relevant municipality (if required)

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	Regional	High	Medium	Almost certain	3
After Mitigation	-	Regional	Medium	Medium	Likely	2

Potential Aspects & Impacts	Proposed Management Objectives / Mitigation Measures
Inundation of LIA structures and historic / other structures	22.5. Several stone structures / outline of structures from the LIA and historic period will be inundated. The sites have been attributed a medium to high significance. Phase 2 AIA is recommended and permit for rescue excavations must be obtained from Amafa in terms of Regulation 2 and 5 of the Heritage Regulations prior to inundation

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	Local	High	Permanent	Almost certain	3
After Mitigation	-	Local	High	Permanent	Likely	2

Environmental Feature	**23. Cultural heritage**
Relevant Alternatives & Activities	**Access roads, tunnel portals, borrow areas (western section)**
Project life-cycle	**Pre-Construction, construction and operational phases**
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Destruction or damage to cultural heritage sites including structures older than 60 years, LIA sites and graves, etc.	23.1. Phase 2 HIA of tunnel portals due to undisturbed condition of areas where portals will be located. 23.2. See protocol for chance finds.
Destruction of drystone wall by realignment of R617	23.3. The drystone wall is one of few surviving examples of that specific farming technique. The deviation of the R617 should be moved more north to avoid impacting on the wall and to follow the existing gravel road. If the above is not possible, the photographic and historical recording of the structure must be undertaken and a permit to destroy that section of the wall must be obtained from Amafa as the structure is well over 60 years. 23.4. A buffer of 15m must be placed around the remainder of the drystone wall to prevent damage by the construction of the R617 deviation. The buffer must be highly visible to construction personnel. 23.5. It is recommended that the buffer becomes permanent in order to avoid damage to the wall during road maintenance or if the road is widened.
LIA / historic period structures	23.6. Structures must be avoided by access roads, quarries, waste disposal areas, etc. The structures must be protected by a 15 m buffer to avoid accidental damage through construction activities. 23.7. If the structures cannot be avoided, application must be made in terms of Regulations 2 and 5

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	Local	High	Permanent	Likely	3
After Mitigation	-	Local	Medium	Permanent	Moderate	2

Environmental Feature	**24. Cultural heritage**
Relevant Alternatives & Activities	**Tunnel, outlet portal, Balancing Dams, pipelines, access roads (central and eastern section)**
Project life-cycle	**Construction & operational phases**
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Destruction or damage to cultural heritage sites including structures older than 60 years, LIA sites and graves, etc.	24.1. Phase 2 HIA of tunnel portals due to undisturbed condition of areas where portals will be located. 24.2. See protocol for chance finds.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	Local	Medium	Short-term	Almost certain	3
After Mitigation	-	Local	Low	Short-term	Unlikely	1

Environmental Feature	25. Archaeological Sites and Features
Relevant Alternatives & Activities	Smithfield Dam, tunnel, access roads, pipelines, Balancing Dams, etc.
Project life-cycle	Pre-construction and Construction phases
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Destruction or damage to archaeological sites and remains	25.1. A Phase 2 AIA is recommended to assess spatial patterns of settlements & significance of archaeological remains. 25.2. Depending on the significance of sites identified, either the sites will need to be recorded and rescued if sites are of high significance or application for destruction will have to be made to Amafa in terms of Regulation 5. 25.3. See protocol for chance finds.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	Local	Medium	Short-term	Likely	3
After Mitigation	-	Local	Low	Short-term	Moderate	2

Environmental Feature	26. Palaeontology
Relevant Alternatives & Activities	Smithfield Dam, access roads; inlet portal of tunnel, etc. (western section)
Project life-cycle	Pre-construction and Construction phases
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
• Inundation of fossils by Dam • Destruction or damage to fossils unearthed during construction process	26.1. A Phase 2 PIA is required where specialists will go to site as there is a high possibility of finding fossil plants in the project area. 26.2. See protocol for chance finds.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	Local	High	Short-term	Almost certain	3
After Mitigation	-	Local	Low	Short-term	Unlikely	2

Environmental Feature	27. Palaeontology
Relevant Alternatives & Activities	Tunnel; outlet portal, pipelines, access roads, Balancing Dams, etc. (central and eastern sections)
Project life-cycle	Pre-construction and Construction phases
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Destruction or damage to fossils unearthed during construction process	27.1. See protocol for chance finds.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	Local	Low	Short-term	Unlikely	2
After Mitigation	-	Local	Low	Short-term	Remote	1

12.14 Air Quality

12.14.1 General

The following observations are made with regards to sensitive noise and dust receptors in the study area:

- Smithfield Dam –
  - Dwellings located on the north-eastern side of the dam could be affected by the construction activities associated with Borrow area B as well as the hauling of material (amongst others).
  - No dwellings are situated closer than 500m from the main dam wall or saddle dam wall, where major construction activities will take place.
- Raw Water Conveyance Infrastructure –
  - Dwellings located on the north-eastern side of the dam could be affected by the construction activities associated with spoil site at the tunnel inlet, as well as the hauling of spoil material (amongst others).
  - Dwellings are located in excess of 700m to the north-east of the central portal and spoil site.
  - Dwellings are located in excess of 700m to the south-east of the outlet portal.
  - The Baynesfield Estate Lodge lies approximately 330m to the north-east of the tunnel outlet and will be affected by construction activities at the outlet portal.
  - The nearest dwelling on The Mynde Farm to the tunnel outlet is situated approximately 750m to the south-east.
  - The nearest dwelling on The Mynde Farm to the tunnel outlet and the western sections of the raw water pipeline route options is situated approximately 750m and 350m, respectively to the south-east.
  - The raw water pipeline to WTW Options 2 passes in close proximity to the Baynesfield Club sports ground as well as residential dwellings (on Portions 65 and 85 of the Farm Nels Rust 849).
  - The raw water pipeline to WTW Options 3 travels past buildings (on Portions 22, 43 and 44 of the Farm Brasfort Park 1295) as well as chicken houses (on Portion 43 of the Farm Hopewell 881).

  - The alternative gauging weir sites are remote and no homesteads, schools, clinics or other sensitive receptors to noise are located nearby.
- Balancing Dam –
  - The Baynesfield Estate Lodge will be affected by construction activities at the Mbangweni Balancing Dam option, and construction traffic on the balancing dam access road option 1 (amongst others).
  - The nearest dwelling on The Mynde Farm to the Mbangweni Balancing Dam option is located approximately 460m to the east.
  - The revised options for the balancing dam access road (refer to **Section 11.3.5.2**) attempt to avoid dwellings. However, local residents could be affected by the noise and dust created by construction-related traffic on the local roads.
  - Dust-intolerant crops such as avocado orchards are located alongside the proposed access road to the tunnel outlet and balancing dam on the Baynesfield Estate.
- The locations of the two proposed hydropower plants are generally remote and no related noise and dust impacts are thus expected.
- Sensitive fauna and flora species (e.g. blue swallows).

It is recommended that the dwellings on the north-eastern side of the dam be relocated prior to construction to avoid construction-related impacts to the occupants.

Dust will be generated during the construction period from various sources, including blasting, tunnelling (outlets), activities at the borrow areas and quarries, operations at the batching plant(s) and crusher area(s), aggregate stockpiles, use of haul roads and access roads, transportation of spoil material to the waste disposal sites, soil stockpiles and general construction activities on site.

As part of impoundment, the dams (Smithfield Dam and the balancing dam) could contribute to greenhouse gas emissions, where inundated plant material that decays in an anaerobic environment will release methane and carbon dioxide. Refer to related discussion in **Section 12.3**.

Mitigation measures are included in the EMPr to ensure that the air quality impacts during the construction phase are suitably monitored (dust fallout and particulate matter) and managed and that regulated thresholds are not exceeded. The EMPr also includes measures to control and minimize greenhouse gas emissions by optimizing the utilisation of construction resources.

12.14.2 Impact Assessment

Environmental Feature	28. Air Quality
Relevant Alternatives & Activities	Construction domain of all project infrastructure
Project life-cycle	Construction phase
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Excessive dust levels as a result of construction activities	28.1. Appropriate dust suppression measures or temporary stabilising mechanisms to be used when dust generation is unavoidable (e.g. dampening with water, chemical soil binders, straw, brush packs, chipping), particularly during prolonged periods of dry weather. Dust suppression to be undertaken for all bare areas, including construction area and access roads. Note that all dust suppression requirements should be based on the results from the dust monitoring and the proximity of sensitive receptors. 28.2. Speed limits to be strictly adhered to. 28.3. The Contractor will take preventative measures to minimise complaints regarding dust nuisances (e.g. screening, dust control, timing, pre-notification of affected parties). 28.4. Air quality to be monitored (baseline and during construction) for dust fallout and particulate matter. Sampling locations to consider major sources of dust and sensitive receptors. 28.5. Provide suitable cover for the road surface for the access road to the tunnel outlet and balancing dam on Baynesfield Estate.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	medium	short-term	likely	2
After Mitigation	-	local	low	short-term	unlikely	1

12.15 Noise & Vibration

12.15.1 General

Sensitive noise receptors are noted in **Section 12.13.1**.

During construction, localised increases in noise will be caused by blasting, activities at the borrow areas and quarries, operations at the batching plant(s) and crusher area(s), vehicles on haul roads and access roads, and general construction activities on site. Vibration would be felt close to construction equipment.

Noise and vibration impacts to sensitive avifauna, in particular the blue swallows, required specific attention as noted in the Avifauna Study Report (Wildskies, 2015) (refer to **Appendix H8** and **Section 12.9**).

Major construction activities will occur in the Baynesfield area, which will be associated with the tunnel outlet, hauling of spoil material to the waste disposal site and the construction of the balancing dam and raw water pipeline. This may cause a nuisance to the surrounding homesteads located on The Mynde Farm and Kyalami Farm.

Excavation of the outlet portal of the Umkhomazi-Umlaza Tunnel will be carried out with soil movement excavation machinery only. The portal face and parts of the bottom of the excavation will be formed in rock from approximately 50m away from the toe of the mountain and 200m into the mountain and limited drill and blasting techniques may be used. Controlled blasting to take place.

Noise that emanates from construction and operational activities will be addressed through targeted best practices for noise monitoring and management in the EMPr. The associated regulated standards need to be adhered to.

Project personnel working on the construction site will experience the greatest potential exposure to the highest levels of noise and vibration. Workplace noise and vibration issues will be managed as part of the Occupational Health and Safety Management System to be employed on site, which will include specific measures aimed at preventing hearing loss and other deleterious health impacts.

12.15.2 Impact Assessment

Environmental Feature	29. Noise
Relevant Alternatives & Activities	Construction domain of all project infrastructure
Project life-cycle	Construction phase
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Excessive noise levels as a result of construction activities.	29.1. The provisions of SANS 10103:2008 will apply to all areas within audible distance of residents. 29.2. Working hours to be agreed upon with Project Manager, so as to minimise disturbance to landowners/occupiers and community members. 29.3. Construction activities generating output levels of 85 dB or more will be confined to normal working hours. 29.4. Noise preventative measures (e.g. screening, muffling, timing, pre-notification of affected parties) to be employed. 29.5. Blasting operations to be controlled to ensure sound pressure levels are kept below the generally accepted 'no damage' level of 140 decibels. 29.6. Survey potentially affected structures prior to and after blasting. 29.7. Noise to be monitored (baseline and during construction). Sampling locations to consider major noise sources and sensitive receptors.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	medium	short-term	likely	2
After Mitigation	-	local	low	short-term	unlikely	1

Environmental Feature	30. Vibration
Relevant Alternatives & Activities	Tunnel, Balancing Dam
Project life-cycle	Construction phase
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Excessive vibrations as a result of construction activities.	30.1. Monitoring and management of vibrations. 30.2. Vibrations to remain within set limits. 30.3. Identify blast and vibration attenuation features. 30.4. Develop vibration limits for sensitive avifauna species in consultation with EKZNW and avifauna specialist. 30.5. Vibrations to be monitored (baseline and during construction). Sampling locations to consider major noise sources and sensitive receptors. 30.6. Undertake controlled blasting using lower chargers controlled by the peak particle velocity in rock to 12 m/s 30m away from the blasting front, in sensitive areas.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	medium	short-term	likely	2
After Mitigation	-	local	low	short-term	unlikely	1

12.16 Socio-Economic Environment

12.16.1 General

The socio-economic environment in the western portion of the study area varies significantly from the eastern portion, where the former falls under a Traditional Authority area and state land and the latter consists of private land. For this reason, the explanation to follow regarding the possible impacts of the project is split.

Western part of study area -

- Possible impacts to the socio-economic environment during the construction phase include (amongst others):
  - Relocation of access roads;
  - Loss of land through inundation (Smithfield Dam) and project infrastructure;
  - Risk to livestock;
  - Nuisance from dust and noise; and
  - Influx of people seeking employment and associated impacts (e.g. foreign workforce, cultural conflicts, squatting, demographic changes, anti-social behavior, and incidence of HIV/AIDS).
- From the Socio-Economic Survey it was found that there are at least 28 dwellings situated within the Smithfield Dam's buffer zone. These households would need to be relocated to another suitable area. Any development on Traditional Authority land at the Smithfield Dam site, which includes the project infrastructure and appurtenant works, would be subject to the consent of the Traditional Authority and the Ngonyama Trust Board. The landowners would need to be appropriately compensated for the acquisition of the land. Compensation would also be required for the relocation of graves, including exhumation and reburial.
- The dependence of the local community on the reach of the uMkhomazi River that will be inundated, which may include obtaining water for domestic purposes, irrigation and stock watering, will need to be evaluated as part of the RAP.
- The reservoir could become a breeding ground for disease vectors, such as mosquitoes and snails. If necessary, a monitoring plan will be considered as part of the Operational EMPr.

- The status of land claims needs to be assessed and resolved before the project can proceed.
- On a positive note, employment opportunities will be created during the construction phase, with accompanying skills transfer. Where possible, goods and services will also be sourced locally during construction.

Eastern part of study area -

- Possible impacts to the socio-economic environment during the construction phase include (amongst others):
  - Loss of land through inundation (balancing dam) and project infrastructure;
  - Safety and security;
  - Use of local road network;
  - Nuisance from dust and noise;
  - Impacts to tourism and environmental education activities at The Baynesfield Estate Lodge;
  - Impact to visual quality and sense of place; and
  - Light pollution.

Following a RMP process to determine the possibility of allowing recreational use at Smithfield Dam, coupled with the proximity of the dam to the Impendle Nature Reserve, tourism activities may increase in this area.

Substantial infrastructure in terms of uMWP-1 Raw Water and Potable Water (namely the tunnel outlet, balancing dam, raw water pipeline, WTW and potable water pipeline) is proposed in the Baynesfield area and surrounding private agricultural land. This may affect the sense of place of the receiving environment.

12.16.2 Social Impact Assessment

An extract from the Social Impact Assessment (Dr Neville Bews & Associates, 2016) follows.

Categories and social impacts variables considered across the project include:

1. Health and social well-being impacts;
2. Quality of the living environment (Liveability) impacts;
3. Economic and material well-being impacts (positive);
4. Economic and material well-being impacts (negative);
5. Cultural impacts;
6. Family and community impacts;
7. Institutional, legal, political and equity impacts; and
8. Gender relations impacts.

These categories are not exclusive and at times tend to overlap as certain processes may have an impact within more than one category. For instance changes to the division of labour, as discussed under the category gender relations, will also have an impact on the family and community. In much the same manner increased demand on existing infrastructure, facilities and social service, addressed under the category institutional, legal, political and equity, will have some bearing on the quality of the living environment.

With regard to large dam projects most social impacts are experienced during the construction phase, as this is when processes such as relocation and construction related activities, resulting in the influx of labour and the use of heavy machinery and explosives, occur. The seven categories listed above are addressed below as they apply across the project as a whole.

12.16.2.1 Health and social well-being related impacts

The health and social wellbeing impacts related to the project include:

- Annoyance, dust and noise;
- Increase in crime;
- Increased risk of HIV and AIDS;
- Increased social tensions, conflict or serious divisions within the community;
- Presence of construction workers; and
- Reduced actual personal safety, increased hazard exposure.

12.16.2.2 Quality of the living environment impacts

The following quality of the living environment impacts are related to the project:

- Disruption of daily living;
- Increased population density and crowding;
- Disruptions to social and community infrastructure;
- Reduced adequacy of physical infrastructure;
- Reduced quality of housing; and
- Reduction in perceived quality of life.

12.16.2.3 Economic and material well-being impacts (negative)

The negative economic and material well-being impacts associated with the project include.

- Relocation of households;
- Deteriorating economic situation; and
- Decreased autonomy, independence, security of livelihoods.

12.16.2.4 Economic and material well-being impacts (positive)

The positive economic and material well-being impacts associated with the project include:

- Increase in employment opportunities; and
- Increased opportunities for SMMEs.

Other economic changes which will occur during construction and which will lead to positive impacts are addressed in the Socio-economic Report (Nemai Consulting, 2016a).

12.16.2.5 Cultural impacts

Numerous sensitive cultural heritage and archaeological sites, which fall within and around the FSL of the Smithfield Dam, were identified during a Heritage Impact Assessment (Beater & Prins, 2015).

Apart from this, and on a social basis, the following processes also need to be considered:

- Diminished cultural integrity
- Loss of rights over and access to natural resources
- Changes in movement patterns

12.16.2.6 Family and community impacts

Both the displacement of people as well as the influx of construction workers will have an impact on families and the sense of community within the vicinity of the project. These impacts are likely to include:

- Disruption to family structures and social networks; and
- Changed attitudes towards local communities and the level of satisfaction with the neighbourhood.

12.16.2.7 Institutional, legal, political and equity impacts

The institutional, legal political and equity impacts associated with the project include:

- Increased demand on existing infrastructure facilities and social services;
- Attitude formation towards project;
- Decreased level of community participation in decision making, loss of empowerment; and
- Disaster management.

12.16.2.8 Gender relations impacts

The gender relationships associated with the project may include.

- The burden of resettlement;
- Cultural resistance towards women; and
- Division of labour.

12.16.2.9 Impact Assessment

The tables to follow were extracted from the Social Impact Assessment (Dr Neville Bews & Associates, 2016).

