PROPOSED UMKHOMAZI WATER PROJECT PHASE 1

Potable Water Component

EIA REPORT

DRAFT

June 2016

DEA Ref. No.: 14/12/16/3/3/3/95

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:

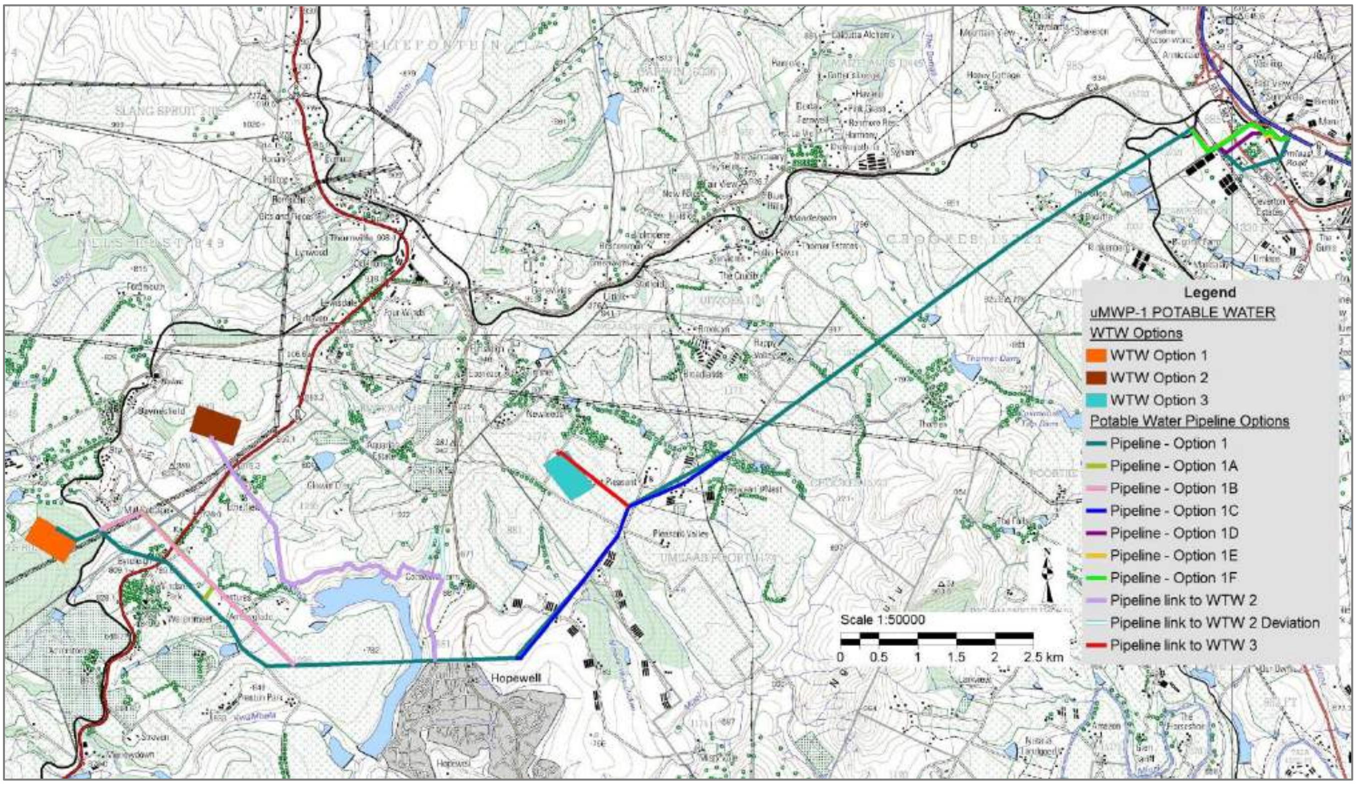
- **Module 1: Technical Feasibility Raw Water -** the Department of Water Affairs (DWA) is the project proponent and appointed AECOM (previously known as BKS) to undertake this study;
- **Module 2 Environmental Impact Assessment** (EIA) **-** Nemai Consulting was appointed as the independent Environmental 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, in the uMgungundlovu District Municipality. The western part of the project area falls within the Richmond local Municipality and the eastern part in the Mkhambathini Local Municipality.

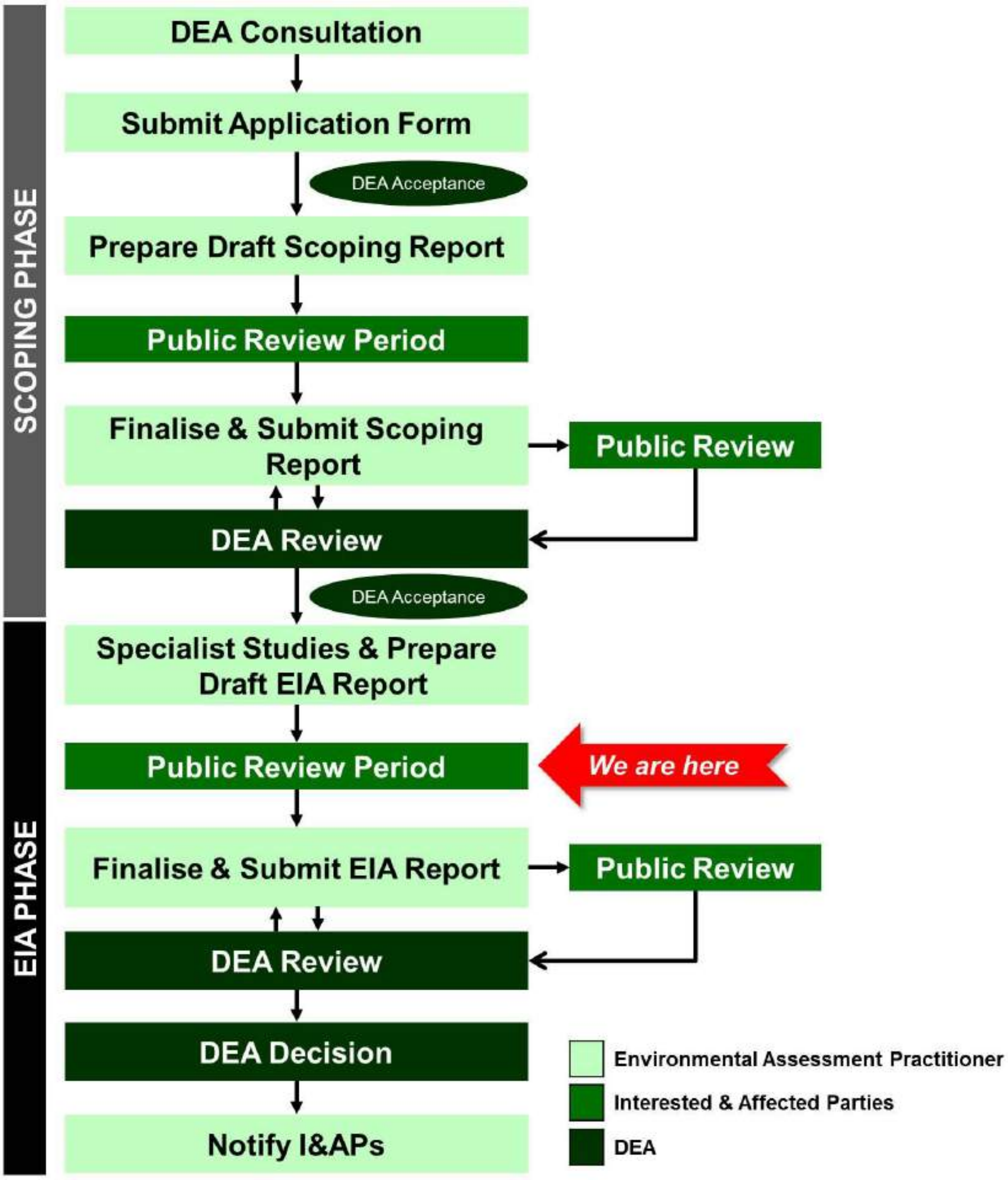
The majority of the project area is located on privately owned land which is predominantly used for commercial farming and forestry. In the north-eastern part the pipeline crosses the light industrial area of Umlaas Road.



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.

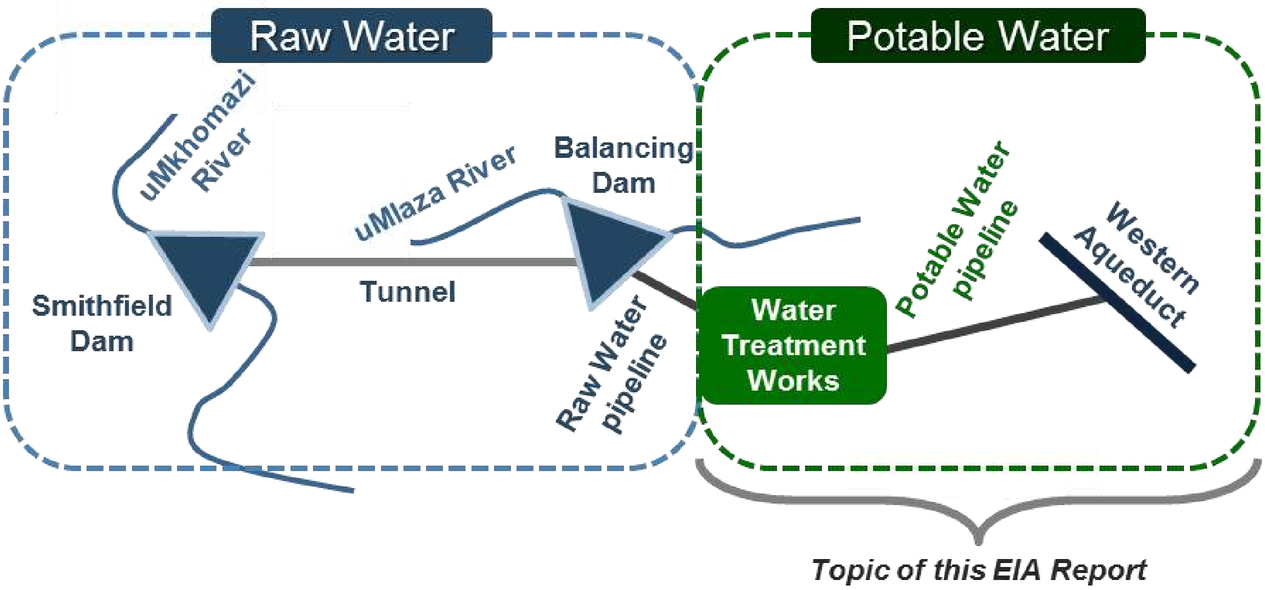


Overview of Scoping and EIA process

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 (Umgeni Water) is a statutory body in terms of NEMA Section 24C.

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 Potable Water component.



Simplified diagram of uMWP-1 components

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

uMWP-1 Potable Water Project Components & Associated Infrastructure

Potable Water Component	Associated Infrastructure
WTW & Potable Water Reservoir	❖ Access roads ❖ 600 m by 350 m (21 Ha) WTW, which includes (amongst others): • Control room • Inlet works • Chemical storage area • Pre-chlorination facility • Clarifiers • Filters • Post-chlorination facility • Sludge holding tanks • Thickeners • Sludge storage area • Sludge dewatering area ❖ Reservoir for storage of treated water ❖ Operator's offices ❖ Parking facilities ❖ Fencing
Potable Water Pipeline	❖ Access roads ❖ Two x 2500mm gravity pipelines running in parallel ❖ Chambers and valves

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 Potable Water project components are shown in the table to follow.

uMWP-1 Potable Water Components – Alternatives

<table>
<tr><th>No.</th><th colspan="2">Components</th><th>Alternatives</th></tr>
<tr><td rowspan="3">1.</td><td colspan="2" rowspan="3">Water Treatment Works</td><td>1. Option 1</td></tr>
<tr><td>2. Option 2</td></tr>
<tr><td>3. Option 3</td></tr>
<tr><td rowspan="14">2.</td><td rowspan="14">Potable water pipeline</td><td rowspan="10">Alignment</td><td>Option 1</td></tr>
<tr><td>Option 1A</td></tr>
<tr><td>Option 1B</td></tr>
<tr><td>Option 1C</td></tr>
<tr><td>Option 1D</td></tr>
<tr><td>Option 1E</td></tr>
<tr><td>Option 1F</td></tr>
<tr><td>Link to WTW 2</td></tr>
<tr><td>Link to WTW 2 Deviation</td></tr>
<tr><td>Link to WTW 3</td></tr>
<tr><td rowspan="4">Crossing of Mapstone Dam</td><td>Steel Suspension Bridge</td></tr>
<tr><td>Conventional Steel Pipe Bridge</td></tr>
<tr><td>Pipe Supported on Concrete Piers</td></tr>
<tr><td>Pipe Buried in Dam Basin</td></tr>
</table>

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; and
8. Avifauna Study.

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;
- Geotechnical Investigation;
- Economic Impact Assessment; and
- Traffic Impact Assessment.

H. IMPACT ASSESSMENT

The EIA Report assessed the pertinent environmental impacts that could potentially be caused by the proposed uMWP-1 Potable 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 *inter alia* 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

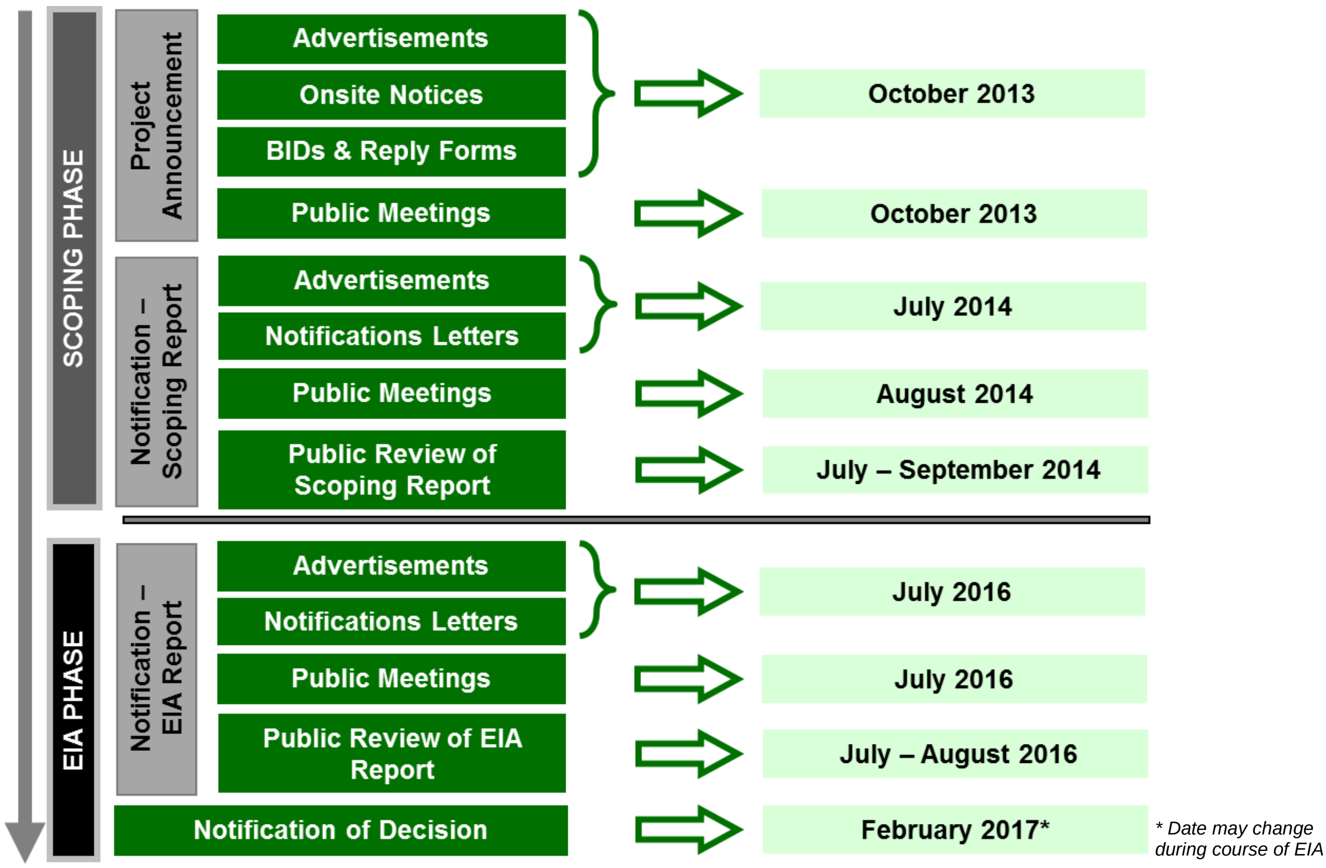
- Over-utilisation of water resources could adversely affect the ecological functioning of the Mgeni River system.

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:

- <u>WTW Site</u> – WTW Option 1;
- <u>Potable water pipeline route</u> – **Western section** - Option 1B, **Central section** - Option 1C and **Eastern section** - Option 1F; and
- <u>Crossing of Mapstone Dam</u> – Pipe Buried in Dam Basin.

J. PUBLIC PARTICIPATION

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



<u>**Outline of Public Participation Process**</u>

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

K. EIA CONCLUSIONS AND RECOMMENDATIONS

Attention is drawn to specific sensitive environmental features (with an accompanying sensitivity map) 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 - Potable Water Component***
Report Title:	***Draft EIA Report***
Authors:	***D. Henning***
Authority reference no.:	**14/12/16/3/3/3/95**
Status of report:	***Draft***
Date of issue:	***June 2016***

Consultants: *Nemai Consulting*

Approved for Consultants by:

……………………………………….

N Naidoo

Study Leader

UMGENI WATER

Approved for Client by:

……………………………………….

G. Subramanian

Planning Services

Prepared by Nemai Consulting
for Umgeni Water

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

AIDS	Acquired Immunodeficiency Syndrome
BID	Background Information Document
BPEO	Best Practicable Environmental Option
CBA	Critical Biodiversity Area
COGTA	Cooperative Governance and Traditional Affairs
CR	Critically Endangered
°C	Degrees Celsius
DAFF	Department of Agriculture, Forestry and Fisheries
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
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
EAP	Environmental Assessment Practitioner
EBA	Endemic Bird Area
EFR	Estuarine Freshwater Requirements
EIA	Environmental Impact Assessment
EIP	Environmental Implementation Plan
EIS	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
FEPA	Freshwater Ecosystem Priority Area
FRAI	Fish Response Assessment System
GGP	Gross Geographic Product
GIS	Geographical Information System
GN	Government Notice
ha	Hectare
HIV	Human Immunodeficiency Virus
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
IWMP	Integrated Waste Management Plan
km	Kilometre
km^2	Square kilometre
kV	Kilovolts
KZN	KwaZulu-Natal
ℓ	Litres
l/s	Litres per second
LM	Local Municipality
LUMS	Land Use Management Scheme
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
MHI	Major Hazard Installation
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
Ml/day	Mega litre per day
mm	Millimetre
MSDS	Material Safety Data Sheet
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
NWA	National Water Act (Act No. 36 of 1998)
OHS	Occupational Health and Safety
PES	Present Ecological State
RQO	Resource Quality Objective
SAAB	South African Association of Botanists
SABAP	Southern African Bird Atlas Project
SACNASP	South African Council for Natural Scientific Professions
SAIEES	South African Institute of Ecologists and Environmental Scientists
SANBI	South African National Biodiversity Institute
SANS	South African National Standard
SASAqS	South African Society for Aquatic Scientists

SASS-5	South African Scoring System, version 5
SAWS	South African Weather Services
SCA	South Coast Augmentation
SDF	Spatial Development Framework
SEA	Strategic Environmental Assessment
SEMP	Strategic Environmental Management Plan
SQ	Sub Quaternary
TDS	Total Dissolved Solids
TE	Threatened Ecosystem
ToR	Terms of Reference
uMWP-1	uMkhomazi Water Project Phase 1
VEGRAI	Vegetation Response Assessment Index
VU	Vulnerable
WDM	Water Demand Management
WMA	Water Management Area
WSA	Water Services Authority
WSS	Water Supply System
WTP	Water Treatment Plant
WTR	Water Treatment Residues
WTW	Water Treatment Works

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 Potable Water component, where Umgeni Water is acting as the project proponent. The proposed project consists of the following:

- A Water Treatment Works (WTW) and potable water storage reservoir in the uMlaza River valley; and
- Potable water pipeline from the WTW to Umlaas Road where it connects into the existing ’57 Pipeline owned by Umgeni Water.

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 09 December 2014.

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	R31(2)(f)	A description of the need and desirability of the proposed activity.
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;
			(ii) the nature of the impact;

Chapter	Title	Correlation with GN No. R. 543	GN No. R. 543 Description
			(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 Transfers to the Integrated Mgeni Water Supply System

3.1.1 Background

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

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 five 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 1**, the Integrated Mgeni WSS comprises the Midmar, Albert Falls, Nagle and Inanda Dams in KZN, a water transfer scheme from the Mooi River and the newly constructed Spring Grove Dam. The current system (Midmar, Albert Falls, Nagle and Inanda Dams and the MMTS-1) 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

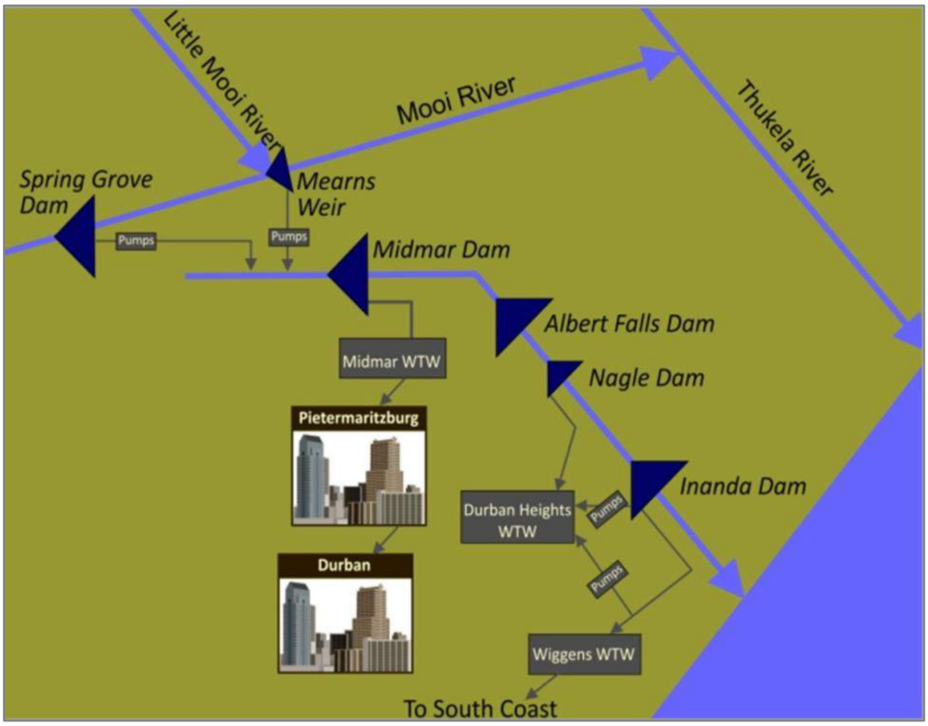


Figure 1: **Schematic of integrated Mooi-Mgeni System**

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 2**.

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).

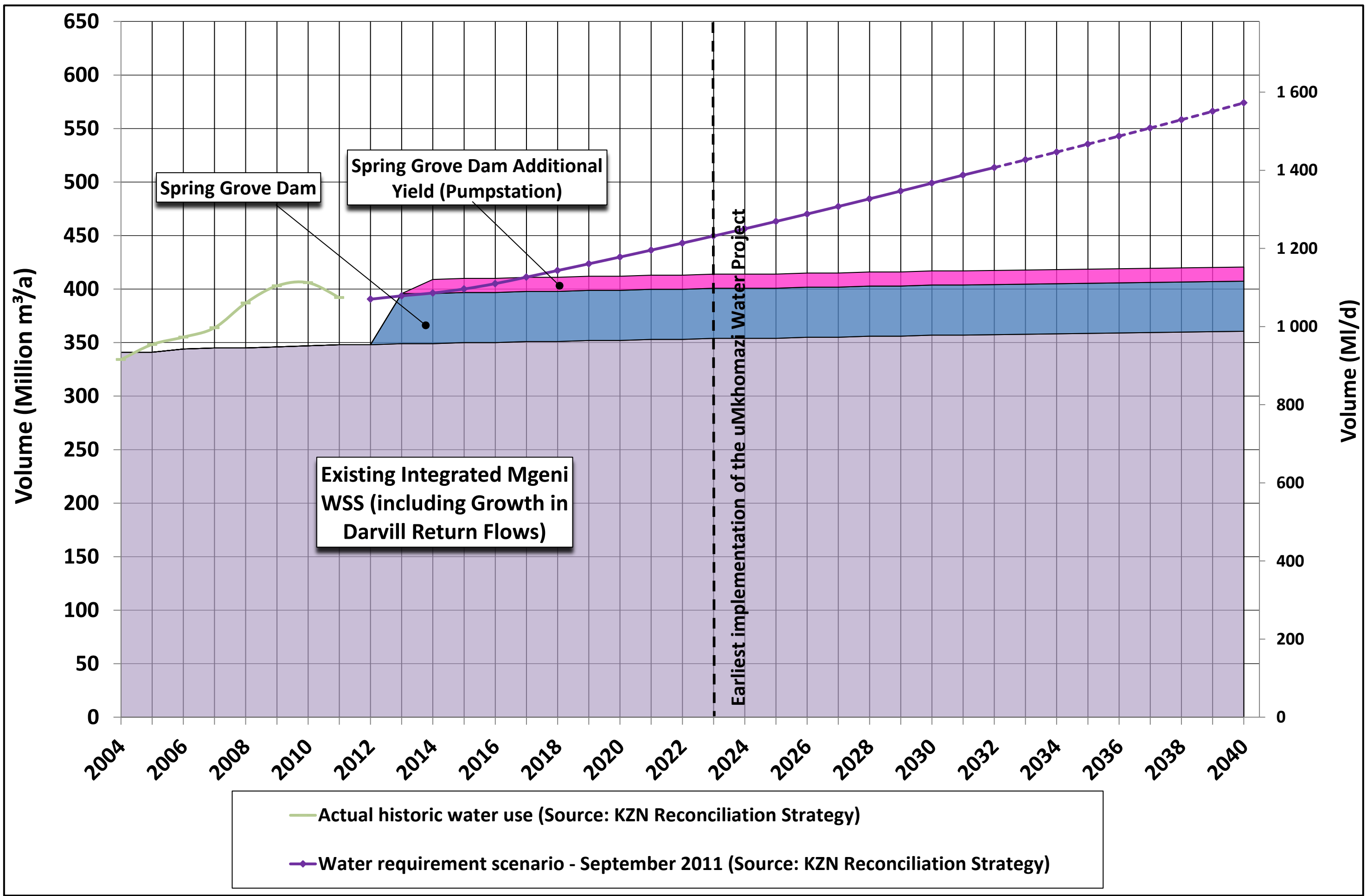


Figure 2: Long-term water balance projection for the Integrated Mgeni WSS

Note that the figures included in **Figure 2** are for the entire Mgeni System and apply to the portion that will be supplied by uMWP-1.

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.

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 DWA aims to have the uMWP-1 scheme implemented by 2023.

3.1.2 The uMWP-1 Water Supply Area

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 3** and comprises parts of:

- The Integrated Mgeni WSS, downstream of Umlaas Road; and
- 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 4**). 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 Plant (WTP).

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 WTP that will be moved (or “shed”) onto the uMWP1 when Durban Heights WTP reaches its operating capacity limit.

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

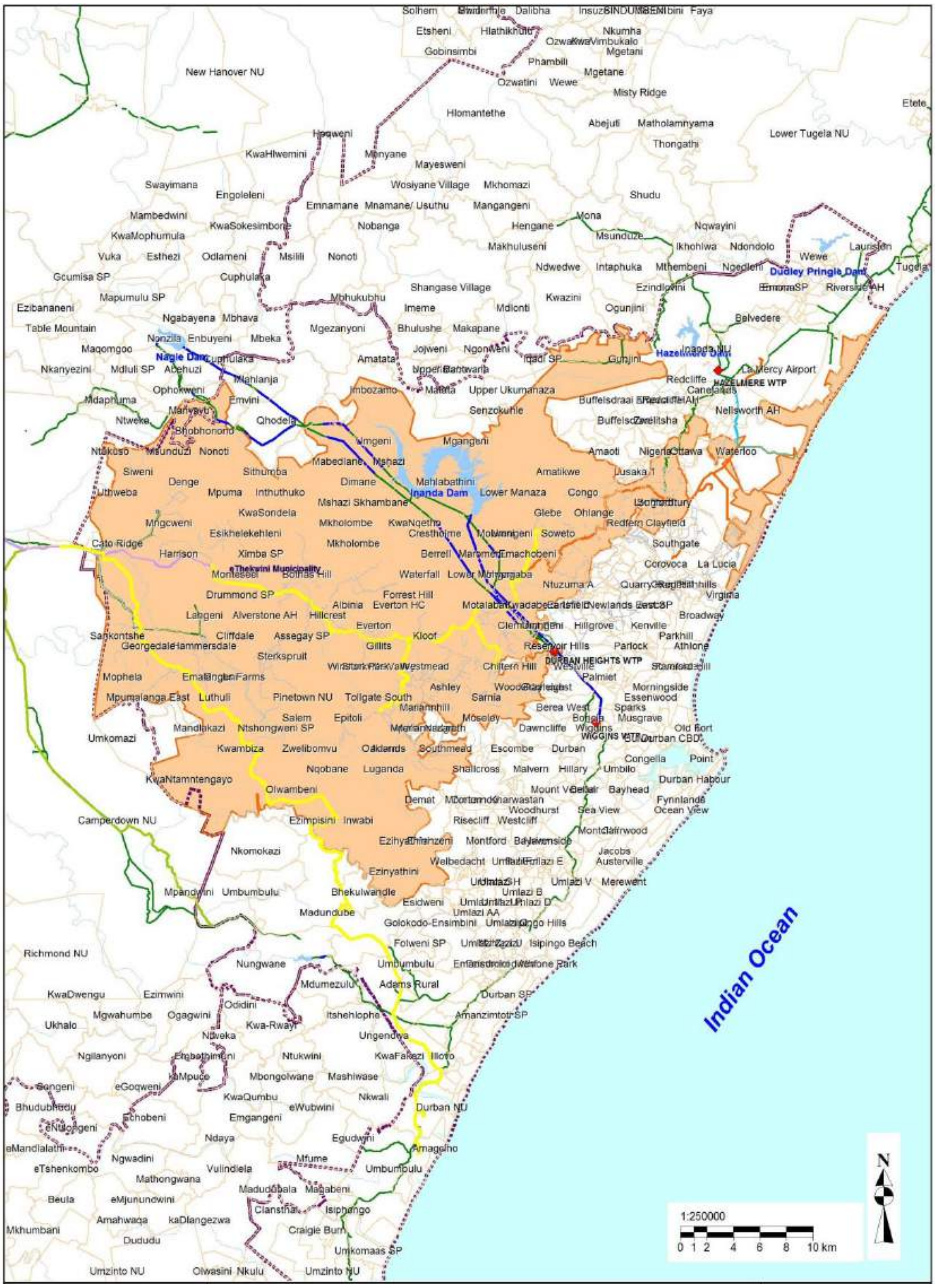


Figure 3: **The proposed water supply areas: uMWP, North Coast & South Coast**

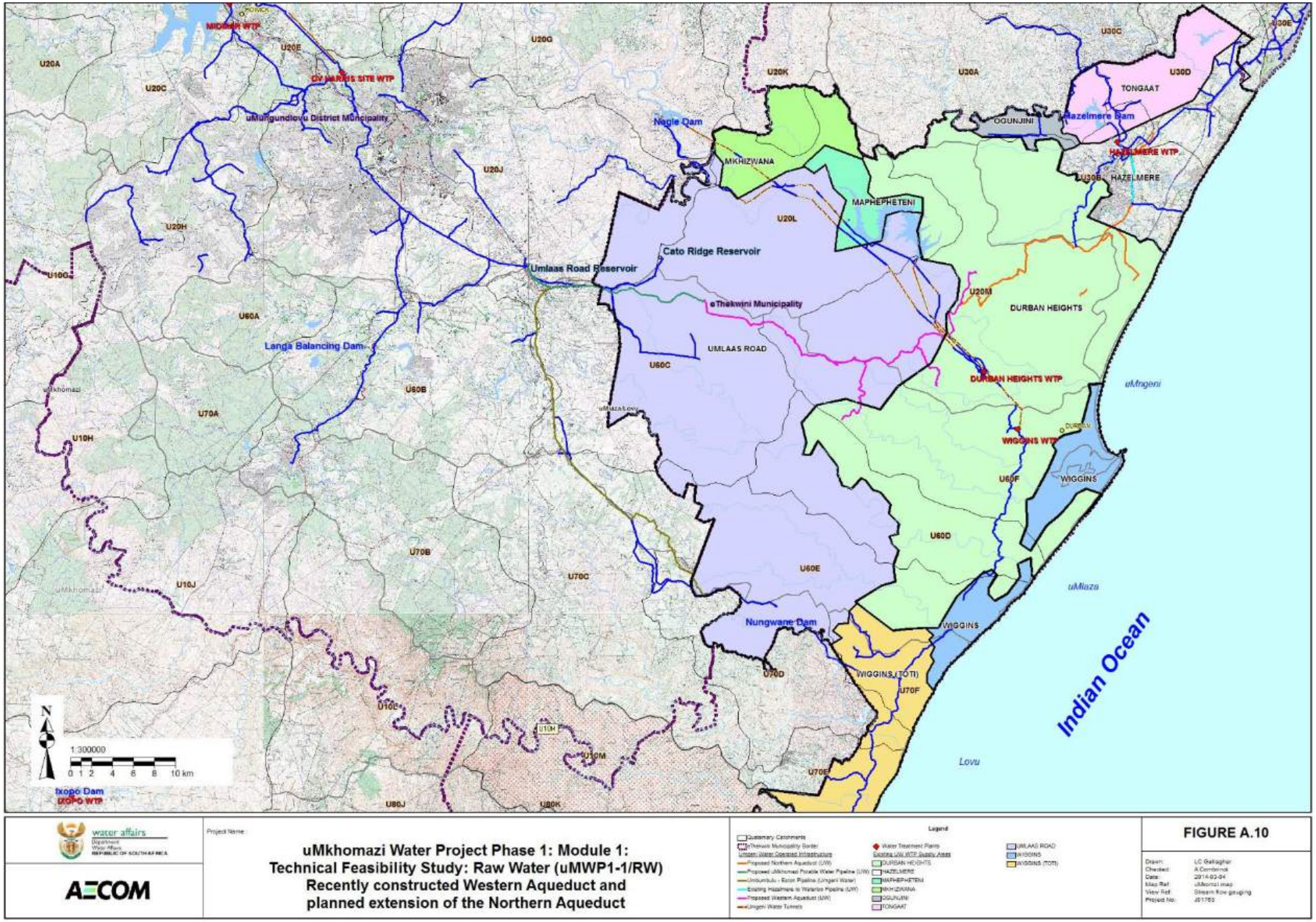


Figure 4: **Western and Northern Aqueduct**

3.1.3 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 5**, including both the “Low”- and “High”-road scenarios, as well as scenarios based on a 1.5% growth rate for comparison purposes. **Figure 6** shows the “Low”-road scenario, separated into the three main uMWP-1 sub-areas of supply through key infrastructure.