Environmental Feature	31. Health and Social Well-Being
Relevant Alternatives & Activities	Raw Water Component – Smithfield Dam Area and Conveyance Infrastructure
Project life-cycle	Construction & operational phases

Potential Impact	Proposed Management Objectives / Mitigation Measures
Annoyance, dust and noise	31.1. Apply the dust suppression and noise reduction mitigation measures recommended in the EMPr.
Increase in crime	31.2. Ensure that construction workers are clearly identifiable. All workers should carry identification cards and wear identifiable clothing.
	31.3. Fence off all construction sites and control access to these sites.
	31.4. Clearly mark any hazardous areas and regularly monitor these areas to ensure that they are avoided by people and animals.
	31.5. Liaise with the South African Police Services (SAPS) and Community Policing Forums to ensure that construction sites are monitored.
	31.6. Encourage local people to report any suspicious activity associated with the construction sites.
	31.7. Prevent loitering within the vicinity of the construction camp as well as construction sites.
Increased risk of HIV and AIDS	31.8. Ensure that an onsite HIV and AIDS policy is in place and that construction workers have easy access to condoms.
Increased social tensions, conflict or serious divisions within the community	31.9. Communicate the limitation of opportunities created by the project through the Traditional Authorities and Ward Councillors.
Presence of construction workers	31.10. Draw up a recruitment policy in conjunction with the Traditional Authorities and Ward Councillors of the area and ensure compliance with this policy.
Reduced actual personal safety, increased hazard exposure	31.11. Ensure all construction equipment and vehicles are properly maintained at all times.
	31.12. Ensure that operators and drivers are properly trained and make them aware, through regular toolbox talks, of any risk they may pose to the community. Place specific emphasis on the vulnerable sector of the population such as children and the elderly.
	31.13. Ensure that fires lit by construction staff are only ignited in designated areas and that safety precautions, such as not lighting fires in strong wilds and completely extinguishing fires before leaving them unattended, are strictly adhered to.
	31.14. Make staff aware of the dangers of fire during regular tool box talks.
	31.15. During operation consider the viability of having life guard facilities available, particularly if recreational facilities associated with the dam are developed.
	31.16. Encourage/facilitate swimming lessons within the communities surrounding the dam basins.
	31.17. Consider the viability of fencing off sections of the dam that may pose a risk drowning.
	31.18. During the operational phase ensure that fires are only lit in designated areas and not during the windy season. All fires must also be extinguished before being left unattended. In this regard warning signs must be placed in appropriate areas.
	31.19. Ensure all construction equipment and vehicles are properly maintained at all times.

	Impacts	Extent	Magnitude	Duration	Probability	Significance
Construction Phase						
Before Mitigation	Negative	Regional	High	Short term	Almost certain	2
After Mitigation	Negative	Regional	Medium	Short term	Almost certain	2
Operational Phase						
Before Mitigation	Negative	Regional	Medium	Long term	Almost certain	2
After Mitigation	Negative	Regional	Low	Long term	Almost certain	2

Cumulative Impact: The area is poor with a high degree of malnutrition and food insecurity particularly within the rural areas of the province. There is a high level of crime across the county with 477 crimes being recorded in Impendle and 906 in Bulwer in 2014/15.

Environmental Feature	32. Quality of the living environment (Liveability)
Relevant Alternatives & Activities	Raw Water Component – Smithfield Dam Area and Conveyance Infrastructure
Project life-cycle	Construction & operational phases
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Disruption of daily living	32.1. Ensure that, at all times, people have access to their properties as well as to social facilities such as schools, churches, transport and shops.
	32.2. Investigate and consult local communities on the need to provide suitable access points around the dam basin for people and animals.
Increased population density and crowding	32.3. Liaise with the appropriate local authorities to ensure that they are aware of the increase of population.
	32.4. See measures that apply to social and physical infrastructure below
Reduced adequacy of community social infrastructure	32.5. Alert local businesses to the fact that with the arrival of construction workers the population of the area will increase and they are likely to be faced with a higher demand and will need to prepare for this
	32.6. Apply the mitigation measures suggested in the socio-economic and traffic impact assessment reports.
Reduced adequacy of physical infrastructure	32.7. Where damage has been reported regularly follow up to ensure rapid repair ensues.
	32.8. Regularly monitor the effect that construction is having on infrastructure and immediately report any damage to infrastructure to the appropriate authority.
	32.9. Where damage has been reported regularly follow up to ensure rapid repair ensues.
	32.10. Ensure that where communities' access is obstructed, such as due to the road deviations, that this access is restored to an acceptable state. In respect of the 16 km addition for the Nonguqa Community it may be necessary to consider the construction of a pedestrian bridge. The solution would, however, need to be found through consultations with the affected community
Reduced quality of housing	32.11. Ensure that any dwellings that are replaced are equal to, or better, than the original dwelling that it replaces.
Reduction in perceived quality of life	32.12. Appoint a Professional Service Provider to establish and facilitate an independent forum for communication and liaison
	32.13. Ensure that this forum is representative and consists of representatives of the Traditional Authority, municipalities, ward councillors and communities to address any concerns or grievances that community members may have regarding the project, and to facilitate relocation and other activities affecting the communities. This forum will from here on be referred to as 'The Forum' under other sections of this report.
	32.14. Consult The Forum in an effort to reduce the impact that the project may have on the movement patterns of people. This should be done, in an attempt to retain these patterns as far as is possible.
	32.15. Establish channels of communication between local communities and contractors to

	ensure that construction workers behave in a manner acceptable to these local communities.
	32.16. Put procedures and regulations in place to control loitering and the construction of informal dwellings in the vicinity of the construction sites.

	Impacts	Extent	Magnitude	Duration	Probability	Significance
Construction Phase						
Before Mitigation	Negative	Regional	Medium	Short term	Almost certain	2
After Mitigation	Negative	Regional	Medium	Short term	Almost certain	2
Operational Phase						
Before Mitigation	Negative	Regional	Medium	Long term	Almost certain	2
After Mitigation	Negative	Regional	Low	Long term	Almost certain	2

Cumulative Impact: Relocation of 28 households and loss of agricultural land. The area is relatively quiet and with the arrival of a large workforce the population of the area will suddenly increase thus initiating a number of impacts associated with this demographic change process.

Environmental Feature	33. Economic and material well-being (negative)
Relevant Alternatives & Activities	Raw Water Component – Smithfield Dam Area and Conveyance Infrastructure
Project life-cycle	Construction & operational phases
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Relocation of households	33.1. Set up a Forum, consisting of a broad base of representatives including displaced and host communities, to oversee the relocation process.
	33.2. Afford both displaced persons and host communities opportunities to participate in planning any relocation.
Deteriorating economic situation	33.3. Ensure that the RAP takes the risk of impoverishment fully into account and includes support structures aimed at minimising such risks.
	33.4. Residents should be sufficiently compensated and assisted throughout the relocation process and resettlement period.
	33.5. Also see under decreased autonomy, independence, security of livelihoods below
Decreased autonomy, independence, security of livelihoods	33.6. Keep family units, and where possible, social networks intact.
	33.7. The Forum should consider the feasibility of establishing a trust fund to assist affected households to re-establishing themselves. Particular emphasis should be placed on marginal and vulnerable groups.
	33.8. Assist with the relocation of livestock and, where feasible, after construction swiftly rehabilitate the land to its original condition.
	33.9. Where land cannot be rehabilitated within a reasonable period of time ensure that stock feed or an acceptable alternative is provided in consultation with The Forum.

	Impacts	Extent	Magnitude	Duration	Probability	Significance
Construction Phase						
Before Mitigation	Negative	Regional	High	Short term	Almost certain	2
After Mitigation	Negative	Regional	Medium	Short term	Almost certain	2
Operational Phase						
Before Mitigation	Negative	Regional	Medium	Long term	Almost certain	2
After Mitigation	Negative	Regional	Medium	Long term	Almost certain	2

Cumulative Impact: People in the area are poor which will result in a range of financial difficulties as people respond to relocations. Vulnerable communities are less able to care for themselves and are susceptible to a number of knock on impacts such as a decreased food security, threats to sustainable livelihoods and access to social services.

Environmental Feature	34. Economic and material well-being (positive)
Relevant Alternatives & Activities	Raw Water Component – Smithfield Dam Area and Conveyance Infrastructure
Project life-cycle	Construction & operational phases
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Increase in employment opportunities	34.1. Local residents should be recruited to fill semi and unskilled jobs.
	34.2. Women should be given equal employment opportunities and encouraged to apply for positions
	34.3. A skills transfer plan should be put in place at an early stage and workers should be given the opportunity to develop skills which they can use to secure jobs elsewhere post-construction
Increased opportunities for SMMEs	34.4. A procurement policy promoting the use of local business should, where possible, be put in place to be applied throughout the construction phase.

	Impacts	Extent	Magnitude	Duration	Probability	Significance
Construction Phase						
Before Mitigation	Positive	National	Medium	Short term	Almost certain	2
After Mitigation	Positive	National	Medium	Short term	Almost certain	2
Operational Phase						
Before Mitigation	Positive	National	Medium	Long term	Almost certain	2
After Mitigation	Positive	National	Medium	Long term	Almost certain	2

Cumulative Impact: The increasing of a large number of jobs within an area that has a high level of unemployment and few development opportunities will result in a number of impacts such as the development of skills and a more secure household income which could have a positive impact over the long term.

Environmental Feature	35. Cultural
Relevant Alternatives & Activities	Raw Water Component – Smithfield Dam Area and Conveyance Infrastructure
Project life-cycle	Construction & operational phases
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Diminished cultural integrity	35.1. Sensitise construction workers from outside the area to the traditions and practices of local communities.
	35.2. Provide communication channels and mechanisms through which local communities and construction workers can address their expectations and concerns.
Loss of rights over and access to natural resources	35.3. Consult traditional healers, herbalists, traditional doctors and elderly people of the area to ensure that any lost access to natural resources is restored to former levels.
	35.4. Follow the mitigation measures suggested by the Heritage Specialist.
Changes in movement patterns	35.5. Wherever possible reinstate access to sites of cultural importance.
	35.6. Follow the mitigation measures suggested by the Heritage Specialist.

	Impacts	Extent	Magnitude	Duration	Probability	Significance
Construction Phase						
Before Mitigation	Negative	Regional	Medium	Short term	Almost certain	2
After Mitigation	Negative	Regional	Low	Short term	Almost certain	2
Operational Phase						
Before Mitigation	Negative	Regional	Low	Long term	Unlikely	2
After Mitigation	Negative	Regional	Low	Long term	Unlikely	2

Cumulative Impact: The rate of globalisation in the area may be accelerated through the arrival of construction companies and workers which could have significant consequences for local culture.

Environmental Feature	36. Family and community
Relevant Alternatives & Activities	Raw Water Component – Smithfield Dam Area and Conveyance Infrastructure
Project life-cycle	Construction & operational phases

Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Disruption to family structures and social networks	36.1. Include a section in the induction programme for incoming construction workers that cover local traditions and practices.
	36.2. Regularly reinforce, amongst incoming construction workers, the importance of respecting local traditions and practices via the regular toolbox talks. In this regard encourage the participation of locally recruited construction workers to assist in reinforcing this point.
	36.3. Provide a communication channel via The Forum through which local communities can voice their experiences and expectations of construction workers.
	36.4. Avoid involuntary resettlement wherever possible.
	36.5. Where feasible encourage displaced people to resettle themselves and support them throughout the process.
	36.6. Undertake consultations with displaced people regarding acceptable alternatives and strategies and include these in the planning, implementing and monitoring processes.
	36.7. Choose the relocation site to ensure that the minimum disruption to displaced families as well as host communities occurs.
	36.8. Sensitise host communities to the pending arrival of the displaced communities.
	36.9. Establish a forum or resettlement committee through which resettlement and integration can be monitored and controlled by those affected.
Changed attitudes towards local communities and the level of satisfaction with the neighbourhood	36.10. Establish a forum or resettlement committee through which resettlement and integration can be monitored and controlled by those affected.
	36.11. A formal accessible grievance procedure should be implemented and communicated to both the displaced and host communities.
	36.12. Address all grievances swiftly, fairly and in a transparent manner.
	36.13. Provide swift and honest feedback in response to all queries.
	36.14. Ensure the infrastructure and social facilities within the host communities will not be compromised with the arrival of additional people into the area.

	Impacts	Extent	Magnitude	Duration	Probability	Significance
Construction Phase						
Before Mitigation	Negative	Regional	Medium	Short term	Almost certain	2
After Mitigation	Negative	Regional	Medium	Short term	Almost certain	2
Operational Phase						
Before Mitigation	Negative	Regional	Low	Long term	Unlikely	2
After Mitigation	Negative	Regional	Low	Long term	Unlikely	2

Cumulative Impact: Changes in family structure and social networks as well as changes with regard to the satisfaction with the neighbourhood are likely to extend well beyond the construction phase of the project, particularly if a number of construction workers choose to remain in the area after the construction phase, which has been the experience with other South African dam projects. This will result in result in a number of impacts that will last over a long period.

Environmental Feature	37. Institutional, legal, political and equity
Relevant Alternatives & Activities	Raw Water Component – Smithfield Dam Area and Conveyance Infrastructure
Project life-cycle	Construction & operational phases

Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Increased demand on existing infrastructure facilities and social services	37.1. Ensure that the receiving environment is prepared and has adequate infrastructure, facilities and social services to support both the displaced and host communities, prior to moving the displaced communities.
	37.2. Ensure that the facilities and services available to both displaced and host communities are equitable.
	37.3. Ensure equitable access to common resources such as water, grazing land and forests.
	37.4. Set up a grievance committee comprising of host and displaced community representatives as well as representatives of the responsible authorities.
	37.5. Provide a channel through which both the host and resettled communities can route grievances or concerns regarding service delivery.
	37.6. Swiftly address any grievance raised concerning service delivery in a transparent and equitable manner.
	37.7. Regularly monitor the effect that the resettlement has had on existing infrastructure facilities and social services within the host community.
Attitude formation towards project	37.8. Promptly deal with any raised expectations amongst communities regarding perceived benefits, through a process of communication and consultation.
	37.9. Promptly address any concerns raised by the public in a transparent manner.
	37.10. Where necessary always provide prompt and clear feedback to communities.
Decreased level of community participation in decision making, loss of empowerment	37.11. Assist both displaced and host communities to become self-reliant thus raising their self-esteem and empowering them.
	37.12. Include all relevant community members in decisions affecting them.
Disaster management	37.13. During both construction and operation implement surveillance and monitoring programmes, and undertake regular dam break safety inspections.
	37.14. Implement a disaster management plan that includes a well-developed public communication process and evacuation plan.
	37.15. Ensure that all communication and warning systems are regularly tested and maintained.

	Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Construction Phase						
Before Mitigation	Negative	Regional	Medium	Short term	Almost certain	2
After Mitigation	Negative	Regional	Medium	Short term	Almost certain	2
Operational Phase						
Before Mitigation	Negative	Regional	Medium	Long term	Almost certain	2
After Mitigation	Negative	Regional	Medium	Long term	Almost certain	2

Cumulative Impact: The speed with which the project unfolds will have an effect on a number of impacts as the social and institutional environment is unlikely to cope well with too rapid a development

Environmental Feature	38. Gender relations
Relevant Alternatives & Activities	Raw Water Component – Smithfield Dam Area and Conveyance Infrastructure
Project life-cycle	Construction & operational phases

Potential Impact	Proposed Management Objectives / Mitigation Measures
The burden of resettlement	38.1. Ensure that all consultation is gender inclusive.
	38.2. Ensure gender inclusivity and equity with respect to all compensation.
	38.3. Prioritise gender inclusivity and equity in access to resources, goods, services and decision making with the aim of empowering women.
	38.4. Promote equal job opportunities for women and men during the construction and operational processes.
	38.5. Prioritise and articulate gender inclusivity and equity in the project documents by including specific strategies and guidelines for implementation.
	38.6. The project documents should also include clear mechanisms through which the actual implementation of the activities and the impact on the ground can be monitored and evaluated.
	38.7. Develop a grievance procedure to specifically address gender matters.
	38.8. Factors such as culture should be considered when planning for gender activities since they play a great role in influencing gender relations.
Division of labour	38.9. Ensure that gender differences are taken into account when hiring staff.
	38.10. When providing staff facilities ensure that gender differences are taken into account.

	Impacts	Extent	Magnitude	Duration	Probability	Significance
Construction Phase						
Before Mitigation	Negative	Regional	Medium	Short term	Almost certain	2
After Mitigation	Negative	Regional	Low	Short term	Almost certain	2
Operational Phase						
Before Mitigation	Negative	Regional	Low	Long term	Likely	2
After Mitigation	Negative	Regional	Low	Long term	Likely	2

Cumulative Impact: There is likely to be a cultural resistance to women entering the workforce which may even take a passive form and manifest in unintended consequences such as resistance within the family as the nurturing and domestic roles of women are seen to be compromised.

12.16.3 Socio-Economic Impact Assessment

An extract from the Socio-Economic Impact Assessment (Nemai Consulting, 2016a) follows.

The following project activities were categorised as posing a high risk to the socio-economic environment:

- Widening or lengthening of existing roads to create access roads, and for the relocation of roads that will be inundated;
- Relocation of existing road R617, which is administered by the KZN DoT;

- Significant area to be inundated by the Smithfield Dam and the balancing dam;
- “Dangerous goods” that are likely to be associated with the greater project, are fuel stores for generators at the various pumping station sites, as well as any such goods used during the construction phase; and
- Change of land use from agriculture.

The following potentially significant impacts of the project are assessed:

- Impact on income;
- Job creation and skills development;
- Relocation of families;
- Access to social infrastructure;
- Tourism;
- Impacts on culture; and
- Construction impacts.

12.16.3.1 Impact Assessment

The tables to follow were extracted from the Socio-Economic Impact Assessment (Nemai Consulting, 2016a).

Environmental Feature	39. Impact on Income
Relevant Alternatives & Activities	Construction activities, relocation of infrastructure and people, and inundation of land.
Project life-cycle	Pre-Construction phase
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Loss of income from agricultural activities	39.1. All negotiations and payments relating to compensating affected landowners should be conducted and concluded before construction begins. 39.2. Those landowners who will be required to sell their property to DWS must be compensated for any business that is operating on the premises. 39.3. All landowners whose businesses will be affected by the proposed project should be compensated to the full value of their immovable assets and any loss of income. 39.4. Negotiations should take place between the landowner and DWS for any compensation of potential income denied as a result of the servitude agreements. 39.5. Subsistence agriculture and grazing takes place on communal land and land owned by households as allocated by the Traditional Councils. Given the loss of communal grazing land, DWS must approach the Traditional Councils to identify alternative land that can be used for grazing. 39.6. Households that are to be relocated must be compensated for the loss of

	income-earning land. 39.7. Negotiations with Baynesfield Estate should take place regarding appropriate mitigation measures for the educational and tourism facilities. Agreements must be done with a long-term approach to ensure the sustainability of all the current facilities at the estate. 39.8. Income supplementary activities of the families to be relocated must be compensated for. Trees should be at the stage where they are able to bear fruit so that the households do not have a loss of income. 39.9. Land for grazing must be provided to individual families as well as communities.

	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Local	Medium	Medium Term	Almost Certain	3
After Mitigation	Negative	Local	Medium	Medium Term	Almost Certain	2

Environmental Feature	40. Impact on Income
Relevant Alternatives & Activities	Construction activities, relocation of infrastructure and people, and inundation of land.
Project life-cycle	Construction phase
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Loss of income due to the deviation of the R617.	40.1. The internal road network connecting communities in the Smithfield Dam Basin to the road to Nonguqa must be upgraded and maintained throughout the construction phase to mitigate against the deviation. The upgrade will allow for better use of the roads for income generating activities as well as reduced costs of travel. 40.2. Mitigation measures management should be adhered to according the TIA.