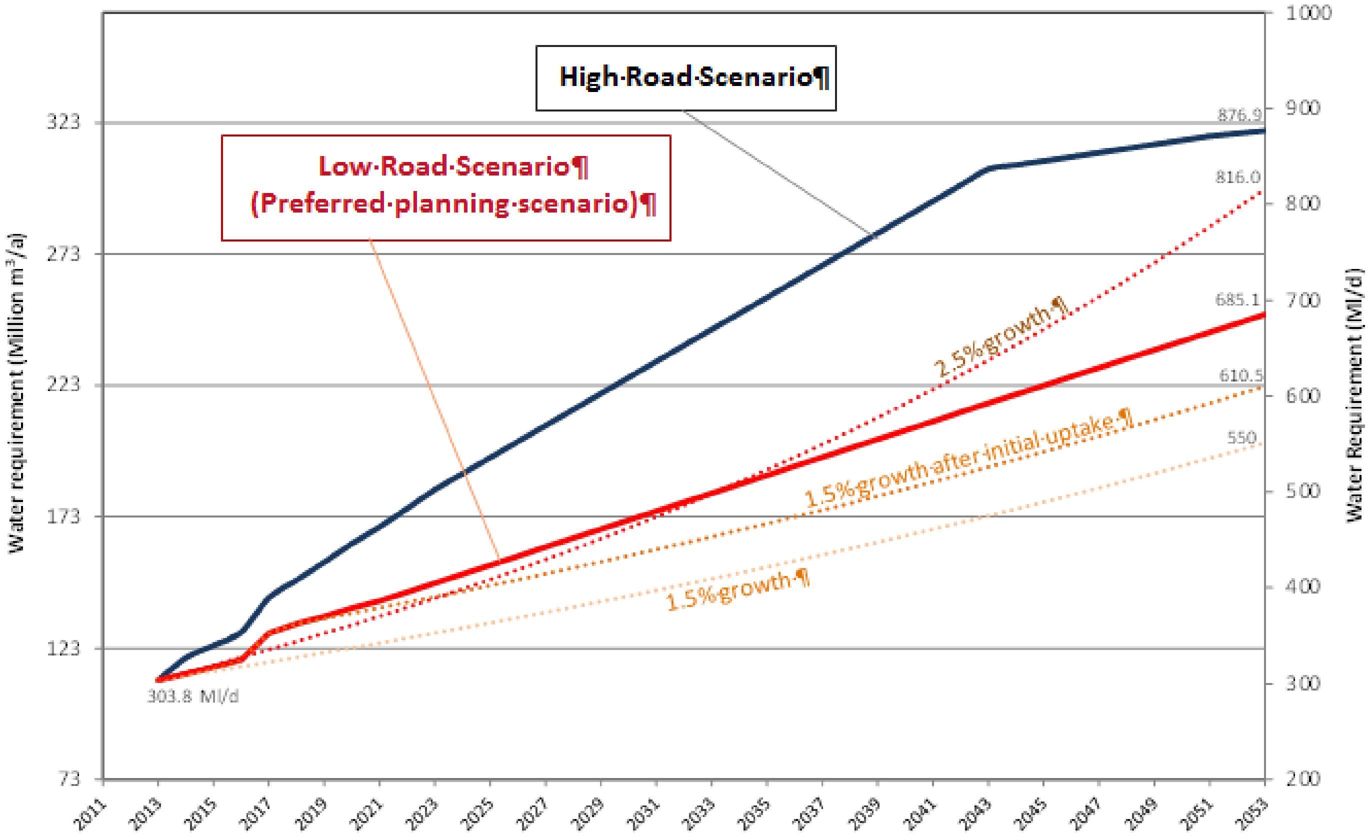


Figure 5: Updated water requirement projections for the uMWP1 supply area

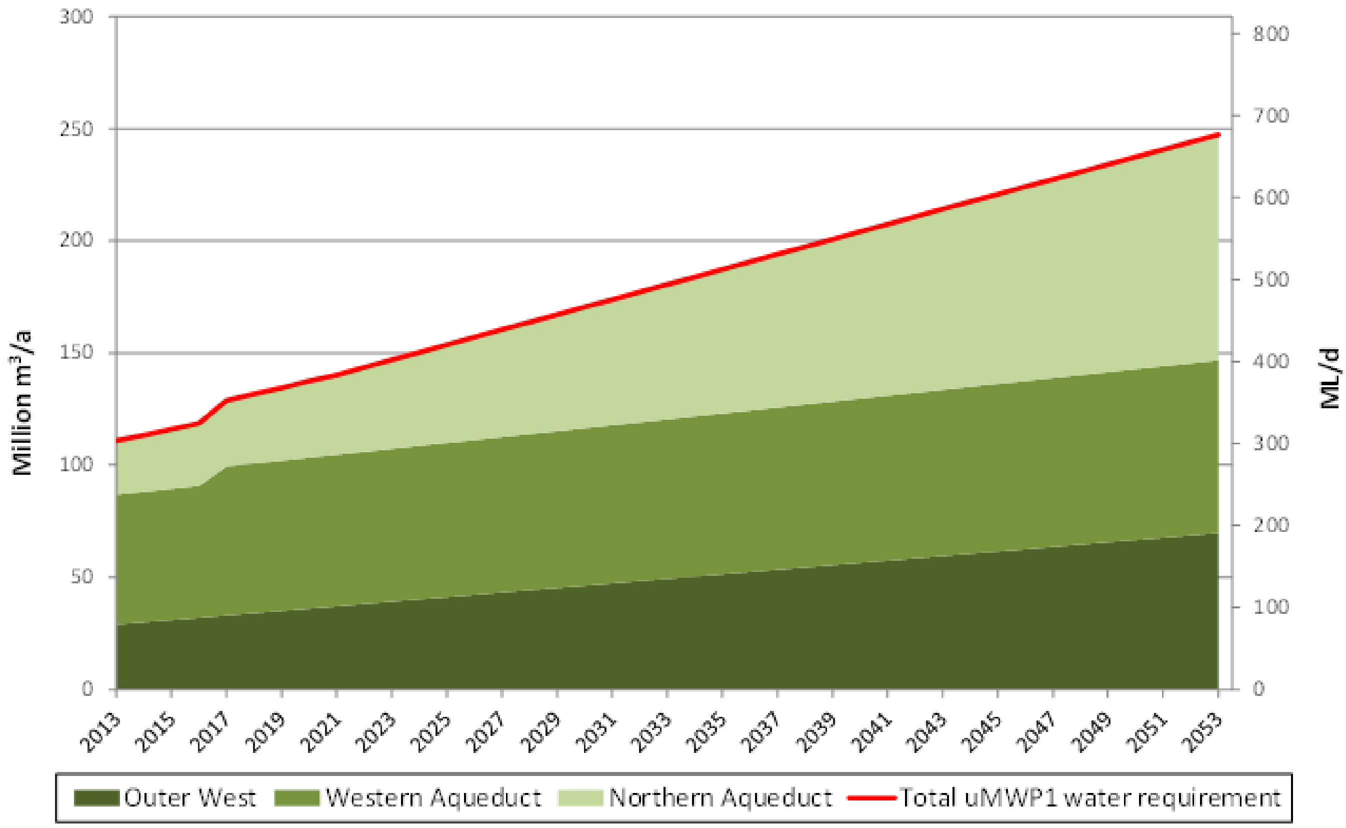


Figure 6: Selected water requirement projection scenario for the uMWP1 supply area

The water requirement projections indicated for the Western and Northern Aqueduct sub-areas in **Figure 6** includes shed zones, which will be shed from Durban Heights WTP onto the uMWP-1. As such the water requirements shown in **Figure 6** 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.

3.2 Distinction between uMWP-1 Modules

The overall uMWP-1 Feasibility Study has been divided into 3 modules, as presented in **Table 2** and **Figure 7**. This document represents the EIA Report for the EIA (Module 2) that is being undertaken for the uMWP-1 **Potable Water** component.

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).

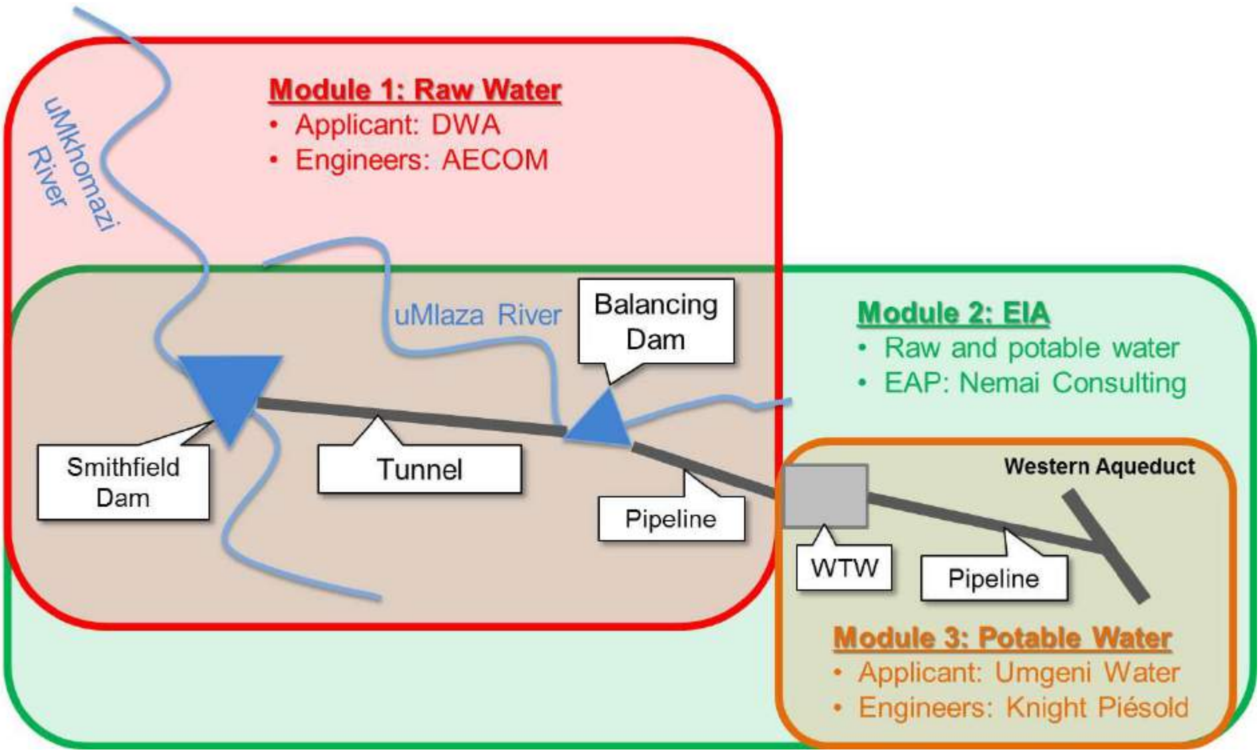


Figure 7: Distinction between uMWP-1 Modules

4 PROJECT LOCATION

For the sake on conveying the entire uMWP-1 footprint, **Figure 8** shows both the Raw Water and the Potable Water components, although this report only focuses on Potable Water (**Figure 9**). Refer to locality maps contained in **Appendix A**.

The uMWP-1 Potable Water project area is situated in the southern part of KZN, in the uMgungundlovu DM. The western part falls within the Richmond LM and the eastern part in the Mkhambathini LM.

The majority of the project area is located on privately owned land which is predominantly used for commercial farming and forestry. In the north-eastern part the pipeline crosses the light industrial area of Umlaas Road.

The nearest town to the western part of the project area is Richmond, which is located more than 10km to the south-west of Option 1 of the WTW at Baynesfield Estate. The potable water pipeline route travels past the north of Hopewell. Apart from Umlaas Road and Hopewell, the project infrastructure is located within rural areas.

A more detailed description of the properties affected by the project infrastructure is provided in **Section 10.1.2.1**.

As discussed in **Section 10.2**, the location of the project infrastructure was influenced by various factors, such as topography and associated elevation, impacts to the receiving environment, existing servitudes, existing structures and infrastructure, access, site constraints and geotechnical conditions (amongst others). From a technical perspective, a primary determinant in siting the infrastructure was ensuring the correct elevation to maintain a gravity fed system.

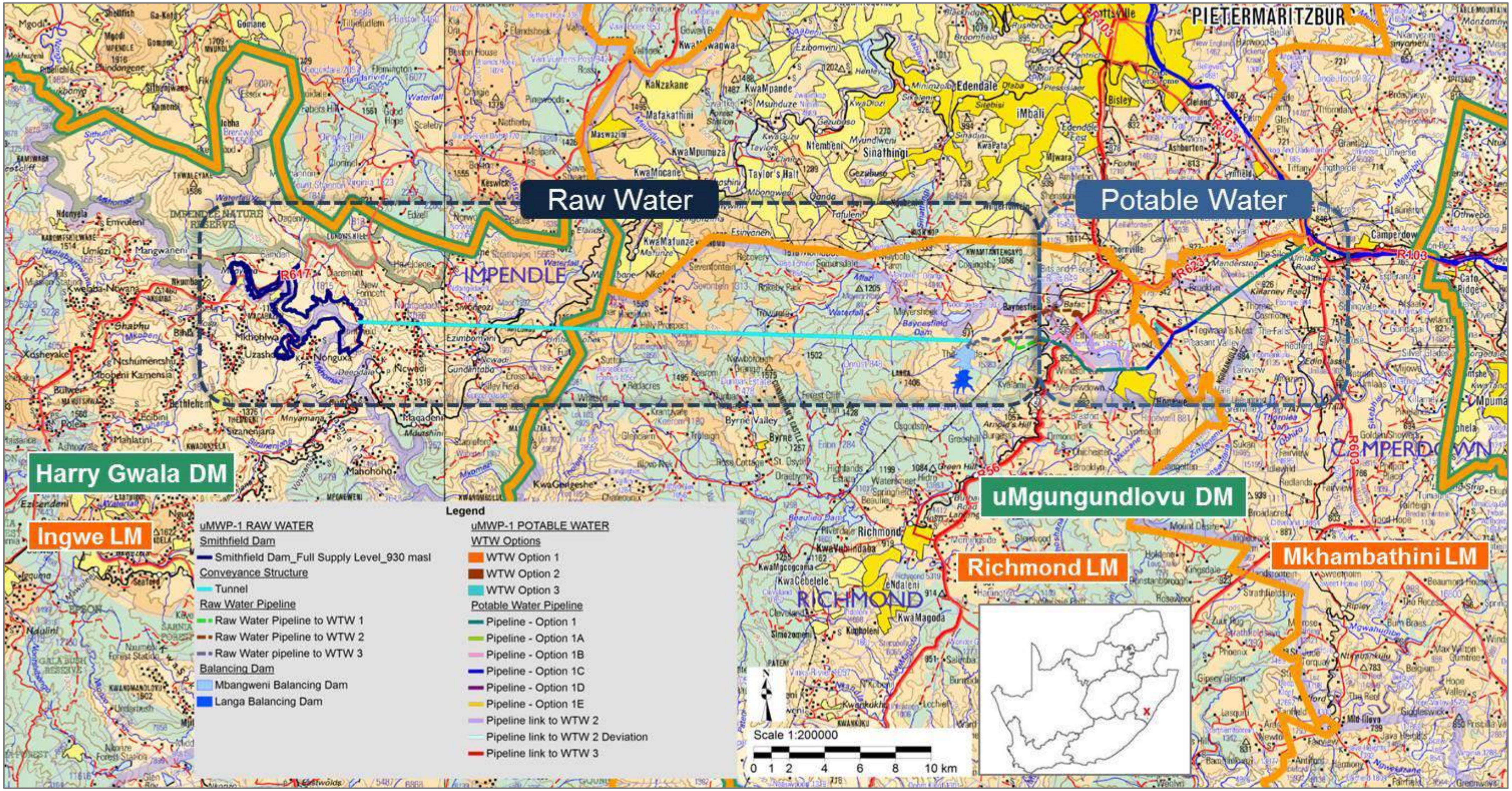


Figure 8: **Regional Map – uMWP-1 Raw Water & Potable Water** ***(Note – not all sub-components shown)***

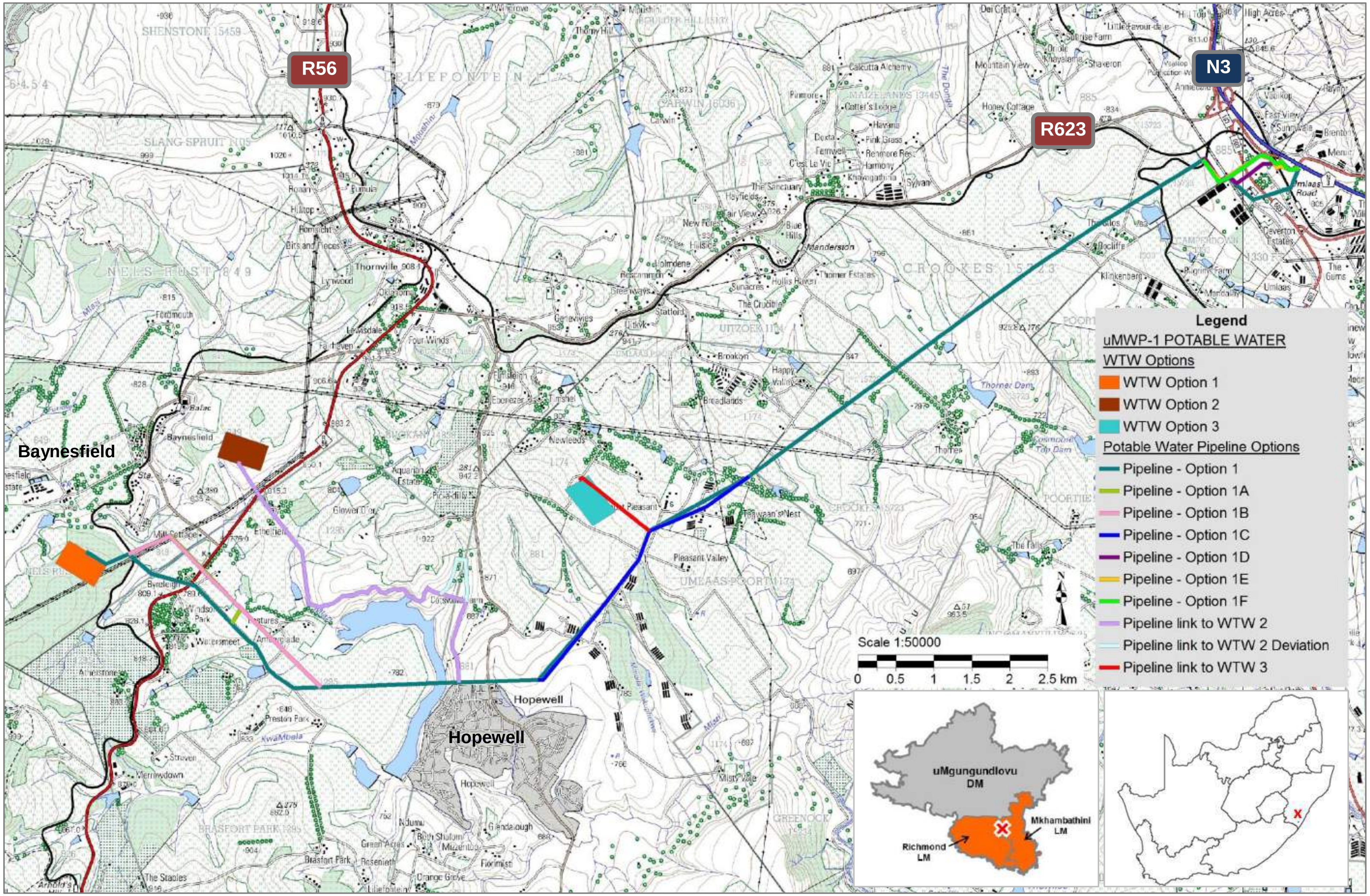


Figure 9: Locality Map – uMWP-1 Potable Water

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 Potable 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 (DEDTEA) (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.
	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.
	12. The construction of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50 000 cubic metres or more, unless such storage falls within the ambit of activity 19 of Notice 545 of 2010.
	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

Legislation	Relevance
	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.
	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).
	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 June 2010	3. 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 more than 500 cubic metres.
	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.
	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.
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:

Legislation	Relevance
	(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(iii - iv). The construction of: ❖ buildings with a footprint exceeding 10 square metres in size; or ❖ 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.
	24 (c – d). The expansion of (c) buildings where the buildings will be expanded by 10 square metres or more in size; or (d) 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. • Authority – DWA.
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, 2004 (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), where relevant • Authority – DEA.
National Forests 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 (not applicable to this project). • Authority – Department of Mineral Resources (DMR).

Legislation	Relevance
Occupational Health & Safety Act (Act No. 85 of 1993)	• Provisions for Occupational Health & Safety • 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.
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 National Environmental Management Act

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 undertaken 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 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 Integrated 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: Explanation of the relevant activities listed in the EIA Regulations (2010)

GN	Activity No.	Relevance of Listed Activity
544, 18 June 2010	9 (i), (ii)	Details of bulk water pipelines are as follows: • Length – route option 1 = 21.3km; • Length – route option 2 = 24.5 km; • Internal diameter = 2.5 m; and • Peak throughput = 500 Megalitres per day.
544, 18 June 2010	11 (iii), (v), (x), (xi)	A number of watercourses that form part of the uMlaza River system will be traversed by both pipeline route alternatives. Access roads may also be located within 32 metres of a watercourse.
544, 18 June 2010	12	The capacity of the reservoir associated with the WTW is expected to exceed this threshold. The dimensions are as follows: 200 m x 350 m x 10 m deep.
544, 18 June 2010	13	"Dangerous goods" that are likely to be associated with the greater project, include the following: • Fuel stores for construction purposes; • Goods used for the operation of the sub-station(s); and • WTW operations.
544, 18 June 2010	18 (i)	A number of watercourses that form part of the uMlaza River system will be traversed by both pipeline route alternatives. Access roads may also be located within 32 metres of a watercourse.
544, 18 June 2010	22 (i), (ii)	Access roads to the sites – either upgrading of existing roads or building of new roads to facilitate access to the sites by the construction equipment.
544, 18 June 2010	23 (ii)	Footprint of WTW expected to exceed this threshold, where a maximum area of 600 m by 350 m will be required for the complete 1 250 Ml/d plant.
544, 18 June 2010	24	Zoning status of land affected by project infrastructure to be confirmed. Land earmarked for WTW to be rezoned.
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 probable.
544, 18 June 2010	47	Widening or lengthening of existing roads to create access roads for the construction and operational phases.
544, 18 June 2010	56	Possible phased activities that may collectively trigger this listed activity.
545, 18 June 2010	3	"Dangerous goods" that are likely to be associated with the greater project, include the following: • Fuel stores for construction purposes; and • Goods used for the operation of the WTW (including Chlorine, Ammonium Hydroxide, Sodium

GN	Activity No.	Relevance of Listed Activity
		Hydroxide).
545, 18 June 2010	10 (ii)	Construction of new WTW and bulk water pipeline to allow for transfer of water from the uMkhomazi River to the uMlaza River.
545, 18 June 2010	15	Footprint of WTW expected to exceed this threshold, where a maximum area of 600 m by 350 m will be required for the complete 1 250 Ml/d plant.
546, 18 June 2010	2(a)(iii)	Possible occurrence of sensitive biodiversity features at areas to be affected by the proposed reservoir. Refer to findings from Terrestrial Ecological Study.
546, 18 June 2010	4 – (a)(ii)(bb – ee; gg)	Access roads to the various sites, which may be located in areas that are deemed to be important from a biodiversity perspective. Refer to findings from Terrestrial Ecological Study.
546, 18 June 2010	10 – (a)(ii) (bb – ee; gg; ii)	Dangerous goods" that are likely to be associated with the greater project, include the following: • Fuel stores for construction purposes; and • Goods used for the operation of the WTW (including Chlorine, Ammonium Hydroxide, Sodium Hydroxide). Possible occurrence of sensitive biodiversity features in the project area. Refer to findings from Terrestrial Ecological Study.
546, 18 June 2010	12 – (a); (b)	Construction activities may 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. Refer to findings from Terrestrial Ecological Study.
546, 18 June 2010	13 – (a); (b); (c)(ii)(bb – dd; ff)	Construction activities may 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. Refer to findings from Terrestrial Ecological Study.
546, 18 June 2010	14 – (a)(i)	Construction activities may 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. Refer to findings from Terrestrial Ecological Study.
546, 18 June 2010	16(iii – iv) – (a)(ii)(bb; dd; ee; ff; hh)	Construction of infrastructure within watercourse (e.g. pipeline river crossings). Possible occurrence of sensitive biodiversity features at affected areas. Refer to findings from Terrestrial Ecological Study.
546, 18 June 2010	19 – (a)(ii)(bb – ee; gg; ii)	Possibly related to access roads that may be required. Potential occurrence of sensitive biodiversity features at affected areas. Refer to findings from Terrestrial Ecological Study. Refer to findings from Terrestrial Ecological Study.
546, 18 June 2010	24 (c – d) – (a)(ii)(bb – ee; gg	Construction of infrastructure within watercourse. Possible occurrence of sensitive biodiversity features at affected areas. Refer to findings from Terrestrial Ecological Study.
546, 18 June 2010	26	Possible phased activities that may collectively trigger this listed activity.

The following activities that were included in the initial Integrated Application Form are no longer applicable:

- GN No. R. 545 (18 June 2010) activity no. 5 – there will not be any discharge from the WTW under normal operating conditions.
- GN No. R. 545 (18 June 2010) activities no. 19 and 20, as well as GN No. R. 545 (18 June 2010) activities no. 20 and 21 – no borrow pits will be created as part of the project.

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 application submitted for this project:

- 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 were 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
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	10	The development and related operation of infrastructure exceeding 1000 metres in length for the bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes – (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 sewage, effluent, process water, waste water, return water, industrial discharge or slimes inside a road reserve; or (b) where such development will occur within an urban area.
983 4 Dec 2014	12	The development of- (i) canals exceeding 100 square metres in size; (ii) channels exceeding 100 square metres in size;

GN	Activity No.	Description of Listed Activity
		(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; (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	13	The development of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50000 cubic metres or more, unless such storage falls within the ambit of activity 16 in Listing Notice 2 of 2014.
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	24	The development of- (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,

GN	Activity No.	Description of Listed Activity
		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; (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;

GN	Activity No.	Description of Listed Activity
		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	4	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 more than 500 cubic metres.
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.
985 4 Dec 2014	2(d)	The development of reservoirs for bulk water supply with a capacity of more than 250 cubic metres.
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	18(d)	The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre.
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;

GN	Activity No.	Description of Listed Activity
		(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 Form applied for approval of waste management activities listed in GN No. 718 of 03 July 200, which primarily related to the management of the sludge that will be generated at the proposed potable WTW. The Scoping Report further 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 the Scoping phase and an assessment of the sludge management options (refer to **Section 9.4.5**), it was confirmed that the sludge will be disposed of at a registered landfill. This obviated the need for a Waste Management

Licence in terms of NEM:WA, as the landfill selected will be in possession of the requisite environmental approvals to accept the sludge. Accordingly, the Application Form was amended to only relate to NEMA activities (refer to **Appendix C**).

5.1.4 National Water Act (Act No. 36 of 1998)

The types of water use are defined in Section 21 of the National Water Act (NWA) (Act No. 36 of 1998). The water uses associated with uMWP-1 Potable Water are tabulated below.

Table 6: Explanation of the relevant NWA Section 21 Activities

Section 21	Description of Water Use	Relevance to Project
21(c)	Impeding or diverting the flow of water in a watercourse	Instream works for watercourse crossings by the potable water pipeline and access roads.
21(i)	Altering the bed, banks, course or characteristics of a watercourse	Construction activities within the regulated area of any watercourse (i.e. 1:100 year floodline or delineated riparian habitat, whichever is greatest) or 500m radius of a wetland.
21(g)	Disposing of waste in a manner which may detrimentally impact on a water resource	The trigger of this water use type relates to the drying of the sludge at the WTW.

A Water Use Licence Application (WULA) will be compiled and submitted to the DWS KZN Regional Office.

5.2 Guidelines

The following guidelines were considered during the preparation of the Scoping Report:

- 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

The following regional plans will be considered during the execution of the EIA:

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

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. Separate EIAs are thus being undertaken for these respective components, however, a combined public participation process was adopted due to the interrelationship between these two components.

An Application for Integrated Environmental Authorisation and Waste Management Licence was made for the Potable Water component of the uMWP-1 in terms of:

- 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).

Refer to **Section 5.1** for further discussion in the project's legal framework.

As explained in **Section 5.1.3**, the original Integrated Application Form needed to be amended as there was no longer a need for a Waste Management Licence in terms of NEM:WA for managing sludge from the WTW. The amended Application Form, which is included in **Appendix C**, now only relates 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 (**Table 4**), the requisite environmental assessment for the project is a Scoping and EIA process.

The process for seeking authorisation under NEMA is undertaken in accordance with GN No. R. 543 of 18 June 2010, promulgated in terms of Chapter 5 of NEMA. 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**).

6.2 Environmental Assessment Authorities

In terms of NEMA the lead decision-making authority for the environmental assessment is DEA, as the project proponent (Umgeni Water) is a statutory body in terms of NEMA Section 24C. 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 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, an amended Integrated Application Form was submitted due to the increase in the understanding of the project and the receiving environment, further engagement with authorities, advancements in the technical feasibility study, as well as the publishing of the new waste management activities under GN No. 921 of 29 November 2013.
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. 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.
6. 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.
7. Various public meetings were held in August 2014 to present the Draft Scoping Report.
8. An Environmental Authorities Meeting was held on 03 September 2014 to provide an overview of the draft Scoping Report.
9. A site visit was held with DEA on 04 September 2014.
10. 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.
11. A meeting to clarify the project's possible relation to NEM:WA was held with DEA on 03 December 2014.
12. DEA issued approval for the Scoping Report on 09 December 2014 (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.

6.4 EIA Methodology

6.4.1 Formal Process

An outline of the Scoping and EIA process for the proposed uMWP-1 Potable Water is provided in **Figure 10**.

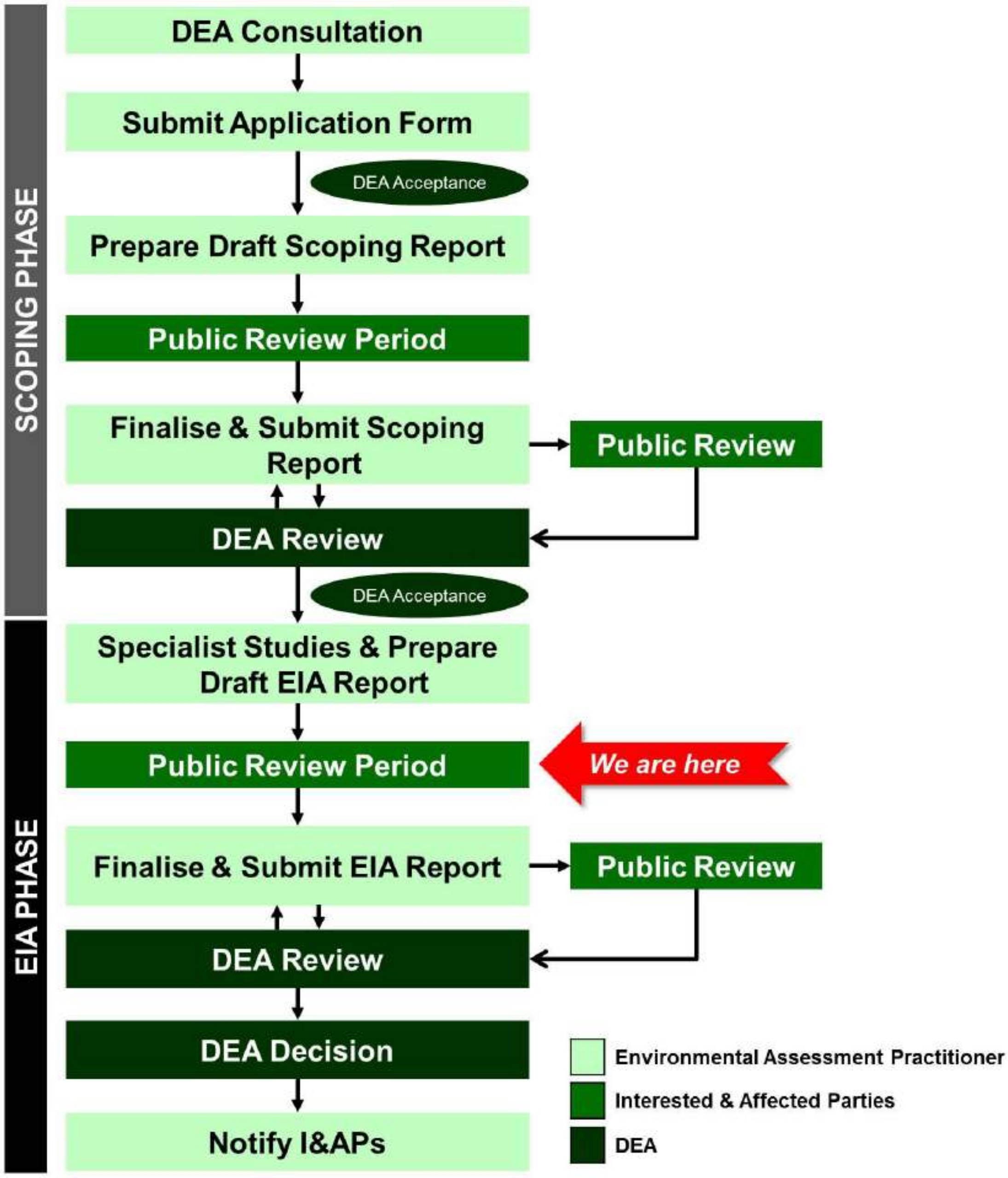


Figure 10: Outline of Scoping and EIA process

6.4.2 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.

6.4.3 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.	• **Sections 11;** and • **Section 12**
Specialist studies to be completed in accordance with Terms of Reference.	• **Section 11**; and • **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.

6.4.4 Addressing DEA 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.	The proposed WTW and potable water pipeline are considerable investments and under suitable maintenance decommissioning of the scheme is not considered relevant. Depending on water supply requirements, the scheme could possibly be upgraded or at least maintained to cater for projected needs. 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 potable 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**, as well as impacts assessed in **Section 12.5**.
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** as well as impacts assessed in **Section 12.7**.
f) Possible impacts and effects of the development on the surrounding industrial area.	In the north-eastern part of the project area the pipeline crosses the light industrial area of Umlaas Road. 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 community will benefit.	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 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 11.2.1**.

DEA Requirements	Response/Status
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 9.10** 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 EMPrs (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 Form is included in **Appendix C**.

6.4.5 *Screening of Alternatives*

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.

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).

6.4.6 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 Environmental Management Programme (EMPr) (see **Appendix I**).

6.5 Environmental Assessment Practitioner

Nemai Consulting was appointed by Umgeni Water as the independent EAP to undertake the environmental assessment for the proposed uMWP-1 Potable 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 9** below, and their respective Curricula Vitae are contained in to **Appendix E**.

Table 9: Scoping and EIA Core Team Members

Name	Qualifications	Experience	Duties
Ms D. Naidoo	B.Sc Eng (Chem)	19 years	• Project Manager • Quality Control • EIA Process
Mr D. Henning	• B.Sc (Hons) Aquatic Health • M.Sc River Ecology	14 years	• Project Leader • EIA Process • Scoping & EIA Reports
Mr C. Chidley	• B.Sc Eng (Civil); • BA (Economics, Philosophy) • MBA	21 years	• Quality Reviewer • Technical Input • EMPr
Ms R. Maharaj	BA (Hons) Environmental Management	4 years	Public Participation Coordinator

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 through the design phase.
- 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.
- Based on the Technical Feasibility Study, the EIA assumed the following –
  - There will not be any discharge to a watercourse from the normal operations of the WTW. Based on the outcomes of the design phase, if provision needs to be made for any discharge, the necessary approval processes will need to ensue in terms of the appropriate environmental legislation which may include NEMA, NEM:WA and NWA.
  - Of the various options considered for the management of the sludge generated at the WTW, the most feasible option at this stage was deemed to be the disposal at a suitably registered landfill. If one of the other options becomes more favourable at a later stage of the project life-cycle, all the necessary environmental approvals will need to be sought by Umgeni Water.
- The Heritage Impact Assessment noted the following limitations (Beater & Prins, 2015):
  - The entire length of the proposed pipeline and deviations were not inspected as much of the pipeline runs through private property. Heritage resources along the sections of pipeline not inspected could be found during the construction phase; however, due to the highly disturbed nature of much of the alignment of the pipeline that runs through intensively farmed vegetable and sugar cane farming and forestry, it is not expected that intact and significant heritage sites will be found.
  - Visibility was compromised by dense vegetation and well established woodlot plantations in portions the study area.

- The Agricultural Impact Assessment noted the following limitations (Index, 2015):
  - The observations, conclusions and recommendations made in this report are based on the best available data and on best scientific and professional knowledge of the directors of INDEX (Pty) Ltd; and
  - The report is based on GIS programming and utilises satellite tracking to map survey points.
- The Socio-Economic Impact Assessment noted the following assumptions and limitations (Nemai Consulting, 2016a):
  - It is assumed that information obtained during the correspondence with the landowners provide an honest account of the community structure and community relationship to the uWMP-1 Potable Water Project;
  - 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 time frames 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; and
  - It is assumed that no relocation of families or people will take place for this project.
- 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 out dated; and

  - Although an attempt was made within the available time frame and budgetary constraints to gather as wide a range of data as possible there was a limitation to the data that could be gathered.
- The Visual Impact Assessment noted the following assumptions and limitations (Axis Landscape Architecture, 2015):
  - This assessment was undertaken during the conceptual stage of the project and is based on information available at the time;
  - 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; and
  - The location, size and number of the construction camps are unknown.
- The Aquatic Impact Assessment noted the following assumptions and limitations (Enviross, 2016):
  - The conclusions to the 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 Avifauna Study noted the following assumptions and limitations (Wildskies, 2015):
  - This study made the assumption that the 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;
    - As a result of the short term nature of this study, the opportunity for primary data collection was limited. This study therefore depends heavily on secondary or existing data sources such as those listed above. It is assumed that these sources are dependable and of good quality; and
    - Predictions in this study are based on experience of these and similar species in different parts of South Africa, through the authors' experience working in

the field of wildlife – energy interaction since 1999. 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; and
  - Since environmental impact studies deal with dynamic natural systems additional information may come to light at a later stage and the specialist 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 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 28(1)(i) 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 10**.

Table 10: 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).	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 SDF for the uMgungundlovu DM (2013), the western part of the project area in Baynesfield falls predominantly within an 'Agricultural Priority Areas'. The eastern part is located in a Secondary Node, which constitutes urban centres with good existing levels of economic development and the potential for growth, serving the sub-regional economy and beyond. Light and service industry is expected to be concentrated at Umlaas Road. The Umlaas Road area is also situated alongside a Provincial Priority Corridor (Camperdown – Msunduzi – Mooi River (N3)), as well as a Primary Corridor (Camperdown – Umbumbulu – South Coast (R603)). According to the Mkhambathini LM (2012) SDF, the pipeline routes fall within an area designated for agriculture and light industrial (Umlaas Road). According to the Richmond LM (2013) SDF, the land designation for the area affected by the project footprint is 'rural settlements'. Concern was expressed by the planning unit in the Mkhambathini LM that the proposed project, in particular one of the earlier site options (discarded) for the WTW that was located closer to Umlaas Road in the north-eastern part of the study area (on Portion 6 of the Farm Crookes 15723), may influence future development in the Umlaas Road area. There are no further obvious indications that the timing of the uMWP-1 is in conflict with the project and programmes listed in the municipal IDPs and SDFs. According to the long-term water requirement projections and water balance of the Mgeni System, it is intended for the Smithfield Scheme (uMWP-1) to be implemented by 2023.

No.	Question	Response
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 11.2**, 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 System. As part of the Mkomazi-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 System, it is intended for the Smithfield Scheme (uMWP-1) to be implemented by 2023.
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 3.1**. 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 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 9.10**. The sludge that will be generated during the operational phase of the WTW will need to be disposed of. Options under consideration include disposal to land to support an agricultural operation, disposal at a licenced landfill, and re-use (e.g. using it as additive for making bricks).
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 operate the bulk water supply scheme once completed.
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 project aims to increase the yield of this system to supply the long-term water requirements of these areas. The provision of potable water to communities is a National programme and the development of resources to supply the potable water is therefore also of National importance

No.	Question	Response
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 sites for the WTW options and aligning the potable water pipeline. 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 **Section 10.11**).
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 uMgungundlovu DM Biodiversity Sector Plan, Strategic Environmental Assessment and Strategic Environmental Management Plan, as well as the KZN Systematic Conservation Plan and other environmental management and planning tools were assessed as part of the EIA.
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 WTW options and pipeline route options (including geological conditions, topography, sensitive features, 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 Economic Impact Assessment (refer to **Section 11.2.1**).
14	Will the proposed land use result in unacceptable cumulative impacts?	Cumulative impacts are assessed in **Section 12.17**.

9 PROJECT DESCRIPTION AND ALTERNATIVES

9.1 Screened Alternatives

The screened alternatives focus on the entire project, with particular emphasis on the uMWP-1 Raw Water component. It was deemed that this information is also relevant to the discussion on the alternatives for the Potable Water, as this component forms part of the overall transfer scheme. It is also necessary to provide the context to this project in terms of previous options investigated to meet the water demands of the supply area.

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 (DWAF, 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) is currently underway. The MMTS-2 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: Option Analysis recommended that Hazelmere Dam should be raised to augment the water supply and reduce the risks of shortages.

Augmentation options for the North 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.
- Direct 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. Desalination of sea water is being 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 Development scheme. 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 (DWAF, 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.

9.1.5 uMkhomazi-Mgeni Transfer Scheme

The information contained below was sourced from the Mkomazi-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 11**):

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 Mlazi 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 Mkomazi 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 11**).

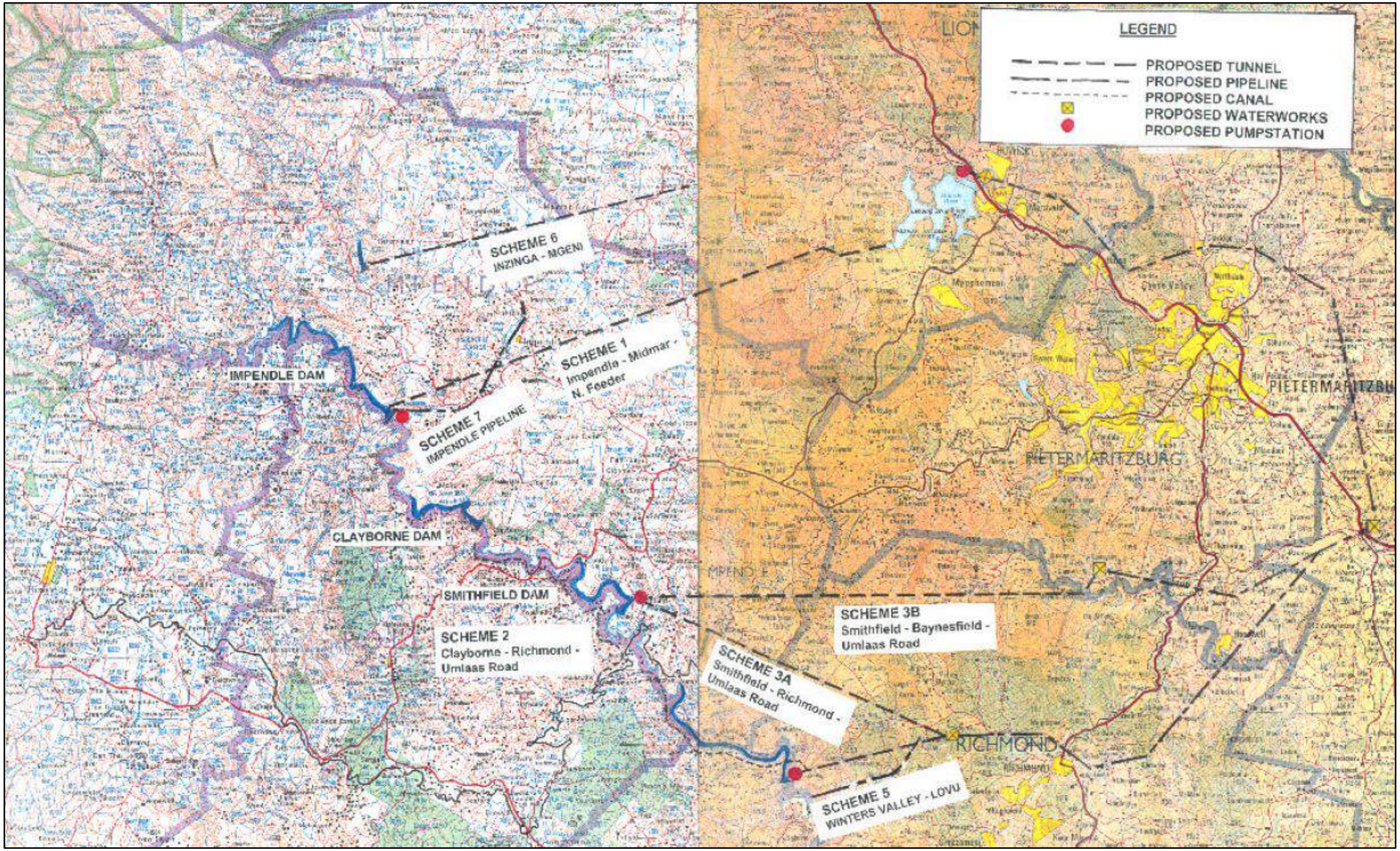


Figure 11: **Layout of Schemes considered during Pre-feasibility Study (DWAF, 1999a)**

Table 11: 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
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 of 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 12**), one of the schemes was eliminated and a second was identified as probably being environmentally unacceptable, but requiring further investigation to confirm this.

Table 12: 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 ❖ <u>Unacceptably high social and environmental impacts of canal</u> ❖ <u>High maintenance costs of canal and risk of interruption of supply due to instability</u> ❖ 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
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 12**), 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. 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 13**), from further investigation and to proceed to Pre-feasibility phase with two schemes, namely the Impendle Scheme and Smithfield Scheme.

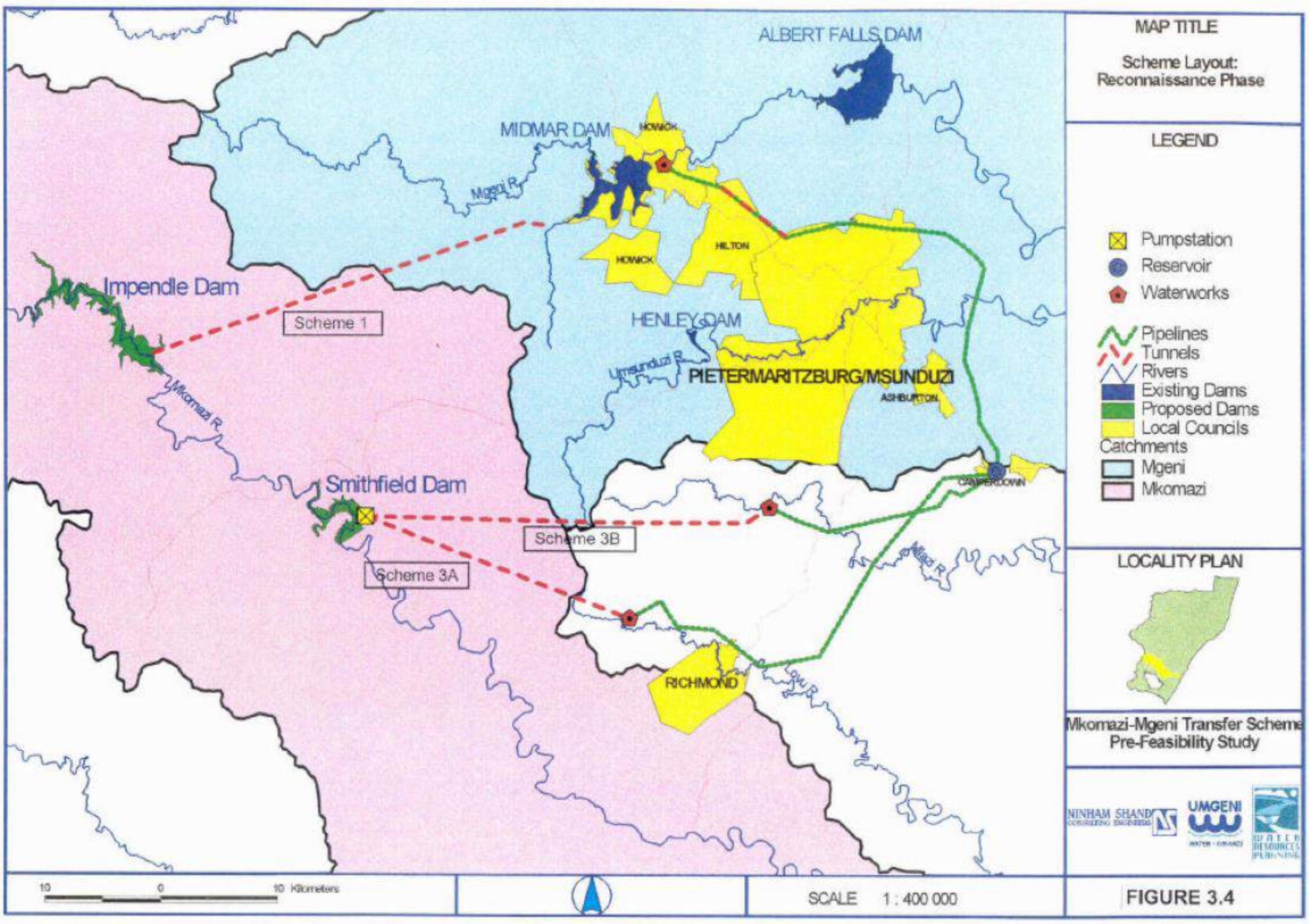


Figure 12: **Layout of Schemes -** Reconnaissance Phase **(DWAF, 1999a)**

Table 13: 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 14** and a comparison of the technical and economic aspects is provided in **Table 15**.

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 – 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 ie. brownfields development. **1,5**	Extensive green-fields development. Predominantly low density agricultural landuse. **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

Table 15: 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 put in place 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 uMzimkhulu 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 Potable Water Infrastructure and Alternatives

uMWP-1 entails the transfer of water from the undeveloped uMkhomazi River to the existing Integrated Mgeni WSS. 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 13**. As mentioned, this report only focuses on the uMWP-1 Potable Water component.

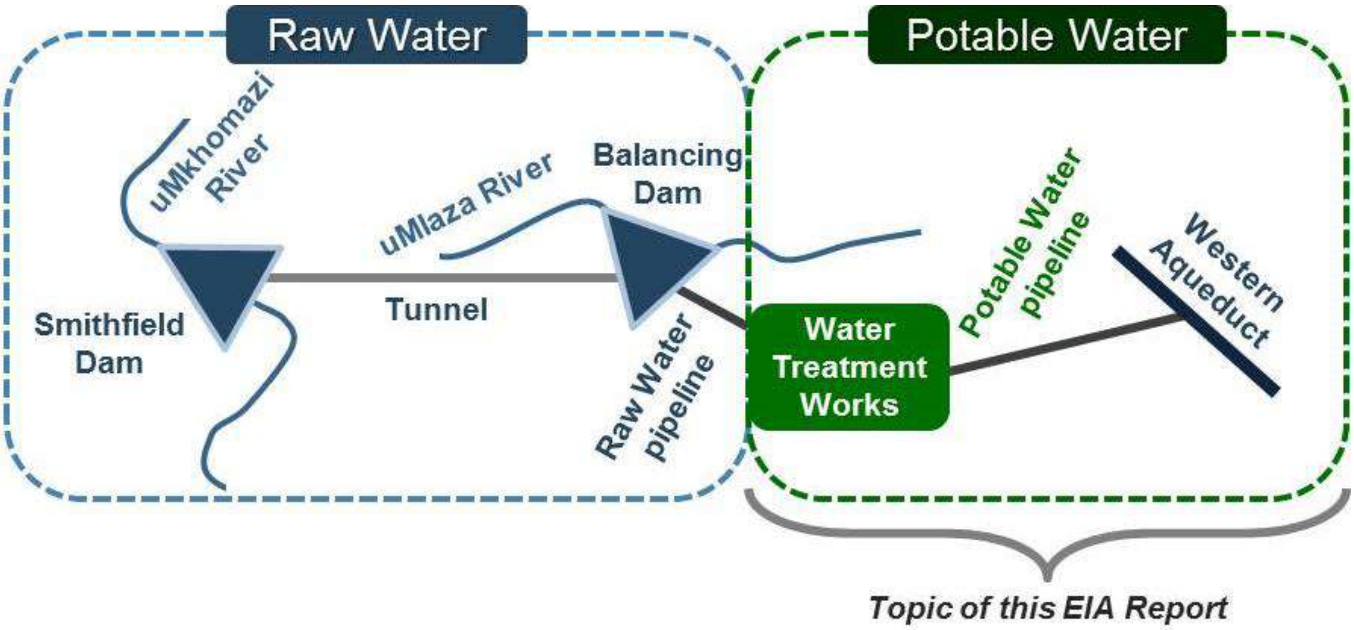


Figure 13: Simplified diagram of uMWP-1 components

The components of uMWP-1 Potable Water, including the associated infrastructure and activities, are listed in **Table 16**. The identified alternatives, which are comparatively assessed in **Section 13**, are listed in **Table 17** and shown in **Figure 9**.

The technical information presented in the sections to follow was primarily sourced from the Module 3 Technical Feasibility Study undertaken by Knight Piésold Consulting.

Table 16: uMWP-1 Potable Water Project Components and Related Activities

<table>
<tr><th>Potable Water Component</th><th>Associated Infrastructure</th><th>Associated Activities (simplified)</th></tr>
<tr><td>WTW & Potable Water Reservoir</td><td>❖ Access roads
❖ 600 m by 350 m (21 Ha) WTW, which includes (amongst others):
• Control room
• Inlet works
• Chemical storage area
• Pre-chlorination facility
• Clarifiers
• Filters
• Post-chlorination facility
• Sludge holding tanks
• Thickeners
• Sludge storage area
• Sludge dewatering area
❖ Reservoir for storage of treated water
❖ Operator’s offices
❖ Parking facilities
❖ Fencing</td><td>❖ Site clearing and establishment
❖ Construction camp
❖ Hauling of material
❖ Storage
❖ Cut and fill
❖ Related construction activities
❖ Commissioning of works
❖ Sludge and washwater management
❖ Water quality monitoring
❖ Operation and maintenance</td></tr>
<tr><td>Potable Water Pipeline</td><td>❖ Access roads
❖ Two x 2500mm gravity pipelines running in parallel
❖ Chambers and valves</td><td>❖ Construction servitude
❖ Site clearing and establishment
❖ Drilling
❖ Hauling and disposal of spoil material
❖ Related construction activities
❖ Permanent servitude registration
❖ Operation and maintenance</td></tr>
</table>

Table 17: uMWP-1 Potable Water Components and Alternatives

<table>
<tr><th>No.</th><th colspan="2">Components</th><th>Alternatives</th></tr>
<tr><td rowspan="3">1.</td><td colspan="2" rowspan="3">Water Treatment Works</td><td>1. Option 1</td></tr>
<tr><td>2. Option 2</td></tr>
<tr><td>3. Option 3</td></tr>
<tr><td rowspan="14">2.</td><td rowspan="14">Potable water pipeline</td><td rowspan="10">Alignment</td><td>Option 1</td></tr>
<tr><td>Option 1A</td></tr>
<tr><td>Option 1B</td></tr>
<tr><td>Option 1C</td></tr>
<tr><td>Option 1D</td></tr>
<tr><td>Option 1E</td></tr>
<tr><td>Option 1F</td></tr>
<tr><td>Link to WTW 2</td></tr>
<tr><td>Link to WTW 2 Deviation</td></tr>
<tr><td>Link to WTW 3</td></tr>
<tr><td rowspan="4">Crossing of Mapstone Dam</td><td>Steel Suspension Bridge</td></tr>
<tr><td>Conventional Steel Pipe Bridge</td></tr>
<tr><td>Pipe Supported on Concrete Piers</td></tr>
<tr><td>Pipe Buried in Dam Basin</td></tr>
</table>

9.3 Potable Water System Configuration Options and Pipeline Routing

9.3.1 Criteria for Pipeline Route Selection

The pipeline route selection and location of the associated WTW are inter-dependent. A change in one impacts on the other. The process of choosing a pipeline route could therefore not be separated from the process of choosing a WTW location.

Two main criteria were used to route pipelines and locate WTW sites, the first being that pipeline routes and WTW sites were selected so as to meet the requirement for gravity flow throughout the system. Pipelines and the WTW were required to be located in a specific elevation range to meet the requirements for gravity flow. The second main criterion was that as far as possible, the earthworks for the WTW sites needed to have closely balanced cut and fill. These criteria are discussed below.

9.3.1.1 Gravity Flow

This criterion involved finding the most direct route for the raw and potable water pipelines whilst maintaining gravity flow. This generally involved following ground contours no higher than the hydraulic grade line of the pipelines whilst minimising deviations from the general direction of the pipeline.

In addition, the hydraulics of the raw and potable water pipelines were checked for suitability with the elevations of the associated WTW site, after bulk earthworks had been completed on the WTW site.

WTW sites had to be located within a specific elevation range in order to meet the requirements for gravity flow.

9.3.1.2 WTW Earthworks Cut and Fill

Unbalanced cut and fill would result in one of the following problems:

- Excess cut: Large volumes of material to be hauled away and dumped - this would entail additional haulage costs and the need to find suitable spoil disposal sites with associated environmental requirements.

- Excess fill: Large volumes of material to be imported - this would entail additional haulage costs as well as identifying a source of large volumes of fill material.

On a project of this magnitude involving a WTW covering some 20 hectares, the haulage of large volumes of materials is to be avoided if possible.

In addition to cut and fill balancing, the ideal site is one where the total volume of earthworks is kept to a minimum.

9.3.2 Other Routing Considerations

Other factors that were considered in routing the pipelines were:

- Access for construction activities including the availability of additional space for temporary construction servitudes alongside the permanent servitude.
- Minimal disruption of access to farmers, businesses and residents.
- Whereas smaller diameter pipelines are generally required to be routed adjacent to cadastral boundaries, it is mostly impractical to apply this requirement to the large diameter pipelines proposed for this project. The pipeline routes therefore generally cut across properties unless a cadastral boundary follows the general direction of the pipeline.

9.4 uMkhomazi WTW

9.4.1 General

A potable water treatment plant, namely the uMkhomazi WTW, has been proposed as part of the uMWP-1 to allow for the purification of water that has been transferred via the raw water infrastructure from the uMkhomazi River.

9.4.2 Water Demand and Phased Treatment Capacity Implementation

Water demand estimates for the complete uMkhomazi Supply Scheme for the next 30 years are reflected in **Figure 14** for the Total uMkhomazi Water Demand curve and shows a high- and low-road scenario for water demand.

A realistic time-frame to do detail design, construction and implementation of a project of the magnitude and complexity of the complete Smithfield Scheme would be ten years, thus if a new plant is built, operation will only start realistically in 2023. A shortfall will be experienced over the next 30 years if other potable water supplies in the area are taken into consideration, as shown in **Figure 14**.

In 2023, the projected shortfall from the uMkhomazi Supply Scheme will already be over 200 Ml/d. Ten years later, in 2033, when the Pinetown, KwaDabeka and Tshelimnyama demand is shed to uMkhomazi, this shortfall is estimated to be around 350 Ml/d. In 2043, which will only be 20 years after start-up, the shortfall is estimated to be 375 Ml/d, but will increase sharply to 475 Ml/d within a year (2044) when a portion of the Northern Aqueduct demand is shed to uMkhomazi.

Phase 1 of the project needs to allow sufficient treatment capacity for the envisaged plant for 20 years from start-up before Phase 2 is implemented. Thus, from the above figure, Phase 1 should allow for a capacity of ca 500 Ml/d, which must be available already in 2043 to allow for the increase in demand to ca 475 Ml/d in 2044 when a portion of the Northern Aqueduct is shed to uMkhomazi. When the above future demand figures are then taken into consideration, a treatment plant with a basic unit treatment capacity (train) of 125 Ml/d would be well sized to increase capacity as required. **Table 18** reflects how the demand would be satisfied if multiples of units with a capacity of 125 Ml/d per unit would be employed.

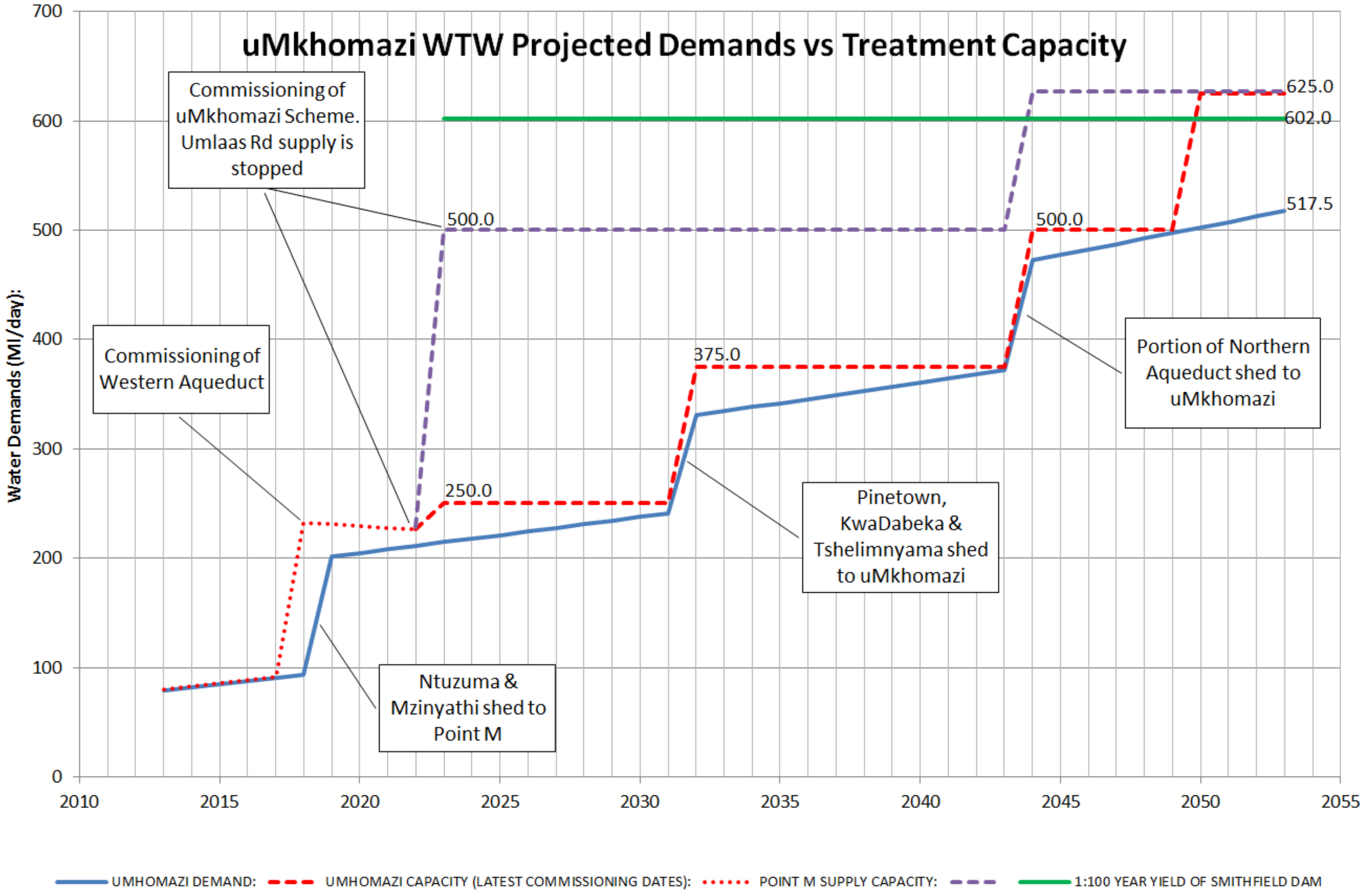


Figure 14: uMkhomazi WTW Projected Demands vs Treatment Capacity

Table 18: Water Demand and Recommended Plant Capacity up to 2042 for Phase 1

	Units	Up to 2023	2023	2023 to 2031	2032 to 2037	2037 to 2044
Water Demand	Ml/d	215	215	215 up to 240	335 up to 350	350 up to 475
Trains used Capacity in use	Trains Ml/d	0 0		2 250	3 375	3 up to 4 500
Max. Operational Capacity Needed	Trains Ml/d	0 0		2 240	3 350	3 475
Capacity to be employed	Trains Ml/d	0 0	2 250	2 250	3 375	4 500
Spare Capacity Available	Trains Ml/d	0 0		2 35 to 10	0 40 to 25	2 150 to 25

Treatment capacity for Phase 1 can be provided in three trains, each with a capacity of 125 Ml/d to give a total capacity of 375 Ml/d, which will suffice up to 2043. However, a steep rise in demand in 2044 to 475 Ml/d will necessitate an extra train already being available in 2043. Also, one spare train should be available at all times as per UW request, which will require an additional train of 125 Ml/d to be provided with start-up in 2023.