	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Local	Medium	Long term	Almost Certain	3
After Mitigation	Negative	Local	Medium	Long Term	Almost Certain	2

Environmental Feature	41. Impact on SMMEs
Relevant Alternatives & Activities	Construction activities
Project life-cycle	Construction phase
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Impact on SMMEs	41.1. Construction and other materials to be sourced from local suppliers to boost the regional economic and drive the creation of more sustainable jobs 41.2. SMME opportunities should be provided to everyone on an equal basis. Where possible, DWS should support and encourage the development of SMMEs and local or regional suppliers. 41.3. Where possible, procurement should come from local and regional business so that the profits stay in the area, increasing economic activity. 41.4. DWS should make use of existing council structures to identify beneficiaries of the program.

	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Positive	Local	Medium	Short term	Likely	2
After Mitigation	Positive	Local	Medium	Short Term	Likely	3

Environmental Feature	42. Job Creation and Skills Development
Relevant Alternatives & Activities	Construction activities, relocation of infrastructure and people, and inundation of land.
Project life-cycle	Construction phase
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Skills transfer	42.1. DWS must develop a skills development program for the duration of the construction activity. 42.2. Beneficiaries of educational programs should be residents who live close to the project area. 42.3. The selection process should be transparent 42.4. In order to increase the size of local employment, women should also be employed in the construction of the dam.
Increased employment	42.5. Preferential treatment to local job seekers before employing labour from outside. 42.6. Communities around the Smithfield Dam area, the Smithfield Dam basin, conveyance infrastructure and balancing dam area should be considered for employment. No prejudice should be given to any one community. 42.7. Maximise sourcing of unskilled labour from local community. 42.8. In order to increase the size of local employment, women should also be employed in the construction of the dam. 42.9. The selection process should be transparent, fair and have measures of accountability if abused. 42.10. Where possible, labour intensive methods should be used for the construction the proposed dam. 42.11. A Community Liaison Officer should be made use of to assist in the employment process unless this process is rejected by the communities. 42.12. A social facilitator should manage overall communication and the duties of the CLO.
Indirect employment	42.13. Employment through spaza shops; eateries and other business will result as workers need to be fed.

	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Positive	Local	Medium	Short term	Likely	2
After Mitigation	Positive	Local	Medium	Short Term	Likely	3

Environmental Feature	43. Relocation of Families
Relevant Alternatives & Activities	Relocation of infrastructure; Construction of the Smithfield Dam
Project life-cycle	Pre-Construction Phase
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Relocation of Family dwellings and graves	43.1. A RAP must be developed in line with best practice. 43.2. A comprehensive Stakeholder Engagement Plan must be developed with the RAP. 43.3. The RAP must take into account principles from the Ingonyama Trust Board when relocating households. 43.4. In order to accurately compensate the households, an asset survey will be required. It is recommended that a Quantity Surveyor is appointed to conduct a full asset survey of each household which is to be signed off by the head of each household. 43.5. Following the asset survey an entitlement framework should be conducted which will highlight per asset what the compensation will be as well as what the design of the household be in detail. Furthermore, the entitlement framework will also detail the economic compensation they that each household will receive to ensure minimal impact on their standard of living.

Potential Impact	Proposed Management Objectives / Mitigation Measures
	43.6. The RAP must have an on-going monitoring plan and communication strategy to ensure effective control over the relocation process. 43.7. The relocation of graves should be done in line with AMAFA regulations, the Heritage Impact Assessment and cultural beliefs. Sensitivity and understanding must be ensured during this process.
Compensation for loss of income	43.8. It is critical that the relocation process does not leave the families more vulnerable than before. All income generating activities must be compensated for in full. 43.9. The families must be provided with trees, seeds, and all materials required to reproduce all supplementary income activities. Where possible, trees must be fruit bearing already. Where this is not possible, compensation for the loss of fruit should be provided until such time that the families can produce enough to sustain themselves. 43.10. Compensation will be required for the loss of assets and assistance to improve or restore their current standard of living. Compensation for the relocation must be equivalent or more. 43.11. Families should also be compensated for the loss of grazing land. It is ideal that alternative land is provided for grazing rather than monetary compensation to sustain livestock farming.
Impact on social environment	43.12. Every attempt must be made to ensure that the host community is of the same Traditional Council as those who are relocated. 43.13. In addition, every attempt must be made to ensure that families do not lose their extended family based structures and support. Therefore, relocation should be in close proximity to the Smithfield Dam basin. 43.14. Training should be provided to the Traditional Authorities to enable them to effectively support the families that are to be relocated. 43.15. Counselling services should be offered to each family during and after the relocation.
Communication and support	43.16. A communication strategy must be drawn up in consultation with ITB, Traditional Authorities, political structures and the community. 43.17. The relocation team must make use of the IsiZulu when communicating about the relocation. 43.18. Sensitivity on the cultural issues and anxiety over the relocation process must be ensured. A series of meetings must take place with each family to ensure that all concerns are heard. 43.19. Families should have a point of contact to raise issues relating to the relocation for the duration of the relocation process. 43.20. The response time for all concerns raised by the families must be addressed within in 1 week of raising the concern. This should be stated in the RAP and the communication strategy. 43.21. The communication strategy should include a plan for engagement with the host community as they are critical to the relocation process and integration of the families. 43.22. Where required all engagements should be led by the Traditional Authorities who must be informed of all engagements prior to them occurring.
Impact on community post relocation.	43.23. The RAP should have a monitoring programme established for a period of ten years, with intensive intervention initially and only bi-annual monitoring at the end of the ten years. The monitoring process should ensure at least the following takes place: ○ That the families are not struggling to survive in the new community. ○ There is successful integration into the host community. ○ These families are supported by the traditional and political leadership. ○ The RAP should have an intervention plan that should be implemented should any of the above fail.

	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Local	High	Permanent	Almost Certain	3
After Mitigation	Negative	Local	High	Permanent	Almost Certain	3

Environmental Feature	44. Reduced access of Social Infrastructure
Relevant Alternatives & Activities	Relocation of infrastructure; Construction of the Smithfield Dam
Project life-cycle	Pre-Construction Phase
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Compensation for Servitudes	44.1. Compensation has been provided for in the project budget and must be paid to land owners based on an independent evaluation of the property. 44.2. All negotiations and payments relating to compensating affected landowners should be conducted and concluded before construction begins. 44.3. Compensation should take place for all stages of the project life-cycle. 44.4. Those landowners who will be required to sell their property to DWS must be compensated for any business that is operating on the premises. 44.5. All landowner who whose business will be affect by the proposed project should be compensated to the full value of their immovable assets and any loss of income. 44.6. Negotiations should take place between the landowner and the Implementer for any compensation of potential income denied as a result of the servitude agreements. 44.7. The municipality should conduct a property valuation of all properties. The valuation should be done by an estate agent and be based on the market value. 44.8. A second valuation should be conducted if any landowner feel the property value has decreased as a result of the project. The results should be compared to the first valuation. Compensation should take place if there is a drop in value that was not cause by damage or changes from the land owner.
Impact on Baynesfield Farm	44.9. The relocation of the Baynesfield tourism and educational facilities to the Baynesfield dam as compensation will be supported if the landowner agrees. This option will result in continued operations during the construction phase.
Impact on R617	44.10. Internal rural road networks linking communities in Smithfield Dam basin to the road to Nonguqa should be upgraded. 44.11. Where necessary, upgrades of roads linking the road to Nonguqa or other main roads to the community's south of the Umkhomazi River should also be upgraded. Communities which should have proper road networks included Kwadushe, Machabasini, Mkholwa, Nkumba, Phosane, Hlananai etc. 44.12. Where necessary a TIA must assess the significance of a rise in transport costs and implications on time spend travelling given the longer travel distances. 44.13. Investigation into the solutions such as subsidised transport should be seen as the last resort to the transport issues. Rather, self-sustaining solutions should be provided. 44.14. Based on the outcomes of the TIA, DWS must consider the need to undertake a feasibility study to build a bridge for motorised and/ or non-motorised transport must be investigated pre-construction.

	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Local	High	Permanent	Almost Certain	3
After Mitigation	Negative	Local	High	Permanent	Almost Certain	3

Environmental Feature	45. Improved access of Social Infrastructure
Relevant Alternatives & Activities	Construction of all infrastructure
Project life-cycle	Construction and operational phase
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Development Potential	45.1. The development potential of eThekwini LM and KwaZulu-Natal as a result of the uWMP-1 is expected to increase significantly. This will a positive impact for the municipality as developers invest in the area. 45.2. Employment opportunities will be generated through the development which will increase household income. 45.3. The local area will have opportunities to expand into new industries and markets as a result of the infrastructure.
Increase in the standard of living	45.4. The provision of water will enable households in the region to access sanitation services which will raise the level of service and standard of living of households.

	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Positive	Local	Medium	Short term	Likely	2
After Mitigation	Positive	Local	Medium	Short Term	Likely	3

Environmental Feature	46. Impact on Tourism
Relevant Alternatives & Activities	Construction of the Smithfield Dam
Project life-cycle	Operational Phase
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Tourism Opportunities	46.1. DWS must develop a RMP. The RMP should identify opportunities for tourism activities within the dam basin 46.2. The RMP must be focused on empowerment and local economic opportunities for the surrounding communities.
Local Economic Development	46.3. Communication of the outcomes of the RMP to the local community in the local language to allow them the opportunity to benefit from the dam. 46.4. Where possible DWS should ensure that the local communities are involved in all dam operations where profits can be generated.

	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Positive	Local	Medium	Short term	Likely	2
After Mitigation	Positive	Local	Medium	Short Term	Likely	3

Environmental Feature	47. Construction Impacts
Relevant Alternatives & Activities	All components
Project life-cycle	Construction Phase
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Impact on Traffic	47.1. Ensure that the necessary signage and traffic measures are implemented for safe and convenient access to the site. 47.2. Measures must also be put in place to ensure that these roads and any access points do not get built up with mud or sand. 47.3. Construction machinery drivers are to travel at appropriate speeds and have flashing lights attached to the roofs of the vehicles. 47.4. Applicable speed limits as set on regional and rural roads must be observed at all times.

Potential Impact	Proposed Management Objectives / Mitigation Measures
	47.5. The number of vehicles present on site must be limited to the minimum. 47.6. Hauls routes must be adhered to by contractors and their sub-contractors. 47.7. Mitigation measures management should be adhered to according the relevant specialist studies.
Impact of Road Conditions on sensitive crops	47.8. Where sensitive crops will be affected by vehicles, a feasibility assessment must be done to see if the roads can be tarred to prevent loss of crops. 47.9. The contractor must maintain the roads on an on-going basis to ensure that there is minimal dust from construction vehicles. 47.10. Mitigation measures management should be adhered to according the relevant specialist studies.
Increase in Dust	47.11. Dust and disturbance can be mitigated through the use of appropriate dust suppression mechanisms. 47.12. Where sensitive crops are affected by dust, DWS should conduct a feasibility study to tar the roads. 47.13. Mitigation measures management should be adhered to according the relevant specialist studies.
Influx of workers	47.14. DWS must make a public announcement that imported labour will not take place on the project. 47.15. Contractors and sub-contractors must have strict conditions that prevent the importing of semi and unskilled labour without prior justification and approval 47.16. A Community Liaison Officer (CLO) process must be made use of to appoint local labour, unless the community resist this approach. 47.17. The contractor must work closely with the traditional authorities and local government to ensure that identification and recruitment processes are fair and transparent regardless of whether or not the CLO process is used. 47.18. The contractor must be held accountable to ensure that its sub-contractors follow the same employment process. 47.19. Family style accommodation should be provided where possible 47.20. Employment of females and youth is encouraged to ensure the empowerment of the most vulnerable to unemployment and poverty. 47.21. Mitigation measures management should be adhered to according the relevant specialist studies.
Safety and security	47.22. Erect signage and fences to deter theft. 47.23. RMP must explore safety mechanisms such as the UPN system to ensure the safety of dam users 47.24. Access to the dam should be controlled but still remain accessible to the public 47.25. Access to dam infrastructure must be strictly controlled with closed off access points. 47.26. Signage must be made use of to alert people to potential dangers in the usage of the dam. 47.27. The EMPr must have strict access control measures in place to protect the farmer's property. 47.28. Gates and fences must be used where possible. 47.29. Construction related material should be kept in access controlled area. 47.30. The construction site should comply to Health and Safety regulations 47.31. Access control measures should be implemented at the construction area.
Impact on Cultural Beliefs	47.32. Graves to be relocated in accordance with the Heritage Impact Assessment 47.33. Communication to take place in the existing Traditional structures to address cultural beliefs surrounding the dam. In particular, the Traditional Authorities should be consulted for guidance on how to manage any fears associated with the Dam. 47.34. Communication of the dam needs to take into account cultural beliefs which need to be treated sensitively and with respect. 47.35. Mitigation measures should be adhered to according the relevant specialist studies.

Potential Impact	Proposed Management Objectives / Mitigation Measures
Land claims could affect the expropriation of land and purchase of servitudes	47.36. Early consultation between the project authorities and DRD&LR and other relevant stakeholder must take place to allow sufficient time before construction activity takes place.

	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Local	Medium	Medium term	Likely	3
After Mitigation	Negative	Local	Medium	Medium term	Likely	2

12.17 Traffic & Access Roads

12.17.1 General

The findings of the Traffic Impact Assessment (DWA, 2015b) follow. The report is contained in **Appendix H9**.

❖ **Road Network**

- The uMWP-1 will mainly influence the provincial routes R617 and R56. In 2014 the R617 had an average daily traffic (ADT) of ±7 800 and annual daily truck traffic (ADTT) of ±600 and the R56 had an ADT of ±6 500 and ADTT of ±600.
- 5 critical intersections were investigated. These intersections are all uMWP-1 access routes as well as routes influenced by route deviations that intersect with the R617 and R56. The traffic volumes at the critical intersections consist mostly of through traffic on the R617 and R56, the intersections all have low traffic volumes making turning movements. Low pedestrian and cyclist volumes are present at all of the intersections.

❖ **Construction Phase**

- It is expected that the skilled staff will reside in the construction camps on site during the construction period and only go home on the last Friday of the month. Professional staff and local labour will travel to and from work on a daily basis.
- It is expected that for the construction a high proportion of the construction material will be sourced from the dam basins and tunnel. A smaller percentage of the

required construction material will thus be imported to site from commercial sources.

- It is expected that the peak trip generation will be in 2020 during the construction phase. 312 light vehicle trips and 281 heavy vehicle trips will be generated during the weekday AM peak. 385 light vehicle trips and 265 heavy vehicle trips will be generated during the Friday month-end PM peak.
- The ADT in 2020 for the R617 and R56 is expected to increase by ±10% and ±7% respectively. The ADTT in 2020 for the R617 and R56 is expected to increase by ±30% and ±40% respectively.
- All of the critical intersections are expected to operate at an acceptable level of service (LOS) with ample spare capacity.
- The Equivalent Standard Axle of 80kN (E80s) on the R617 and R56 is increases by 20% and 50% respectively over the 6-year construction period.

❖ **<u>Operational Phase</u>**

- Additional vehicle trips will be added to the road network during the operational phase owing to employees travelling to and from work, sludge removal and delivery of chemicals (WTW).
- Approximately 51 light vehicle trips and 20 heavy vehicle trips will be generated during the weekday AM peak. 51 light vehicle trips and 20 heavy vehicle trips will be generated during the weekday PM peak.
- An operational analysis was performed for each of the critical intersections in the first year of operation (2024) and all 5 intersections are expected to operate at an acceptable LOS with ample spare capacity.

The construction phase is expected to start in 2018 and be completed in 2023. The operational phase will thus start in 2024. Based on the operational analyses the critical intersections are expected to operate at an acceptable level of service during the peak periods. It is thus expected that if traffic related issues arise it will be owing to road safety issues and social impacts.

12.17.2 Impact Assessment

<table>
<tr><th colspan="1">Environmental Feature</th><th>48. Traffic & Access Roads</th></tr>
<tr><td>Relevant Alternatives & Activities</td><td>All construction activities that affect the existing road network</td></tr>
<tr><td>Project life-cycle</td><td>Construction & operational phases</td></tr>
<tr><td>Potential Aspects & Impacts</td><td>Proposed Management Objectives / Mitigation Measures</td></tr>
<tr><td>

Inadequate road conditions
Disruptions to existing road users
Safety risks
Crossing main roads
Increase in dust levels
Road maintenance

</td><td>
48.1. Strict adherence to speed limits by construction vehicles on the R617, R56 and access roads. Appropriate speed limits need to be posted on all access roads according to the geometric design and limitations of heavy vehicles.
48.2. The access roads need to provide sufficient width for heavy vehicles to navigate around curves in the road.
48.3. When construction vehicles are required to cross the R617 or R56 appropriate safety and traffic calming measures need to be in place. This will include flag men, speed reductions and warning signage.
48.4. Where construction of a pipeline crosses the R56 appropriate safety measures need to be in place to prevent and safeguard crossing of the road as applicable.
48.5. The payloads delivered by heavy vehicles need to be recorded and audited to prevent overloading of heavy vehicles.
48.6. Abnormal load permits must be acquired for the transport of abnormal loads.
48.7. Traffic accommodation to South-African Road Traffic Signs Manual standards where any construction affects an existing road.
48.8. Time restrictions for delivery vehicles through built-up and socially sensitive areas.
48.9. Implement traffic monitoring which includes –

Baseline traffic monitoring, 1 year ahead of construction, to confirm the traffic status quo on the road links that are to be worst affected.
Traffic Monitoring during the construction period, to confirm whether the traffic increase is similar to forecasted increase, whether the contractor complies with activity time restrictions, whether posted speed limits are adhered to, etc.
Overloading Management through auditing of bulk construction material delivery slips to ensure high-level adherence to current legislation.
Monitoring of dangerous locations (e.g. truck crossings, schools, road diversions etc.).
Traffic monitoring after completion of construction (operation phase), 6 months after construction to confirm the new level of traffic resulting from normal operations.
Evidence of the actual impact on the local road network as well as the effect of implemented mitigation measures can then be readily made available.

48.10. From a road maintenance point of view:

Based on the observed condition of the R617 and R56 pavement it is recommended that a more detailed pavement investigation be done to determine the pavement condition to refine the pavement maintenance action plan for the construction phase;
To reduce the impact and prevent dust clouds the access road to the balancing dam at Baynesfield Estate as well as the access road to the Smithfield main dam embankment need to be paved.