This Conceptual Study for the new uMkhomazi WTW was therefore based on providing an initial treatment capacity of 500 Ml/d in four equal trains of 125 Ml/d each, which will be available at start-up in 2023. This will be undertaken under Phase 1 of the project and will provide sufficient treatment capacity to meet Umgeni Water's demand for this Scheme up to 2043, thus for the initial 20 year period.

Phase 2 will entail increasing capacity of the plant up to 1 250 Ml/d. This figure allows for full development of the available yield of 1 020 Ml/d plus 20% to allow for taking units out of operation for maintenance, servicing and cleaning and then rounding to 1 250 Ml/d to allow for expansion in standard trains of 125 Ml/d each. Thus, finally the complete project will allow for a treatment plant consisting of ten off trains in parallel, each with a treatment capacity of 125 Ml/d and will be planned in two phases (Phase 1 and 2), with Phase 1 allowing for a capacity of 500 Ml/d (4 trains) and Phase 2 an additional 750 Ml/d (6 trains).

The planning, process flow diagram and site layout drawings incorporate the total plant capacity for Phases 1 and 2 (1 250 Ml/d).

9.4.3 <u>Raw Water Characterisation</u>

The expected raw water that needs to be treated in the new WTW was analysed and characterised with regards to its water quality and physical/chemical parameters. Whereas the former included chemical and biological analyses of main quality parameters, latter included mainly flocculation, sedimentation and filtration tests conducted on the raw water, and thickening and dewatering of the sludge that accumulates during the treatment process.

9.4.3.1 Water Quality Assessment

The expected raw water that needs to be treated in the new WTW was analysed and characterised with regards to its water quality and physical/chemical parameters. This included chemical and biological analyses of main quality parameters, as well as flocculation, sedimentation and filtration tests conducted on the raw water, and thickening and dewatering of the sludge that accumulates during the treatment process. This allowed for the evaluation of the different unit processes suitable for treating the raw water to potable water quality.

The following two sampling points were identified that best represent the expected raw water quality at the inflow to Smithfield Dam:

- uMkhomazi Smithfield Inflow, sampling the uMkhomazi River at Lundy's Hill Weir. This will be the main source of feed for the envisaged new dam and data from March 1996 to date is available; and
- Luhane Smithfield Inflow. Data collected from March 2007 to present is available.

Cognisance was taken of the fact that significant reductions in certain contaminants can be observed with impoundment. For example, the new Smithfield Dam is planned with retention time not less than 0.3 years and 11.6 km impounded river length at full supply level. This will reduce turbidity, suspended solids, iron, manganese and total phosphorus values by at least 50% (Umgeni Water, 2013).

Table 19 was drawn up using data extracted from the Water Quality Assessment Report (Umgeni Water, 2013). This table depicts minimum, average and maximum contaminant levels only for constituents that were identified from the Report that need to be considered for the design of the new water treatment plant.

Final design values were then defined, taking into account reductions in certain parameters due to impoundment but also increases in other parameters due to eutrophication.

Table 19: Main Parameters Considered for Design of New uMkhomazi WTW

Contaminant	Units	Raw Water Inflow			Plant Design Values		
		Min.	Av.*	Max.	Min.	Av.	Max.
Algal Count	Cells/ml	0	1 147	22 103	500	3 000	8 300
Alkalinity	mg/l CaCO3	13	33	61	10	28	55
Calcium	mg/l as Ca	2	6.3	11.5	2	6	11.5
Chlorophyll a	µg/l	0.5	0.7	2.8	2	6	16
E.coli	Count/100 ml	<10	873	14 140	40	140	3 000
Iron	mg/l as Fe	0.1	1.0	18	0.1	0.8	2
Magnesium	mg/l as Mg	1.4	2.7	8.4	1.5	2.7	8.0
Manganese	mg/l as Mn	0	0.06	2.5	0	0.1	0.5
pH		6.8	-	8.9	7.2	7.8	8.5
Soluble Organic Carbon	mg/l as C	1.2	2.3	3.75	0.5	2.3	4.0
Suspended Solids	mg/l	2	92	4240	2	22	400
Total Hardness	mg/l as CaCO3	11	27	63	11	27	63
Total Organic Carbon	mg/l as C	0.4	2.5	19.6	0.4	2.3	19.6
Total Phosphorus	µg/l as P	7.5	50.3	1988	7.5	50	1 000
Turbidity	NTU	1.4	91	5 530	2	45	800

** Highest Average value was chosen from the three inflow sources under consideration.*

When choosing most appropriate unit processes to treat the above raw water, the following water quality aspects need to be taken into consideration:

- Significant elevated turbidities can be expected to occur occasionally at the abstraction point due to high peak inflow values and under severe storm conditions. These turbidity peaks may not be sufficiently reduced in the envisaged Smithfield Dam because of the relatively small impoundment size of 0.3 years;
- The envisaged impoundment size is, however, sufficiently large to significantly reduce suspended material, notably silt particles, which will be removed by sedimentation;
- The bacteriological quality of the inflow will also improve due to in-dam processes when an impoundment as envisaged is provided;
- The envisaged impoundment (Smithfield Dam) is anticipated to be mesotrophic, i.e. enriched with nutrients, which will result in occasional blooms of nuisance algal species. This will initially be manageable with proper dam operation such as spilling, scouring and abstracting raw water from the aerobic zone for treatment in the WTW. However, raw water quality in the impoundment may deteriorate in future due to increased nutrient discharge into the catchment area of the river. Latter will result in the envisaged dam

becoming eutrophic and will require treatment in a WTW to reduce mainly organic carbon and microbial by-products;

- Thermal stratification during summer with dam turnover (de-stratification) in autumn is highly likely. This will result in elevated metal concentrations, notably iron and manganese, which will be liberated from the sediments under anoxic conditions and must be removed in the treatment plant; and
- The raw water is very soft with average Total Hardness of only 27 mg/l as CaCO3. Untreated, the final water will be very aggressive and will therefore require lime stabilisation during treatment.

9.4.3.2 Physical-Chemical Assessment

Laboratory tests to simulate physical-chemical processes were conducted on the main raw water sources that will feed the envisaged uMkhomazi WTW, being the uMkhomazi River (sample taken at Lundy's Hill Weir), Luhane Smithfield inflow and Baynesfield Dam. Stabilisation, iron and manganese removal, turbidity reduction and disinfection to achieve potable water standards were assessed. Sludge dewatering and thickening was also addressed, since it is anticipated that large volumes of clarifier underflow and filter washwater will be produced by the new WTW.

Chemicals that will be used at the new uMkhomazi WTW as well as the annual consumption for a 500 Ml/d (Phase 1) treatment works have been established based on the water quality and physical-chemical assessments. **Table 20** reflects envisaged minimum, average and maximum chemical dosages that the new WTW will have to apply to treat the raw water to potable water standard. These dosages are also very much in line with what UW is currently using at their other plants dealing with similar river water, e.g. Midmar, Wiggins and Durban Heights WTW.

Table 20: Envisaged Chemicals and Application Range for Phase 1 (750 Ml/d)

Chemical/Additive	Units	Envisaged Application Range (mg/l)			Phase 1 Annual Average Consumption (Ton/year)	Phase 2 Annual Average Consumption (Ton/year)
		Min.	Av.	Max.		
Alum	mg/l *	10	15	25	2 738	6 844
Bentonite	mg/l*	0	3	5	548	1 369
Lime						
- Stabilisation	mg/l *	8	10	16	1 825	4 563
- Sludge treatment	mg/l sludge	120	150	180	126	318
Chlorine (gas):						
- Pre-chlorination	mg/l as Cl_2	1.0	1.5	3.0	274	684
- Final chlorination	mg/l as Cl_2	2.0	2.0	2.0	365	913
Poly electrolyte (U3500®):						
- Flocculation	mg/l *	0	1	2	183	456
- Sludge treatment	kg/T DS	4.5	9	13.5	1 188	2 988
Potassium Permanganate	mg/l as $KMnO_4$	0.6	1.0	1.6	183	456

** mg/l as commercially delivered product*

9.4.4 Process and Plant Design

9.4.4.1 Basic Design Philosophy

The general and specific design aspects that have been taken into consideration when selecting specific unit processes for the uMkhomazi WTW include:

1. **Raw water source**. A new plant must cater for all typical river water conditions and changes in raw water quality due to seasonal changes in inflow, stratification and inversion of a dam. It is, however, envisaged that the impact thereof will be smoothened through optimum dam management, such as regular dam scouring and spilling, and controlling abstraction depth to ensure that only water from the aerobic zone will be fed into the new WTW. The rather short impoundment retention time of 0.3 years, as currently envisaged for the Smithfield Dam, will result in more profound fluctuations in raw water quality reaching the plant than, for example at Midmar, where latter dam has a 1.25 year retention time.

2. **Operation and maintenance**. Emphasis was placed on simple, operation, ease of maintenance and minimal process adjustments, coupled to familiar processes as also used at other plants operated by Umgeni Water personnel. It can be assumed that operators will be rotated between existing treatment

works at Umgeni Water and if similar unit processes as employed at Midmar, Durban Heights and Hazelmere WTW can also be employed at the uMkhomazi WTW, it would have an added operational benefit.

3. **General design aspects**. The following aspects have been taken into account for choosing a specific unit treatment process:
   - Known by Umgeni Water, well-proven unit processes preferred;
   - Availability of electricity is limited and power costs are expensive – energy-intensive unit processes were avoided;
   - Simplicity with regards to operation and maintenance;
   - Limited reliance based on skilled personnel;
   - Routine maintenance to be performed by locally trained personnel;
   - Duplication of critical equipment such as pumps and valves to ensure limited stocks of spares can be kept on site.

4. **Specific design aspects**. The Technical Feasibility Study, as Phase 1 of the uMkhomazi Water Project required specific attention to be given to the following important aspects for a new WTW:
   - Small footprint. Whereas several locations have been identified as possible sites for the new WTW, all of these sites will require expropriating and compensating current land owners for their valuable, productive agricultural land and/or will impact on the landscape. Public meetings conducted in October 2013 for the EIA of this project profoundly highlighted the necessity of minimizing the land area to be expropriated and reducing the overall size of the plant to reduce visibility thereof and to easier blend in with the surrounding natural landscape. Reducing the footprint of a unit process substantially can only be achieved when employing high-rate technology. Therefore, even where conventional treatment processes were chosen, an in-depth investigation of latest, high-rate technology in that field was undertaken in order to reduce the overall footprint of the plant.
   - Limited headloss available. The prefeasibility investigation concluded in 1999 recommended that the new WTW should be located downstream of

a new dam at Smithfield and discharge treated water *via* gravity pipeline into the Umgeni Water bulk distribution system at Umlaas Road. Initial headloss calculations between these two points showed that there will, at times of low water levels in the dam, only be approximately 10 m of spare headloss available that can be used by the WTW for gravity-flow processes.

9.4.4.2 Treatment Processes and Design Capacity for New WTW

Based on Water Quality (**Section 9.4.3**) and Physical-Chemical Assessment (**Section 9.4.4**) of the raw water it was decided to employ conventional water treatment processes as typically applied in river water treatment plants, also for the new uMkhomazi WTW. The final water will comply with the guidelines laid down by SANS 241: 2011 for drinking water.

Basic treatment process train selected

The basic unit processes that were chosen and need to be incorporated will be:

- Chemical dosing, allowing for:
  - Oxidation of iron and manganese;
  - Stabilization;
  - Addition of a coagulant/flocculant;
  - Addition of a ballasting agent;
  - Chlorination – pre and post chlorination is required.
- Flash mixing and coagulation;
- Flocculation;
- Sedimentation;
- Filtration;
- Disinfection; and
- Sludge dewatering and thickening.

An overview of the typical treatment steps to produce potable water is provided in **Table 21**.

Table 21: Typical Treatment Steps in Potable Water Production (adapted from WRC, 2008)

Step	Description	Purpose
Pre-chlorination	Addition of chlorine to the raw water.	Disinfection and oxidation. Oxidation effective to remove colour, iron and/or manganese. Disinfection prevents biofilm growth in channels, settling tanks and filters.
Potassium permanganate addition	Oxidation of iron and manganese	Precipitation of iron and manganese for subsequent removal in filters.
pH adjustment/ stabilisation	Addition of chemicals such as lime, soda ash or carbon dioxide which change the pH.	Adjust the pH to fall in a required range for good floc formation and/or to prevent corrosion or excessive scaling in the distribution system.
Coagulation	Addition and flash mixing of coagulants (also called flocculants) such as alum and/or polymer solutions to raw water.	Add chemicals which produce small floc. Floc contains many of the contaminants present in the original raw water.
Flocculation	Formation of floc in channels or tanks - stage between coagulant addition and the settling tanks.	Form larger flocs, which settle and are thereby easy to remove in settling tanks.
Settling	Floc sinks to bottom of the settling tank and is discharged as underflow to waste. Clarified water is discharged on top as overflow for further treatment.	Removal of floc formed in coagulation and flocculation steps.
Filtration	Water is filtered through a granular media	Removal of floc or particles not removed in the settling tanks.
Disinfection/ post-chlorination	Addition of chlorine to the filtered water. Final water storage reservoir.	Killing of microbes in the final water and provide residual disinfection capacity to prevent later reinfection of final water.
Finished water storage	After disinfection, the treated water flows to a storage reservoir on or near the plant.	Allow sufficient time for the chlorine to act and ensure an adequate supply of water during periods of high demand or disruptions to the operation of the plant.
Sludge treatment and washwater recovery	Dirty backwash water and/or sludge from the settling tanks is dewatered. Sludge is disposed, water recovered as far as possible and returned to plant.	Reduces water losses on the plant, reduces waste sludge load and avoids discharging sludge and spent backwash water to either a natural water body or into the environment.

Figure 15 depicts the envisaged process schematics for the plant and unit processes. The layout of the proposed WTW is depicted in **Figure 16**.

The footprint of the entire plant will be 600 m by 350 m (21 Ha), which will include space for a separate sludge treatment plant. Drawings are also provided in **Appendix F**.

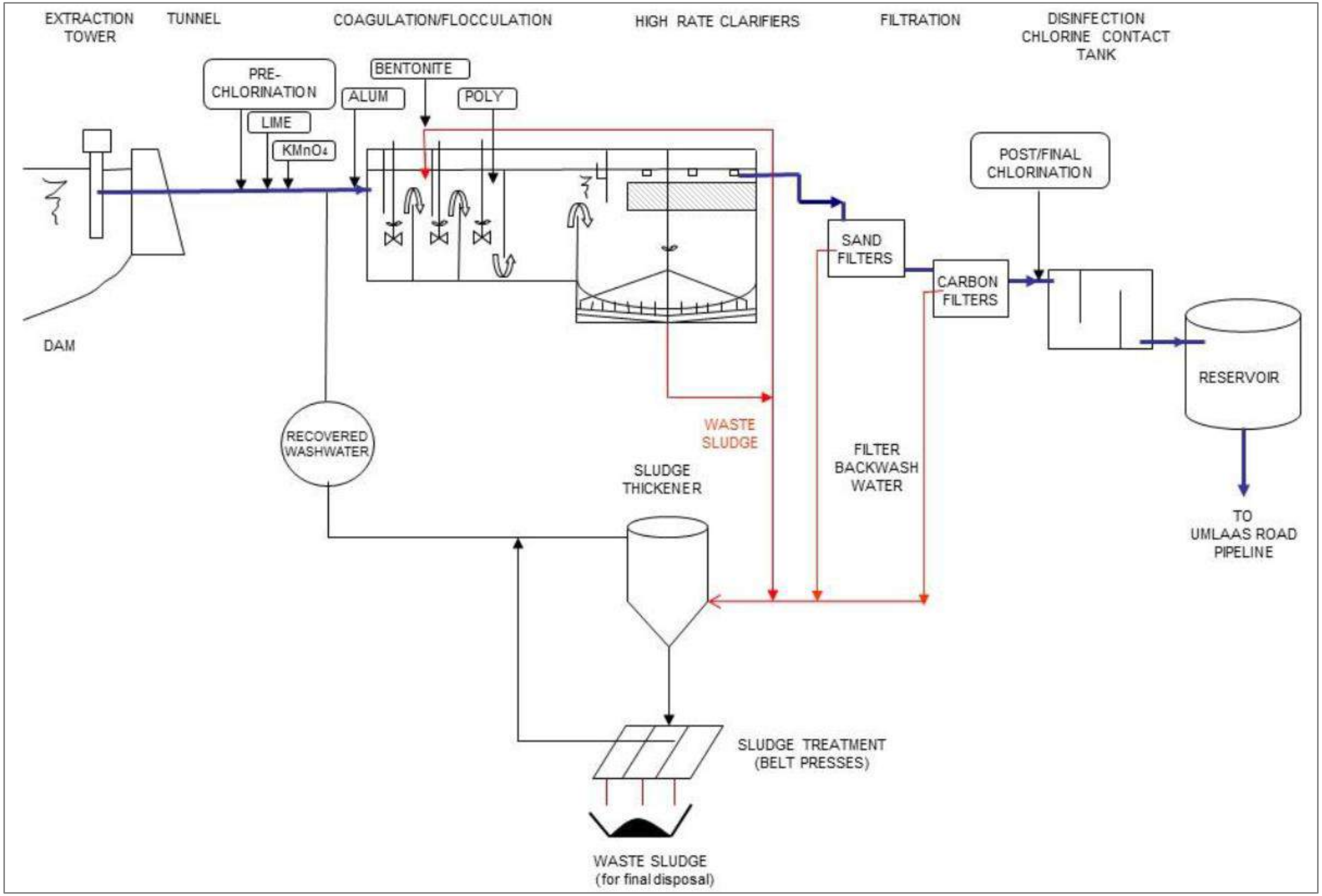
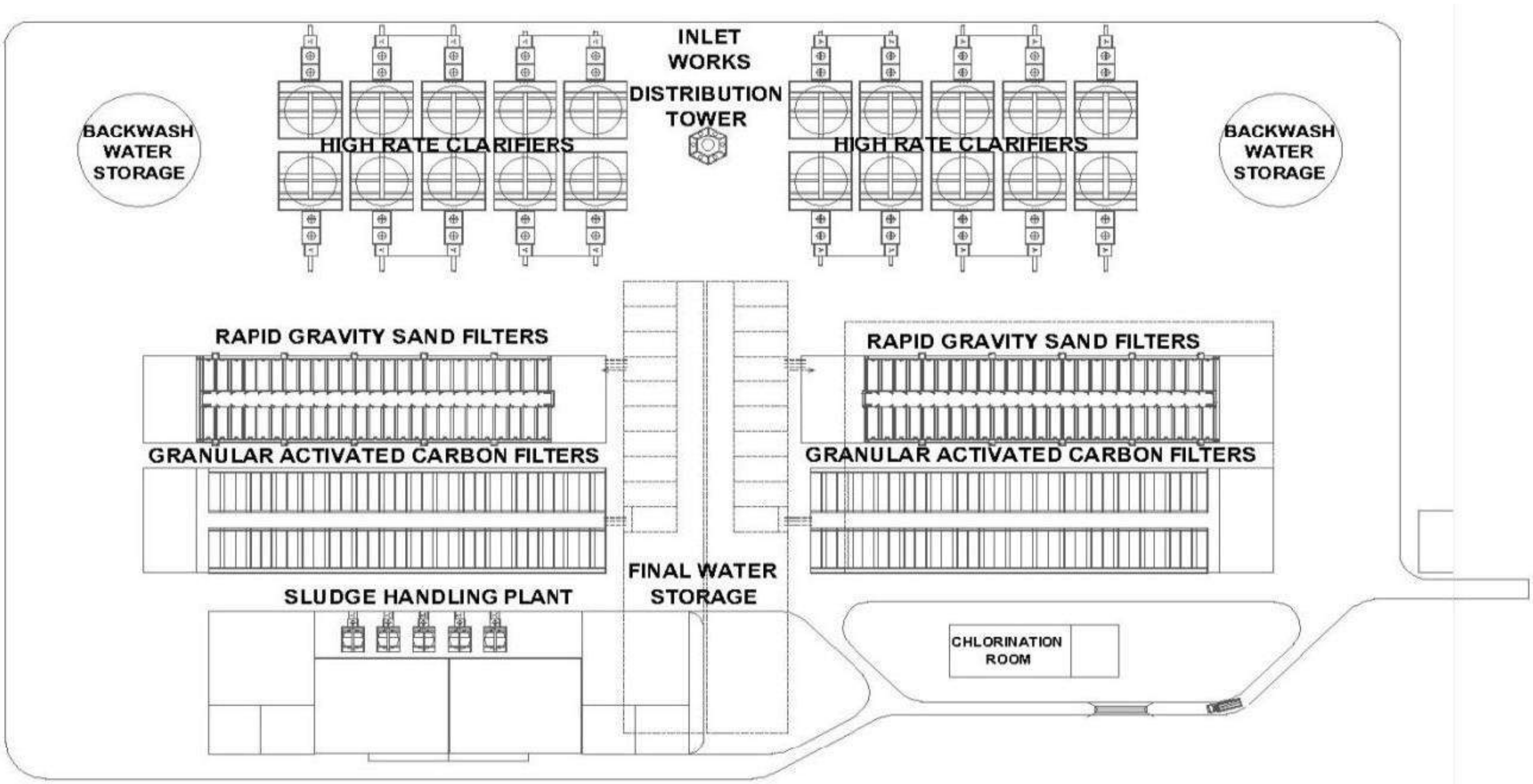


Figure 15: Process schematics of the uMkhomazi WTW



<u>Figure 16:</u> **Proposed WTW layout**

The following water treatment processes and auxiliary facilities have been proposed for the uMkhomazi WTW:

1) Pre-chlorination, water stabilisation with lime and iron and manganese oxidation with potassium permanganate will be performed at or upstream of the inlet works of the plant. Mixing will occur inherently while water is transferred through the distribution tower, which distributes the raw water to the separate treatment plant trains;

2) Coagulation with alum will be done using mechanical mixing to achieve the desired mixing intensity as hydraulic or static mixers will require excessive static headloss, which is not available;

3) Flocculation with an organic polyelectrolyte will be done using mechanical mixing to achieve the desired mixing intensity. As with coagulation, this is preferred over hydraulic mixing methods since this will conserve static headloss;

4) Clarification/sedimentation will be performed using high-rate clarifiers that may employ bentonite as ballasting agent and will include sludge recirculation for the rapid formation of heavy flocs. These high rate clarifiers significantly reduce the overall plant footprint. Scraper bridges will collect waste sludge for removal to the sludge handling facility;

5) Rapid gravity sand filters with a dual-media bed of anthracite and silica sand will be used to ensure maximum floc penetration and filter run times. Double bed filters will be used with a filtration rate not exceeding 10 m/h. Backwashing will be done using both air and water;

6) Granular activated carbon (GAC) filtration has been allowed for in the plant design, even though the initial plant will not include this treatment step. If the source water becomes enriched with nutrients at a later stage GAC will be necessary for the removal of organic material;

7) Chlorination using chlorine gas will give residual disinfection capability to prevent contamination of the final water in the water distribution system;

8) Final water will be stored on site in an 80 000 m^3 intermediate tank to serve the plant's final water demand, with a retention time of 3 hours;

9) An additional, 564 000 m^3 final water storage reservoir, serving the distribution system downstream, will be provided on site to allow for 11.2 h storage capacity at full production;

10) Various auxiliary facilities have also been included in the WTW design. These will be vital in the successful operation of the plant:

- Chemical storage and dosing of all chemicals coagulants and flocculants, including alum, potassium permanganate, lime, polyelectrolyte, bentonite and chlorine. Dry feeding of alum, lime, potassium permanganate and bentonite is suggested, while provision will be made for the preparation and dosing of dry as well as liquid polyelectrolyte;
- Chlorination installation will allow for the application of chlorine to the raw water (pre-chlorination) as well as the final water (post-chlorination). The chlorination equipment will be housed in a separate building from all other chemicals for safety reasons. All necessary safety equipment as well as a chlorine neutralisation scrubber system need to be provided;
- Clarifier underflow, sand filter backwash and GAC filter backwash water will be 46.4 ML/d (at 1% (m/m) DS content), which will be collected and treated in a dedicated sludge handling facility on site. The water recovered by this facility will be returned to the inlet works of the plant while the thickened and dried final sludge will be disposed of off-site;
- The final, waste sludge produced will be 0.92 tons/day at 50% (m/m) DS content;
- Various options are under consideration for the disposal of the sludge (refer to **Section 9.4.5**);
- Water for backwashing of the sand and GAC filters will be stored in a washwater reservoir on site. The reservoir is filled with chlorinated water from the chlorine contact tank;
- Facilities at the plant will include a control room, laboratory, operator change rooms and ablutions, chemical make-up and storage area, general storage areas; and
- Site services will include security fencing with access control, flood lighting, access road to the plant, sanitation, safety equipment and adequate drainage.

It is intended that the plant operations will be similar to that of the Midmar WTW. Photographs of the Midmar WTW are provided in **Figure 17**.

Access gate

Offices and plant

Chlorine room

Poly flocculent storage tanks

Clarifiers

Filters

Sludge treatment plant

Figure 17: Photographs of Midmar WTW

Plant design capacity

The complete, new uMkhomazi WTW was planned to provide 1 250 Ml/d of final water to consumers, of which 500 Ml/d will be provided under Phase 1. **Table 22** reflects how the actual available capacity will then correspond with projected future demand and recommended minimum availability. For "Recommended Availability" in the below table, the actual demand plus 20% is used, which corresponds to UW's design philosophy, viz. to have 20% excess capacity available to take process units such as filters and/or clarifiers out of operation for cleaning and maintenance purposes.

Table 22: Water Demand, Recommended Plant Capacity and Actual Design Capacity for Phase 1

	Units	Projected Demand	Recommended Availability*	Actual Availability (as per Design)
Water Demand:				
• Up to 2022	Ml/d	up to 215	0	0
• 2023 to 2031	Ml/d	215 to 240	288	375
• 2032 to 2043	Ml/d	335 to 375	450	500

** Recommended Availability = Expected Demand plus 20%*

From **Table 22** it can be seen that spare treatment capacity will be available from the envisaged first inception of Phase 1 in 2023. This spare capacity is important to have, since it will serve as emergency capacity to augment supply to consumers if a serious breakdown is encountered at any of the other big treatment plants of Umgeni Water.

Although the complete plant capacity of 1 250 Ml/d has been considered when drawing up process flow diagrams, setting aside the required plant area and planning the plant layout, the Conceptual Design allows for Phase 1 requiring only 500 Ml/d.

The Phase 1 capacity of 500 Ml/d will be provided in four major, parallel trains. This is due to the fact that the projected demand by the time this project has realised in 2023 will already be 215 Ml/d, growing to 340 Ml/d within ten years from completion. The first five years are seen as crucial for the plant to prove itself, *viz* operators can get experience in running the plant, production at full design capacity is possible and uninterrupted and sustainable production can be maintained.

A process flow diagram based on the selected treatment processes and above design capacity is contained in **Appendix F**.

9.4.5 Management of WTW Residues

Residuals generated by the treatment process will include coagulation solids (sludge) and spent backwash.

9.4.5.1 Sludge Thickening and Dewatering

The waste sludge from the high-rate clarifiers and backwash water from the rapid gravity sand filters (RGSF) and granular activated carbon (GAC) filters gravity flows to a sludge thickening and dewatering facility. The objective of the dewatering and thickening facility is to first obtain a blended sludge with more or less uniform consistency. This sludge will then be thickened and dewatered as far as possible to give a waste product high is solids for disposal off-site, while recovering as much as possible wastewater, which will be recycled back to the plant, at the inlet works of the WTW. The sludge handling facility consists of two unit treatment processes, *viz.* new generation sludge thickeners and belt presses.

The sludge entering the sludge handling facility consists of various streams with different sludge consistency. In order for the sludge thickeners to operate optimally, a uniform or homogeneous sludge first needs to be produced from the various sludge streams. This is done in a sludge holding tank, where blowers are used to mix the sludge and to obtain a uniform sludge concentration throughout the tank. Without blowers, the sludge would settle to the bottom of the tank and a uniform concentration for downstream processing in the sludge thickeners would not be achieved.

The process for sludge thickening is almost identical to the high rate clarification process with sludge recycling in a sludge contact clarifier. For clarification, the desired result is to get the liquid component as pure and free of solids as possible, while the solid component is discharged for further treatment. For sludge thickening, this is reversed. The aim is to get the solids component as concentrated (dewatered) as possible and discharging the liquid component back to the inlet of the plant. Advanced coagulation and flocculation methods used for clarification are also used for sludge thickening, with solid and liquid components eventually being separated in a lamella clarifier. The clarifier underflow draw-off is the thickened sludge, which is then further dewatered typically in centrifuges or belt presses, while the clarifier overflow is returned to the inlet works to be treated in the WTW.

After thickening, the sludge from the sludge thickeners needs to be further dewatered to reduce the total volume of waste sludge and to recover as much water as possible. This can be done using various technologies, typically incineration, centrifuges and belt presses. Incineration produces a final ash as waste product while belt presses and centrifuges produce a final dewatered sludge that can be finally disposed of in an appropriate manner. For a plant of this size, sludge management is of crucial importance as reuse and disposal options are very limited for the large quantities of sludge that will be produced daily.

The envisaged uMkhomazi WTW will produce large quantities of final water treatment residue (WTR) or sludge that needs to be reused or disposed of. **Table 23** shows estimated quantities of dried sludge (50% DS) produced and recovered water from the sludge drying facility that will be returned to the inlet works.

Table 23: Estimated final WTR quantities

	500 ML/d Phase 1	1 250 ML/d Phase 2
DS in final sludge	184 t/d	460 t/d
Water in final sludge	184 m^3/d	460 m^3/d
Volume	205 m^3/d	512 m^3/d
Mass	368 t/d	920 t/d
Elutrate returned to inlet works	1.94 ML/d	4.84 ML/d

The conceptual design was based on the following design considerations:

- Belt press technology will be used for sludge drying purposes as this is the most effective technology currently available for a large plant such as the new envisaged uMkhomazi WTW;
- Final sludge when using belt presses will have a solids concentration of ca 50% DS (m/m);
- The liquid component (elutrate) will be recovered by returning it to the inlet works of the plant; and
- Sludge dewatering is a vital component of the plant and ample standby capacity will be required to ensure that sludge can be treated at all times. Therefore, 10 off duty and 6 off standby belt presses will be provided for the full plant capacity of 1 250 ML/d, so that maintenance can be performed without interrupting operation.

9.4.5.2 Sludge Disposal

The various options available for the treatment and disposal of the sludge and washwater from a WTW are shown in **Figure 18**.

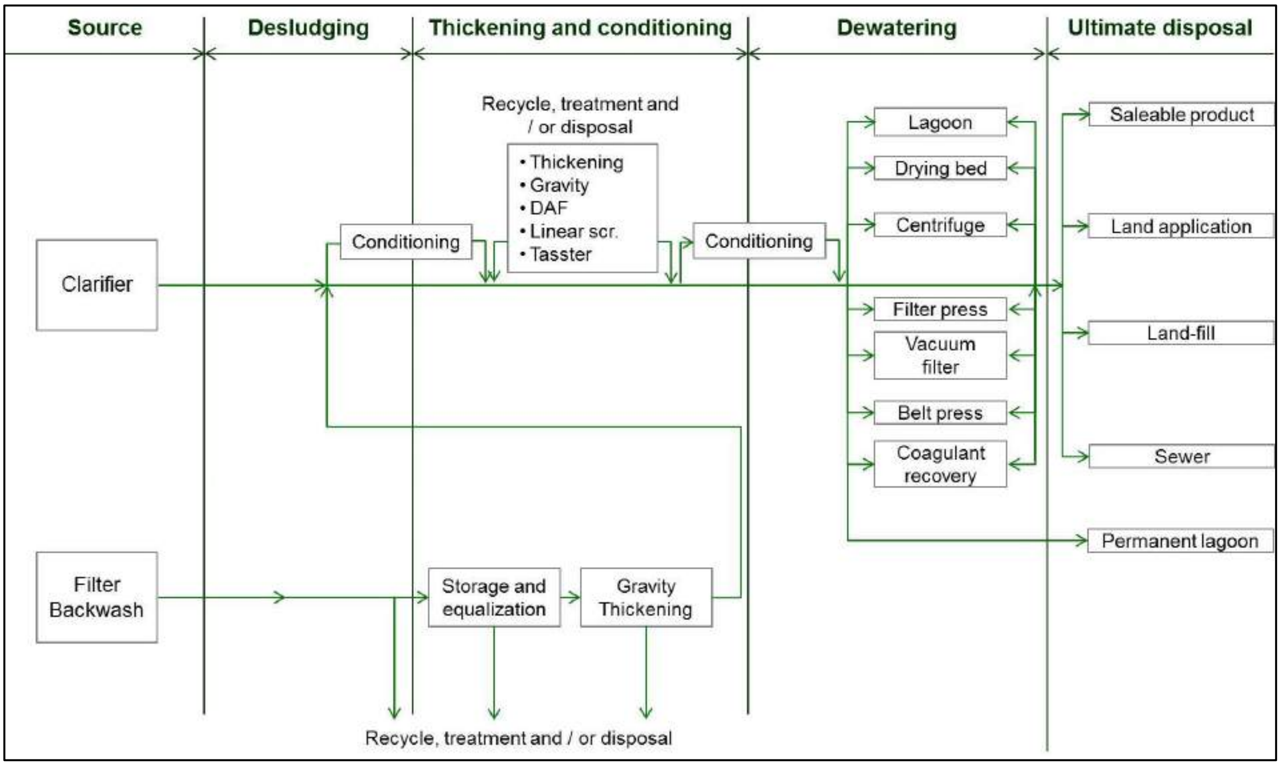


Figure 18: Sludge and washwater treatment options and ultimate disposal methods

Of the various options, the following alternatives for sludge disposal were deemed to be feasible for further investigation during the EIA phase:

Option 1: Landfill

Dewatered sludge may be disposed of at a landfill site that has been designed with specific consideration for volume and characteristics of sludge, design life of the WTW and leachate generation and management. An analysis for design requirements specifically for the uMkhomazi WTW revealed that a G:L:B+ type landfill would be required.