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

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	medium-high	short-term	almost certain	3
After Mitigation	-	local	low	short-term	moderate	1

12.18 Existing Structures and Infrastructure

12.18.1 General

The Scoping phase identified the following impacts to existing structures and infrastructure:

- The infrastructure and structures affected by the various project components will be relocated, as necessary. Alternatively, compensation will also be considered, where relevant. Major infrastructure to be relocated includes:
  - Smithfield Dam basin affects the following –
    - Two sections of road R617;
    - High voltage Eskom power line;
    - Access dirt roads to traditional areas;
    - Telephone line;
  - Balancing dam basin options affect the following –
    - Section of power line;
    - Private farm road; and
    - Access roads to cultivated areas and timber plantations.
- Disruptions to services may occur as a result of construction activities.
- Disruptions to traffic at road crossings and where pipeline routes follow existing road alignments (e.g. D360).
- Construction-related disturbances (e.g. noise, dust).
- Permanent access along the pipeline servitude will be required after construction.
- Pipeline markers (concrete posts) will be installed at changes in direction and at regular intervals along the route.
- Following the installation of the pipeline, the servitude can still be utilised by the landowner for certain types of land use, for examples grazing and planting of certain crops. However, the use of the land covering the servitude will be subject to certain restrictions. In this regard, certain activities will not be permitted such as the planting of trees, excavation over the pipeline, building of structures and installation of services.

As part of the land acquisition process, suitable compensation measures will need to be identified for the affected landowners. The following factors need to be taken into consideration (amongst others):

- Loss of land (municipal or private), crops, structures (e.g. dwellings) and infrastructure (e.g. irrigation pipelines) within the dam's purchase line or within servitudes of associated infrastructure;
- Impact on the economic viable of remaining land portions;
- Restoration of access and services to properties; and
- Loss of graves as well as other cultural and historical resources.

12.18.2 Impact Assessment

Environmental Feature	49. Existing Structures and Infrastructure
Relevant Alternatives & Activities	All construction activities that affect existing structures and infrastructure
Project life-cycle	Construction & operational phases
Potential Aspects & Impacts	Proposed Management Objectives / Mitigation Measures
• Disruption of existing services • Relocation of infrastructure	49.1. Identify and record existing services 49.2. Conform to requirements of relevant service providers (e.g. KZN DoT, Telkom, Eskom, water, sewerage). 49.3. Ensure access to infrastructure is available to service providers at all times. 49.4. Immediately notify service providers of disturbance to services. Rectify disturbance to services, in consultation with service providers. Maintain a record of all disturbances and remedial actions on site. 49.5. Notify landowners of any disruptions to essential services. 49.6. Deviate landowners' existing services (e.g. reticulation, irrigation lines), where possible, to accommodate construction activities. 49.7. Adequate reinstatement and rehabilitation of affected environment.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	medium-high	short-term to permanent	almost certain	3
After Mitigation	-	local	low	short-term	moderate	1

12.19 Aesthetic Qualities and Tourism

12.19.1 General

A substantial area will be cleared within the construction domain to build the physical infrastructure associated with the project and to accommodate the construction camp, workshop, batching plant, storage areas and access roads. In addition, the sense of place will be adversely affected through the various activities associated with the construction phase as well as the permanent project components during the operational phase.

Potentially significant visual impacts will be caused by the following project components:

- Smithfield Dam –
  - Smithfield Dam will replace the existing landscape from natural area and communal tribal land to a water body.
  - The attractive riverine scenery behind the Smithfield Dam wall will be inundated.
  - The dam wall and saddle dam wall will be substantial man-made structures. However, due to the surrounding rural landscape and settlement pattern these dam walls will only be visible to a small portion of the community.
  - A large construction workforce will be accommodated on site, as suitable facilities are not available in the surrounding rural area and travelling distance to nearby towns may not be favourable. It is anticipated that the permanent site offices will be built within the same area that has been earmarked for the labour camp (see **Section 9.20.8**).
  - The EMPr includes measures to manage the impacts linked to providing accommodation facilities.
  - From the areas that are granted a view of the basin it could be argued that the landscape would be improved as the body of water over time could be viewed as a natural area (see three-dimensional view in **Figure 237**).
  - Depending on the future permitted use of the dam it may afford recreational opportunities, as is the case with other dams that have been built in rural KZN such as Nagle Dam that is located in a tribal area, and offers accommodation, angling and canoeing.
- Raw Water Conveyance Infrastructure –
  - The tunnel adit and outlet will entail substantial excavations to grant access to the TBMs (see **Section 9.5.1**). Both these areas are located in rural areas, with the latter situated on Baynesfield Estate. Post-construction, the works areas will be rehabilitated, as can be seen in the three-dimensional image in **Figure 238**.

- The spoil sites to be created at the tunnel inlet and central portals will be shaped and provided with a final cover of a 200 mm thick layer of topsoil lightly compacted after spreading and planted with local grasses and shrubs.

❖ Balancing dam –

- The balancing dam will inundate a section of the Mbangweni River (Mbangweni and Langa Balancing Dam options), as well as surrounding agricultural and forestry areas.
- The construction activities may be visually obtrusive to the local residents (particularly at The Mynde Farm), depending of the viewscapes established as part of the Visual Impact Assessment.
- The views of the waterbody created by the balancing dam could enhance the area's visual quality (see three-dimensional view in **Figure 239**).
- In acknowledging the possible ecotourism opportunities associated with this dam, the Baynesfield Estate has conveyed an interest in using the balancing dam for associated purposes, which will need to be investigated further with DWS.

Figure 237: Three-dimensional layout of Smithfield Dam

Figure 238: Three-dimensional view of tunnel outlet

Figure 239: Three-dimensional layout of Lange Balancing Dam

- General –
  - Linear disturbance associated with the project, namely the raw water pipeline, re-aligned D617 and new access roads, will cause scarring and visual impacts. The infrastructure that is situated outside of the dam basins will also serve as visual

intrusions in the landscape. Through adequate reinstatement and rehabilitation, and considering the general absence of sensitive visual receptors, these impacts can be mitigated to such an extent that the residual impacts are rendered as insignificant.

- Quarries and borrow areas have been identified within the Smithfield Dam and balancing dam basins, which will be inundated and will thus not pose a visual impact during the operational phase. At Smithfield Dam, Quarries II (plunge pool) and III (spillway approach) that fall outside of the basin will also not pose visual impacts once the construction phase has been completed.
- Light pollution may be caused particularly during the construction phase. Adequate provision is made in the EMPr to address this.

The EMPr includes measures to manage visual impacts and to rehabilitate areas affected by construction activities. In addition, a dedicated Rehabilitation Management Plan will be developed during the construction phase.

Refer to **Section 12.2.2** for a discussion on managing the impacts to the Baynesfield Estate Lodge that is located next to the Mbangweni Dam.

The findings from the Visual Impact Assessment (Axis Landscape Architecture, 2015) follow.

12.19.2 Landscape Impacts

The landscape impact severity refers to the magnitude of impact resulting from the proposed project components. The severity of landscape impact is examined by discussing the following factors:

- **Visual absorption capacity:** Visual Absorption Capacity (VAC) signifies the ability of the landscape to accept additional human intervention without serious loss of character and visual quality or value. VAC is founded on the characteristics of the physical environment such as vegetative screening, diversity of colours and patterns and topographic variability. It also relates to the type of project in terms of its vertical and horizontal scale, colours and patterns; and

- **Visual contrast:** Visual contrast is the degree to which the aesthetic characteristics (line, form, colour and texture) of the proposed project differ from that of the existing landscape.

The severity of the following landscape impacts will be discussed:

1. Loss of grassland;
2. Alteration to existing tributaries; and
3. Change in surface cover.

<u>Loss of grassland during construction</u>

The proposed development will cover large areas of grassland in order to accommodate the proposed Smithfield dam and infrastructure. Due to the sloping topography, vegetation and existing land-use the area has a high VAC.

<u>Alteration to watercourses as well as the loss of a waterfall on Luhane River</u>

The existing tributaries and rivers are currently in a moderately good state. During construction, the earthworks will expose soil that will visually contrast in colour with the vegetated areas surrounding it. The water diversion structures and earthworks equipment will permanently detract from the existing character. Due to the high VAC of the area the permanent character change will only be experienced on a local level.

After construction the disturbed areas will be rehabilitated. The impact will be negative but, rehabilitation of the disturbed watercourses and maintaining it will reduce the negative impact through the operational stage.

<u>Change in surface cover</u>

The site preparation and construction stage will cause high levels of visual contrast. Portions of the vegetated surface cover will be cleared to make way for the new proposed development. The exposed soil and the presence of construction equipment, material stockpiles, site offices and construction camps will contrast in colour and form with the receiving environment. The high VAC of the receiving environment will minimise the exposure of the construction activity.

The construction areas will cause a moderately high character change due to greater visual contrast that will be visible between the construction site and the receiving environment.

The completed development will introduce alternative land uses to the site that will alter the existing character. On a regional scale, the development can be interpreted as a new development, expanding the development land use into the open space.

12.19.3 Visual Impacts

Severity of visual impact refers to the magnitude of change to specific visual receptor's views. Severity of visual impact is influenced by the following factors:

- The **viewer's exposure** to the development -
  - Distance of observers from the proposed development;
  - The visibility of the proposed development;
  - Number of affected viewers;
  - Duration of views to development experienced affected viewers; and
- Degree of **visual intrusion** created by the development.

Empirical research has indicated that the visibility of an element in the landscape and hence its severity of visual impact, decreases as the distance between the observer and the element increases. This is due to the fact that the further one stands from an element in the landscape, the less area it occupies in one's visual field and the less significant the element becomes in relation to the rest of the viewed landscape. The landscape and all its comprising components start to dominate this one element and the severity of visual impacts becomes negligible.

The severity of the following potential visual impacts will be discussed:

- Residents;
- Recreational users/Tourists; and
- Motorists.

Residents

The residents of the surrounding villages will be affected by the construction of the proposed dam due to their proximity to the site. The visibility of the construction activity will be high especially when construction occurs near the boundary of the site, which is closest to the affected receptors. The active operation of construction equipment may generate dust clouds and noise that will increase resident's awareness of the operation. The construction activity will cause unsightly views as the soils are exposed and the disorganised arrangement of stockpiles, site offices and construction equipment dominate the scene.

Visual intrusion will increase as the project nears completion and the site is cleared of construction elements.

Residents outside the 2 km radius zone will not experience the full extent of the development and may only be exposed to fragmented views of the construction phase and completed development due to the topography that screens most of the site. The visual intrusion is considered to be minimal and the distance between the observers and the proposed development is in itself a mitigating factor. The severity of visual impact for both stages of the development will be *low*.

Recreational Users and Tourists

Tourists travelling on the R617 and local district gravel road will experience views of the sites and the construction activity. The visual intrusion, caused by the exposed soil and the construction operation will be low.

The visual exposure will be relatively low considering the number of tourists travelling these roads. Their duration of views of the construction activities will be short, only lasting for a few minutes. The severity of visual impact is low.

Motorists

During construction, traffic delays may occur due to construction of the deviated R617, construction activities next to the road verges or heavy vehicle circulation on the roads. The traffic delays increase motorist's awareness and increase the duration of their exposure to views of the construction activity. The severity of visual impact will be *moderate* during the construction stage and will decrease to *low* severity once the development is completed.

12.19.4 Impact Assessment

Environmental Feature	**50. Visual Quality**
Relevant Alternatives & Activities	**All construction activities that affect the project area's visual quality**
Project life-cycle	**Construction and operational phases**
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
• Reduction in visual quality due to construction activities. • Visual impacts associated with the operation of the dam.	50.1. On-going housekeeping to maintain a tidy construction area. 50.2. The site will be shielded / screened to minimise the visual impact, where practicable. 50.3. Where practicable, development designs to compliment the natural surroundings in order to preserve a sense of place. 50.4. In general, no slopes steeper than 1(V):3(H) are permitted in cut-and-fill areas (outside dam basin), unless otherwise specified by the Project Manager. Steeper slopes require protection. New slopes must mimic the natural slopes and topography, where possible. 50.5. After the construction phase, the areas disturbed that are located outside of the dam basins (Smithfield Dam and balancing dam) and that are not earmarked for operational purposes must be rehabilitated by appropriate landscaping, levelling, topsoil dressing, land preparation, alien plant eradication and vegetation establishment. 50.6. Monitor the re-growth of invasive vegetative material (outside of the dam basin). 50.7. Manage encroachment of exotic vegetation in the dam draw down zone, as necessary.

	+/- Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Before Mitigation	-	local	medium-high	short - medium-term	almost certain	2
After Mitigation	-	local	medium	short-term	likely	1

The impacts assessment for the visual quality and associated attributes is supplemented by the following evaluation conducted as part of the Visual Impact Assessment (Axis Landscape Architecture, 2015).

Environmental Feature	51. Landscape Impacts: Loss of grassland
Relevant Alternatives & Activities	All construction activities that affect the project area's visual quality
Project life-cycle	Construction phase
Potential Aspects & Impacts	Proposed Management Objectives / Mitigation Measures
• Removal of grassland during construction phase • Removing landscape elements that are fundamental in establishing a valued landscape character	51.1. If practically possible, locate construction camps in areas that are already disturbed or where it isn't necessary to remove established vegetation like for example, naturally bare areas. 51.2. Rehabilitate or vegetate disturbed areas as soon as practically possible after construction. This should be done to restrict long stages of exposed soil and possible erosion that will result in indirect landscape and visual impacts.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Regional (3)	High (4)	Permanent (5)	Definite (5)	Medium (60)
After Mitigation	Negative	Local (2)	Moderate (3)	Medium (3)	Highly (4)	Medium (32)

Environmental Feature	52. Landscape Impacts: Alteration to tributaries and rivers
Relevant Alternatives & Activities	All construction activities that affect the project area's visual quality
Project life-cycle	Construction and operational phases
Potential Aspects & Impacts	Proposed Management Objectives / Mitigation Measures
Alteration to existing tributaries and river – construction phase Upgrading and maintaining the tributaries to a high standard – operational phase	52.1. Rehabilitate or vegetate disturbed areas as soon as practically possible after construction. This should be done to restrict long stages of exposed soil and possible erosion that will result in indirect landscape and visual impacts

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Local (2)	Moderate(3)	Short (2)	Highly (4)	Low (28)
After Mitigation	Positive	Local (2)	Low (2)	Short (2)	Medium (3)	Low (18)

Environmental Feature	53. Landscape Impacts: Change in surface cover
Relevant Alternatives & Activities	All construction activities that affect the project area's visual quality
Project life-cycle	Operational phase
Potential Aspects & Impacts	Proposed Management Objectives / Mitigation Measures
Adding additional land uses that alter the grassland character of the site and cause a loss of open space and the sense of place	53.1. Maintain the landscape to a high aesthetic standard to retain a high visual quality for visitors and observers 53.2. All exposed areas with a slope of less than 1 horizontal : 1,5 vertical should be rehabilitated with a grass mix that blends in with the surrounding vegetation. 53.3. Add top soil on all cuts and fills

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Local (2)	Moderate(3)	Short (2)	Highly (4)	Low (28)
After Mitigation	Negative	Local (2)	Moderate(3)	Short (2)	Highly (4)	Low (28)

Environmental Feature	54. Visual Impacts: Potential impact on villages and settlements
Relevant Alternatives & Activities	All construction activities that affect the project area's visual quality
Project life-cycle	Construction and operational phases
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Altering the visual character of the site due to the presence of unsightly views of the construction activity and the introduction of new land uses on the site	54.1. Keep the construction sites and camps neat, clean and organised in order to portray a tidy appearance 54.2. Maintain the landscape to a high aesthetic standard to retain a high visual quality for visitors and observers

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Local (2)	Moderate(3)	Short (2)	Highly (4)	Low (28)
After Mitigation	Negative	Local (2)	Moderate(3)	Short (2)	Highly (4)	Low (28)

Environmental Feature	55. Visual Impacts: Potential impact on tourists
Relevant Alternatives & Activities	All construction activities that affect the project area's visual quality
Project life-cycle	Construction and operational phases
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Altering the visual character of the site due to the presence of unsightly views of the construction activity and the introduction of new land uses on the site	55.1. Keep the construction sites and camps neat, clean and organised in order to portray a tidy appearance; 55.2. Maintain the landscape to a high aesthetic standard to retain a high visual quality for visitors and observers

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Local (2)	Low(2)	Short (2)	Medium (3)	Low (21)
After Mitigation	Negative	Local (2)	Moderate(3)	Short (2)	Low(2)	Low (14)

Environmental Feature	56. Visual Impacts: Potential impact on motorists using local and major routes as well as the deviated R617
Relevant Alternatives & Activities	All construction activities that affect the project area's visual quality
Project life-cycle	Construction and operational phases
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Altering the visual character of the site due to the presence of unsightly views of the construction activity and the introduction of new land uses on the site and the deviation of the R617	56.1. Keep the construction sites and camps neat, clean and organised in order to portray a tidy appearance 56.2. Maintain the landscape to a high aesthetic standard to retain a high visual quality for visitors and observers

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Local (2)	Low(2)	Short (2)	Low (2)	Low (12)
After Mitigation	Negative	Local (2)	Low(2)	Short (2)	Low (2)	Low (12)

12.20 Health

Health-related risks associated with the project may include the following:

- Construction phase –
  - Hazards related to construction work;
  - Increased levels of dust and particulate matter;
  - Increased levels of noise;
  - Water (surface and ground) contamination;
  - Poor water and sanitation;
  - Communicable diseases;
  - Psychosocial disorder (e.g. social disruptions);
  - Safety and security;
  - Lack of suitable health services;
- Operational phase –
  - Water-borne diseases;
  - Vector-borne diseases;
  - Community safety – swimming;
  - Flooding; and
  - Social well-being.

These risks are addressed through mitigation measures identified under other environmental features, such as socio-economic environment, surface water, air quality, noise and vibration, climate, as well as best practices included in the EMPr. Additional management requirements associated with health will be included in the following:

- Occupational Health and Safety system;
- Operational Management Programme;
- Operation and Maintenance Manual;
- Communicable diseases awareness and prevention programme;
- RAP; and
- RMP.

12.21 'No-Go' Impacts

12.21.1 General

The no-go alternative, which implies maintaining the status quo, provides the baseline against which the impacts of the other project options are compared.

Through a water balance analysis it was confirmed that the long-term water requirements of eThekwini Municipality, Msunduzi LM and surrounding areas exceed the yield of the water resources of the Mgeni System. The forecasting of the water requirements was based on demographic, economic, development and infrastructural variables. Detailed investigations have been conducted to date to exhaust the various options to meet the water requirements of the Integrated Mgeni WSS, and to advance towards identifying the current feasible project alternatives that are being assessed as part of the EIA.

The implications of the 'no go' option are as follows:

- The long-term water deficit that will exist in the Integrated Mgeni WSS means that the water requirements of the supply area will not be met;
- Water supply shortfalls could adversely affect the various water user sectors, and would suppress development with related socio-economic implications; and
- Over-utilisation of water resources could adversely affect the ecological functioning of the Mgeni River system.

12.21.2 Pre-feasibility Study Findings

The Pre-feasibility Study (DWAF, 1999a) also assessed the implications of the 'no development' option. The main focus of the study was to identify the socio-economic impacts associated with constrained water supply, should the uMkhomazi-Mgeni Transfer Scheme not be implemented. The gross geographic product (GGP) and employment within the study area (supply area) and within KZN 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. The following 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 uMkhomazi-Mgeni Transfer Scheme is not commissioned but water requirement is managed by the relative authorities. Impacts include the following:

- 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; and
- 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 KZN.