For comparison, it was assumed that this sludge will consist of 50% (m/m) DS, be non-hazardous and thus a General (G) landfill design can be adopted. Approximately 920 tons wet sludge (at 50% DS) per day of sludge will need to be disposed of at the landfill site, which therefore requires the provision of a large (L) landfill, which is the classification for any landfill receiving waste in excess of 500 tons per day. The leachate management requirements were determined by taking moisture content of sludge and historical evaporation data into account, which determined that significant leachate will be produced (classified as B+) and an appropriate leachate management system will be required. Co-disposal of waste with solid and liquid components such as sludge is allowed at a G:L:B+ site as long as proper leachate management is performed. The co-disposal ratio is affected by various factors and needs to be calculated after a specific landfill site is selected.

Discussions were held with the uMgungundlovu DM regarding the viability of this option. The landfill sites under consideration included:

- Proposed Regional Landfill in the district;
- New England Road Landfill (limited airspace); and
- Richmond Landfill.

Refer to **Appendix L** for a letter from the uMgungundlovu DM, which commits to accepting the sludge at the proposed regional landfill.

Option 2: Agricultural land application

Umgeni Water presently disposes of the sludge generated at Midmar WTW by a process called land application. In this operation, dewatered sludge is transported to a farm, Brookdale Farm, approximately 3.5 kilometres from Midmar WTW (see **Figure 19**).

Figure 19: Aerial image of Brookdale Farm

A brief case study on the Brookdale Farm operation was undertaken as part of Technical Feasibility Study with the intention of assessing its relevance to the proposed uMkhomazi project.

Brookdale Farm was purchased by Umgeni Water for the purpose of land application of the Midmar WTW sludge. Umgeni Water as the owner leases the property to a farmer. The lease agreement gives Umgeni Water the right to dispose of the WTW sludge on areas of the farm that are not in productive use over the period of time that sludge is applied to that portion of the land. Under the present lease agreement, it is the responsibility of the farmer to collect sludge at an agreed frequency from Midmar WTW.

Sludge generated at the Midmar WTW is dewatered by means of a centrifuge to a 25% DS content. The farm currently receives approximately 6 loads of sludge per day, i.e. 18 m^3/day or 21.6 t/day. The sludge is transported by road in a 'muck spreader' pulled by a tractor (see **Figure 20**).

Figure 20: **Typical Rotor-spreader "Muck" spreader used on the Brookdale Farm**

A muck spreader is an agricultural machine typically used to distribute manure over a field. A typical muck spreader consists of a tractor which tows a trailer with a rotating mechanism driven by the tractor's power take off (PTO). The muck spreader currently in use at Brookdale Farm has a capacity of three cubic metres.

A typical application rate of 76 t/ha of wet sludge is presently achieved. The sludge is allowed to air dry after application for two months before the next application cycle.

The farm is divided into 4.5 Ha blocks of land, each containing 65 strips approximately 690 m^2 in size. The strip size has been calculated to roughly match the area covered in a single run when the tractor pulls the muck spreader in 1st gear at 2 000 r.p.m. Once the 4.5 Ha block has received the equivalent of 128 t/Ha of dry sludge it is returned to its former land-use and another 4.5 Ha block is identified for further sludge disposal. The case study determined that it takes approximately 2 years of continuous sludge disposal with the 2 month drying period per strip for the 4.5 Ha block to achieve the 128 t/Ha maximum advisable coverage.

Although Brookdale Farm was purchased by Umgeni Water to provide a ‘guaranteed’ disposal area for the Midmar WTW sludge, this may not necessarily be the case for the uMkhomazi scheme. Phase 1 of the uMkhomazi Project will generate an estimated 920 t/day of sludge with a total solids content of 25%, which is considerably higher than the 21.6 t/day of sludge presently generated at Midmar WTW. The high volume of sludge expected to be generated by the uMkhomazi WTW will necessitate a different scale of operation in comparison with the Brookdale Farm operation.

For landfill application, the sludge needs to be relatively thin. Only sludge with 25% dry solids content was considered, as is presently the case with the Midmar WTW sludge.

Given the expected large volumes of sludge from the proposed uMkhomazi WTW, it is proposed instead of transporting the sludge to a single farm, that the sludge be sent to numerous different farms. At this stage, it has been assumed that no land would have to be purchased by Umgeni Water for this purpose. The sludge would be given to farmers in the region free of charge for them to utilize on their land. Delivery may be in the form of large capacity tip trucks or even by pumping of the sludge as slurry. For the purposes of this study, road transport has been assumed for discarding 920 tons of sludge per day.

By applying the techniques used at Brookdale Farm to the proposed Umkhomazi WTW, it was possible to estimate the total area that would be required for the disposal of sludge generated from the proposed treatment process.

Applying the present application rate at Brookdale, it has been calculated that a total area of 15.1 Ha would be required per day. Alternatively if say 20 separate sites were used, a daily area of 0.76 Ha per site would be required to dispose of this sludge.

If the same methodology and drying period that is currently used at the Brookdale farm is applied to these proposed sites, land parcels of approximately 45.4 Ha each would need to be identified. Each land parcel would then be further divided into 823 strips approximately 552 m^2 in size. The area of each strip is sized to match the volume of sludge that can be distributed in a single run by a 4.2 m^3 muck spreader, which is the largest capacity muck spreader commercially available in South Africa.

Once the 45.4 Ha block receives the recommended load for each rotation cycle, i.e. 128 t/ha over 2 years as is the case at Brookdale Farm, it would be returned to its former use and another 45.4 ha block would have to be identified for further sludge disposal. The rotation cycle would be dependent on the soil characteristics as well as the levels of phosphorus present in the sludge.

The rotation cycle however, is also dependent on the commercial need to develop the portion of the farm receiving the sludge, i.e. the timing of planting crops on that piece of land may not coincide with the time required to complete the land application process to the optimal coverage.

The total area of farmland required to make land application viable over each two year cycle is 908 Ha. If it is assumed that the sludge will be disposed of by land application on farms within a 15 km radius of the WTW, less than 2% of the available farmland within this radius will be required at any given time for the purposes of land application.

After this two-year period, the land will be released for cultivation and new portions identified for land application. It is possible that the land application cycles could also be timed to coincide with existing crop rotation cycles.

The option to dispose of the uMkhomazi WTW sludge by land application therefore appears to be viable. It will be on a considerably larger scale than the Midmar sludge disposal operation and will therefore have to be more sophisticated and well controlled. It would be best to distribute the sludge to as many different locations as possible so as not to burden one particular farmer with the responsibility for land application. Having numerous different sites on which to dispose of the sludge also reduces the risk to Umgeni Water.

When the WTW is operational and once the volumes of sludge are known more accurately, Umgeni Water would need to take a decision on whether to purchase farmland for the purpose of land application or to sign agreements with farmers to accept the sludge onto their land. The option of land application can also be paired with the option of sludge disposal at a landfill site, which will further reduce Umgeni Water's risk.

Table 24: Comparison of Midmar WTW and proposed uMkhomazi WTW land application viability

Midmar Water Treatment Works - Brookdale Farm Land Application Initial Tests	
Volume of sludge produced per day	6.5 tonnes/day
Percentage Solids contained in Sludge to be spread	24 - 28 %
Capacity of Spreader	5.25 m^3
Application Rate of Spreader	7.6 kg/m^2 of wet sludge in 1st gear at 2000 r.p.m.
Coverage area	690 m^2 (3 m wide x 230 m long)
Drying Period	2 months
Total Farm Area	126 hectares
Total Usable Area	9.32 hectares
Rotation Cycle	2 years
Maximum Loading per Cycle	128 tonnes/hectare
Umkhomazi Water Treatment Works - Land Application Estimated Quantities for Sludge Containing 25% solids – PHASE 1 only	
Volume of sludge produced per day	920 tonnes/day
Percentage Solids contained in Sludge to be spread	25 %
Capacity of Spreader	4.2 m^3
Estimated Application Rate of Spreader	6.08 kg/m^2 of wet sludge in 1st gear at 2000 r.p.m.
Estimated Coverage area	552 m^2 (3 m wide x 184 m long)
Estimated Drying Period	2 months
Estimated Total Daily Usable Area Required	15.1 hectares/day
Estimated Rotation Cycle	dependent on levels of Phosphorus present in sludge and soil characteristics
Estimated Maximum Loading per Cycle	dependent on soil characteristics and intended crops

Option 3: Brickmaking

It was assumed that the final, dewatered sludge will be handed over to an existing brick maker in the closer vicinity of the new plant (within 15 km), who will be able to use the sludge instead of base material. Thus, no new land will need to be acquired in the vicinity of the plant and the brickmaking process with subsequent sales will be viable to carry all costs associated with final disposal of the sludge.

A comprehensive study into the feasibility of using the uMkhomazi WTW's waste sludge for brickmaking was undertaken especially taking South African conditions into account.

WTW waste sludge that mainly utilised alum as primary flocculant has a similar composition to that of natural clay. Substitution of natural clay with this waste sludge has been done successfully with up to 50% sludge:clay mixes. A key consideration is the dry solids content of the sludge used in the brickmaking process. The lower the dry solids content, the more water needs to be removed during the brick firing (baking) process, which requires more energy input. Thus, a higher solids content sludge is preferred.

Location. The intended uMkhomazi WTW is situated 45km west of Pietermaritzburg, meaning that it is surrounded by the Lower Ecca Group or Pietermaritzburg Formation of shale and sandstone (**Figure 21**). This is the main source of clay for the larger clay brick manufacturers in the area – there are 3 particularly large manufacturers in the area – and the abundance of iron oxides in the clay provides the rich red colouring on some of their products.

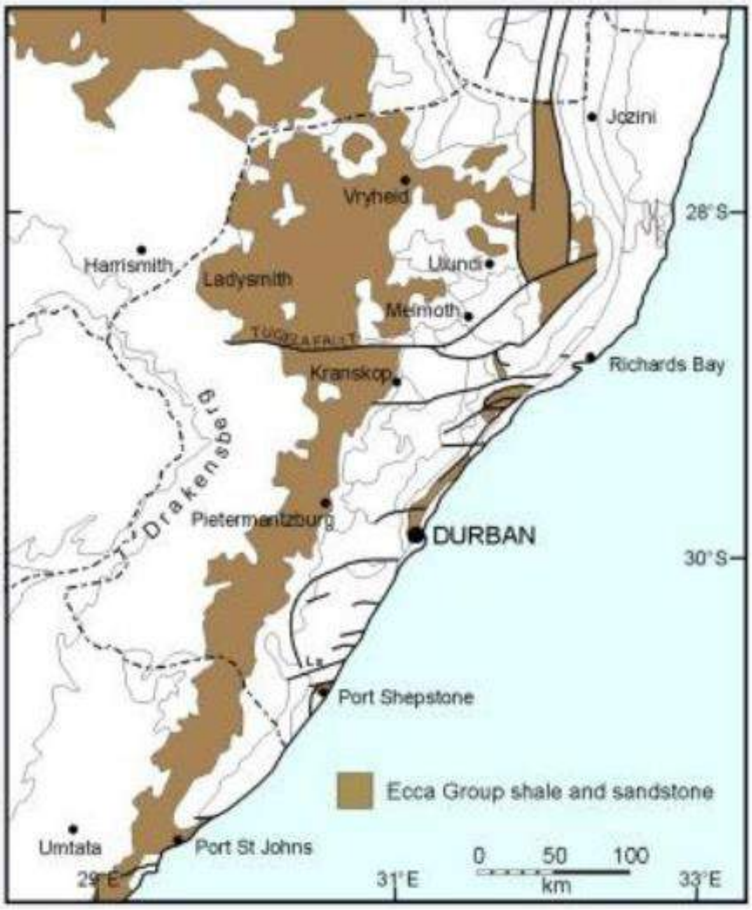


Figure 21: **Ecca Group shale and sandstone formation in the Pietermaritzburg area (UKZN)**

Very little additives are required in this type of clay due to the natural plasticity and green strength during extrusion as well as compressive strength after firing. It must be noted that the green strength (the strength of the green extruded brick that needs to be dried then fired/burnt) is assisted by a relatively large amount of quartz present in the clay. The location of the WTW is thus logistically suitable with regard to the supply of raw materials and the physical access to the required markets. The type of clay abundant in the area lends itself well to addition of wet substance since it has a superior green strength. In addition to the above, the relatively close sources of coal in KZN as main energy driver for the process, provides an operational advantage in that the delivered price of coal is not as inhibitive as it is, for example, in the Western Cape.

Process. Smaller constituents in the waste sludge, such as organic content and other waste components, do not play a significant role in the actual quality of the final brick (due to the type of manufacturing process employed) but will influence the look/colour of the final product. The dryness of the waste sludge, on the other hand, has a major impact on the amount of bricks that needs to be manufactured to capture all the sludge. To ensure the final brick product has qualities equivalent to that minimum required in SANS 227, particularly fired compressive strength and water absorption, the cumulative amount of clay and waste sludge in the green brick (on a dry basis) should not be below 50% to 55% otherwise the green strength would be below the minimum threshold to ensure the handling of the wet brick without high % of wastage. The aim is to get to 70% to ensure the minimum wastage during extrusion and wet brick handling. It is fortunate that the high percentage of quartz in the natural clay of the Ecca Formation will impart a good portion of green strength during manufacturing. **Table 25**, compares brick quality and quantities that can be produced using dried sludge from the WTW. The 25 % DS sludge is considered for comparative purposes only, to ascertain whether centrifuge technology for sludge drying can be used prior to the brickmaking process.

Table 25: Economic comparison of sludge disposal options

	Option 1	Option 2	Option 3
Waste Sludge Solids%	25%	25%	50%
Dry Sludge % added to mix	10%	20%	20%
Dry Clay/Sludge % in wet brick	69%	55%**	73%
Equivalent Bricks / day	2,0 million / d	1.2 million / d	0.92 million / d
Equivalent Bricks / month	60,4 million/m	36,2 million / m	27,6 million / m
Equivalent Bricks / year	735 million / y	441 million / y	336 million / y

From the above table it is recommended that a 50% dry waste sludge (Option 3) be added to the clay and coal mix. This would result in a manufacturing facility that produces 336 million bricks per year at a clay and sludge content of above the recommended 70% utilising the uMkhomazi waste sludge.

The manufacturing process, a Zig-Zag Habla kiln, was chosen for this preliminary investigation due to its low overall energy requirements, simplicity of operation, reduced emissions in relation to the most common production processes and relatively low capital requirements.

In this manufacturing process, the main energy source of the firing and drying cycles are provided by the addition of particulate coal into the clay mixture. A minimum quality of coal with a specific size distribution must be incorporated in this process. This is readily available in KZN. It must be ensured that the minimum amount of fixed carbon in the final green brick should be 4,85 – 5,0 %. This calculates the coal requirements for the wet brick mix which translates to approximately 105,000 tons per annum of washed slurry coal with 1-2 mm particle size distribution.

<u>Market for clay bricks</u>. The market for clay bricks is predominantly residential (approximately 50%) and this sector in KZN has shown a growth rate of 26% in 2013 with little sign of turn-down in 2014. The net effect on the brick manufacturing industry, specifically the clay brick industry due to the disproportionate rise in cement brick pricing, is net positive growth that has a cyclical nature over the decades.

In 2000 the annual national clay brick production was approximately 3.5 billion bricks which grew to 4.9 billion bricks in 2006 and it is expected that the annual demand for clay bricks in 2016 will be in the region of 6.6 billion bricks at current economic conditions (supressed).

It is expected that the facility will not service customers outside a 250 km radius but the possibility of exports are not excluded *via* the Durban port. Ease of entry into the market is not a huge issue due to the fact that the market is very much price and quality driven.

<u>Economic considerations</u>. Given the chosen technology, economy of scale, low fuel costs (close proximity to fuel sources) and available off-set market, the gross

profit margin per 1 000 bricks will be in the region of R 200. The manufacturing costs will be approximately R 1 150 per 1 000 bricks and selling price will be approximately R 1 350 (per 1 000 bricks). For 336 million bricks per year, the gross profit will therefore be in excess of R 65 million per annum. Net profit will depend on outsourcing contracts and company structure. The waste sludge produced by the WTW can therefore be used to obtain revenue. Regardless of the final net profit, even if under worst-case conditions UW does not receive any portion of this revenue, this sludge disposal method will be cost-neutral to UW as sludge can be given to the brickmaking facility at no cost, whereas any other disposal method will require significant capital and/or operational financial input.

Additional considerations. The amount of clay that will be removed due to mining operations will render a pit of considerable size. The pit will grow by a factor 500 more daily than the actual (wet) sludge volume delivered per day. At some stage, the pit itself will become a buffer facility for the sludge during the maintenance period (25 days per year) or it could become a processing facility to dry the sludge even more to effect more process possibilities (i.e. higher combined clay/sludge mix ratio). Another option is to treat the ever growing pit as an official landfill site (earmark it for dried sludge, construction waste etc.) and thus save on rehabilitation costs and reduce the ultimate size required for the brickmaking facility.

Is very difficult to determine, at this early stage already, if there will be sufficient demand for farmers to take the huge quantities of final sludge to be disposed of, or if a suitable area can be identified that can be developed as landfill site within 30 km from the plant. Also, although brickmaking will be economically viable, it will require pilot tests and convincing existing brickmakers to use this sludge in their brickmaking process.

Way forward

Of the various options considered for the management of the sludge generated at the WTW, the most feasible option at this stage was deemed to be the disposal at a landfill. This obviated the need to seek approval under NEM:WA, as the landfill selected will be in possession of the requisite environmental approvals to accept the sludge. Refer to **Appendix L** for a letter from the uMgungundlovu DM, which commits to accepting the sludge at the proposed regional landfill.

9.4.6 *Management of Backwash / Washwater*

It is intended that the proposed WTW will not discharge into a watercourse. This will be achieved by managing the quality of the raw water that enters the plant as well as a providing a washwater and sludge recovery system. However, under emergency situations provision may need to be made for discharges.

The uMkhomazi WTW will not have a direct take-off from a water resource but will instead be fed by the uMWP-1 raw water system, which will include Raw Water Conveyance Infrastructure (i.e. tunnel and raw water pipeline) to convey the raw water from Smithfield Dam to the plant. The quality of the raw water will be managed through a storage dam, which will have sufficient capacity to supply more than 100 days' retention time, as well a trough a multi-level intake tower at the proposed Smithfield Dam. In particular, exceedingly high turbidity raw water peaks can be managed as incoming water will have time to pre-settle and the depth at which water is drawn off can be varied at the intake tower to select draw-off from a less turbid layer in the dam.

Provision will be made at the WTW for a full washwater and sludge recovery system. This system will also be able to recirculate substandard water to the Inlet Works. By planning properly during the detail design stage, with sufficient parallel trains and stand-by equipment, provision can also be made for a spare train of equipment.

9.4.7 *Operation and Maintenance*

9.4.7.1 General

Drinking water treatment plants require skilled personnel for successful operation and maintenance. The more complex the treatment processes and technologies employed at the plant, the more skilled the process controller and operator(s) need to be. Even though the proposed uMkhomazi WTW consists of conventional treatment processes with technologies that UW operators will be mostly familiar with, the high-rate clarification process will be new to them and additional skills will have to be developed for personnel operating at this plant to ensure optimum plant performance and the safe supply of drinking water at all times. However, sufficient control will be incorporated to ensure that, if the water after clarification goes out of specification in a particular train, this train will be shut off and a warning given to the operator.

The on-site sludge treatment facility will be operated as its own entity, with specially trained operators and technicians. The sludge treatment facility manager will report to the WTW plant manager, but from an organizational point of view, the two facilities will be independent.

9.4.7.2 Personnel

Figure 22 shows the proposed organogram for the WTW and the sludge treatment facility.

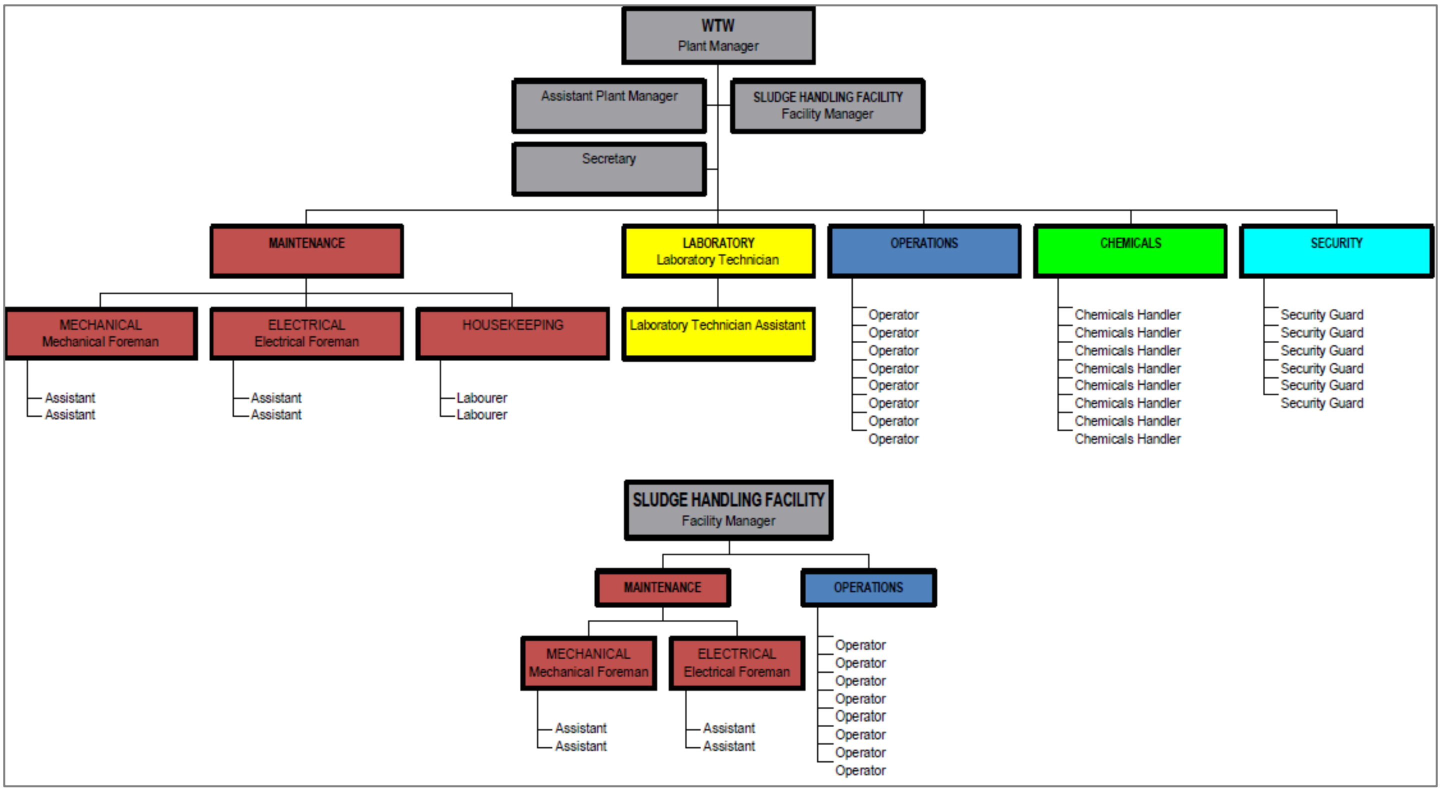


Figure 22: WTW and sludge treatment facility organograms

Operations, chemicals and security personnel will have shift teams for continuous, 24-hours a day operation of the treatment works. Plant operators and chemical handlers will have four teams that operate in 8 hour shifts while security will have three teams that operate in 12 hour shifts. Due to the plant not situated in or close to a town, Umgeni Water will most probably have to permanently employ security staff, instead of employing a specialist contractor for this function. Critical equipment will be provided with standby units in case of failure, but maintenance teams will also be on stand-by for after-hours emergency breakdowns.

Environmental audits are performed at all Umgeni Water's water and wastewater sites at various stages of the project life-cycle to ensure compliance with relevant legislation and the principle of best practice.

The operator of the WTW (including the sludge treatment plant) will poses the following set of skills (amongst others):

- ❖ Sludge Plant –
  - Process control;
  - Plant-specific preventative and maintenance management system;
  - Monitoring programme;
  - Failure response management;
- ❖ Residue disposal site (if applicable)–
- ❖ Agricultural expertise for vegetation requirements; and
- ❖ Water quality monitoring of associated ground water systems.

An environmental team will oversee compliance with the EMPr and the associated waste management provisions during the operational phase of the WTW. A monitoring programme will be implemented, which will include pre-determined targets, objectivises and indictors for waste management.

9.4.7.3 Operating Manual

The WTW will have a proper operating manual containing all the details necessary to successfully operate and understand processes and procedures of the plant. The following information will be included in the manual, as a minimum:

- The commissioning procedure and plant settings after successful commissioning;
- All plant-related drawings and diagrams. This includes layout, mechanical, and piping and instrumentation drawings as well as electrical wiring diagrams and any other drawings which may be useful for plant operation and maintenance;
- Complete functional description of the process including the control philosophy;
- Illustrated operating instructions including start-up, shut-down, backwashing, regeneration and/or cleaning procedures and emergency actions to be taken in the case of possible equipment failures;
- Maintenance instructions to include the descriptions and required frequency of all maintenance tasks;
- Equipment data sheets and manufacturer's operation and maintenance instructions;
- Procedures for chemicals preparation with cautionary notes and clearly visible signage for hazardous chemicals. Clear instructions for emergency procedures to be followed in case of an accident involving chemicals must be easily visible and available;
- Chemicals suppliers contact details;
- Trouble shooting notes with contact details for emergency action;
- Suggested typical plant operating parameters, such as chemical dosing, flow rates and head losses. After commissioning, such values that are fine-tuned during the commissioning process should be included in the commissioning report and included in the operation and maintenance manual; and
- Sample calculations where applicable.

9.4.7.4 Spares and Consumables

In addition to the regular checks and procedures to be followed, it is very important to keep stock of critical spares and consumables on the plant. In the event of failure of equipment that is crucial to the successful operation of the plant, a technician should be able to replace or repair such equipment with minimal or no plant shutdown. Stock levels of consumables and chemicals should also be managed carefully in order to ensure that sufficient time is allowed for re-ordering and delivering new supplies. Typical spares to be kept on site include pumps, valves, pipes and fittings, instrumentation and service kits for major equipment.

9.4.7.5 Asset inventory

An asset inventory helps water services providers to identify what assets they own, where these assets are located or stored and what their condition and service history is.

9.4.7.6 Dangerous Goods Used at the WTW

The choice of specific chemicals to be used at the WTW will primarily depend on the source water quality and the type of treatment to be performed. The chemicals used will perform the following functions:

- Coagulants;
- Disinfectants;
- Taste and Odour Control;
- Algae Control;
- Corrosion Control;
- Softening; and
- Fluoridation.

The Material Safety Data Sheet (MSDS) provides pertinent information and a profile of a particular hazardous substance or mixture, and includes at least the following information:

- Identification of composition, formula, and common and scientific names;

- Specific gravity, boiling/freezing points, solubility and vapour pressure;
- Incompatible substances and decomposition products;
- Health hazards;
- Environmental impacts;
- Personal protective measures and engineering/administrative controls; and
- Safe handling, storage, disposal and cleanup procedures.

The MSDS for each chemical that is to be stored at the plant will be kept at the site.

Water treatment chemicals will be transported to the site by road and stored in designated areas. The chemicals can be stored in a number of ways including (1) solid (dry) form (bags, cartons, drums); (2) liquid form (drums, tanks, cylinders); and (3) gaseous form (cylinders). General requirements at the WTW for the storage of hazardous substances in containers exceeding regulated quantities will include:

- Containers will be situated in an area which is constructed and maintained to prevent any release from entering a water supply, sanitary sewer or storm sewer or from contaminating any other area;
- Containers will be stored within a building or area outside of a building which is fenced and posted to restrict access and warn of the materials stored within;
- Containers will be clearly marked or labelled in accordance with legal requirements;
- Containers will be kept in segregated storage which, in the event of a spill or release, will prevent chemical reactions or fires;
- Chemicals will be stored apart from food for people or animals; and
- Certain records and documents will be kept including MSDSs, an inventory of chemicals (hazardous substances) in storage, records of spills, leaks or unaccountable inventory discrepancies, inspection and maintenance records for leak detection and containment systems at the facility and an emergency response plan in relation to chemicals stored on site.

Chlorine is an acutely hazardous substance that will be stored and used at the proposed WTW. Chlorine is a strong respiratory irritant, and either prolonged exposure to chlorine gas or high concentrations of chlorine gas could be fatal. Various safety equipment will be provided at the facility, such as shower and eye wash facility, emergency breathing apparatus and chlorine gas detector (as required).

9.4.7.7 Major Hazard Installation

In terms of the Major Hazard Installation (MHI) Regulations (GN R.692 of 30 July 2001), which were promulgated under the Occupational Health and Safety Act (Act No. 85 of 1993), a MHI means an installation:

1. Where more than the prescribed quantity of any substance is or may be kept, whether permanently or temporarily; or
2. Where any substance is produced, used, handled or stored in such a form and quantity that it has the potential to cause a major incident.

The proposed uMkhomazi WTW may be classified as a MHI. A preliminary MHI screening study and Risk Assessment will be conducted for the plant by Umgeni Water.

9.4.8 *Potable Water Reservoir*

Umgeni Water requested that the minimum potable water storage volume at the WTW should be the equivalent of 12 hours of the WTW capacity.

In order to reduce the area of land required for the WTW and potable water reservoir, it was proposed that the storage be constructed beneath the various WTW structures. There are three proposed reservoir complexes. Complex no. 1 will have a size of 292 Ml and will be located beneath the left bank of Rapid Gravity Filters, Granular Activated Carbon Filters and Sludge Handling Plant. Complex no. 2 will have a size of 38 Ml and will be located beneath the Sludge Collection Tank and Wash-water Recovery Tank. Complex no. 3 will have a size of 292 Ml and will be located beneath the right banks of Rapid Gravity Filters, Granular Activated Carbon Filters and the Chlorine Room.

The proposed potable water reservoir complexes are depicted in **Figure 23**.

The planned capacity of the first phase of the WTW is 500 Ml/day. 12 hours of storage for this size of WTW equates to 250 Ml of potable water storage required initially. Since the storage is proposed to be constructed beneath roads and various structures, the minimum volume of storage that can practically be constructed with the first phase of the WTW is 330 Ml. Reservoirs will generally be constructed in modules of 50 Ml each.

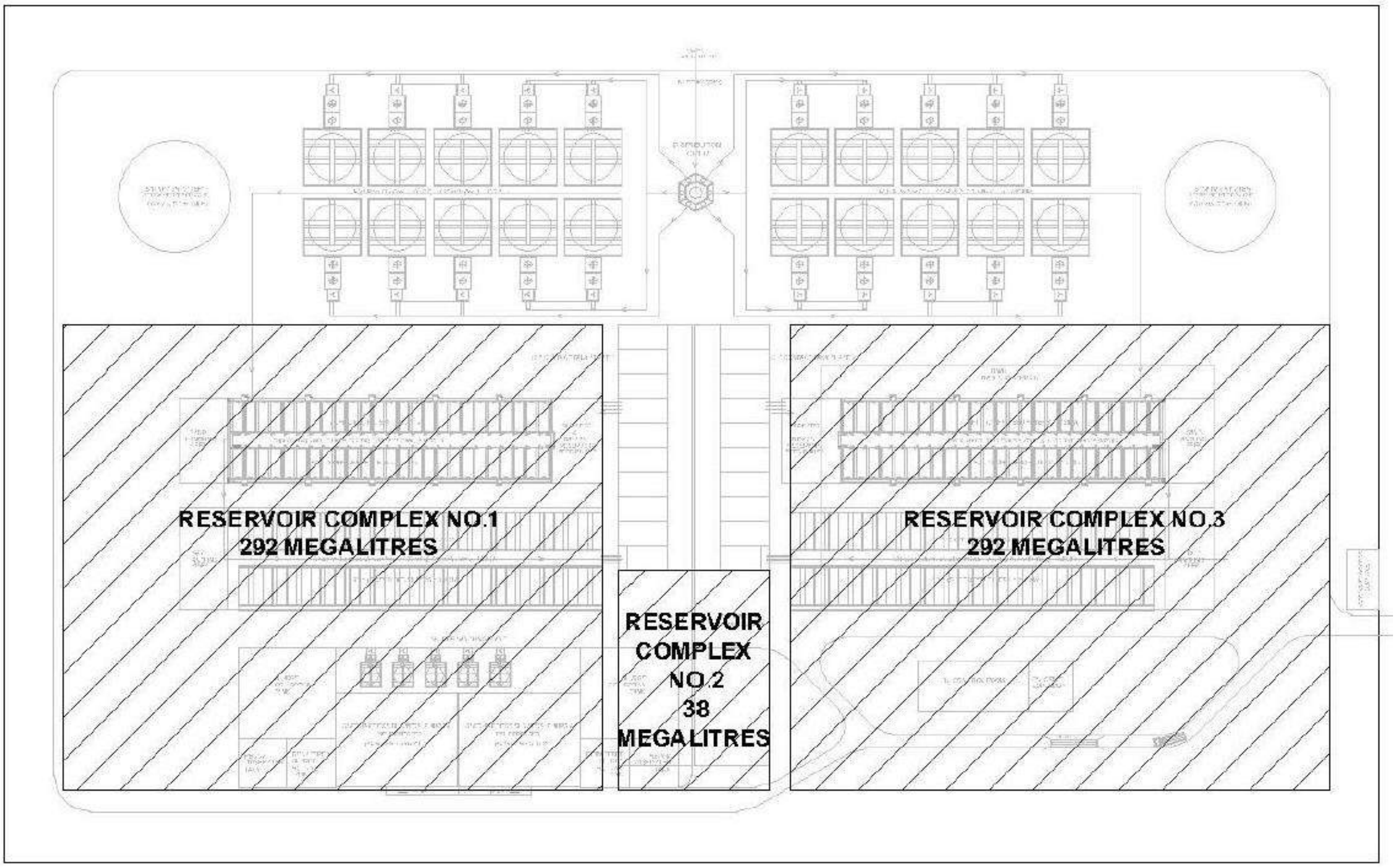


Figure 23: Proposed Potable Water Storage

9.4.9 Alternative WTW Sites

9.4.9.1 Overview

The primary criteria employed in selecting suitable sites for the WTW include elevation, so as to ensure that water is supplied under gravity. A system that requires pumping is significantly more expensive to construct, operate and maintain than similar gravity-flow systems.