❖ ***Augmentation Scenario (Smithfield or Impendle)***

Unconstrained economic growth occurs within the study area and the uMkhomazi-Mgeni Transfer Scheme is commissioned according to the time frame specified by Umgeni Water. In addition, water requirement is managed by the relative authorities. Impacts include the following:

- Cumulative GGP throughout the study period, within the supply area and KZN, is 26% higher than for the Non-Augmentation Scenario; and
- Employment in the study area (and for KZN as a whole), over the lifetime of the study, is 34% higher than for the Non-Augmentation Scenario.

The GGP provides a measure of the total and sectoral economic activity on an annual basis within local municipalities of South Africa. Achievable GGP and employment levels would be significantly higher with commissioning of the uMkhomazi-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 WSS, 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.

In contrast, should the proposed uMWP-1 not go ahead, any potentially significant environmental issues associated with the project (refer to **Section 14**) would be irrelevant and the status quo of the local receiving environment would not be affected by the project-related activities. The objectives of the project would, however, not be met with significant consequences for the water supply in the Integrated Mgeni WSS.

12.21.3 Economic Impact Assessment

An Economic Impact Assessment (DWA, 2015a) (refer to discussion in **Section 11.2.1** and **Appendix H10**) was conducted for the proposed uMWP-1 to determine *inter alia* an understanding of both the costs of the scheme as well as the long term benefits within an economic cost-benefit framework that reviews the opportunity costs associated with the proposed scheme.

The Economic Cost Benefit Analysis (ECBA) found that the scheme is anticipated to have a net benefit of R58 370m in 2014 Rand terms, and retains a positive discounted rate for net present value rates up to 25%.

The opportunity cost considered was the productive function of the supply area's economic activities as measured by economic output in gross value added terms. If 2022 is used as the critical tipping point for water scarcity in the system, then the foregone economic production, i.e. the opportunity cost to the economy from 2022 until 2044 equates to R13.3bn in constant 2005 year Rands. This would have the consequence of foregone business sales for KZN province of R13 227 458 in 2005 Rand terms; a loss of R 1 222 866 in 2005 Rands of gross geographic production; an absolute loss of 376 055 employment opportunities over the 19 year period and a loss of income and wages of R1 717 103 in 2005 Rands.

12.21.4 Conclusion

Through the mitigation of the identified impacts associated with the various phases of the project life-cycle, and considering the nett benefits that accompany uMWP-1 (as opposed to maintaining the status quo), it is concluded that the no-go option should be rejected in order for the objectives of the project to be met.

12.22 Cumulative Impacts

12.22.1 General

Box 3:	**What is a "Cumulative Impact"?**
According to GN No. R543 (18 June 2010), a ***"cumulative impact"***, in relation to an activity, means the impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.	

Cumulative impacts can be identified by combining the potential environmental implications of the proposed uMWP-1 Raw Water component with the impacts of projects and activities that have occurred in the past, are currently occurring, or are proposed in the future within the project area.

12.22.2 Water Resource Management

Phase 2 of the uMWP includes the construction of the Impendle Dam further upstream on the uMkhomazi River to release water to the downstream Smithfield Dam. This is.

As the flow in the uMkhomazi River is currently un-regulated, with no other impoundments in the system, the proposed Smithfield Dam will not contribute to a cumulative impact in this regard. However, Impendle Dam that forms part of phase 2 of the uMWP which is intended to address the long-term deficit in water supply in the Integrated Mgeni WSS, which is calculated to be after 2048 (see **Section 3.4**) will need to consider the collective impacts of this impoundment with Smithfield Dam. The same applies to the Ngwadini Off-channel Storage Dam, which has been identified by SAPPI to be constructed on a tributary of the uMkhomazi River. The cumulative impact of both dams must be determined and managed to ensure that the Reserve and other water user requirements in the uMkhomazi River are not compromised.

Various impoundments already existing on the uMlaza River. The proposed balancing dam would lead to the further fragmentation of the watercourse. Provision would also need to be made for releases from the balancing dam for the Reserve requirements and downstream users.

Significant soil erosion occurs in the catchment, with resultant heavy silt loads in the uMkhomazi River. This accelerated erosion is associated with livestock related erosion (trails and overgrazing), subsistence farming practices, loss of indigenous vegetation and colonization by invasive species (which bind the soil less well), disturbed lands associated with forestry and clear-felling of trees, and erosion associated with compaction of the soils in the road network. High intensity rain events also occur in this catchment. Construction activities within or alongside the watercourses and run-off from bare areas could contribute towards elevated turbidity levels in the system. Suitable provision for stormwater management and mitigating water quality impacts are included in the EMPr. As part of catchment management initiatives, and in support of the concept of ecological infrastructure, erosion needs to be addressed within the uMkhomazi catchment.

The cumulative impacts of major dam developments (such as Smithfield Dam) as well as other developments (e.g. Ngwadini Off-channel Storage Dam and Sappi Saiccor abstractions) on the uMkhomazi River in terms of reduced fluvial sand supply need to be investigated further. This must include a detailed understanding of the current state of the sediment regime as well as establishing a monitoring programme. Most likely a host of interventions will need to be explored by the mandated authorities (including DEA, DWS, KZN DEDTEA, EKZNW, DMR, eThekwini Municipality, etc.) which may include *inter alia* addressing illegal/unpermitted sand mining, targeted catchment management, investigating the feasibility of adding a sand bypass tunnel at the Smithfield Dam, and a beach nourishment programme.

As part of the Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives (DWS, 2014b) the impacts of the following operational scenarios in the uMkhomazi River system were assessed at the

EWR sites: uMWP-1; Bulwer Water Supply Scheme; and Ngwadini OCD (refer to **Sections 12.6.5** and **12.7.2**). This allowed for the cumulative impacts of current and future major developments on the uMkhomazi River system to be evaluated.

12.22.3 Socio-Economic Environment

The forecasting of the water requirements for the Integrated Mgeni WSS was based on demographic, economic, development and infrastructural variables. uMWP-1 will allow for the water demands of this system to be satisfied until 2048. In turn, this will have a positive impact on the macro socio-economic environment that will benefit from this scheme (refer to **Section 11.2.1**).

If the WSA provides water to the community surrounding Smithfield Dam more people may relocate to the area that is to be serviced in order to gain access to water. The settlement on the tribal land that is located to the south of the uMkhomazi River is managed by the Ingonyama Trust and the Traditional Authorities in the area. However, the Harry Gwala DM and the Department for Cooperative Governance and Traditional Affairs may need to intervene where settlement conflict could arise over the provision of water services.

The raw water pipeline routes may impact on properties that are already traversed by existing infrastructure (e.g. gas lines, power lines, etc.). These properties will thus have a network of infrastructure with the associated servitude restrictions.

12.22.4 Transportation Network

The construction period will be associated with traffic-related impacts to the local road network. If it is deemed necessary to obtain construction material from a commercial source, the cumulative impacts to the roads that are to be affected would need to be considered and the current Traffic Impact Assessment would need to be updated accordingly.

No other large-scale developments are known to be earmarked for the greater area, and there is thus no cumulative impact to the transportation network.

12.22.5 Biodiversity

The Terrestrial Fauna and Flora Study and the Avifauna Study identified species of conservation significance that could be adversely affected by the project activities. These studies took into consideration the existing local impacts to the biodiversity and the incremental loss of conservation-worthy species of the project within the context of the provincial conservation goals and targets.

The Blue Swallow, which is Critically Endangered, is an intra-Africa migratory species that is threatened by the destruction and degradation of its grassland and wetland habitats on both its breeding and non-breeding grounds. As discussed in **Section 10.8.2.4**, the Blue Swallow occurs and breeds in the greater project area. Limited literature exists with regards to the impacts of noise and vibration on this particular species. A recommendation that emanates from the EIA is that a specific and dedicated noise and vibration monitoring programme must be established for the project that takes into consideration sensitive receptors such as protected avifauna species.

Exotic vegetation is encountered in the project area and is mostly associated with grazing and disturbances linked to subsistence livelihoods. Large areas will be cleared during the construction phase of the project and all disturbed areas outside of the dam basins will need to be appropriately rehabilitated to ensure that a cumulative impact is not caused in this regard.

Through the search, rescue and relocation a concerted effort will be made to prevent the loss of red data, protected and endangered fauna and flora species that will be affected by the project. With the relocation of these species to suitable habitat the cumulative impact to biodiversity could be adequately managed.

The soils in some parts of the project area are erodible. Any previous disturbance (including grazing) will be aggravated by the construction activities if this impact is not properly managed.

12.22.6 Agriculture

The cumulative loss of current and potential future agricultural land on Baynesfield Estate would need to be taken into consideration as part of the compensation, as the farming operations are geared towards supplying sufficient feed to the piggery.

13 ANALYSIS OF ALTERNATIVES

13.1 General

Alternatives are the different ways in which the project can be executed to ultimately achieve its objectives. Examples could include carrying out a different type of action, choosing an alternative location or adopting a different technology or design for the project.

The section provides an appraisal of all the environmental and technical considerations associated with the various alternatives through a comparative analysis to eventually distil the Best Practicable Environmental Option (BPEO). Münster (2005) defines the BPEO as the alternative that "*provides the most benefit or causes the least damage to the environment as a whole, at a cost acceptable to society, in the long term as well as in the short term*".

13.2 'No Go' Option

As standard practice and to satisfy regulatory requirements, the option of not proceeding with the project is included in the evaluation of the alternatives.

Through a water balance analysis it was confirmed that the long-term water requirements of eThekwini Municipality, Msunduzi LM and surrounding areas exceed the yield of the water resources of the Mgeni System. Detailed investigations have been conducted to date to exhaust the various options to meet the water demands of this system, and to advance towards identifying the current feasible project alternatives.

The implications of the 'no go' option are discussed in **Section 12.22**. The 'no go' alternative is not supported due to the following reasons:

- ❖ The long-term water deficit that will exist in the Integrated Mgeni WSS means that the water requirements of the supply area will not be met;

- Water supply shortfalls could adversely affect the various water user sectors, and would suppress development with related socio-economic implications; and
- Over-utilisation of water resources could adversely affect the ecological functioning of the Mgeni River system.

13.3 Screened & Feasible Alternatives

Other options such as measures to increase the water resource, desalination and re-use, use of groundwater and Water Conservation and Water Demand Management were analysed as part of the Water Reconciliation Strategy for the KZN Coastal Metropolitan Areas (DWA, 2009). Refer to the discussion on screened alternatives contained in **Section 9.1**.

The Mgeni River System Analysis Study carried out between 1991 and 1994 identified the uMkhomazi River as a potentially viable source of water for augmentation of the Mgeni System. The subsequent uMkhomazi-Mgeni Transfer Scheme Pre-Feasibility Study included an investigation of augmentation schemes on the uMkhomazi River preceded by scheme identification and reconnaissance investigations. The initial eight schemes that were identified were refined based on technical, environmental and economic factors. The Pre-feasibility Study recommended that the Smithfield Scheme be taken forward to the next phase of investigation in a detailed Feasibility Study.

13.4 Specialist Studies

Tables 100 – 103 summarise the findings of the various relevant specialists in terms of their respective preferences for the project’s feasible alternatives. Note that the following abbreviations were used:

- *TEIA: Terrestrial Ecological Impact Assessment;*
- *AqIA: Aquatic Impact Assessment;*
- *AIA: Agricultural Impact Assessment;*
- *HIA: Heritage impact Assessment;*
- *SEIA: Socio-economic Impact Assessment;*
- *SIA: Social Impact Assessment;*
- *VIA: Visual Impact Assessment; and*
- *AS: Avifauna Study.*

Table 100: Preferred Options (with motivation) in the Smithfield Dam area recommended by Specialists

Component	Options	TEIA		AqIA		AIA		HIA	
Gauging weir	Option 1	-	No preference. The two sites have similar habitats with similar species composition.	✓	Located closer to the dam wall, localisation of impacts, allows greater habitat availability to aquatic organisms from downstream sources.	-	No preference.	-	Due to proximity to river, any heritage resources would have been destroyed or washed away during flooding. No preference.
	Option 2	-				-		-	
		SEIA		**SIA**		**VIA**		**AS**	
	Option 1	-	No preference.	✓	Support the visual impact assessment, apart from this no compelling preferences	✓	Closest to existing infrastructure.	-	No preference.
	Option 2	-						-	
Component	**Options**	**TEIA**		**AqIA**		**AIA**		**HIA**	
Relocation of Transmission Line	Option 1	✓		✓	Shortest route - smallest ecological footprint. 1 major watercourse crossing that can be spanned - negate impacts.	✓	Much shorter route. Less arable land affected.	✓	The area of impact is limited to a new crossing of the river close to the existing servitude; substantially shorter than Option 2
	Option 2		Impacts on the Impendle Nature Reserve.		Longer route with greater ecological footprint. Will need to cross numerous watercourses.		Significantly longer route around the basin. 1,2 km arable land to be affected.		A much longer option with a concomitant increase in the risk of impacting on heritage resources
		SEIA		**SIA**		**VIA**		**AS**	
	Option 1	✓	No servitude agreement is required using this route resulting in less financial and future development implications. This route follows the original power line.	✓	Shortest and less intrusive route	✓	Shortest route, existing power line.	✓	Far less nett length of new power line in the landscape. Crossing the dam will present a high collision risk to birds. However Option 2 will also still cross the dam-river system just below the dam wall, which could be worse as the cables will be obscured against the dark background of the dam wall for any bird flying upstream, and against the ground for any bird flying downstream and having just gained altitude to fly over the wall.
	Option 2		Longer in length requiring a new servitude. Unfavourable land use restrictions from servitude may impact future development and current agricultural practice.				Longest route, more exposure.		

Table 101:Preferred Options (with motivation) for Conveyance Infrastructure Components recommended by Specialists

Component	Alternatives	TEIA		AqIA		AIA		HIA	
Raw Water Pipeline	Route to WTW Option 1	✓	WTW Option 1 is the preferred option in terms of uMWP-1 Potable Water.			✓	Low impact, least loss of high potential land and grazing. However, impact transferred to Potable Water conveyance portion, as total distance will remain same.	✓	WTW Option 1 is the preferred option in terms of uMWP-1 Potable Water.
	Route to WTW Option 2				Has the greatest association with surface water ecosystems and is therefore the least preferred option				Pipeline runs close to Baynesfield Estate buildings.
	Route to WTW Option 3			✓	Is located the furthest from surface water ecosystems				Follows most of Option 1 - crosses mainly disturbed areas; position of pipeline next to Stead family cemetery is cause for concern.
		SEIA		SIA		VIA		AS	
	Route to WTW Option 1		Pipelines have very small socio-economic impacts when compared to WTW. Therefore, the choice of options between the WTW has informed this decision. This option leaves the individual farmer vulnerable to a loss of income.	✓	Furthest option from the Baynesfield Estate building, least loss of high potential land and grazing and least potential impact on heritage sites.				Acceptable.
	Route to WTW Option 2	✓							Not acceptable on basis that it will require the potable pipeline to cross sensitive natural vegetation and steep slopes immediately north of Mapstone Dam.
	Route to WTW Option 3					✓	WTW Option 3 preferred option due to less visual exposure	✓	Furthest from Baynesfield.

Component	Alternatives	TEIA		AqIA		AIA		HIA	
Spoil Site – Tunnel Outlet	Option 1	✓	Affects area disturbed by agriculture.		Utilisation of the spoil in the dam wall is preferred.		Affects large cultivated area.		Impacts on area where heritage sites could be found
	Option 2		Increased footprint in a watercourse.	✓	Utilisation of spoil will decrease the footprint that would otherwise have been necessary for the storage area.	✓	Use of spoil in construction of dam wall.	✓	No impact on heritage sites
		SEIA		SIA		VIA		AS	
	Option 1		Prime agricultural land.						
	Option 2	✓	Less impact on agricultural land.	✓	Least loss of high potential land, no heritage and least visual impacts.	✓	Spoil is reused, minimal visual pollution.	✓	No additional area impacted upon.

Table 102: Preferred Options (with motivation) for Balancing Dam Components recommended by Specialists

Component	Alternatives	TEIA		AqIA		AIA		HIA	
Balancing dam	Mbangweni Balancing Dam	✓		-	No preference.			✓	Situated closer to existing Mbangweni Dam hence there are existing access roads thus limiting need for new access roads.
	Langa Balancing Dam		Will inundate an area of natural grassland.	-		✓	Inundates smaller area of high potential agricultural land.		Outer reaches of dam impact on undisturbed land which increases potential for impacting heritage resources.
		SEIA		**SIA**		**VIA**		**AS**	
	Mbangweni Balancing Dam	-	No preference.	-	No preference.			✓	Although larger in surface area compared to Langa, Mbangweni is in a generally more transformed area with less natural vegetation: ❖ A far higher proportion of inundated area is already transformed for crops and forestry. Nett result is Mbangweni will inundate approx. 62.5 ha of natural grassland and wetland, whilst Langa will inundate 78.3 ha. ❖ A higher proportion of the perimeter of the dam edge is transformed land use – therefore lower potential impacts on this receiving environment. Langa dam total perimeter is 7.9 km, 5.2 km of which is natural vegetation. Mbangweni dam has total perimeter of approx. 8.7 km with 4.5 km natural vegetation. Both dam walls – where most construction will take place are more or less equidistant to Blue Swallow breeding area. Closer to tunnel outlet therefore less additional infrastructure required. Closer to main roads therefore less new access road required and less disturbance of areas en route to new dam.
	Langa Balancing Dam	-		-		✓	Less viewshed onto Zinti Valley.		

Component	Alternatives	TEIA		AqIA		AIA		HIA	
Road – Balancing Dam	Option 1	✓	Follows the existing road for entire length.	✓	Will follow the alignment of a well-established existing roadway.	-	Because the road will largely follow existing alignments, there will be no preference.		Situated on existing road so area is already disturbed; slightly less preferred as longer in length than Option 2
	Option 2		Crosses a watercourse.		Will create the greatest disturbance to establish a roadway of adequate magnitude if this option is decided on.	-		✓	Situated on existing road so area is already disturbed
		SEIA		**SIA**		**VIA**		**AS**	
	Option 1	✓	This route is along an existing road. Thus there are fewer impacts.	-	No preference.	✓	Less visual exposure.	✓	Existing large road.
	Option 2			-					

Table 103: Summary of Preferred Alternatives recommended by Specialists and Technical Team

	Components	Alternatives	TEIA	AQIA	AIA	HIA	SEIA	SIA	VIA	AS	TFS*
Smithfield Dam Area	**Relocation of Eskom Transmission Line**	Option 1	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Option 2									
	Gauging weir (downstream and close to Smithfield Dam - U10F)	Option 1	-	✓	-	-	-	✓	✓	-	✓
		Option 2									
Conveyance Infrastructure	**Raw Water Pipeline**	Route to WTW Option 1	✓		✓	✓		✓			✓
		Route to WTW Option 2									
		Route to WTW Option 3		✓					✓	✓	
	Spoil Site – Tunnel Outlet	Option 1: Position 1	✓								
		Option 2: Spoil to be used in the balancing dam wall		✓	✓	✓		✓	✓	✓	✓
Balancing Dam Area	**Balancing dam**	Mbangweni Balancing Dam	✓	-		✓		-		✓	
		Langa Balancing Dam			✓				✓		✓
	Road – Balancing Dam	Option 1	✓	✓	-			-	✓	✓	
		Option 2				✓					✓

* TFS = Technical Feasibility Study

13.5 Comparative Impacts of Alternatives

13.5.1 General

The alternatives to the project components are compared in the subsections to follow, based on the receiving environment (**Section 10**), findings from specialist studies (**Section 11**) and the outcome of the impact assessment (**Section 12**).