Various alternative sites for the WTW were identified during the Feasibility Study (including the environmental assessment to date), as discussed in **Table 26** and shown in **Figure 24**.

Table 26: WTW Sites - Discarded and Feasible Options

No.	WTW Alternative Site	Description	Status
1.	**WTW A**	Following the pre-feasibility study, a site for the WTW was identified on cultivated land on Portion 12 of the Farm Nooitgedacht 903 and Nels Rust 849. Both these properties fall within Baynesfield Estate. This site was initially presented to the I&APs as *WTW Option 1* during the project announcement phase of the EIA and various concerns and issues were raised pertaining to the plant at this location (refer to minutes of public meeting held at Baynesfield Club on 23 October 2013, as contained in the Comments and Responses Report in **Appendix M**). This site was subsequently discarded due to environmental and technical reasons. Refer to **Figure 24**, where this site is shown as *WTW A.*	Discarded
2.	**WTW B**	Another WTW site was then identified during the Feasibility Study, which is situated in a sugar plantation closer to Umlaas Road in the north-eastern part of the study area, on Portion 6 of the Farm Crookes 15723. This site (named *WTW B* in **Figure 24**) was also later discarded primarily due to the substantial cut and fill required for the site and it was thus not considered further for the purposes of the EIA.	Discarded
3	**WTW Option 1**	Following engagement with the affected landowners and based on an appraisal of the receiving environment, an additional site was identified which is located on the Farm Nels Rust 849. The land on which the site is situated is a timber plantation which is leased by Baynesfield Estate to NCT Forestry Co-operative Limited (see **Figure 24**). This site was deemed to be feasible and was named **WTW Option 1**.	Feasible Option
4	**WTW Options 2 & 3**	Based on the elevation in the area between the uMWP-1 Raw Water tunnel outlet in Baynesfield and the Western Aqueduct tie-in point in Umlaas Road, two additional feasible sites for the location of the WTW were identified. These sites are situated on Portion 85 on the Farm Nels Rust 849 (**WTW Option 2**) and the Remainder of the Farm New Leeds 17871 and Morning Sun 17790 (**WTW Option 3**).	Feasible Options

The initial layouts for the WTW options indicated the reservoirs (clean water storage) located alongside the treatment plants, which lead to a substantial increase in the facility’s overall footprint. In an attempt to keep the size of the plant to a minimum, the new layout makes provision for the reservoir to be built underneath the treatment facility which substantially reduces the area affected by the development (see **Section 9.4.8**).

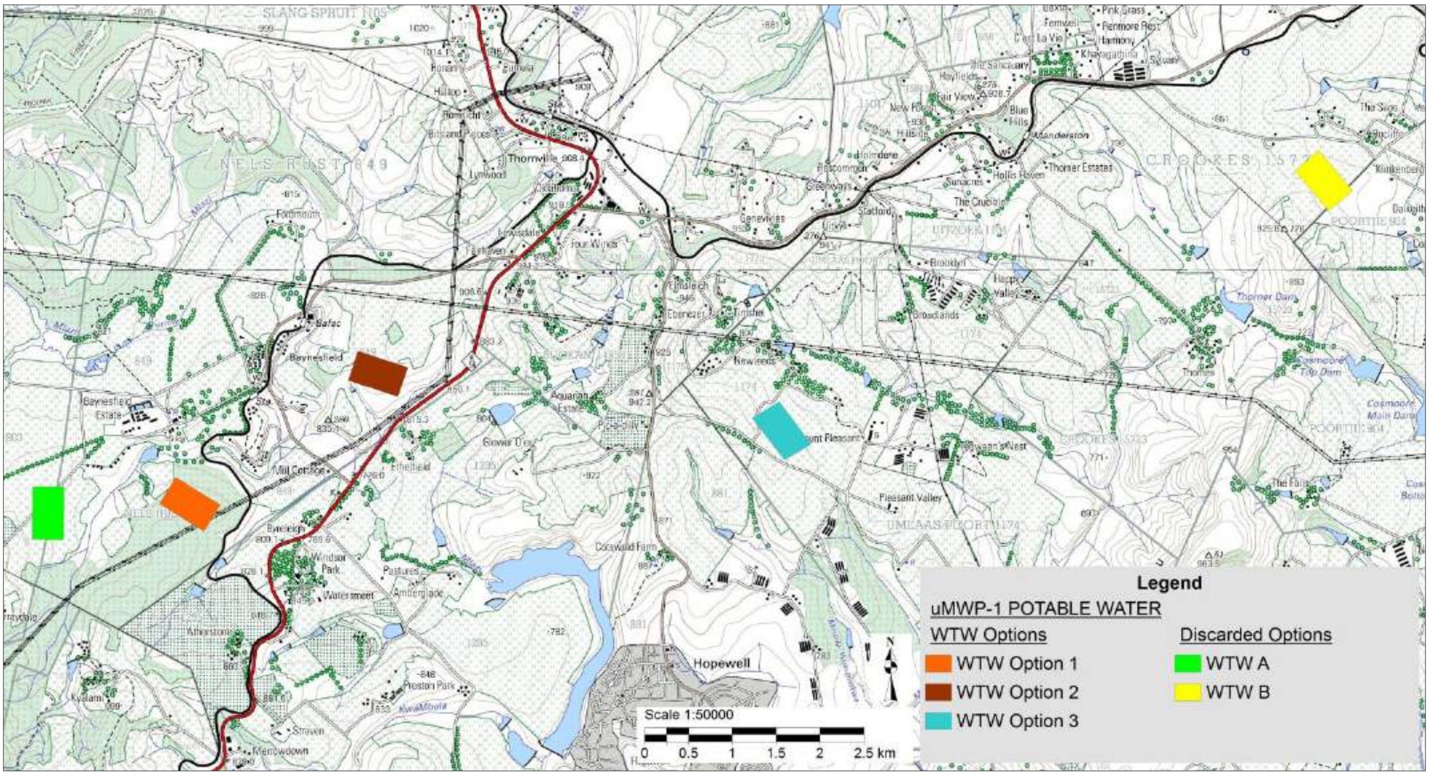


Figure 24: **WTW Alternative Sites**

Figure 25: **General view of WTW A (discarded)**

Figure 26: General view of WTW B (discarded)

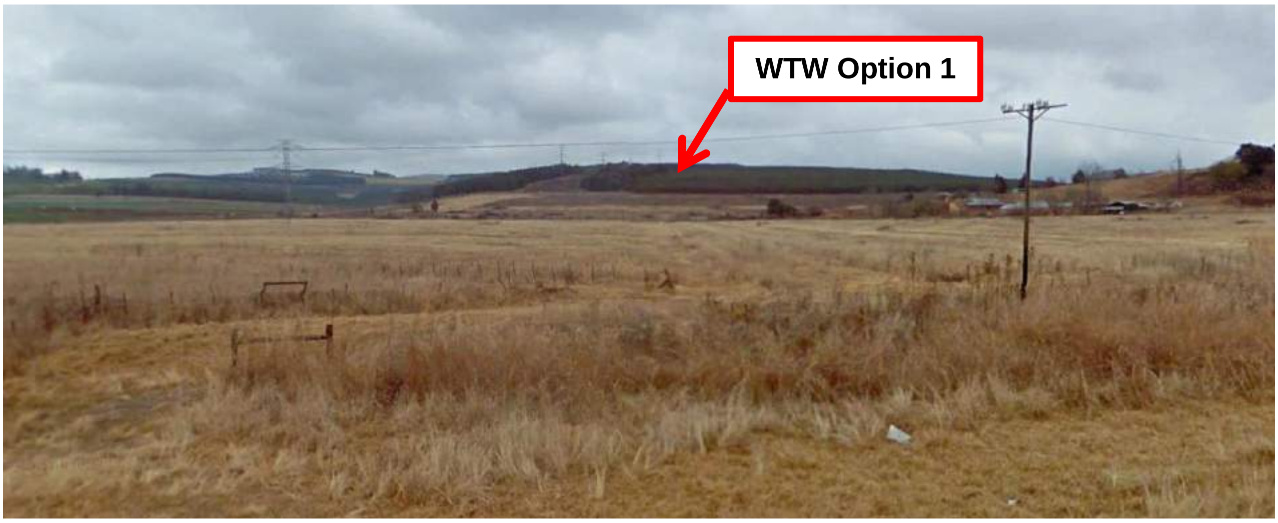


Figure 27: General view of WTW Option 1

Figure 28: General view of WTW Option 2

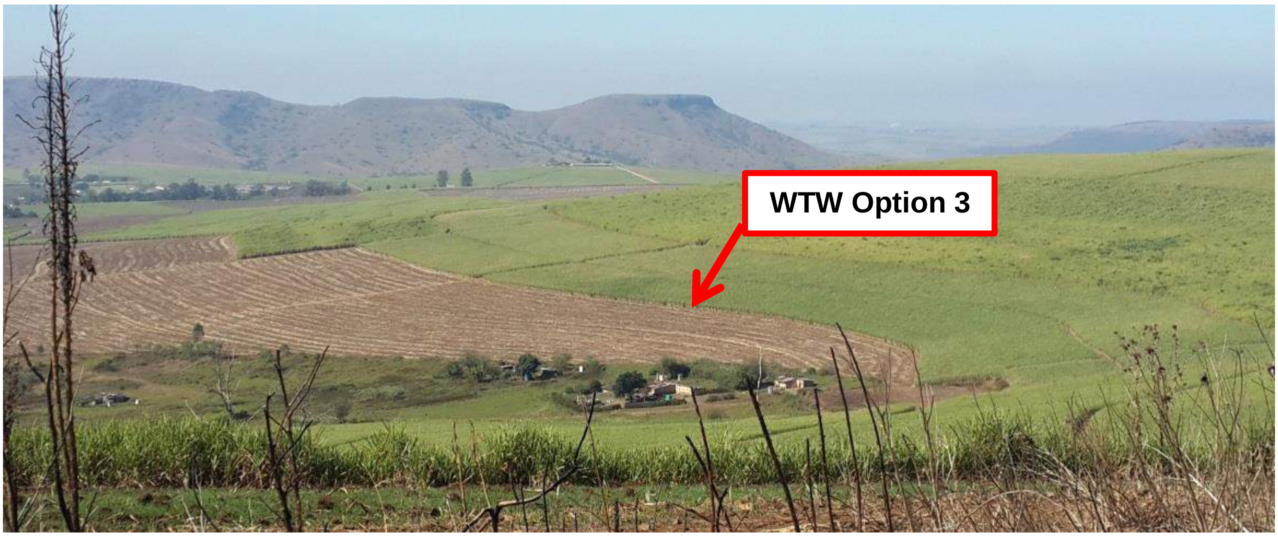


Figure 29: General view of WTW Option 3

9.4.9.2 Access to WTW Sites

Access to WTW Option 1

Refer to **Figure 30**. Access to the proposed WTW will be via Provincial road P315 off the R56 between Thornville and Atherstone. The intersection of the R56 and P315 will be upgraded to allow for the wider turning circle of the articulated vehicles travelling to the proposed WTW. A new access road off provincial road P315 will be constructed approximately 650m west of the upgraded intersection. The new access road will be 1225m long travelling in a south-westerly direction before entering the proposed WTW. The class of road pavement of P315 will also be upgraded to cater for the heavier vehicles and will be upgraded to a Category-B pavement.

The upgraded P315 and the proposed access road will have a Category-B road pavement with the following layerworks:

- 150mm of G10 material – in-situ material compacted to 93% MOD AASHTO;
- 150mm of G9 material – Natural gravel selected subgrade compacted to 93% MOD AASHTO;
- 150mm of G7 material – Natural gravel selected subgrade compacted to 93% MOD AASHTO;
- 200mm of G5 material – Natural gravel subbase compacted to 95% MOD AASHTO;

- 150mm of G2 material – Crushed stone base compacted to 102% MOD AASHTO; and
- 30mm Asphalt surfacing – Continuously graded.

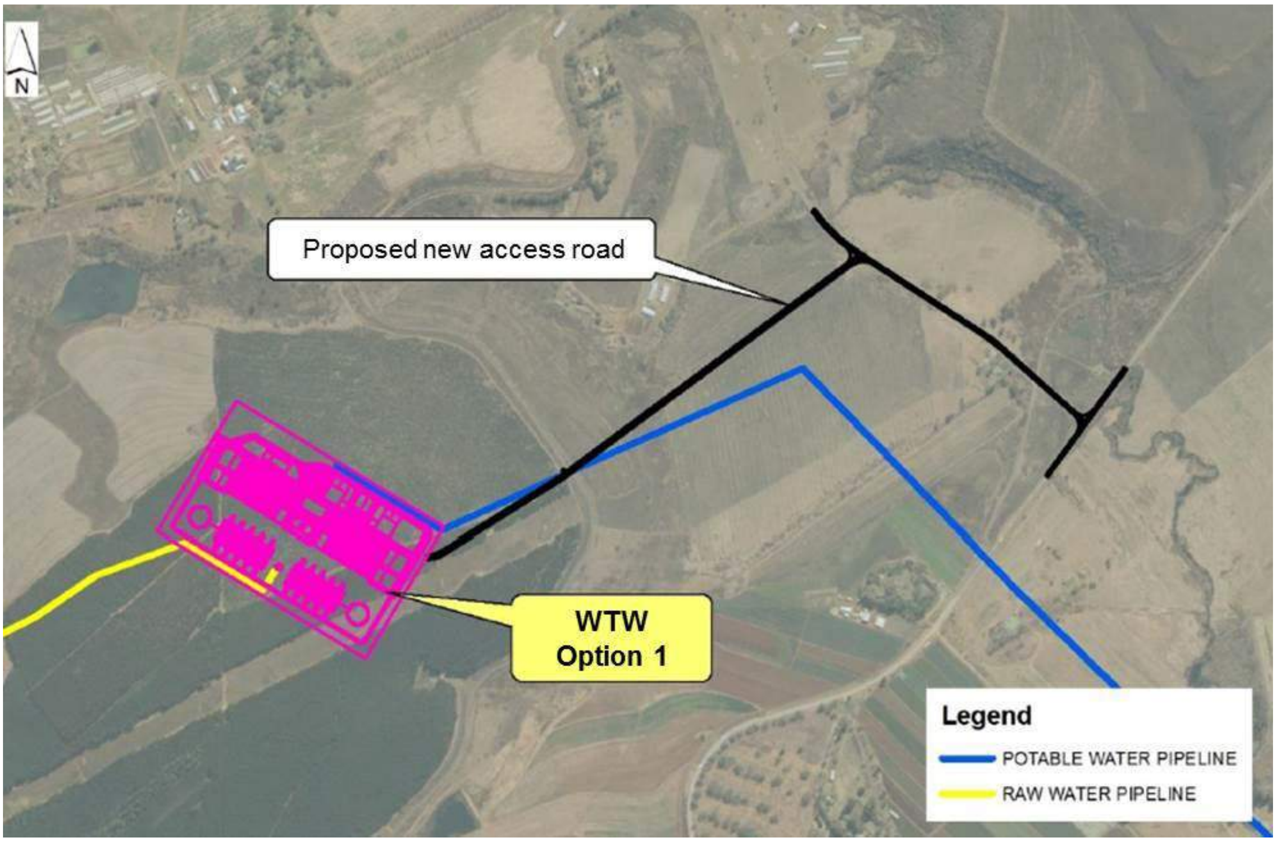


Figure 30: WTW Option 1 - Orientation of WTW & Access (Note: to all pipeline options shown)

Access to WTW Option 2

Refer to **Figure 31**. Access to the proposed WTW will be via Provincial road P334 off the R56 between Thornville and Atherstone. A new intersection and access road is proposed approximately 1.9km west from the R56/P334 intersection. The new access road to the WTW will travel in a southerly direction for approximately 1.1km.

The proposed access road will have a Category-B road pavement with the same layerworks described for WTW Option 1.

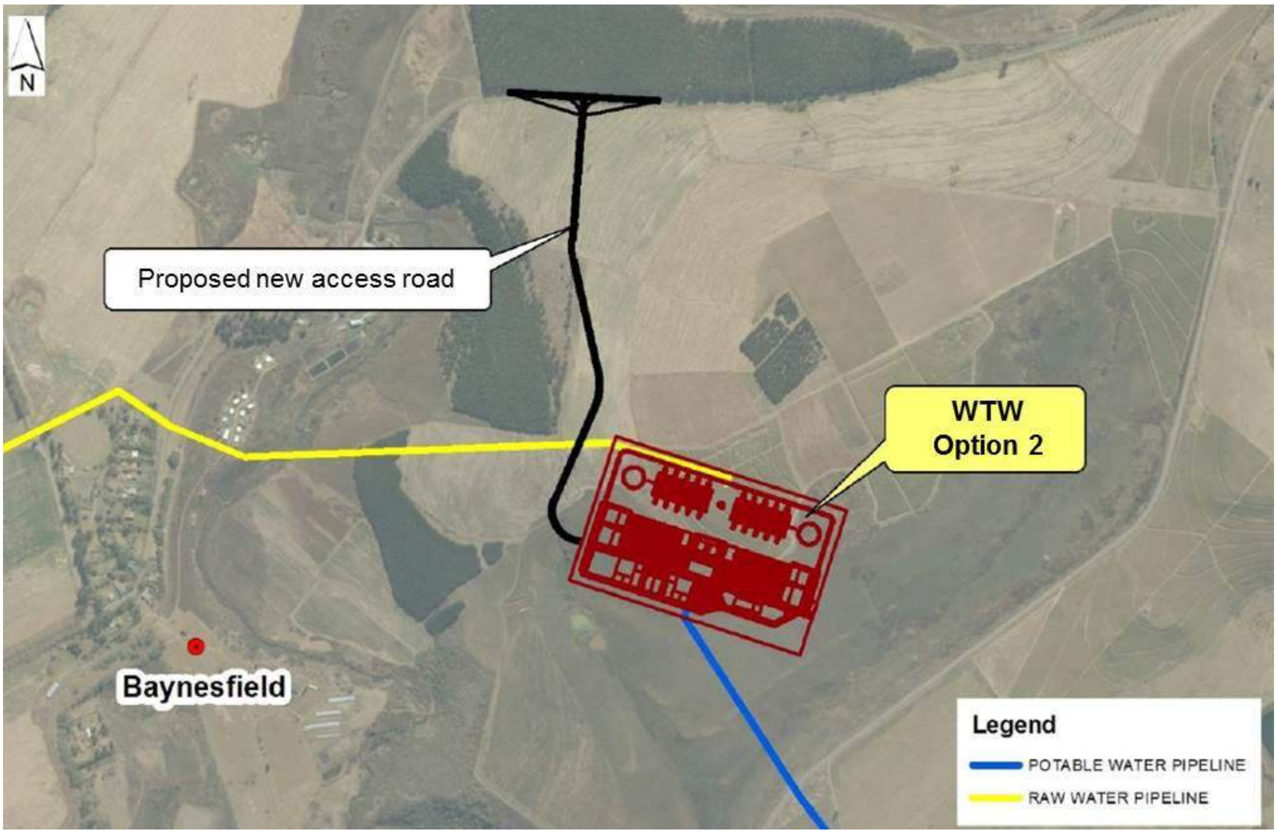


Figure 31: **WTW Option 2 - Orientation of WTW & Access (Note: to all pipeline options shown)**

Access to WTW Option 3

Refer to **Figure 32**. Access to the proposed WTW will be via provincial road R624 between Thornville and Hopewell. A new intersection to provincial road P547 is proposed 3.5km north of the Hopewell Township. The intersection will allow the wider turning circle of the articulated vehicles travelling to the proposed WTW. Approximately 530m of the existing P547 road will be realigned and the road pavement will be upgraded to a category B pavement to cater for the heavier vehicles travelling to the treatment works. A new intersection will be positioned approximately 800m east of the R624 and P547 intersection. The access road to the WTW will commence at the proposed intersection and travel in a northerly direction for approximately 450m before turning right to enter the proposed WTW.

The proposed access road will have a Category-B road pavement with the same layerworks described for WTW Option 1.

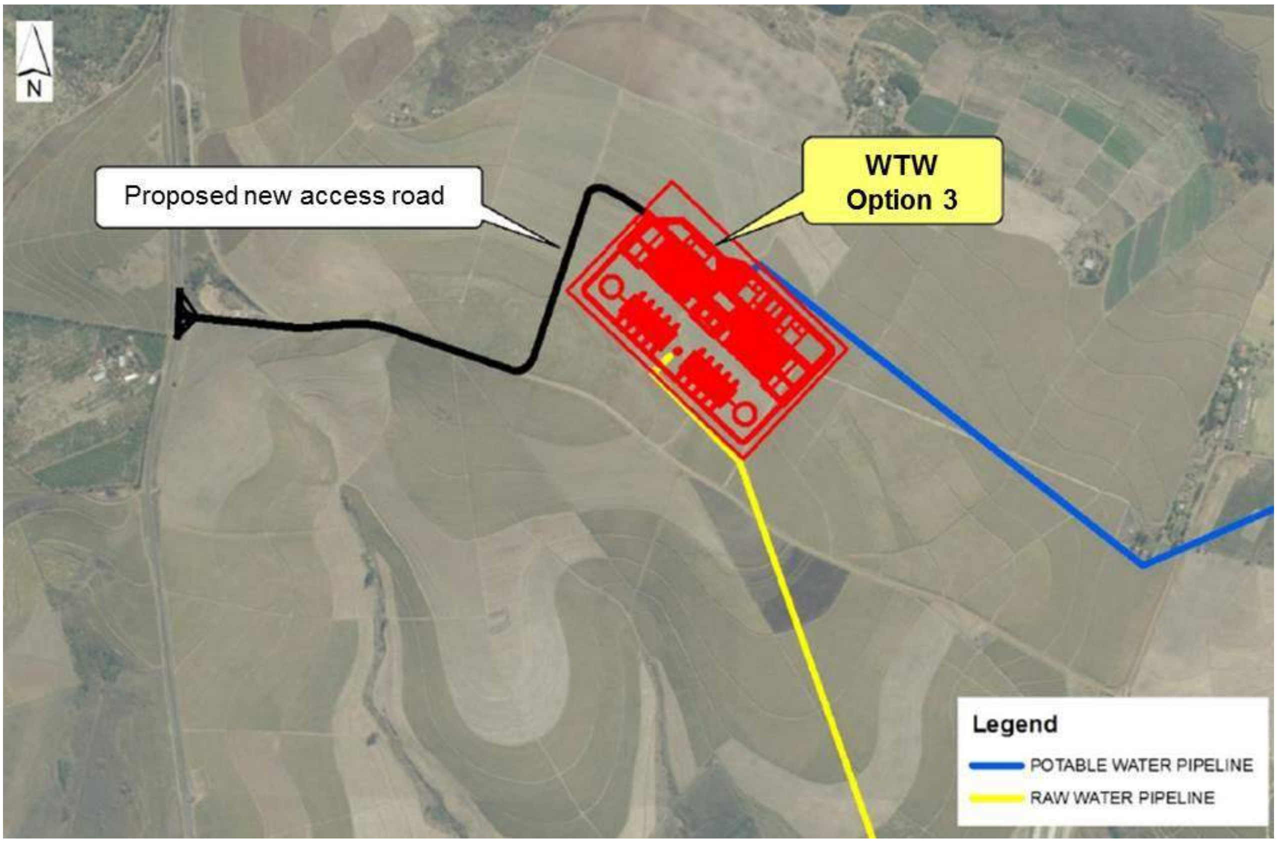


Figure 32: **WTW Option 3 - Orientation of WTW & Access (Note: to all pipeline options shown)**

9.5 Potable Water Pipeline

9.5.1 General

The proposed project focuses only on treating and conveying bulk potable water. It is the responsibility of the Water Services Authority (WSA) to provide access to basic infrastructure and services, which will include the reticulation to the end users.

The gravity pipeline system will transport potable water from the WTW to the Western Aqueduct, which in turn will convey the water to parts of the integrated Mgeni WSS as well as the eThekwini Municipality downstream of the Umlaas Road Reservoir. Note that all pipelines referred to will be installed below-ground, apart from the section that crosses Mapstone Dam which includes a bridge option. All major roads and railway lines will be crossed via pipe jacking (trenchless technology).

As with the WTW, the route of the potable water pipeline is dependent on ensuring the system remains gravity fed. The topography thus plays a dominant role in determining the feasible alignment alternatives for the pipeline. Other factors that affected the route options as well as an overview of the alternative alignments are discussed in **Section 11.3.2**.

The following facilities and structures normally associated with pipelines will be installed en-route:

- Isolating valves;
- Air valves;
- Scour valves;
- Pipe access points;
- Road crossings;
- River crossings;
- Cathodic protection system;
- AC-mitigating system; and
- Protective measures required to curb surge in a pipeline such as, reflux valves, surge tank(s).

9.5.2 Pipeline Design Capacity

The projected water demand up to the year 2053 was one of several factors considered in order to take a decision on the design capacity of the pipeline. The complete list of factors considered include:

- Projected 2053 water demands (685 Ml/day);
- Capacity of the WTW phase up to the year 2053 based on projected water demands (625 Ml/day);
- Capacity of the Western Aqueduct (approximately 490 Ml/day);
- 1:100 year yield of Smithfield Dam (602 Ml/day); and
- 1:100 year combined yield of Smithfield and Impendle dams (1020 Ml/day).

The potable water pipeline was sized to cater for the 1:100 year yield of Smithfield Dam excluding any contribution from Impendle Dam, i.e. 602 Ml/day. The reasoning behind this decision is as follows:

- At 602 Ml/day the pipeline capacity caters for a 30 year project period from the planned commissioning date of the scheme in 2023. This results in a capacity that caters for all expected growth in demand in the supply region, without building in too much of spare capacity that may result in wasteful expenditure. The infrastructure will be neither undersized, i.e. running out of capacity too quickly, nor oversized, i.e. having excess spare capacity over a large part of the project planning period.
- The capacity of the receiving infrastructure, i.e. the Western Aqueduct pipeline, is limited to a peak flow of 490 Ml/day. Whilst having the option of constructing infrastructure with the full 602 Ml/day capacity, the WTW, potable water storage and pipeline can be built in modules or phases to suit the Western Aqueduct capacity.
- When Impendle Dam is built, the combined 1:100 year yield of Smithfield and Impendle dams will be 1020 Ml/day. The final planning for the water conveyance infrastructure from Impendle Dam may however result in raw water being transferred to Midmar Dam instead of Baynesfield. Should this scenario materialise, any potable water treatment, storage and conveyance capacity in excess of 602 Ml/day would be wasted.

The pipeline average annual daily demand (AADD) design capacity is therefore 602 Ml/day which when combined with a peak factor of 1.25, gives a peak capacity of 753 Ml/day. The design flow rate for the pipelines is therefore 753 Ml/day.

9.5.3 Pipeline Configuration Options

To convey the peak demand of 753 Ml/day, three possible pipeline configuration options were considered in the Technical Feasibility Study, namely:

1. A single pipeline sized to convey a peak flow of 753 Ml/day.
2. Two pipelines of equal capacity, each sized to convey a peak flow of 377 Ml/day or a total combined flow of 753 Ml/day. For this option, both pipelines will be commissioned in the year 2023, i.e. the planned commissioned date for the uMWP-1.
3. Two pipelines of unequal capacity intended to be built in two phases. The first phase, to be commissioned in 2023, will be sized to match the peak capacity of the Western Aqueduct pipeline, i.e. approximately 490 Ml/day. The second phase, to be commissioned around 2044, will be sized to provide a further 263 Ml/day to give a total capacity of 753 Ml/day.

Each of the Single, Double Equal and Double Unequal Pipeline configurations was modelled for each of the routes associated with the WTW options. This resulted in nine different hydraulic models to simulate each pipeline configuration and route. A costing exercise was also undertaken for an ultimate capacity and phased capacity approach. The results were as follows:

- **Ultimate capacity** – technically preferred scheme includes a pipeline capacity of 602 Ml/day, equivalent to the 1:100 year yield of Smithfield Dam and will comprise a single 3030mm OD raw water pipeline, 500 Ml/day WTW and a single 2820 mm OD potable water pipeline reducing to 2540 mm OD.
- **Phased capacity** - technically preferred scheme includes a pipeline capacity of 490 Ml/day, equivalent to the capacity of the Western Aqueduct and will comprise a single 2540mm OD raw water pipeline, 500 Ml/day WTW and a single 2450 mm OD potable water pipeline reducing to 2032 mm OD.
- The cost difference between the technically preferred options for the ultimate capacity and phased capacity is R 266 million. The ultimate capacity option costs 9.4% more than the phased capacity option, but provides 53% more hydraulic capacity.
- There would therefore seem to be little point in choosing a phased approach where the pipeline configuration would be built in two phases. In addition, the logistics of laying a second large diameter pipeline parallel to the first in years to come would cause great disruption to farming, business and residential activities. The Umlaas Road region is rapidly developing and the likely lack of working space in the future may make it difficult to duplicate the pipeline at a later time, even if the permanent servitude is purchased up front.
- The Technical Feasibility Study therefore recommended that Umgeni Water proceed with the ultimate capacity option to preliminary and detailed design.

9.5.4 Pipeline Specifications

An overview of the potable water pipeline specifications is provided in **Table 27**.

Table 27: Potable Water Pipeline Specification

Pipe diameter	:	Single 2820 mm OD potable water pipeline reducing to 2540 mm OD
Pipe material	:	Steel pipes with welded joints. Pipes to be lined and coated to safeguard against corrosion (and associated impacts on water quality) and lengthen their lifespan.
Peak throughput		602 Ml/day
Installation	:	• Underground, with a minimum cover above the pipe of 1.5m. • Access/valve chambers will be located where necessary along the route. These will be concrete structures protruding slightly above natural ground level.
Servitude Width	:	15 metre wide permanent servitude and a further 45 metre wide temporary construction servitude
Servitude Conditions	:	• Permanent access to 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 • 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 will be allowed as roots compromise the stability of the pipeline.

Before construction commences, a negotiator from Umgeni Water will engage with the affected landowners to secure servitude rights. This process does not form a part of the EIA.

9.5.5 *Alternative Potable Water Pipeline Routes*

9.5.5.1 Overview

The following aspects were considered in defining the potable water pipeline route:

- Topography and associated elevation;
- Impacts to the social, biophysical and economic 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 various potable water pipeline alignments that were identified as part of the Scoping phase and their status in terms of assessing the routes further in the EIA phase are discussed in **Table 28** and shown in **Figure 33**.