Note that the highlighted blocks in the tables indicate the preferred option for each environmental feature. Hence, where no blocks are highlighted, no obvious preference exists.

13.5.2 Smithfield Dam Area - Gauging Weir and Relocation of Transmission Line

Table 104: Comparative Adverse Impacts - Gauging Weir Alternatives

Environmental Feature / Attribute	Gauging Weir	
	Option 1	Option 2
Land Use	Similar potential impacts to land use. Both sites occur alongside vacant land and subsistence grazing.	
Geology & Soils	The presence of erosion on the western bank may indicate that there may be considerable excavation required in order to find suitable rock foundation material.	Exposed rock face on western bank of the river approximately 60 m upstream indicating that excavation may be easier at this site.
Topography	Gauging weir optional sites located instream of the uMkhomazi River, surrounded by rural area. Similar potential impacts to topography. Proper rehabilitation required for areas affected by construction activities.	
Surface Water	Localisation of the impacts as well as fragmentation of the least amount of aquatic habitat	Further away from proposed dam wall and causes larger section of river to be fragmented.
Terrestrial Ecology	No discernible difference with regards to impacts posed by options to terrestrial ecology, due to similar terrestrial habitats.	
Agriculture	The potential impact on arable land is minimal, and will only be for the period that construction takes place. Proper rehabilitation required for areas affected by construction activities.	
Heritage Resources	Similar potential impacts to heritage resources.	
Socio-Economic Aspects	No discernible difference with regards to impacts posed by options to the socio-economic environment.	
Existing Structures & Infrastructure	No discernible difference with regards to impacts posed by options to existing structures and infrastructure.	
Road Network & Access	A new access road will need to be created for the gauging weir, with similar impacts for both options.	
Visual Quality	Nearest to Smithfield Dam.	-
Avifauna	Both sites pose similar potential impacts to birds. Proper rehabilitation required for areas affected by construction activities.	
Technical	Closest to Smithfield Dam. Good access to site. Considerable excavation for foundation due to erosion.	Less excavation for good foundation. Further away from Smithfield Dam. Additional tributary flowing into uMkhomazi River between dam and weir site - this may affect the accuracy of measuring discharge from Smithfield Dam.

Table 105:Comparative Adverse Impacts - Relocation of Transmission Line Alternatives

Environmental Feature / Attribute	Relocation of Transmission Line	
	Option 1	**Option 2**
Land Use	No new land affected, as it only entails crossing the basin along its existing alignment.	Overall length of new power line route ± 13.6 km. Route crosses over vacant land, grazing area, conservation (Impendle Nature Reserve) and settlements.
Geology & Soils	Power line towers to avoid basin and steep area. Towers to have sufficient attachment height to allow for sufficient clearance.	Route traverses some steep areas. Sections with significant existing erosion.
Topography		Varying terrain along power line route (ridges, low lying areas alongside uMkhomazi River).
Surface Water	Power line to span the dam basin (± 400 m).	New power line route to cross over the uMkhomazi River as well as ± non-perennial watercourses / drainage lines.
Terrestrial Ecology	Minimal potential impacts to terrestrial ecology associated with construction of towers and associated access roads.	Considerably longer route. A section of the route traverses the Impendle Nature Reserve.
Agriculture	Option 1 will follow the alignment of the existing power line and will cross over the basin. Grazing to be affected during construction.	Option 2 will be 15,6 km deviation around the basin. 1,2 km arable land will be affected. If a 30 metres wide strip along the route of the line is impacted, then 40 hectares of grazing and 3,6 hectares of arable land will be affected during construction. In addition, the area of the pylon will be permanently affected.
Heritage Resources	Option 1 will follow the alignment of the existing power line and will cross over the basin.	Much longer route, with increase in risk of affecting heritage resources.
Socio-Economic Aspects	Minimal impact. The existing power line route is followed.	New power line route which crosses over dwellings and areas used for subsistence farming. Additional servitude to be acquired.
Existing Structures & Infrastructure	New towers required to lift power line to allow for the clearance of the dam basin. No other structures of infrastructure affected.	New route crosses over the R617 and 5 local roads. Access roads required for construction and operational purposes.
Road Network & Access	Short sections of new access roads required to reach towers on northern and southern side of the basin.	
Visual Quality	Impact to the visual quality of the waterbody. Potential influence to future recreational value of the dam.	Much longer route, with higher visual exposure. A section of the route traverses the Impendle Nature Reserve.
Avifauna	Smithfield Dam could potentially attract many waterbirds. The power line will pose a threat of collision to these species that migrate along the waterbody and shoreline.	Significantly longer route with new alignment. Threat of bird collision, particularly at point where the power line crosses the uMkhomazi River to the south of Smithfield Dam.
Technical	Lower cost, no deviation required. Elevation of line needs to be lifted.	Higher cost due to longer deviation route of line. Additional length of power line and servitude to maintain.

13.5.3 Conveyance Infrastructure - Raw Water Pipeline and Spoil Site

Note that the raw water pipeline route is dependent on the final location of the WTW, which forms part of the Potable Water component. Hence, the outcome of the impact assessment for the WTW options was also considered in the ultimate selection of the preferred route for the raw water pipeline.

Table 106:Comparative Adverse Impacts - Raw Water Pipeline Alternatives

Environmental Feature / Attribute	Raw Water Pipeline		
	Route to WTW Option 1	Route to WTW Option 2	Route to WTW Option 3
Land Use	Overall length ± 4,9 km. Located on Baynesfield Estate, and route mostly crosses cultivated land, timber plantation, vacant areas and watercourses.	Overall length ± 7.4 km. Predominantly passes through cultivated land and small areas of timber plantation and vacant land, as well as watercourses. First section traverses Baynesfield Estate. Travels past some residential dwellings and the Baynesfield Club sports grounds. Greatest net footprint in overall pipeline length (considering raw and potable water pipelines).	Overall length ± 14.4 km. Crosses Baynesfield Estate and other private land, with the land cover mostly constituting cultivated land followed by timber plantation, vacant areas, grassland and watercourses (including Mapstone Dam). The route travels to the north of Hopewell and also traverses Rainbow Farms property where the route passes chicken houses.
Geology & Soils	Similar types of potential impacts. Detailed geotechnical investigations to be conducted during the design phase.		
Topography	Shortest route through undulating hills and lowlands.	The potable water pipeline from WTW Option 2 crosses a steep area north of Mapstone Dam. Substantial cut and fill required.	Route affects undulating hills and lowlands.
Surface Water	6 watercourse crossings along pipeline route.	6 watercourse crossings along pipeline route. 3 additional watercourse crossings along potable water pipeline from WTW Option 2.	12 watercourse crossings along pipeline route. Depending on the location of the WTW, the 6 watercourse crossings along the eastern section of the route may apply to the potable water pipeline. Hence, there will not be a net increase in watercourse crossings for the overall uWMP-1.
Terrestrial Ecology	Shortest route with least disturbance.	Majority of route traverses CBA 1 Mandatory area. Greater footprint within the Baynesfield Conservancy. The potable water pipeline from WTW Option 2 traverses a ridge and grassland areas. Greater area disturbed (overall net footprint) - more reinstatement and rehabilitation required.	-
Agriculture	Affects 1.7 km field crops, 1.4 km timber land and 1.8 km grazing land. Shortest route.	Affects 4.4 km field crops, 0.8 km timber land and 2.2 km grazing land. Second shortest route.	Affects 9.4 km field crops, 0.9 km irrigated field crops, 1.5 km timber land and 2.3 km grazing land. Longest route – greatest impact on agriculture.
Heritage Resources	Shortest route.	Pipeline runs close to	Longest route, however, follows

Environmental Feature / Attribute	Raw Water Pipeline		
	Route to WTW Option 1	Route to WTW Option 2	Route to WTW Option 3
		Baynesfield Estate buildings.	much of Potable Water Pipeline Option 1, which crosses mainly disturbed areas;
Socio-Economic Aspects	Pipelines have small socio-economic impacts when compared to the WTW. Therefore, the choice of options between the WTW overrides preference with regards to pipeline routes.		
	WTW Option 1 leaves the individual farmer vulnerable to a loss of income.	-	WTW Option 3 leaves the individual farmer the most vulnerable to a loss of income.
Existing Structures & Infrastructure		Route crosses a railway line. Passes in close proximity to the Baynesfield Club sports ground as well as residential dwellings. Travels past buildings as well as chicken houses. Greater net impact on infrastructure associated with agricultural practices.	Route crosses a railway line.
Road Network & Access	Crosses D41.	Crosses D41 and two crossings of P334.	Crossing of D41, R56, P117 and P547. Alignment alongside the D360.
Visual Quality	Shortest route with least disturbance. Potential screening of proposed WTW Option 1 by existing timber plantation.	The potable water pipeline from WTW Option 2 traverses a ridge and grassland areas. Greater area disturbed (overall net footprint) - more reinstatement and rehabilitation required.	WTW Option 3 is the preferred option in terms of uMWP-1 Potable Water, due to less visual exposure.
Avifauna	Shortest route. Linked to WTW Option 1, which is situated in the Baynesfield area (regarded as a sensitive area for birds despite it being intensively developed).	Route crosses sensitive natural vegetation and steep slopes immediately north of Mapstone Dam. Majority of route traverses an area classified as CBA 1 Mandatory. Crosses possible Grey Crowned Crane habitat.	Longest route. Crosses the most number of watercourses (when considered in isolation of potable water pipeline). Linked to WTW Option 3, which is situated the further from the Baynesfield area.
Technical	WTW Option 1 preferred.	-	-

Table 107: Comparative Adverse Impacts – Spoil Site (Tunnel Outlet) Alternatives

Environmental Feature / Attribute	Spoil Site (Tunnel Outlet)	
	Option 1	**Option 2**
Land Use	Affects ± 9,6 ha of cultivated land on Baynesfield Estate.	Affects ± 0.56 ha of cultivated land, as well as ± 0.6 ha of timber land, on Baynesfield Estate.
Geology & Soils	Spoil site will require grading and rehabilitation to prevent erosion along slopes.	Suitable founding conditions at dam wall.
Topography	The spoil site will have a large footprint and create a visual impact in the surrounding	Enlargement of the dam wall footprint in watercourse.

Environmental Feature / Attribute	Spoil Site (Tunnel Outlet)	
	Option 1	Option 2
	landscape.	
Surface Water	Situated on cultivated land. Flanked by two tributaries and the main stem of the Mbangweni River.	Enlargement of the dam wall footprint in watercourse.
Terrestrial Ecology **Avifauna**	Footprint affects transformed area.	Use of spoil material in construction of dam will increase the total length of watercourse and wetland area affected.
Agriculture	Affects ± 9,6 ha of high potential land that is currently used for crop production.	Affects ± 0.56 ha of high potential land that is currently used for crop production, as well as ± 0.6 ha of timber land.
Heritage Resources	Impacts on area where heritage sites could be found.	Lower probability of occurrence of heritage sites.
Socio-Economic Aspects	Situated on cultivated land.	Enlargement of the dam wall footprint in watercourse.
Existing Structures & Infrastructure	Possible loss of agricultural infrastructure.	Enlargement of the dam wall footprint in watercourse.
Road Network & Access	Similar types of potential impacts.	
Visual Quality	Large footprint on cultivated land.	Spoil is reused. Less visual pollution.

13.5.4 Balancing Dam Area - Balancing Dam and Access Road

Table 108:Comparative Adverse Impacts - Balancing Dam Alternatives

Environmental Feature / Attribute	Balancing Dam	
	Mbangweni Balancing Dam	Langa Balancing Dam
Land Use	Situated on Baynesfield Estate. Inundates larger area. Land uses affected include cultivated land, timber plantation and vacant areas.	Situated on Baynesfield Estate. Inundates smaller area. Land uses affected include cultivated land, timber plantation and vacant areas.
Geology & Soils **Topography**	Wider valley section within river. Deeper foundations need to be excavated.	Materials confirmed to be available within the dam basin for dam type. Less excavation required – better foundations conditions. -
Surface Water	Inundates a larger area of the Mbangweni River system. Affects more FEPA wetlands.	Smaller footprint in terms of affected watercourses.
Terrestrial Ecology **Avifauna**	Larger in surface area, however, more transformed with less natural vegetation. Will inundate ± 62.5 ha of natural grassland and wetland. ± 4.5 km of dam perimeter is natural vegetation. Closer to main roads therefore less new access road required and less disturbance of areas *en route* to new dam.	Will inundate ± 78.3 ha of natural grassland and wetland. ± 5.2 km of dam perimeter is natural vegetation.
Agriculture	Inundates 101 ha of high potential land. Increases net impact on agricultural land on Baynesfield Estate.	Inundates 81 ha of high potential land.
Heritage Resources	Existing access roads thus limiting need for new access roads.	Outer reaches of dam impact on undisturbed land which increases potential for impacting heritage resources.

Environmental Feature / Attribute	Balancing Dam	
	Mbangweni Balancing Dam	Langa Balancing Dam
Socio-Economic Aspects	Similar types of potential impacts.	
Existing Structures & Infrastructure	Similar built environment, where both balancing dams impact on private farm roads (access roads to cultivated areas and timber plantations) and possibly farming-related infrastructure (e.g. irrigation pipelines).	
Road Network & Access		
Visual Quality	Higher visibility.	Less viewshed onto Zinti Valley.
Technical	Wider valley section within river. Deeper foundations need to be excavated.	Less excavation required – better foundations conditions.

Table 109:Comparative Adverse Impacts – Balancing Dam Access Road Alternatives

Environmental Feature / Attribute	Access Road	
	Option 1	Option 2
Land Use	Overall length ± 4.68 km. Passes cultivated land, Baynesfield Estate Lodge and vacant areas on Baynesfield Estate.	Overall length ± 4.69 km. Passes cultivated land, timber plantations, Baynesfield Estate Lodge and vacant areas on Baynesfield Estate.
Geology & Soils	Greater earthworks.	Smaller grade and less earthwork volumes.
Topography	Follows existing road for entire length. Existing disturbance along route.	Follows existing road for most of length, however, a section of the route deviates to cross a watercourse and an area with less transformation.
Surface Water		
Terrestrial Ecology		
Avifauna		
Agriculture	Follows existing road for entire length. Passes avocado trees for ± 1.2 km – sensitive to dust associated with construction vehicles that will use access road.	Follows existing road for most of length. Passes cultivated areas and timber land.
Heritage Resources	Follows existing roads that are already disturbed.	
Socio-Economic Aspects	Follows existing road for entire length.	Follows existing road for most of length. Passes cultivated areas and timber land.
Existing Structures & Infrastructure	Follows existing roads.	
Road Network & Access		
Visual Quality	Less visual exposure.	A section of the route crosses a watercourse and an area with less transformation.
Technical	Slightly shorter road length (± 4.68 km). Greater earthwork volumes and higher cost.	Smaller grade and less earthwork volumes. Slightly longer road length (± 4.69 km).

13.6 BPEOs Selection

Based on the recommendations of the specialists, technical considerations, input from I&APs and the comparison of the impacts, the following options were identified as the BPEOs for the related project components:

- Smithfield Dam Area:
  - **Relocation of Eskom Transmission Line -**
    - Option 1 (across the dam);

- **Gauging weir -**
  - Option 1;

❖ Conveyance Infrastructure:

- **Raw Water Pipeline -**
  - Route to WTW Option 1;
- **Waste disposal site – Tunnel Outlet -**
  - Option 2: Spoil to be used in the balancing dam wall;

❖ Balancing Dam Area:

- **Balancing dam -**
  - Langa Balancing Dam;
- **Road – Balancing Dam -**
  - Option 2.

The layouts of the selected scheme are provided in **Figure 240** (western side) and **Figure 241** (eastern side).