Table 28: Potable Water Pipeline Routes - Discarded and Feasible Options

No.	Alternative Routes	Description	Status
1.	**Option 1**	Original route for potable water pipeline.	Feasible Option
2.	**Option 1A**	Deviation of Option 1 to reduce disruptions to traffic on the D360.	Feasible Option
3.	**Option 1B**	Deviation of Options 1 and 1A to reduce disruptions to traffic on the D360.	Feasible Option
4.	**Option 1C**	Deviation of Option 1 to reduce impacts to chicken houses on Portion 43 of the Farm Hopewell 881 and Portion 20 of the Farm Umlaas Poort 1174, based on feedback from by Rainbow Farms (Pty) Ltd.	Feasible Option
5.	**Option 1D**	Deviation of Option 1 to reduce impacts to chicken houses on Portion 0 of Farm 30, based on feedback from Rainbow Farms (Pty) Ltd. Route also identified to avoid disruptions to traffic on the D125.	Feasible Option
6.	**Option 1E**	Deviation of Option 1D. Route suggested by landowners of Erven 34, 35 and 2-28 Umlaas Road to avoid impacts to these properties which are earmarked to be developed for mini-factories and/or warehouses.	Feasible Option (new)
7.	**Link to WTW 2**	Link to alternative WTW site. Avoids crossing of Mapstone Dam.	Feasible Option
8.	**Link to WTW 2 Deviation**	Deviation of link to WTW Option 2 Avoids steep area at river crossing.	Feasible Option
9.	**Link to WTW 3**	Shortest link to WTW site.	Feasible Option
10.	**Option 2**	Avoids crossing of Mapstone Dam.	Discarded

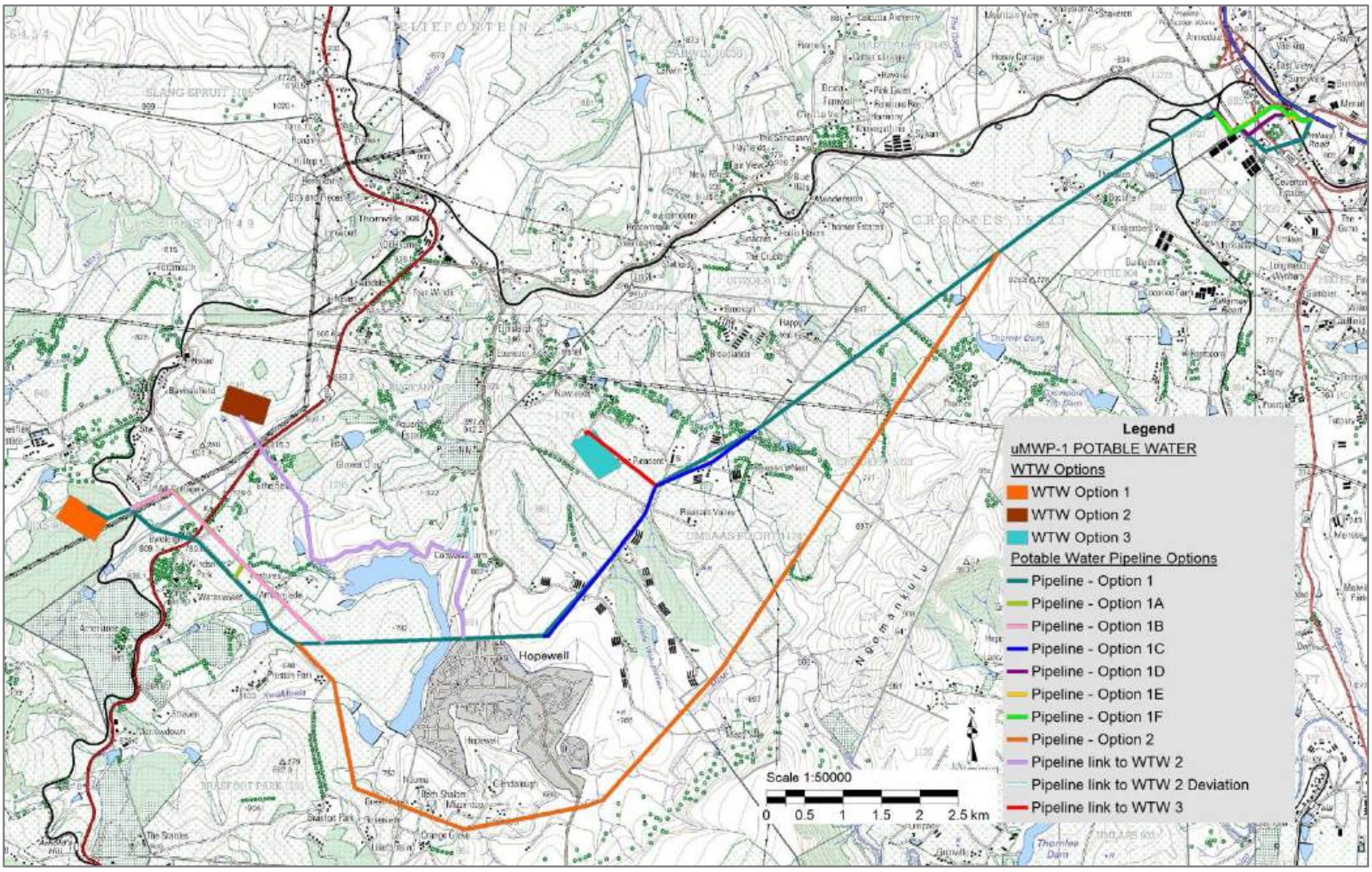


Figure 33: Potable water pipeline route options

9.5.5.2 Affected Properties

Table 29 to follow lists the properties (based on 2006 cadastral information) traversed by the alternative alignments of the potable water pipeline, from west to east starting at WTW Option 1. For detailed maps on the pipeline routes, please refer to **Appendix D**.

All distances and coordinates provided should be regarded as approximates, as they are based on a desktop estimate from a Geographical Information System (GIS). The directional changes indicate bend points in the pipeline.

Table 29: Potable Water Pipeline Routes (NE = north-east; SE = south-east)

Option	Property			Distance (approximate)	Direction	Bend Points Coordinates (approximate)
	Farm	No.	Ptn			
Option 1	Nels Rust	849	0	0m 283m 319m 398m	 SE NE SE	*29°46'21.74"S; 30°20'35.99"E (start point)* 29°46'25.86"S; 30°20'45.67"E 29°46'21.74"S; 30°20'55.81"E 29°46'30.14"S; 30°21'07.27"E
	Brasfort Park	1295	22	464m	SE	-
	Brasfort Park	1295	26	112m 261m	SE SE	29°46'35.25"S; 30°21'28.63"E -
	Brasfort Park	1295	24	737m 64m	SE SE	29°46'58.80"S; 30°21'54.78"E -
	Brasfort Park	1295	20	39m 349m	SE SE	29°47'00.07"S; 30°21'57.84"E 29°47'10.11"S; 30°22'03.76"E
	Brasfort Park	1295	47	148m 275m	SE SE	29°47'13.67"S; 30°22'08.07"E 29°47'18.36"S; 30°22'16.36"E
	Brasfort Park	1295	6	1865m	NE	-
	Hopewell	881	9	79m	NE	-
	Hopewell	881	5	746m	NE	-
	Hopewell	881	6	482m	NE	-
	Hopewell	881	43	20m 1405m	NE NE	29°47'15.29"S; 30°24'15.97"E 29°46'41.07"S; 30°24'50.22"E
	New Leeds	17536	1	669m 77m	NE NE	29°46'23.71"S; 30°25'05.08"E -
	Morning Sun	17790	0	307m 95m	NE NE	29°46'11.84"S; 30°25'10.35"E -
	Umlaas Poort	1174	4	320m	NE	-
	Umlaas Poort	1174	20	936m	NE	-
	Umlaas Poort	1174	14	126m 81m	NE NE	29°45'48.63"S; 30°25'58.90"E -
	Umlaas Poort	1174	21	25m	NE	-
	Crookes	15723	3	601m	NE	-

Option	Property			Distance (approximate)	Direction	Bend Points Coordinates (approximate)
	Farm	No.	Ptn			
	Happy Valley	17667	0	826m	NE	-
	Crookes	15723	3	2372m	NE	-
	Crookes	15723	6	746m 931m	NE NE	29°44'19.01"S; 30°28'18.80"E -
	Crookes	15723	0	1665m 338m 28m	NE SE NE	29°43'34.10"S; 30°29'40.41"E 29°43'42.73"S; 30°29'47.87"E -
	Vaalkop and Dadelfontein	885	844	37	E	-
	Umlaas Road	355	30	20m 64m 439m 12m	E NE SE NE	29°43'42.75"S; 30°29'50.98"E 29°43'41.56"S; 30°29'52.90"E 29°43'51.00"S; 30°30'05.06"E -
	Umlaas Road	355	Rem/44	132m 321m	NE NE	29°43'49.44"S; 30°30'10.17"E -
	Umlaas Road	355	43	24m	NE	-
	Umlaas Road	355	41/5	30m	NE	29°43'45.82"S; 30°30'23.50"E
	Umlaas Road	355	41/6	274m	NE	*29°43'37.53"S; 30°30'27.29"E (termination point)*
Option 1A	Nels Rust	849	0	0m 604m 295m	 NE SE	*29°46'21.68"S; 30°20'55.96"E (start point)* 29°46'13.67"S; 30°21'16.48"E -
	Brasfort Park	1295	22	286m	SE	-
	Brasfort Park	1295	44	709m	SE	29°46'44.91"S; 30°21'50.49"E
	Brasfort Park	1295	43	205m	SW	-
	Brasfort Park	1295	24	15m	SW	*29°46'51.37"S; 30°21'46.44"E (termination point)*
Option 1B	Nels Rust	849	0	0m 604m 295m	 NE SE	*29°46'21.68"S; 30°20'55.96"E (start point)* 29°46'13.67"S; 30°21'16.48"E -
	Brasfort Park	1295	22	286m	SE	-
	Brasfort Park	1295	44	709m	SE	29°46'44.91"S; 30°21'50.49"E
	Brasfort Park	1295	43	351m	SE	
	Brasfort Park	1295	20	482m	SE	
	Brasfort Park	1295	47	347m	SE	
	Brasfort Park	1295	6	298m	SE	*29°47'18.15"S; 30°22'29.68"E (termination point)*
Option 1C	Hopewell	881	43	0m 67m 1361m	 NE NE	*29°47'15.07"S; 30°24'16.04"E (start point)* 29°47'14.93"S; 30°24'18.40"E -
	New Leeds	17536	1	669m 75m	NE NE	29°46'23.30"S; 30°25'05.06"E -
	Morning Sun	17790	0	311m 121m	NE NE	29°46'11.79"S; 30°25'10.25"E -

Option	Property			Distance (approximate)	Direction	Bend Points Coordinates (approximate)
	Farm	No.	Ptn			
	Umlaas Poort	1174	4	242m	NE	-
	Umlaas Poort	1174	20	434m 584m	NE NE	29°46'01.52"S; 30°25'37.90"E -
	Umlaas Poort	1174	14	117m	NE	*29°45'48.51"S; 30°25'58.64"E (termination point)*
Option 1D	Crookes	15723	0	0 - 14m	NE	*29°43'33.88"S; 30°29'40.55"E (start point)*
	Vaalkop and Dadelfontein	885	844	13m 355m 116m 12m	NE SE NE SE	29°43'33.37"S; 30°29'41.43"E 29°43'42.67"S; 30°29'49.15"E 29°43'40.75"S; 30°29'52.82"E -
	Camperdown	1330	151	142m 176m	SE NE	29°43'43.88"S; 30°29'57.06"E -
	Camperdown	1330	62	48m	NE	-
	Umlaas Road	355	34	198m	NE	29°43'35.73"S; 30°30'09.56"E
	Umlaas Road	355	2/38	161m 10m	E SE	29°43'35.58"S; 30°30'15.64"E -
	Umlaas Road	355	Rem/38	51m	SE	29°43'37.26"S; 30°30'16.81"E
	Umlaas Road	355	44	5m	NE	-
	Umlaas Road	355	42	9m	NE	-
	Umlaas Road	355	5/41	27m 18m	NE SE	29°43'36.70"S; 30°30'18.35"E -
	Umlaas Road	355	Rem/41	110m 49m 73m	SE E NE	29°43'35.15"S; 30°30'22.77"E 29°43'38.15"S; 30°30'24.62"E *29°43'37.53"S; 30°30'27.29"E (termination point)*
Option 1E	Crookes	15723	0	0 - 14m	NE	*29°43'33.88"S; 30°29'40.55"E (start point)*
	Vaalkop and Dadelfontein	885	844	8m 363m 338m	NE SE NE	29°43'33.53"S; 30°29'41.29"E 29°43'43.03"S; 30°29'49.25"E -
	Umlaas Road	355	Rem/33	10m	NE	-
	Umlaas Road	355	1/33	10m	NE	-
	Umlaas Road	355	4	46m	NE	-
	Umlaas Road	355	40	108m	NE	-
	Umlaas Road	355	5	46m	NE	-
	Umlaas Road	355	6	55m 4m	NE SE	29°43'32.00"S; 30°30'08.30"E -
	Umlaas Road	355	2/38	41m 68m 57m 52m 21m	SE SE SE SE SE	29°43'32.36"S; 30°30'09.92"E 29°43'33.01"S; 30°30'12.35"E 29°43'34.06"S; 30°30'14.12"E 29°43'35.21"S; 30°30'15.47"E -
	Umlaas Road	355	Rem/38	51m	SE	29°43'37.26"S; 30°30'16.81"E
	Umlaas Road	355	44	5m	NE	-
	Umlaas Road	355	42	9m	NE	-

Option	Property			Distance (approximate)	Direction	Bend Points Coordinates (approximate)
	Farm	No.	Ptn			
	Umlaas Road	355	5/41	27m 18m	NE SE	29°43'36.70"S; 30°30'18.35"E -
	Umlaas Road	355	Rem/41	110m 49m 73m	SE E NE	29°43'35.15"S; 30°30'22.77"E 29°43'38.15"S; 30°30'24.62"E *29°43'37.53"S; 30°30'27.29"E (termination point)*
Option 1F	Crookes	15723	0	353m 25m	SE NE	*29°43'33.94"S; 30°29'40.61"E (start point)* 29°43'43.26"S; 30°29'48.04"E
	Vaalkop and Dadelfontein	885	844	131m 11m	NE SE	- 29°43'40.62"S; 30°29'53.01"E
	Camperdown	1330	151	5m 207m	SE NE	- 29°43'41.01"S; 30°29'53.46"E
	Camperdown	1330	62	59m	NE	-
	Umlaas Road	355	34	132m	NE	-
	Umlaas Road	355	2/38	99m	NE	-
	Umlaas Road	355	44	6m 98m 60m 79m 5m	NE SE SE SE NE	- 29°43'31.91"S; 30°30'08.98"E 29°43'32.78"S; 30°30'12.51"E 29°43'33.85"S; 30°30'14.30"E -
	Umlaas Road	355	5/41	70m 5m	NE SE	- 29°43'34.70"S; 30°30'18.83"E
	Umlaas Road	355	Rem/41	91m 56m 50m 36m 37m	SE SE SE NE NE	- 29°43'37.08"S; 30°30'21.04"E 29°43'38.08"S; 30°30'22.79"E 29°43'38.05"S; 30°30'24.61"E 29°43'37.48"S; 30°30'25.84"E 29°43'37.32"S; 30°30'27.21"E *(termination point)*
Link to WTW 2	Nels Rust	849	85	0m 443m	 SE	*29°45'42.98"S; 30°21'49.63"E (start point)* -
	Nels Rust	849	73	62m	SE	-
	Brasfort Park	1295	1	744m	SE	-
	Brasfort Park	1295	3	165m 705m 2270m	SE SE SE	29°46'20.12"S; 30°22'20.23"E 29°46'42.25"S; 30°22'24.06"E *Various bend points*
	Hopewell	881	5	148m 199m 347m 118m 138m 319m	SE SE SE SE SE SE	29°46'41.57"S; 30°23'40.83"E 29°46'47.79"S; 30°23'37.88"E 29°46'58.40"S; 30°23'34.40"E 29°47'02.49"S; 30°23'34.23"E 29°47'06.13"S; 30°23'36.49"E *29°47'15.83"S; 30°23'37.70"E (termination point)*
Link to WTW 2 Deviation	Brasfort Park	1295	3	0m 113m 193m 220m 98m	 NE NE NE SE	*29°26'38.67"S; 30°23'28.32"E (start point)* 29°46'36.35"S; 30°23'31.43"E 29°46'30.47"S; 30°23'34.50"E 29°46'23.70"S; 30°23'36.43"E -

Option	Property			Distance (approximate)	Direction	Bend Points Coordinates (approximate)
	Farm	No.	Ptn			
	Hopewell	881	45	15m 176m	SE SE	29°46'24.36"S; 30°23'40.57"E -
	Hopewell	881	5	201m 165m	SE SE	29°46'36.49"S; 30°23'41.21"E *29°46'41.77"S; 30°23'41.02"E (termination point)*
Link to WTW 3	New Leeds	17871	0	0m 52m 678m	 NE SE	*29°45'50.19"S; 30°24'35.92"E (start point)* 29°45'49.23"S; 30°24'37.47"E -
	Morning Sun	17790	0	443m	SE	*29°46'11.68"S; 30°25'10.19"E (termination point)*

Note the following with regards to **Table 29**:

- Where the pipeline follows linear infrastructure (e.g. roads) and between farm boundaries, the exact route still needs to be finalised in terms of which side of the aforementioned features it will run alongside to; and
- Although the EIA is investigating a 100m wide corridor (50 m on either side of the centre line) to allow for any possible deviations of the final route within this corridor, the route description is only for the centreline of each alternative pipeline route.

9.5.5.3 Description of Routes

An overview of the pipeline route options follows, focusing on the centreline of each alignment. Note that the ultimate commencement point for the potable water pipeline will depend on the final location of the WTW (depending on the most favourable option). This implies that the route for the raw water pipeline that feeds into the WTW will also depend on the final site that is selected for the plant.

Refer to maps of the western, central and eastern sections of the project area contained in **Figures 34 - 36** for the discussion to follow.

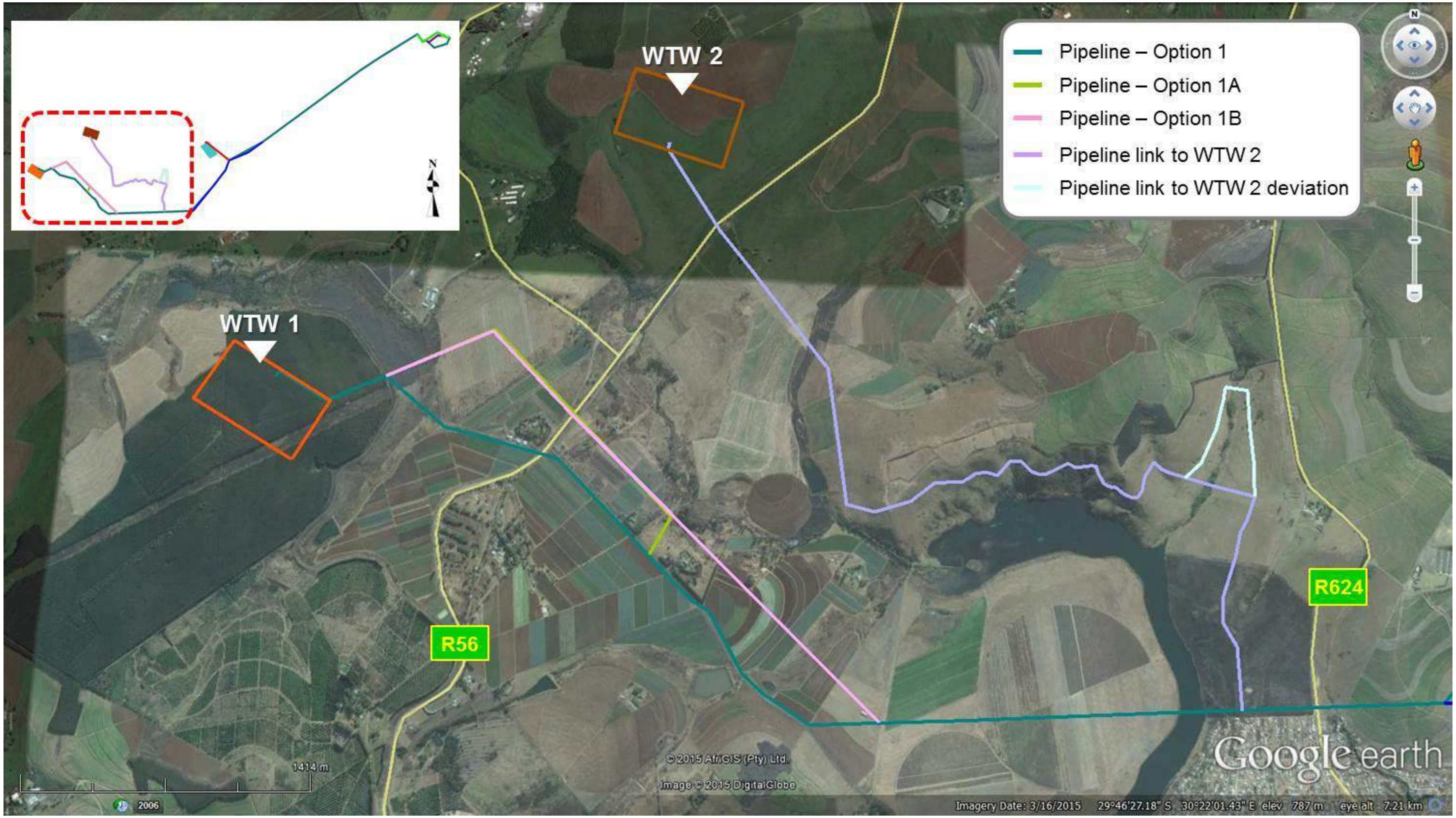


Figure 34: Western section of project area

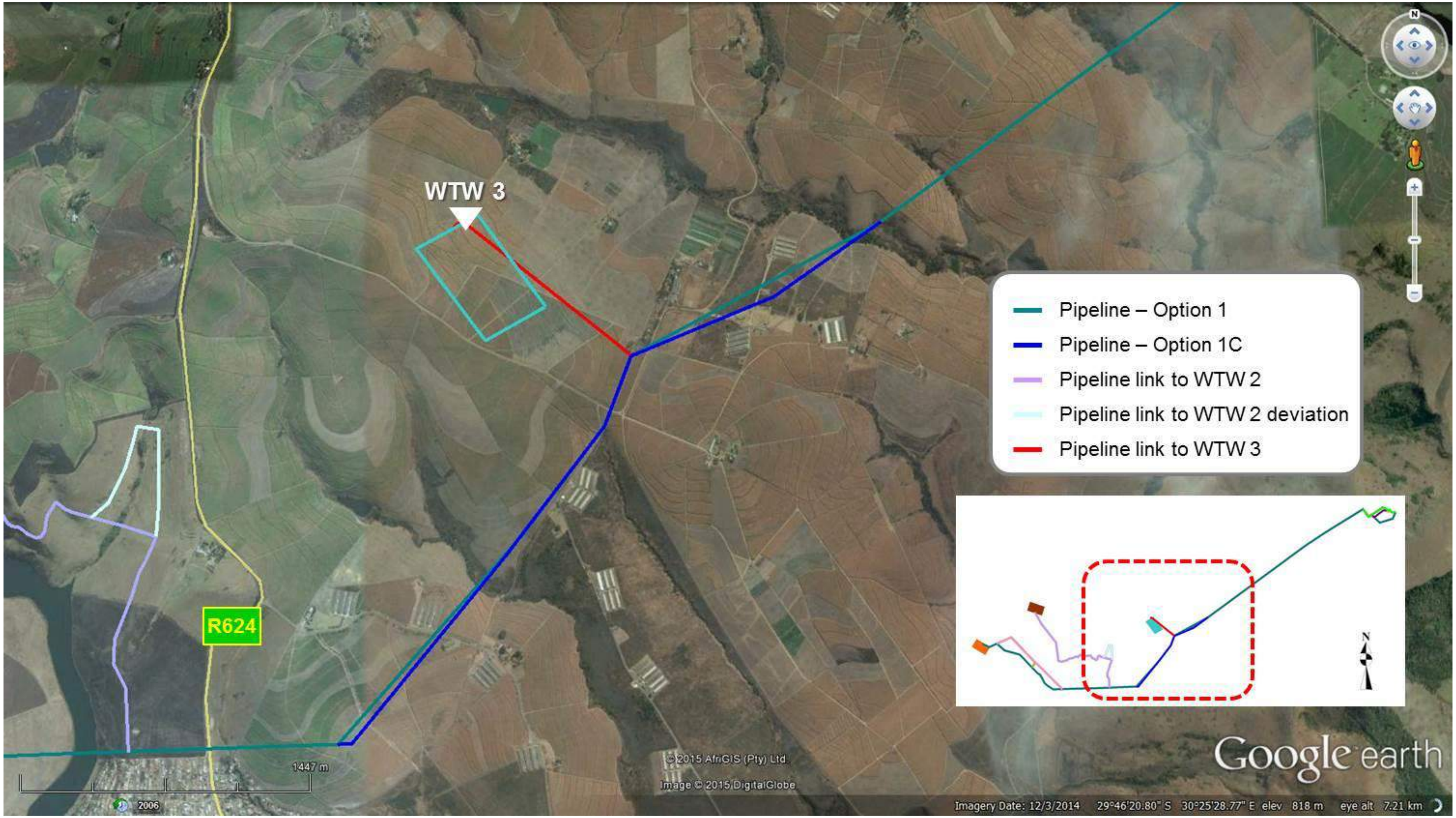


Figure 35: Central section of project area

Figure 36: **Eastern section of project area**

- **<u>Route Option 1</u> –**

  From WTW Option 1, located on Baynesfield Estate (**Figure 37**), the pipeline Option 1 route heads off in a south-easterly direction through a the timber plantation before turning north-easterly and running alongside a power line servitude. It then turns in a south-eastern direction and crosses the power line servitude and a railway line, followed by a watercourse and cultivated land (Byreleigh Farm) (**Figure 38**).

<u>Figure 37:</u> **South-western view of timber plantation (in background) where WTW Options 1 is located**

<u>Figure 38:</u> **North-westerly view along Option 1 pipeline route (timber plantation in background)**

After crossing the R56 the pipeline runs alongside the D360 gravel road, past cultivated lands (**Figure 39**). On Portion 6 of the Farm Brasfort Park 1295 the route turns easterly and traverses cultivated land (**Figure 40**) before crossing the Mapstone Dam (**Figure 41**), followed by vacant land (north of Hopewell) and the R624 (P117). Thereafter in enters land owned by Rainbow Farms and passes chicken houses and traverses a watercourse before exiting the property and passing sugarcane plantations. The route then continues in a north-eastern direction, travelling past more chicken houses, sugarcane plantations, various watercourses, a power line servitude and railway line (amongst others).

Figure 39: South-easterly view along Option 1 pipeline route (D360)

Figure 40: North-easterly view along Option 1 pipeline route

Figure 41: Western view along Option 1 pipeline route (Mapstone Dam crossing)

Figure 42: Eastern view along Option 1 pipeline route (north of Hopewell)

The route then turns south-easterly and passes another sugarcane plantation and a poultry farm before turning north-eastwards to travel alongside the D125 (**Figure 43**). It then crosses over the R603 and continues to follow the D125 (**Figure 44**). It then traverses a railway line before turning more north-easterly and eventually terminating at the Western Aqueduct next to the N3 highway (**Figure 45**).

Figure 43: Westerly view along Option 1 pipeline route next to D125 (R603 crossing)

Figure 44: North-easterly view along Option 1 pipeline route next to D125

Figure 45: Tie-in to '57 Pipeline

- **Route Option 1A –**

  The route Option 1A splits from the route Option 1 on the Farm Nels Rust 849 to cross a railway line and continue in a north-eastern direction alongside a power line servitude. It then turns south-easterly to cross over cultivated land, traversing a power line servitude, a railway line and a watercourse along the way. After crossing the R56 (**Figures 46 - 47**) the route crosses through vacant land, travelling parallel to the D360 (approximately 200m to the north-east), before turning south-westwards to meet up with the Option 1 pipeline route alongside the D360.

Figure 46: **North-westerly view along Option 1A pipeline route (at R56 crossing)**

Figure 47: **South-easterly view along Option 1A pipeline route (at R56 crossing)**

❖ **<u>Route Option 1B</u> –**

The Option 1B pipeline route follows the same alignment as for Option 1A, but splits from this route at the boundary of Portions 44 and 43 of the Farm Brasfort Park 1295 to continue in a south-easterly direction. It crosses vacant land, cultivated land, a watercourse and a private farm road along the way.

The route finally connects to the Option 1 route on Portion 6 of the Farm Brasfort Park 1295 (**Figure 48**).

<u>Figure 48:</u> North-westerly view along Option 1A pipeline route (at R56 crossing)

❖ **<u>Route Option 1C</u> –**

Route Option 1C reflects a refinement of the pipeline alignment Option 1 to minimise the impacts to existing chicken houses on Portion 43 of the Farm Hopewell 881 (**Figure 49**) and Portion 20 of the Farm Umlaas Poort 1174 (**Figure 50**).

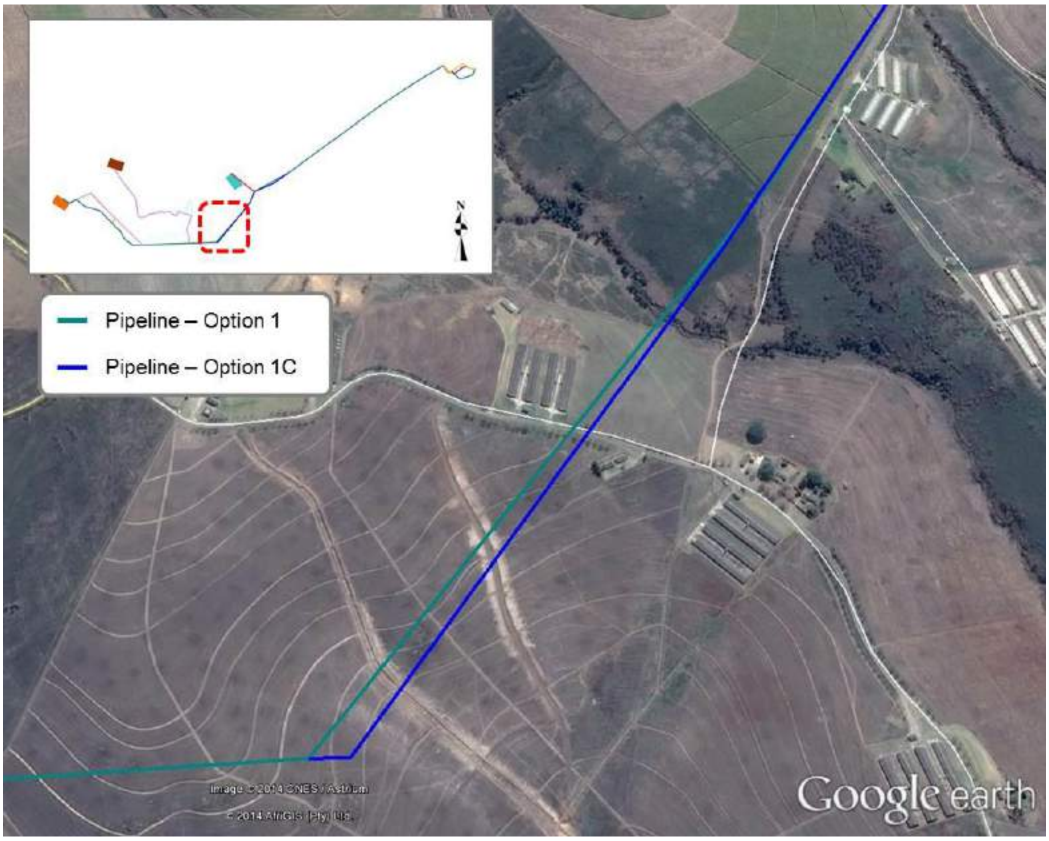


Figure 49: **Aerial view of Option 1C route showing deviation to minimise impacts to chicken houses (Portion 43 of the Farm Hopewell 881)**

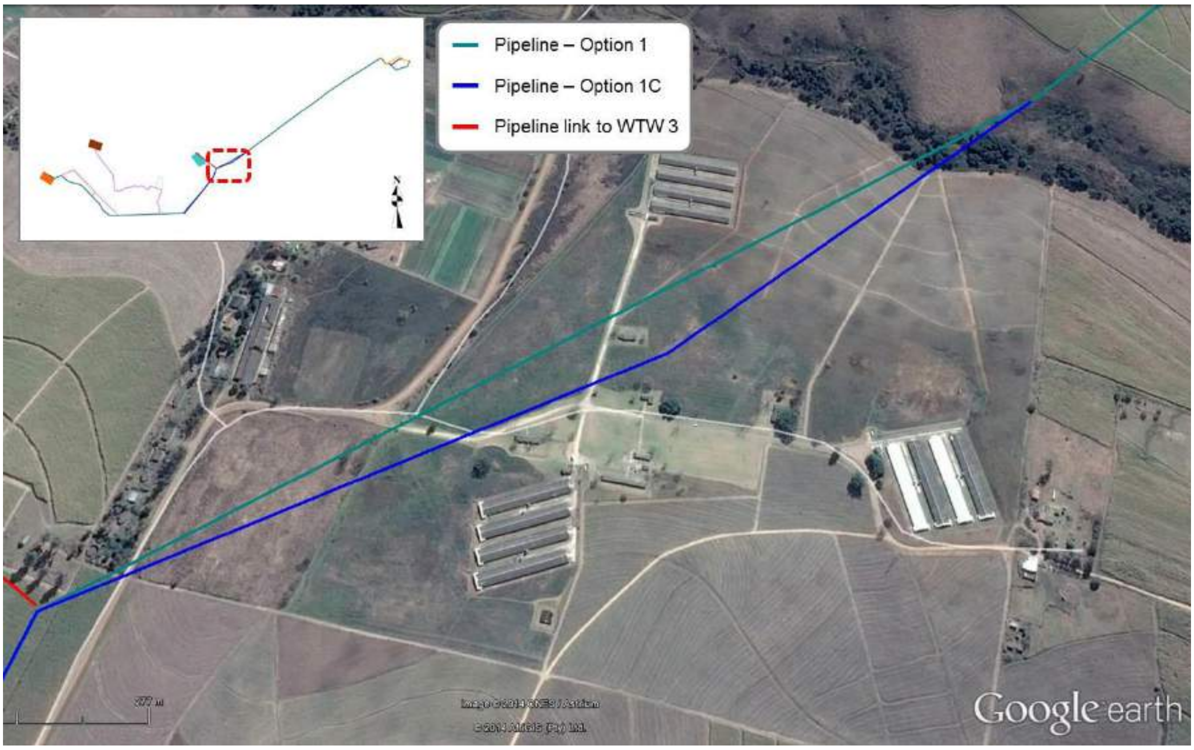


Figure 50: **Aerial view of Option 1C route showing deviation to minimise impacts to chicken houses (Portion 20 of the Farm Umlaas Poort 1174)**

❖ **Route Option 1D –**

Route Option 1D deviates from the Option 1 alignment to minimise the impacts to existing chicken houses on Portion 0 of the Farm 30, as well as to avoid disruptions to traffic on the D125 road (**Figure 51**).