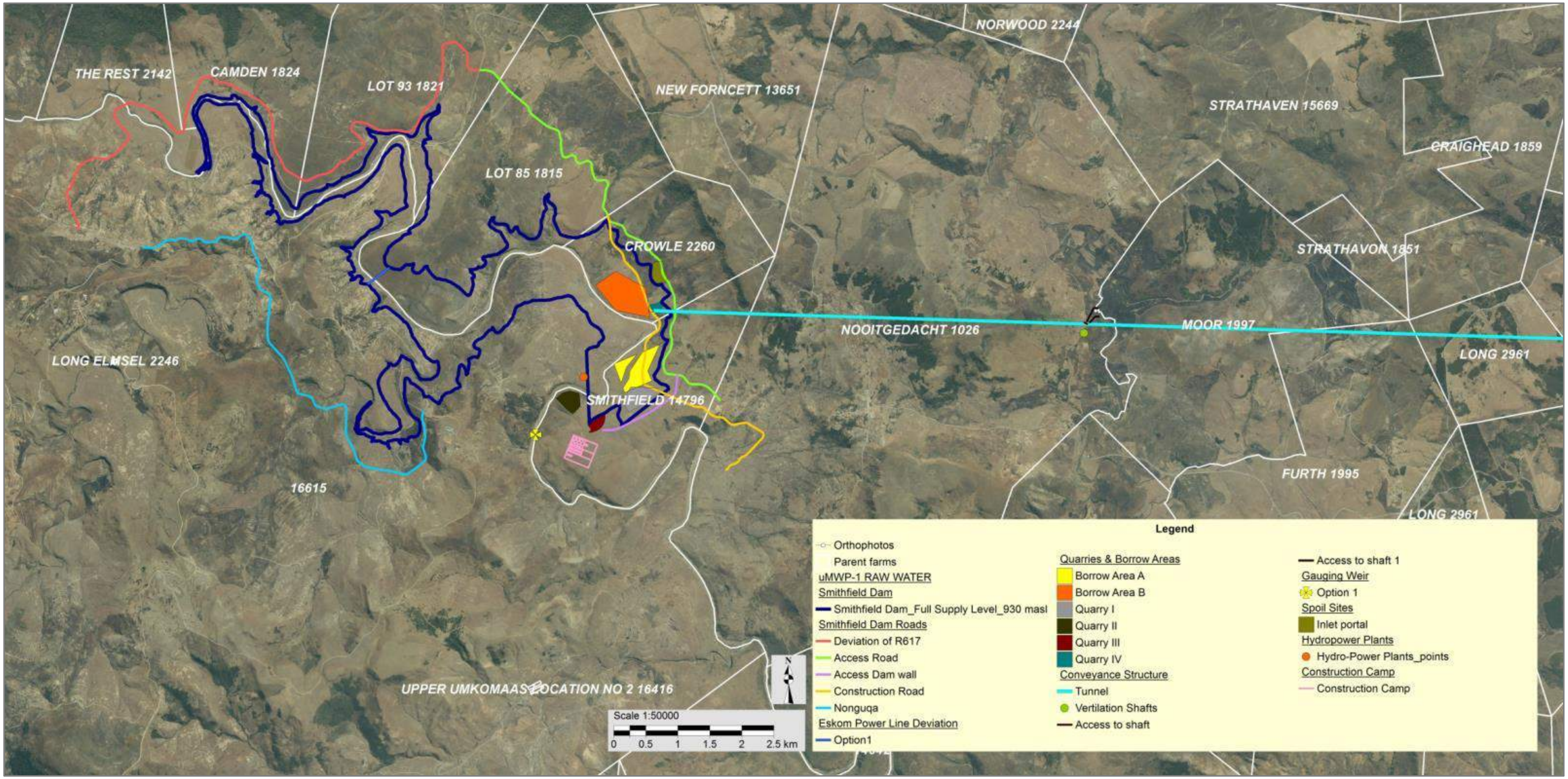


Figure 240: Layout indicating BPEOs for project components – western side

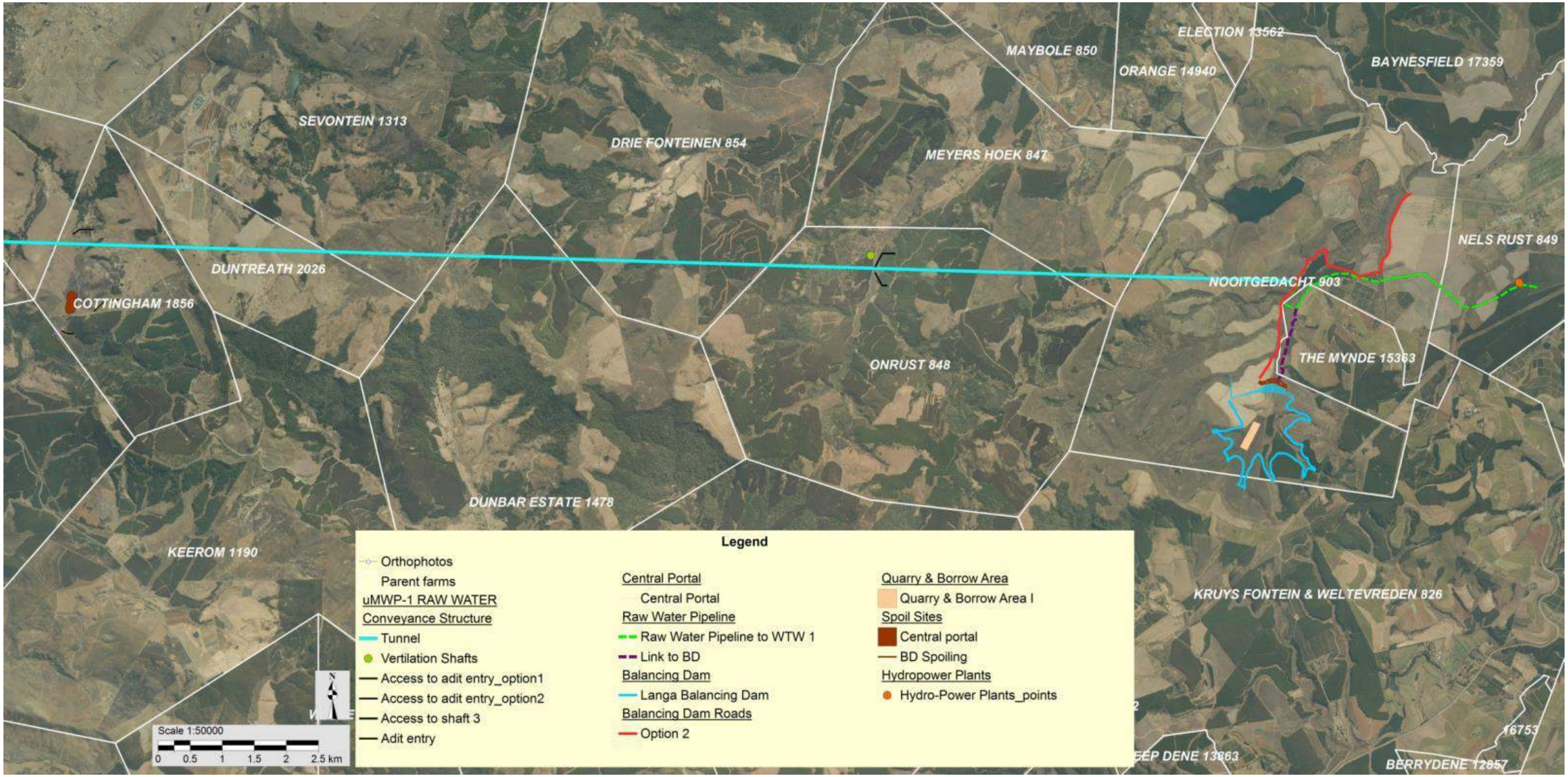


Figure 241: Layout indicating BPEOs for project components – eastern side

14 PUBLIC PARTICIPATION

14.1 General

The purpose of public participation includes:

1. Providing I&APs with an opportunity to obtain information about the project;
2. Allowing I&APs to express their views, issues and concerns with regard to the project;
3. Granting I&APs an opportunity to recommend measures to avoid or reduce adverse impacts and enhance positive impacts associated with the project; and
4. Enabling DWS and the project team to incorporate the needs, concerns and recommendations of I&APs into the project, where feasible.

The public participation process that was followed for the proposed uMWP-1 Raw Water component is governed by NEMA and Government Notice No. R. 543 of 18 June 2010. **Figure 242** outlines the public participation process for the Scoping phase (completed) and EIA phase (current). Note that a combined public participation process for the uMWP-1 Raw Water and Potable Water components was held to date.

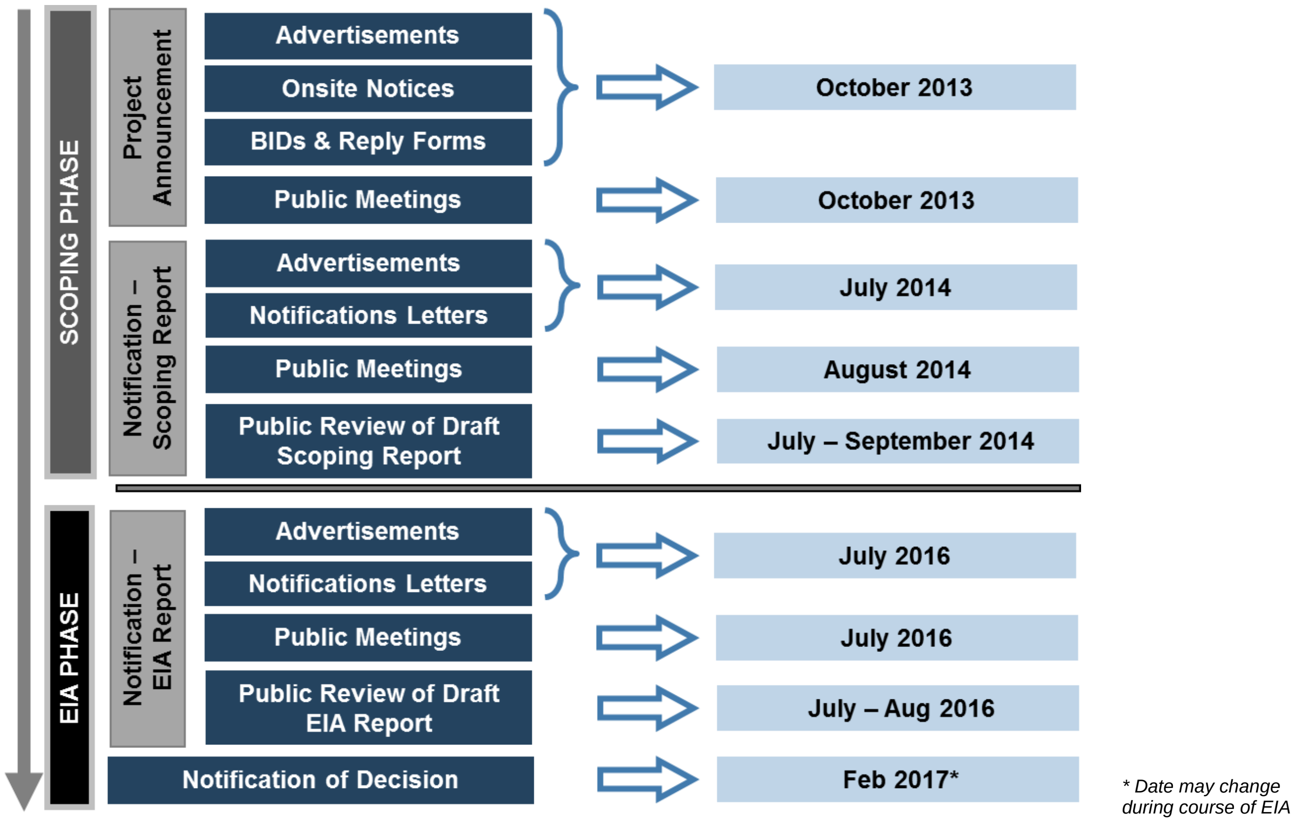


Figure 242: Outline of Public Participation Process

14.2 Public Participation during the Scoping Phase

The primary tasks undertaken as part of public participation during the Scoping phase included the following (details provided in Scoping Report):

- Convening a Pre-Application Consultation Meeting with DEA;
- Convene Environmental Authorities' Meetings and site visits;
- Compiling a database of I&APs;
- Notifying the affected landowners of the project;
- Announcing the project, which included distributing Background Information Documents (BIDs) and Reply Forms, erecting onsite notices and placing newspaper notices;
- Convening separate public meetings and authorities meetings to announce the project and to present the drat Scoping Report;
- Granting I&APs and authorities an opportunity to review the draft and final versions of the Scoping Report; and
- Compiling and maintaining a Comments and Responses Report.

14.3 Public Participation during the EIA Phase

14.3.1 Maintenance of the I&AP Database

A database of I&APs (refer to **Appendix J**), which includes authorities, different spheres of government (national, provincial and local), parastatals, stakeholders, landowners, interest groups and members of the general public, was maintained during the EIA phase.

14.3.2 Comments and Responses Report

The EIA Comments and Responses Report (contained in **Appendix L**) provides a comprehensive summary of comments, issues and queries received from I&APs to date (including the EIA phase). This report also attempts to addresses the comments through input received from the project team.

All comments received following the public review of the Draft EIA Report will be included in the updated EIA Comments and Response Report.

14.3.3 Notification of Review of Draft EIA Report

I&APs were notified as follows of the opportunity to review the Draft EIA Report and the public meetings:

1. A notification letter was forwarded to I&APs on the database via email;
2. Bulk SMSs were sent to I&APs where mobile telephone numbers were available;
3. Formal communication channels were used to notify the communities in the western part of the project area, which included direct notification of the Traditional Councils and community representatives;
4. Advertisements were placed in the following newspapers in July 2016:
   a) The Star (English);
   b) The Witness (English); and
   c) Isolezwe (Zulu).

14.3.4 Accessing the Draft EIA Report

In accordance with Regulation 56 of Government Notice No. R. 543 of 18 June 2010, registered I&APs are granted an opportunity to review and comment on the Draft EIA Report.

Copies of the document were placed at the locations provided in **Table 110**. A 40-day review period (from 4 July – 15 August 2016) was provided.

Table 110:Locations for review of Draft EIA Report

Copy	Location	Address	Tel. No.
1.	Baynesfield Club	Baynesfield	082 920 8499
2.	Beaumont Eston Farmers Club	R603	031 781 1753
3.	Bulwer Public Library	189 Jackson Street, Bulwer	039 832 0181
4.	Richmond Public Library	57 Harding Street, Richmond	033 212 2155
5.	Camperdown Public Library	18 Old Main Road, Camperdown	031 785 1742

Copies of the Draft EIA Report were provided to the following parties, which include key regulatory and commenting authorities:

- DEA;
- KZN DEDTEA;

- Ezemvelo KZN Wildlife;
- DWA KZN Regional Office;
- DMR KZN Office;
- Amafa aKwaZulu-Natali;
- DAFF;
- COGTA;
- KZN Department of Transport;
- Harry Gwala DM and Ingwe LM;
- uMgungundlovu DM and Richmond LM;
- Traditional Authorities; and
- Eskom.

The Draft EIA Report was also uploaded to the project website for downloading purposes - www.dwa.gov.za/Projects/uMkhomazi/default.aspx.

14.3.5 Public Meetings to Present the Draft EIA Report

The details of the public meetings that are convened to present the draft uMWP-1 Raw Water and Potable Water EIA Reports are provided in **Table 111**.

Table 111:Details of public meetings to be held to present the draft uMWP-1 EIA Reports

No.	Date	Time	Target Audience
1	13 July 2016	09h00 – 11h00	Amaqadi Traditional Council and Community
2		12h00 – 14h00	Deepdale Community
3	14 July 2016	09h00 – 12h00	Baynesfield Area
4		14h00 – 17h00	Umlaas Road Area
5	15 July 2016	10h00 – 12h00	KwaBhidla Traditional Council and Community.
6		14h00 – 16h00	Impendle Tenant Community & community on state land
7	16 July 2016	10h00 – 12h00	KwaZashuke Traditional Council and Community

14.3.6 Commenting on the Draft EIA Report

For remarks on the Draft EIA Report the reviewer can complete a Comment Sheet, which is included in **Appendix M** (also attached to the hardcopies of the Draft EIA Report). These completed Comment Sheets need to be forwarded to Nemai Consulting by 15 August 2016.

In accordance with Regulation 57 of GN No. R. 543 of 18 June 2010, the comments received from I&APs (including correspondence and completed Comment Sheets) from the review of the Draft EIA Report will be incorporated into the final Comments and Responses Report.

14.3.7 Review of the Final EIA Report

The Final EIA Report will also be lodged in the public domain for a 3-week review period. Notification in this regard will be provided to I&APs via email, fax or post.

In accordance with Regulation 56(6) of GN No. R. 543 of 18 June 2010, registered I&APs must submit comments on the Final EIA Report to DEA and provide copies of such comments to Nemai Consulting.

14.4 Notification of DEA Decision

All I&APs will be notified via email, fax or post after having received written notice from DEA on the final decision for the project. Advertisements will also be placed as notification of the Department's decision. These notifications will include the appeal procedure to the decision and key reasons for the decision. A copy of the decision will also be provided to I&APs on request.

15 EIA CONCLUSIONS & RECOMMENDATIONS

15.1 Sensitive Environmental Features

Within the context of the project area, cognisance must be taken of the following sensitive environmental features for which mitigation measures are included in the EIA Report and EMPr:

- Steep slopes are encountered in the project area and measures to prevent erosion would need to be employed for construction activities in these areas. Steep areas include –
  - Left- and right flank at dam walls (Smithfield Dam and balancing dam);
  - Gullies along the R617 deviation route, access roads (Smithfield dam and balancing dam) and raw water pipeline;
  - Tunnel inlet and outlet areas;
- All watercourses, including the uMkhomazi and uMlaza Rivers and their tributaries (including drainage lines), are regarded as sensitive and require suitable protection from the construction activities. All construction activities to comply with the National Water Act (Act No. 36 of 1998).
- All existing infrastructure and structures are regarded as sensitive and need to be safeguarded from construction activities until they have been relocated and the redundant sections removed (as relevant).
- This project is situated in an area of generally high avifaunal sensitivity with Blue Swallow as the primary bird species of concern since there are so few breeding pairs left in South Africa, and it is a species known to be susceptible to disturbance. This project is also sited in a core area for the species. Specific measures are included in the EIA Report and EMPr, as recommended by the avifauna specialist, that aim to safeguard sensitive bird species.
- Protected fauna and flora species occur in the area, which need to be protected against the project's potential adverse impacts. All construction activities to comply with the National Environmental Management: Biodiversity Act (No. 10 of 2004), National Forests Act (No. 84 of 1998) and Natal Nature Conservation Ordinance (15 of 1974). Sensitive species to be identified as part of the pre-construction survey. If

relocation is not required, then these species need to be adequately protected from construction activities.

- All traffic and pedestrians on the public roads are regarded as sensitive and measures need to be implemented to safeguard these road users.
- The community around Smithfield Dam need to be consulted at appropriate milestones during the course of the project. In addition, their concerns need to be adequately addressed in the RAP (including arrangements for resettling and compensating affected households), RMP (including future access to and use of the dam), Phase 2 Heritage Impact Assessment and search, rescue and relocation of medicinal plants. Existing communication channels need to be duly respected and adhered to when engaging with the community, which includes the involvement of the Harry Gwala DM, the local councilors, Traditional Authorities and the Ingonyama Trust Board.
- Baynesfield Estate is strategically located in terms of the project footprint and key infrastructure components (including the uMWP-1 tunnel outlet, balancing dam, raw water pipeline and WTW). Impacts to agricultural activities on the property need to be controlled to ensure minimal loss of high potential agricultural land. Ongoing communication and engagement with the Baynesfield Trust needs to be maintained during the project life-cycle. The construction activities associated with the uMWP-1 Raw Water and Potable Water need to be synchronised in such a way as to reduce the overall disturbances to the farming operations and tourism activities at the estate.
- Dust-intolerant crops such as avocado orchards are located alongside the proposed access road to the tunnel outlet and balancing dam on the Baynesfield Estate, and suitable mitigation measures need to be implemented to suppress dust caused by construction activities.
- A number of grave sites and structures older than 60 years were identified within the project area. The final locations of all heritage and cultural features will be confirmed as part of the Phase 2 Heritage Impact Assessment, Archaeological Impact Assessment and Paleontological Impact Assessment. These features may not be disturbed without following legal protocol.
- Prevent construction-related nuisance to the sensitive socio-economic receptors, including –
  - Communities surrounding Smithfield Dam;

  - The community residing on The Mynde Farm; and
  - Dwellings situated in close proximity to the project infrastructure (e.g. along raw water pipeline).
- The noise and air quality monitoring programme needs to take cognizance of sensitive receptors (see above).
- Properties may not be accessed unless consent has been granted by the landowner, or until the land acquisition process has been concluded, or a construction servitude has been registered.
- Livestock and unauthorised access to the construction domain needs to be prevented. Excavations to be adequately safeguarded.

15.2 Environmental Impact Statement

The strategic intent of the project stems from the necessity to support water requirements in the Integrated Mgeni WSS supply area, which is the main water source for the economic powerhouse of KZN. Various options to meeting the project's objectives were considered during a host of previous studies, which eventually lead to the identification of alternatives to be investigated as part of the Feasibility Study. Other options, such as desalinisation of sea water, re-use of treated effluent, use of groundwater and Water Conservation and Water Demand Management, were also considered. The uMWP-1 transfer scheme is deemed to be the most viable option to provide a large volume of water to fulfil the long-term water requirements of the Mgeni system.

The western portion of the project area, including Smithfield Dam and the first ± 21 km of the tunnel, falls under Traditional Authority and state land. The area is characterised by traditional homestead settlements and rural subsistence agriculture. The eastern part of the project area, which includes the remaining part of the tunnel (± 11.5 km), balancing dam and raw water pipeline, is privately owned and predominantly used for commercial farming and forestry. The affected landowners, tenants and occupiers of the affected properties and land were thoroughly engaged with as part of the public participation process as well as during the execution of certain specialist studies (e.g. Socio-Economic Impact Assessment). All the concerns raised were considered by the project team, and where relevant, recommendations and mitigation measures were included in the EIA

Report and EMPr. Of particular importance is that the land acquisition and compensation (including relocation) process needs to adhere to all legal requirements, in negotiation with the affected parties.

The original project layout was adapted as follows in order to address concerns raised by I&APs and to mitigate against potentially significant environmental impacts:

1. Smithfield Dam –
   a. Access roads were deviated and the new routes were optimised to minimise impacts to local traffic (human and vehicular) movement;
   b. The option to span the dam basin for the relocation of the power line was identified following engagement with Eskom;
   c. The option to deviate the power line to the north-west of the dam was excluded due to the potential impacts to the Impendle Nature Reserve;
2. Raw Water Conveyance Infrastructure –
   a. The initial spoil site at the tunnel outlet was discarded as it affected cultivated land on Baynesfield Estate;
   b. The raw water pipeline route to WTW Option 2 was identified after this new site had been identified following input during public participation;
3. Balancing Dam –
   a. In order to address concerns that had been raised by the local community, additional options were identified for the access road to the balancing dam in the Baynesfield area.

Due to the interrelatedness of uMWP-1 Raw Water and Potable Water, the EIA processes for these two components of the scheme were undertaken concurrently and the impacts were jointly assessed. The BPEOs were identified with due consideration of the linked infrastructure (e.g. location of WTW influenced the route of the raw water and potable water pipeline routes).

Critical environmental activities that need to be executed during the project life-cycle include the following:

- **<u>Pre-construction phase</u>** –

- Diligent compliance monitoring of the EMPr, environmental authorisation and other relevant environmental legislation;
- Develop RAP (Smithfield Dam basin) and implement based on area of influence of the construction activities;
- Undertake Phase 2 Heritage Impact Assessment, Archaeological Impact Assessment and Palaeontological Impact Assessment;
- Commence with RMP process;
- Conduct further investigations in terms of biodiversity offsets, based on EIA findings and recommendations;
- Undertake a walk through survey of the project footprint by the relevant environmental specialists to identify sensitive environmental features;
- Search, rescue and relocation of red data, protected and endangered species as well as medicinal plants (based on area of influence of the construction activities);
- Search, rescue and relocation of heritage resources and graves (based on area of influence of the construction activities);
- Develop environmental monitoring programme (sensitive avifauna, air quality, water quality, noise, traffic, social);
- Conduct further baseline environmental studies for environmental monitoring programme;
- Barricading of sensitive environmental features;
- Safeguarding of graves or families will be given the option to choose an alternate reburial site;
- Permits if protected trees are to be cut, disturbed, damaged, destroyed or removed;
- Permits if heritage resources are to be impacted on and for the relocation of graves;
- Establish Environmental Monitoring Committee (EMC);
- On-going consultation with I&APs;
- Other activities as per the EMPr;

❖ **<u>Construction phase</u>** –

- Diligent compliance monitoring of the EMPr, environmental authorisation and other relevant environmental legislation;

- Ongoing search, rescue and relocation of red data, protected and endangered species and medicinal plants (based on area of influence of the construction activities) – permits to be in place;
- Ongoing search, rescue and relocation of heritage resources and graves (based on area of influence of the construction activities) – permits to be in place;
- Implement environmental monitoring programme (sensitive avifauna, air quality, water quality, noise, traffic, social);
- Finalise RMP process prior to impoundment;
- Develop Rehabilitation Management Plan for approval by DEA;
- Reinstatement and rehabilitation of construction domain (outside of inundation areas, as necessary);
- Develop EMPr for Operational Phase for approval by DEA;
- Continued implementation of RAP;
- Biodiversity offset requirements;
- Convene EMC Meetings;
- On-going consultation with I&APs;
- Other activities as per the EMPr;

❖ **Operational phase** –

- Erosion and alien invasive plants monitoring programme;
- Satisfy EWR;
- Monitoring of RAP;
- On-going consultation with I&APs; and
- Other activities as per EMPr for Operational Phase.

Based on the recommendations of the specialists, technical considerations and the comparison of the impacts, the following options were identified as the BPEOs for the related project components:

❖ Smithfield Dam Area:

- **Relocation of Eskom Transmission Line -**
  - Option 1 (across the dam);
- **Gauging weir -**
  - Option 1;

- Conveyance Infrastructure:
  - **Raw Water Pipeline -**
    - Route to WTW Option 1;
  - **Waste disposal site – Tunnel Outlet -**
    - Option 2: Spoil to be used in the balancing dam wall;
- Balancing Dam Area:
  - **Balancing dam -**
    - Langa Balancing Dam;
  - **Road – Balancing Dam -**
    - Option 2.

Where the other alternatives were more favourable, the residual impacts following the recruitment of suitable mitigation measures were not regarded as sufficiently significant or overriding to sway the ultimate selection of the scheme's components.

With the selection of the BPEO, the adoption of the mitigation measures include in the EIA Report and the dedicated implementation of the EMPr, it is believed that the significant environmental aspects and impacts associated with this project can be suitably mitigated. With the aforementioned in mind, it can be concluded that there are no fatal flaws associated with the project and that authorisation can be issued, based on the findings of the specialists and the impact assessment, through the compliance with the identified environmental management provisions.

15.3 Recommendations

The following key recommendations, which may also influence the conditions of the Environmental Authorisation (where relevant), accompany the EIA for the proposed uMWP-1 Raw Water component:

1. The operating rule for Smithfield Dam and the balancing dam must ensure that the existing water use entitlements are not affected (i.e. current assurance of supply will not be adversely affected) and that the EWR for the affected rivers as well as for the uMkhomazi Estuary are satisfied.

2. Conduct environmental sensitivity walk down survey of entire project footprint prior to construction. Specialists to advise on necessity for surveying multiple seasons. Mitigation measures to be included in final EMPr. Survey team to include the following specialists:
    a. Avifaunal specialist;
    b. Terrestrial ecologist;
    c. Aquatic ecologist; and
    d. Heritage specialist.
3. For Smithfield Dam and the balancing dam (where relevant), the construction domains need to be contained within the respective dam basin areas as much as possible to avoid disturbance outside of the eventual impoundment footprints. All external areas that are not associated with permanent infrastructure and the operation of the scheme need to be adequately rehabilitated.
4. Spoil sites (tunnel inlet and central portals) to stay further than 32 m from any watercourse.
5. Project components to avoid watercourses, as far as possible, with suitable buffers (minimum of 32 m) and mitigation measures in place. This includes the spoil sites (tunnel inlet and central portals) and the camp site at Langa Balancing Dam.
6. The dwellings on the north-eastern side of the dam may need to be relocated prior to construction to avoid construction-related impacts to the occupants.
7. Provide suitable cover for the road surface for the access road to the tunnel outlet and balancing dam on Baynesfield Estate.
8. Specific requirements of EKZNW need to be included in the EMPr for the encroachment of the deviated R617 into Impendle Nature Reserve.
9. Develop and implemented a noise and vibration monitoring programme in consultation with BirdLife SA, WESSA and EKZNW, that includes sensitive avifauna (including Blue Swallow and Cranes).
10. The following is suggested in terms of Biodiversity Offsets:
    a. Support targeted investment in the maintenance and rehabilitation of Ecological Infrastructure (functioning ecosystem with associated services) in the uMkhomazi Catchment; and
    b. Land under the Protected Area Expansion Programme that is representative of the Impendle Nature Reserve to be considered further for biodiversity offsets.

11. Undertake Phase 2 Heritage, Archaeological and Palaeontological Impact Assessments prior to construction.
12. Establish an Environmental Monitoring Committee (EMC) in the pre-construction phase, with suitable representation of authorities, stakeholders and I&APs.
13. To mitigate impacts to the Baynesfield Estate Lodge it is recommended that this facility be recreated by DWS at Baynesfield Dam prior to construction.
14. Specific attention will need to be paid to managing impacts to road users for all public roads (including the R617, P334, P124, D41, D1211, D1212) and private roads. Traffic monitoring programme to be implemented and roads to be maintained. Safety of road users to be ensured at all times through appropriate safety and traffic calming measures.
15. Traffic management measures in the EMPr to be amended if aggregate it to be sourced off-site (commercial sources).
16. Prevent interruption of services associated with the relocation of the telephone line and power line.
17. Specific mitigation measures will need to be identified to prevent impacts from the TBM, if it is to remain underground indefinitely.
18. Ensure that where communities' access is obstructed, such as due to the road deviations, that this access is restored to an acceptable state. In respect of the 16 km addition for the Nonguqa Community it may be necessary to consider the construction of a pedestrian bridge. The solution would, however, need to be found through consultations with the affected community. This matter needs to be explored further as part of the detailed design. The relevant approvals will need to be sought, as relevant.
19. DWS to engage with DEA, DMR, DWS KZN Regional Office and eThekwini Municipality on the following:
    a. Impact of Smithfield Dam on the sediment regime of the uMkhomazi River with associated reduced sediments, which may adversely influence future sand mining applications;
    b. Addressing illegal sand mining operations downstream of Smithfield Dam to mitigate impact of reduced sediment loads in the uMkhomazi River to the coastal sediment budget;

   c. Targets to be established in terms of the volume of sediment that should be made available from the system; and
   d. Further investigations must include a detailed understanding of the current state of the sediment regime as well as establishing a monitoring programme to assess the impacts of Smithfield Dam on the sediment regime of the uMkhomazi River.

20. It is recommended that the following management plans be developed to supplement the provisions in the EIA Report and EMPr (if relevant):
   a. RAP for Smithfield Dam;
   b. Smithfield Dam Impoundment EMPr;
   c. Balancing Dam Impoundment EMPr;
   d. Rehabilitation Management Plan for disturbed areas outside of the dam inundation areas; and
   e. Operational EMPr.
21. As discussed in the EMPr, various forms of monitoring is required to ensure that the receiving environment is suitably safeguarded against the identified potential impacts, and to ensure that the environmental management requirements are adequately implemented and adhered to during the execution of the project. The types of monitoring to be undertaken include –
   a. Baseline Monitoring needs to be undertaken to determine to the pre-construction state of the receiving environment, and serves as a reference to measure the residual impacts of the project by evaluating the deviation from the baseline conditions and the associated significance of the adverse effects;
   b. Environmental Monitoring - entails checking, at pre-determined frequencies, whether thresholds and baseline values for certain environmental parameters are being exceeded; and
   c. Compliance Monitoring and Auditing - The independent Environmental Control Officer (ECO) to monitor and audit compliance against the EMPr and Environmental Authorisation.
22. Considerations during the development of the RMP -
   a. For Smithfield Dam, ecosystem connectivity needs to be promoted between the upstream catchment and the system downstream of the dam wall;

b. Consider access to and utilisation of the Smithfield Dam by the surrounding community (e.g. livestock watering and obtaining water for subsistence agriculture);
c. The future use of Smithfield Dam for recreational purposes needs to be adequately considered as well as the assigning of land use objectives that are commensurate with conservation and tourism vision (as relevant), without jeopardising the primary purpose of the dam as part of the transfer scheme;
d. Consider exclusive use of the balancing dam by Baynesfield Estate, as the impoundment is solely situated on the estate. Avifaunal sensitivity at balancing dam needs to be established prior to determining recreational opportunities.
e. Include measures for the on-going rehabilitation and maintenance of vegetation in all the areas that have been disturbed by the infrastructure associated with the building and operation of the scheme;
f. Investigate the feasibility of trap-and-haul or selectively catching appropriate fish species downstream of Smithfield Dam and physically transporting and releasing these fish upstream of the dam wall, which may serve as a more practicable option than a fishway;
g. Consider investment through appropriate mechanisms in ecological infrastructure in the uMkhomazi River catchment; and
h. Explore safety mechanisms such as the Unique Positioning Number (UPN) System as part of the Cooperative Inland Waterways Safety Programme for Smithfield Dam to ensure the safety of dam users.

23. Adaptation responses to Climate Change to be considered during the detailed design stage of the project.
24. A separate EIA will be conducted to seek approval for a new bulk power line to supply electricity to the site.
25. Recommendations from the Heritage Impact Assessment (Beater & Prins, 2015) include-
    a. Due to the extent of inundation by Smithfield Dam, it is recommended that a Phase 2 assessment is undertaken that systematically surveys the footprint of the proposed dam identifying all affected graves and homesteads.

b. It is recommended that all sites (graves, structures, etc.,) situated close to the FSL of the dam are fenced with a 15 m buffer in which no development may take place. Alternatively, families will be given the option to choose an alternate reburial site.
c. Specific attention to be given to the inlet site during the Phase 2 assessment to ascertain the presence of heritage resources especially graves.
d. It is recommended that the Phase 2 assessment include the tunnel outlet works as it is one of the few areas currently undisturbed by agricultural activities.
e. It is recommended that the Phase 2 assessment include the central portal area as the area was only assessed from afar due to access issues.
f. The Phase 2 AIA is recommended to establish spatial patterns of previous development in the project area as well as assessing the significance of archaeological remains found. In addition, the uMkhomazi River valley will thoroughly investigated for the presence of rock art sites.
g. Due to the high fossil sensitivity of the Smithfield Dam / western section of the Raw Water component, a Phase 2 PIA is recommended. This is not required for the eastern section of the component.

26. Recommendations from the Traffic Impact Assessment (DWA, 2015b) include-
    a. A more detailed pavement investigation needs to be done to determine the current pavement condition and if earlier maintenance will be required owing to the increase cumulative E80s over the construction period;
    b. Monitoring and management actions be set in place in order to ensure adherence to the EMPr, pertaining to traffic, can be enforced and monitored; and
    c. The traffic impact study be revised with appointment of the contractor when more detailed information will be available.
27. Recommendations from the Avifauna Study (Wildskies, 2015) include-
    a. The construction of the deviation of the R617 road will pose a risk to avifauna in the Impendle Nature Reserve and Important Bird Area during construction, and will remove a certain amount of natural habitat. The habitat alteration is inevitable and cannot be mitigated significantly. We recommend at least a formal consultation of BirdLife South Africa (with respect to the Important Bird Area) and Ezemvelo KwaZulu-Natal Wildlife with respect to the Nature Reserve. The risk of disturbance of breeding birds in the reserve, particularly Blue Swallows, during construction of the road is high. We recommend that more details regarding the noise created by

these activities be made available and that this aspect be discussed further. Since construction associated disturbance of Blue Swallows breeding is a common high risk aspect for this project (see below), we recommend additional study into this particular aspect.

b. The drilling and excavation of the tunnel poses a high risk to Blue Swallows breeding above on the surface. It is recommend that more details regarding the noise created by these activities be made available and that this aspect be discussed further. At this stage it is recommend that no drilling be undertaken during the Blue Swallows breeding season (September to March – exact dates to be confirmed by specialist during the relevant seasons). Since construction associated disturbance of Blue Swallows breeding is a common high risk aspect for this project, it is recommended that this particular aspect be investigated further.
c. The construction of the balancing dam and associated infrastructure is in a sensitive area for avifauna. Blue Swallow is the primary bird species of concern since there are so few breeding pairs left in South Africa, and it is a species known to be susceptible to disturbance. This project is also located in a core area for the species. Once again, although some habitat will be destroyed by the construction activities and dam inundation, the greater concern is the disturbance of breeding Blue Swallows. We recommend that no construction takes place during the Blue Swallows breeding season (September to March – exact dates to be confirmed by specialist during the relevant seasons).

28. Recommendations from the Aquatic Impact Assessment (Enviross, 2016) include-
    a. It is recommended that offset mitigation measures be considered to compensate for this inevitable loss of ecologically important habitat. It is recommended that measures to improve catchment management be implemented, which could take the form of erosion management or education of local subsistence farmers that may result in a more sustainable use of the resources within the catchment area;
    b. The surface water quality throughout the survey area is considered good, with the aquatic system supporting a diversity of sensitive aquatic macro-invertebrate taxa. It is therefore imperative that the contamination of the surface waters through deleterious effluents and runoff water be avoided;

c. Emergency procedures must be in place to timeously mitigate any accidental spillages and to isolate the impacting features as far as possible;
d. Regular monitoring of water quality to enable early identification of contamination is recommended. The source of any contamination identified though the monitoring should be identified and managed according to best practice guidelines;
e. Soil erosion emanating from disturbances within the riparian zones and other areas of steep gradients is thought to be the greatest impacting feature to potentially impact the overall ecological integrity of the aquatic system. Active stormwater management should be implemented to stop silt and sediments from entering the aquatic system and smothering the habitat units. Disturbed soils and stockpiled soils should be protected from erosional features;
f. The footprint of the actual development as well as the supporting structure and services during the construction phase should be retained as small as possible by construction vehicles being limited to designated roadways only. Destruction of the riparian habitat through the unnecessary clearing of vegetation should be avoided;
g. Dumping of any excess rubble, building material or refuse must be prohibited within riparian and wetland habitat. Dumping of materials should only take place at designated and properly managed areas;
h. Adequate toilet facilities must be provided for all construction crews to negate informal ablutions taking place within riparian zones;
i. Fires within the riparian zones should be prohibited;
j. Exotic vegetation identified presently throughout the survey area should be removed and any future exotic vegetation encroachment should be actively managed. This is largely dominated by exotic *Acacia* and *Eucalyptus* species within riparian areas. The degree of invasion by these species is regarded as problematic and will increase following disturbance features.

29. Recommendations from the Social Impact Assessment (Neville Bews & Associates, 2016) include-

a. The most severe social impacts are related to the inundation of the Smithfield Dam Basin which will result in the displacement of approximately 28 dwellings. The households living within these dwellings will need to be relocated which will also have a negative impact on the host community which still needs to be identified. In this regard it is important that the affected area is carefully surveyed and that a RAP is developed for the project. Specific mitigation measures are included in the Social Impact Assessment to manage the relocation of people.

b. The issue of the road deviations will need to be careful considered, particularly the R617 deviation which, according to the Traffic Impact Assessments will add a further 3.5 km to the existing length of the road and the planned access road to the Nonguqa which adds 16 km to the journey of those residing in and visiting the area. The Sheshi Community have indicated that the R617 deviation will result in their access to the R617 being moved further from them causing them difficulties in accessing the R617 (main road). Consequently, it is important to consider these deviations in consultation with local communities in order to explore possible solutions. This also applies in respect of both the Mdayana and Nonguqa access road deviations. The Nonguqa road deviation will add a further 16 km to the travel distance of members of the Nonguqa community, an unacceptable situation considering the hardship that this situation will result in. This situation will need to be amicably resolved.

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APPENDICES