Figure 51: Aerial view of Options 1D, 1E and 1F

The route cuts across Portion 151 of the Farm Camperdown 1330 in a north-easterly direction. It then traverses the R603 (**Figures 52** - **53**) and passes through the Umlaas Road light industrial area before crossing a railway line (**Figure 54**) and eventually terminating at the Western Aqueduct next to the N3 highway.

Figure 52: South-westerly view along Option 1D pipeline route (R603 crossing)

Figure 53: North-easterly view along Option 1D pipeline route (R603 crossing)

Figure 54: South-westerly view along Option 1D and Option 1E pipeline routes (yellow line) - railway crossing

- **Route Option 1E –**

  Route Option 1E initially follows alignment Options 1D, but then deviates from this route to avoid impacts to Erven 34, 35 and 2-28 Umlaas Road which are earmarked to be developed for mini-factories and/or warehouses (in accordance with comments received from representatives of the landowner). It then links up again with route Option 1D after the aforementioned properties. See aerial view of route in **Figure 51** and photographs in **Figures 55** – **56**.

Figure 55: **South-westerly view along Option 1E pipeline route (R603 crossing)**

Figure 56: **North-easterly view along Option 1E pipeline route (R603 crossing)**

- **Route Option 1F –**

  Route Option 1F was identified to minimise the impacts on the properties Umlaas Road Erf 41 and Erf 885 Portion 114 of the Farm Vaalkop and Dadelfontein no. 885.

  The pipeline route primarily follows Option 1E. The pipeline would travel in a south-easterly direction on Erf 15723 Crookes before turning left into Erf 885 Portion 114 of the Farm Vaalkop and Dadelfontein. It then turns right into Erf

44 Umlaas Road and travels perpendicular to the R603 and crosses under the R603 via a pipe jack before continuing toward the railway line via the north-western boundaries of Erf 34 and Erf 38 Umlaas Road and cross under the railway line via a pipe jack. The pipeline would then travel alongside the sub-station on the northern boundary of Erf 41 Portion 6. The pipeline will then run alongside the R103 within Erf 41 Portion 6 before tying-in to the Western Aqueduct. See aerial view of route in **Figure 51**.

- **Pipeline Link to WTW 2 –**
  From the WTW Option 2 site on Portion 85 on the Farm Nels Rust 849, the pipeline travels in a south-eastern direction over vacant land and crosses a power line servitude, watercourse and the R56 (**Figures 57 - 58**). It then continues over vacant land followed by cultivated land and another watercourse. The route then travels in a predominantly eastern direction past the north of Mapstone Dam and then turns southwards and continues to the east of the dam until it connects to the Option 1 route on Portion 5 of the Farm Hopewell 881.

Figure 57: **North-westerly view along pipeline link to WTW 2 (R56 crossing)**

Figure 58: South-easterly view along pipeline link to WTW 2 (R56 crossing)

- **Pipeline Link to WTW 2 Deviation –**

  The deviation to the pipeline link to the WTW Option 2 site makes provision for crossing the watercourse that flows into the Mapstone Dam in an area where the gradient is less steep (**Figure 59**).

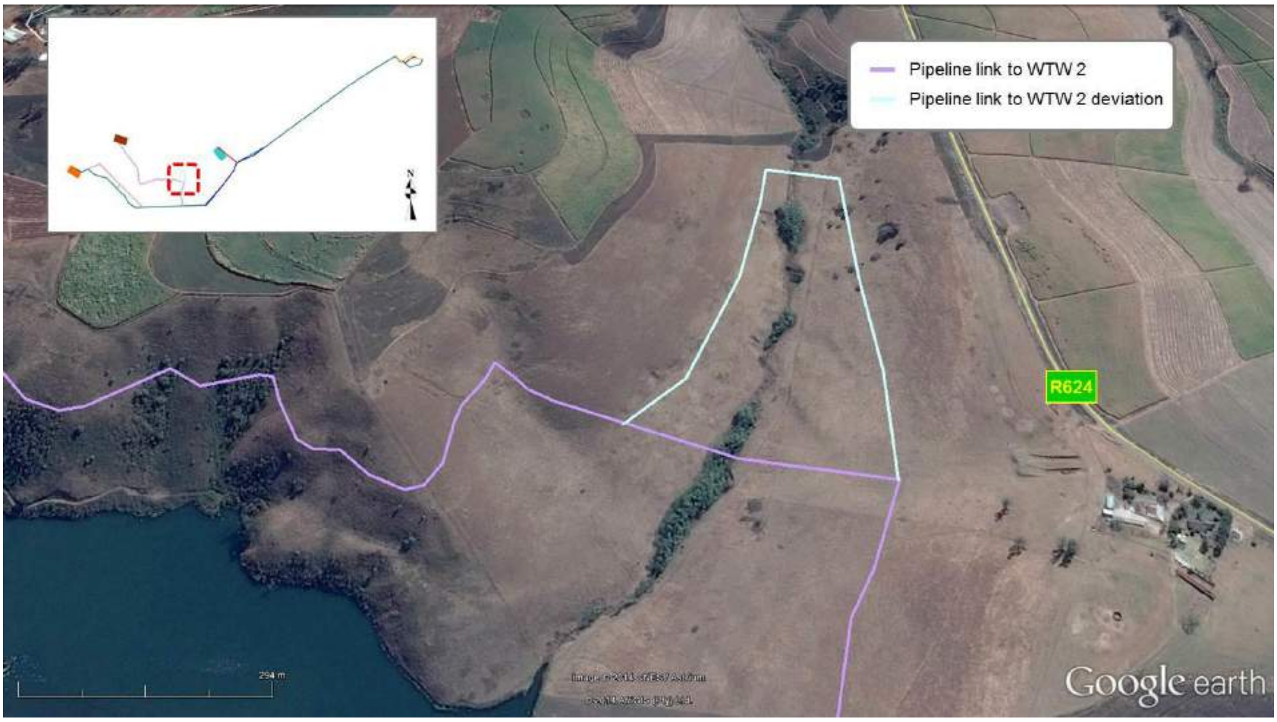


Figure 59: Aerial view of pipeline link to WTW 2 deviation

- **Pipeline Link to WTW 3 –**

  The pipeline link to the WTW 3 travels from the plant in a south-eastern direction trough a sugarcane plantation (see **Figure 60**) until it connects with the Option 1 pipeline route on the Farm Morning Sun 17790.

Figure 60: General view of WTW 3 site

9.5.6 Alternative Methods for Crossing Mapstone Dam

The shortest practically constructible routes require that the pipeline crosses Mapstone Dam. The pipeline has been routed to cross the dam at its narrowest section measuring 120 metres. The pipeline route in relation to the crossing of Mapstone Dam is depicted in **Figure 61**.

Depending on the WTW location and pipeline configuration options, a solution is required to allow the pipeline or pipelines to cross Mapstone Dam. Four options have been identified as discussed in the sub-sections to follow.

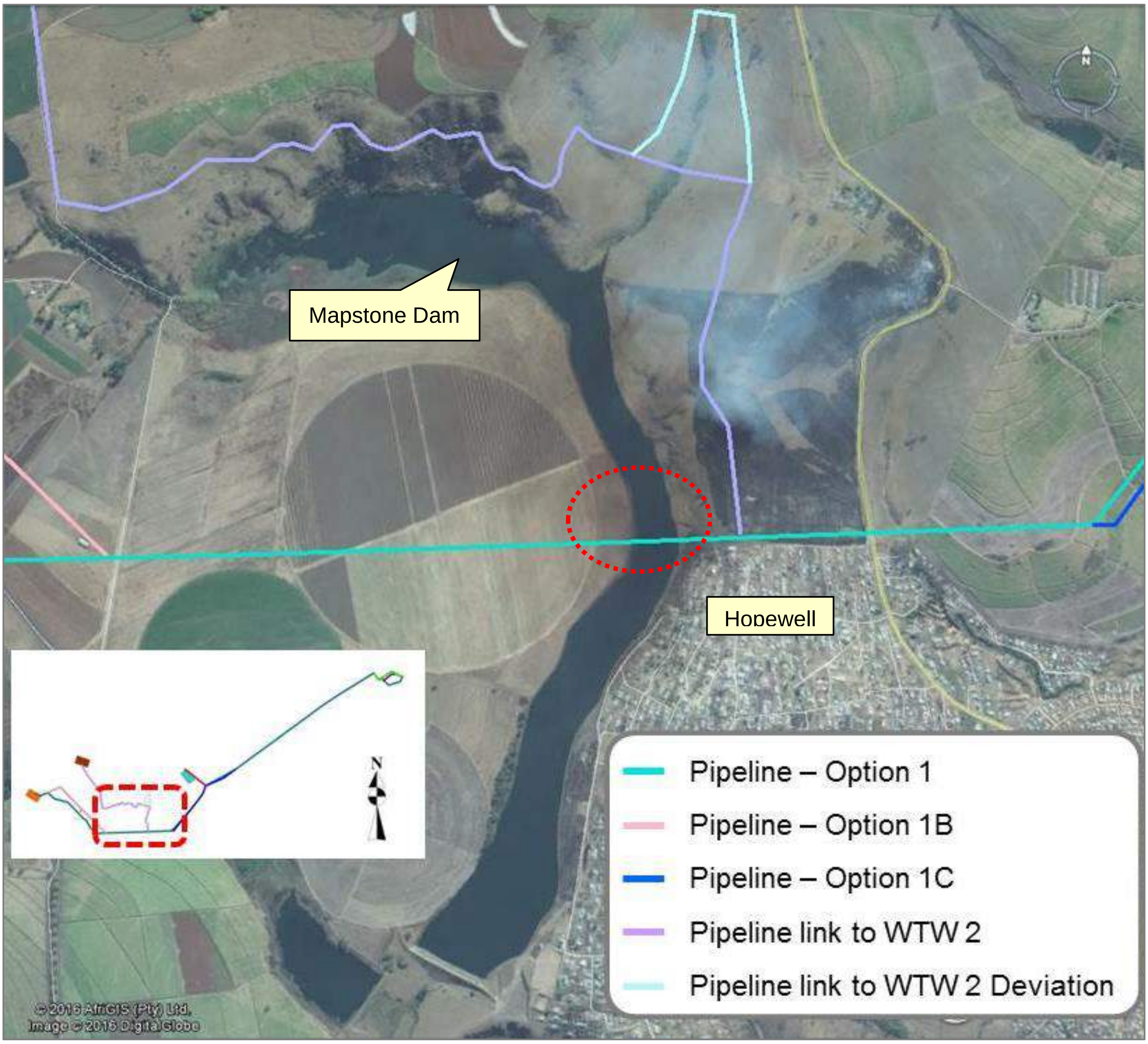


Figure 61: Crossing of Mapstone Dam

9.5.6.1 Steel Suspension Bridge

At least one of the options for crossing Mapstone Dam needed to span the entire length of the dam without any construction required within the submerged area. To this end, a steel suspension bridge was proposed that would span 160 metres, covering the 120 metre width of the dam as well as a twenty metre allowance on either side.

A conceptual design was carried out and a report has been prepared for the proposed suspension bridge concept. The estimated cost of the suspension bridge is R 47 million excluding VAT.

The nature of a suspension bridge is such that it cannot have unbalanced loading around its centreline. For this reason, more than one pipe on the bridge cannot be allowed as this will cause an imbalance in the loading if for example, one pipe is empty and the other is full of water. For the double pipeline options therefore, it was assumed that an equivalent larger diameter pipe would be required for the suspension bridge crossing.

This bridge concept is depicted in **Figures 62 - 64**. A larger scale plan and section for the proposed suspension bridge option is included in **Appendix F**.

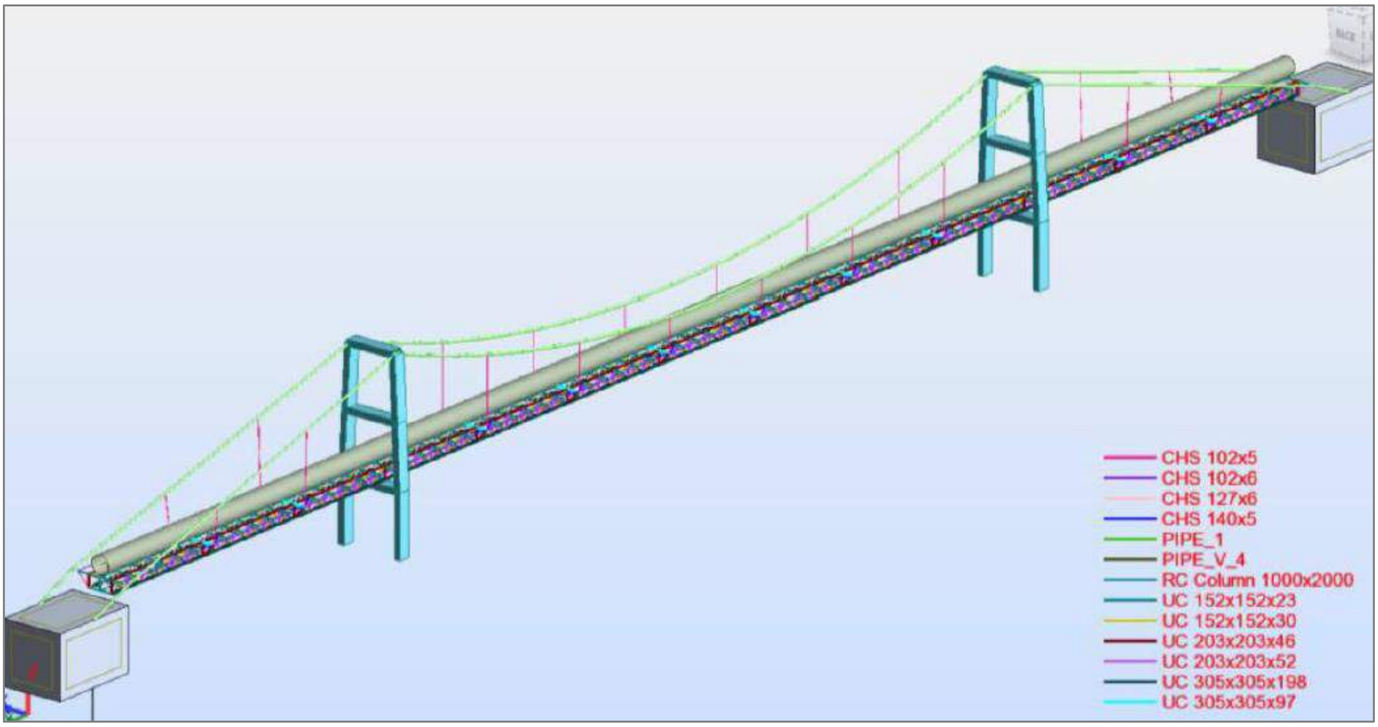


Figure 62: Three-Dimensional View of Suspension Bridge

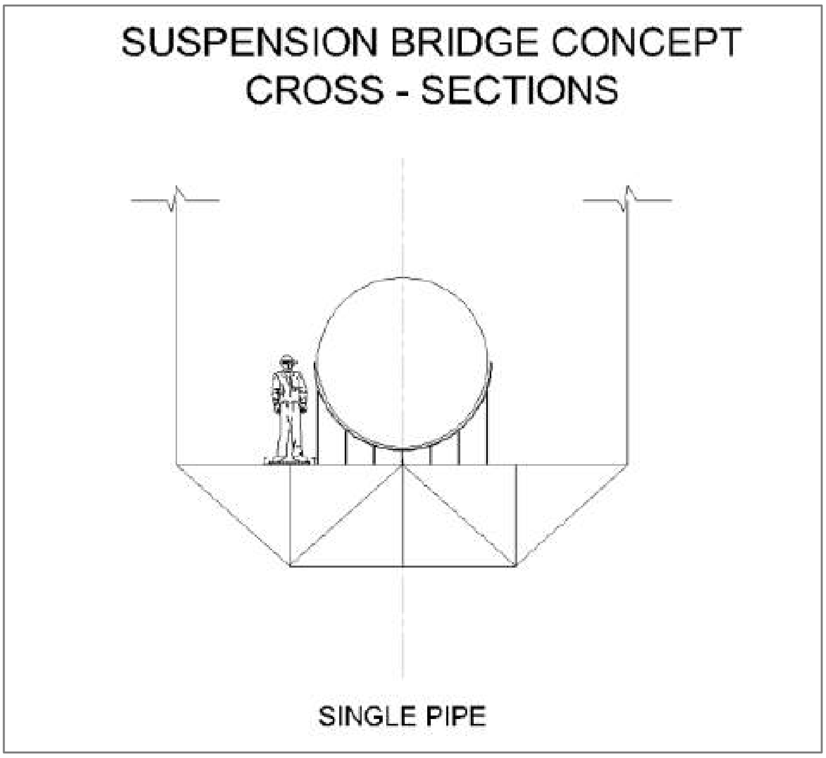


Figure 63: Cross Section through Suspension Bridge

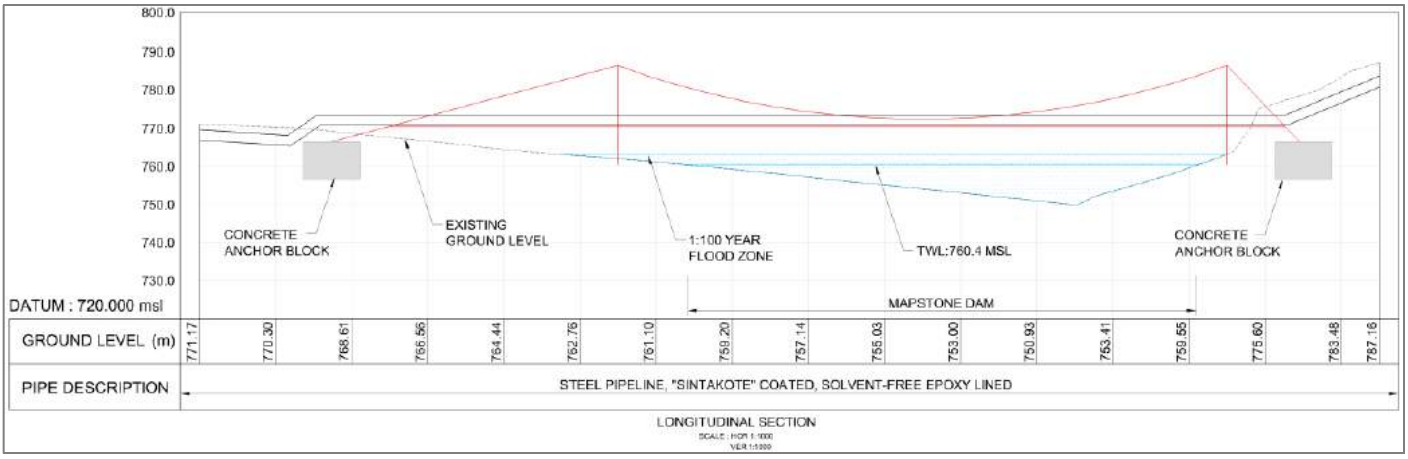


Figure 64: Longitudinal Section through Suspension Bridge

9.5.6.2 Conventional Steel Pipe Bridge

The second option considered for the crossing of Mapstone Dam was to construct a steel pipe bridge across the dam. The bridge will be supported on concrete piers that sit within the dam basin. The concrete piers in turn may require a piled foundation. Piling and the construction of concrete piers will have to take place under submerged conditions.

Conceptual drawings have been prepared out for pipe bridges to carry single and double pipes of differing sizes. This concept is depicted in **Figures 65 - 66**. A larger scale plan and section for the proposed bridge is included in **Appendix F**.

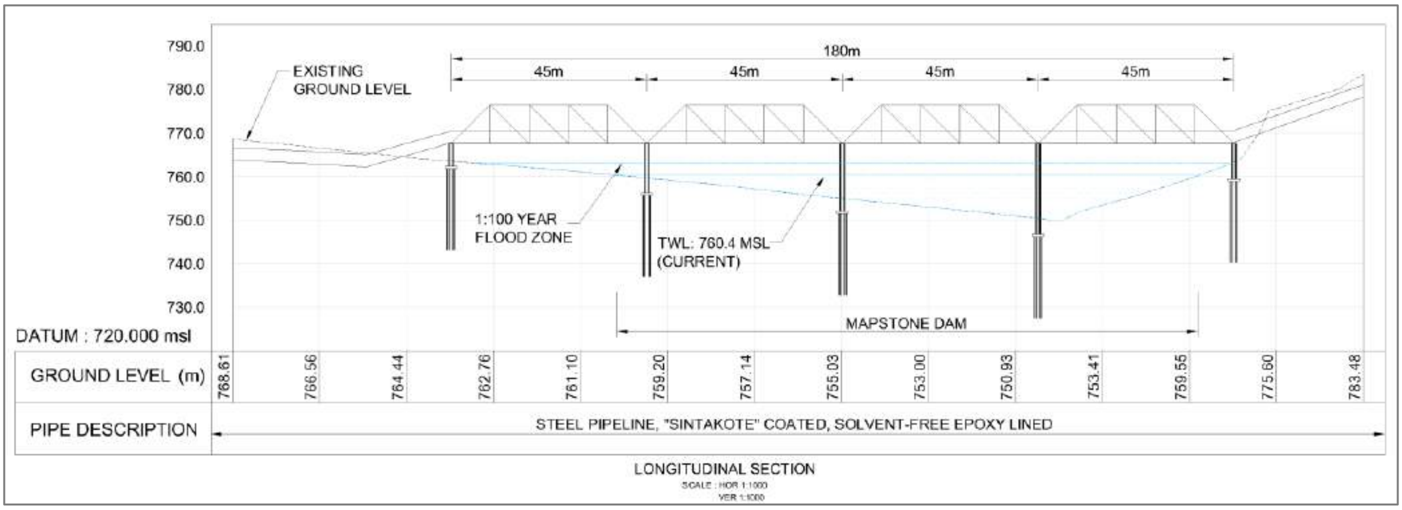


Figure 65: Longitudinal Section through Conventional Steel Pipe Bridge

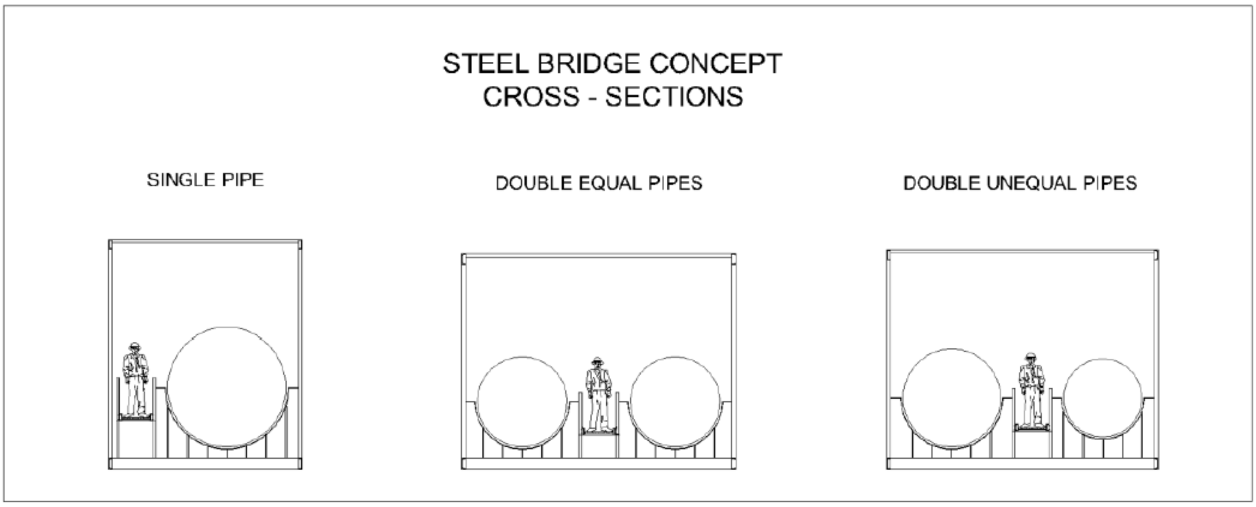


Figure 66: Cross Sections through Conventional Steel Pipe Bridge

9.5.6.3 Pipe Supported on Concrete Piers

A third option for crossing Mapstone Dam is to construct the pipe on concrete piers. In this option, the pipe is supported on concrete piers and is allowed to span the distance between each pier. It has been calculated that piers will be required every 20 metres. Each pier may require a piled foundation.

This concept is depicted in **Figures 67 - 68**. A larger scale plan and section for the proposed bridge is included in **Appendix F**.

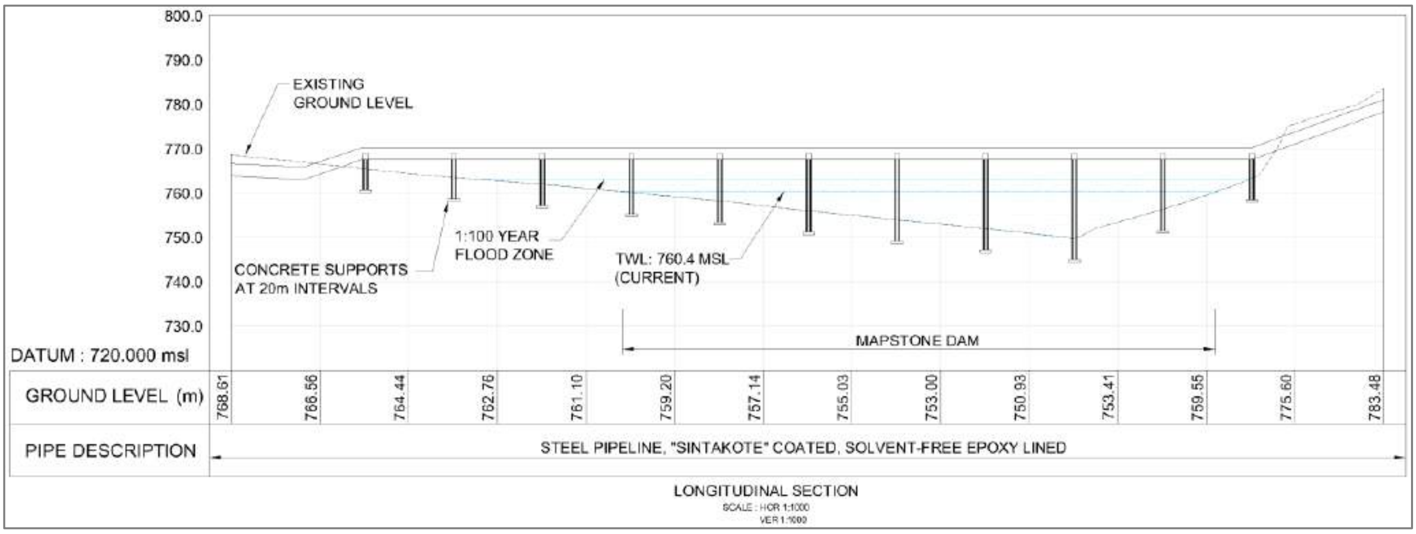


Figure 67: **Longitudinal Section through Concrete Piers Option**

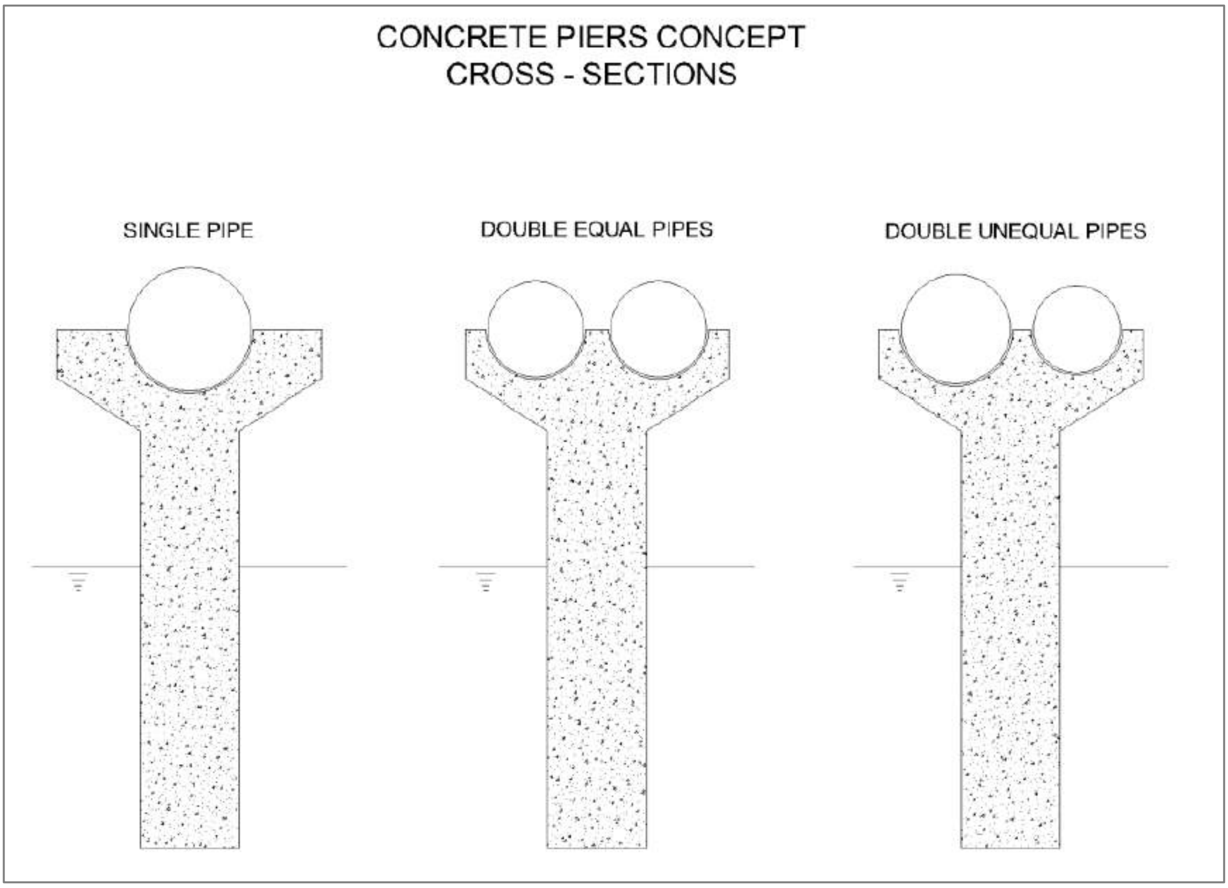


Figure 68: **Cross Sections through Concrete Piers Option**

9.5.6.4 Pipe Buried in Dam Basin

The fourth option that was considered was to lay the pipe on the floor of the dam basin. One idea on how this may be done is to drain the dam and then lay the pipe in a conventional manner in a trench dug through the dam basin. The trench would be relatively shallow and would be backfilled with concrete instead of soil in order to protect the pipe coating and to secure the pipe.

Another option that could be considered is to construct the pipeline on the surface of the dam by allowing it to float on the dam surface during the welding process. Once welding is complete, the pipe will be filled with water which would cause it to sink into position onto concrete cradles prepared for the purpose of seating the pipe. Precast concrete cradle 'caps' could then be lowered into position to secure the pipe in position and prevent movement. This will be a highly specialised operation requiring experienced construction personnel and specialised equipment typically used for laying pipe in marine conditions.

This concept is depicted in **Figures 69 - 70**. A larger scale plan and section for this option is included in **Appendix F**.

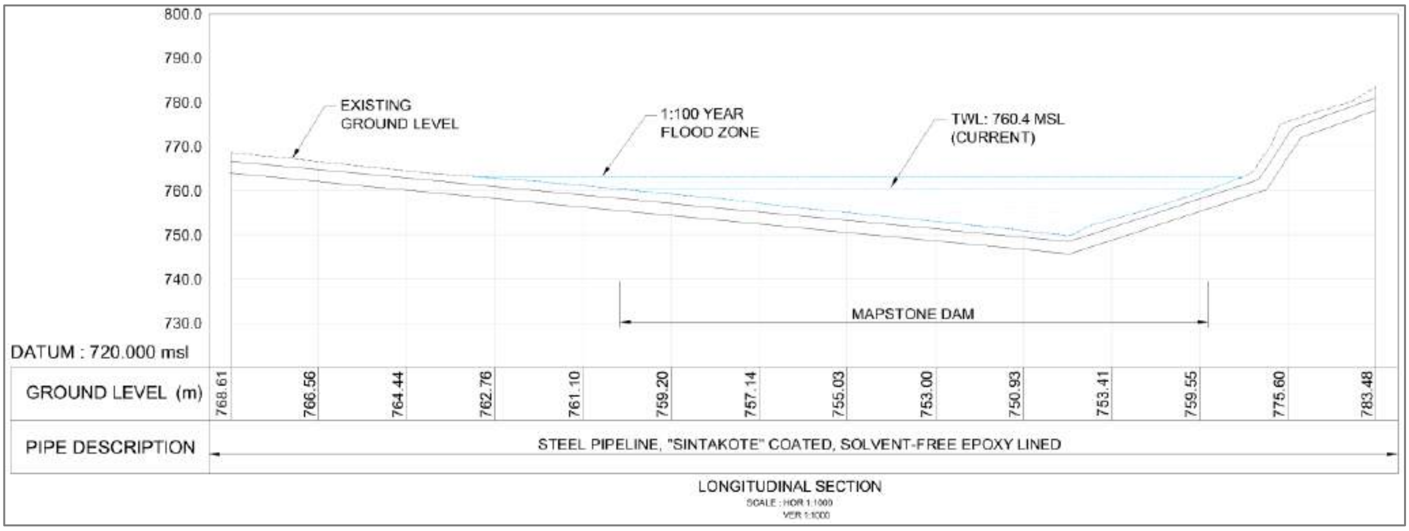


Figure 69: Longitudinal Section through Buried Pipeline Option

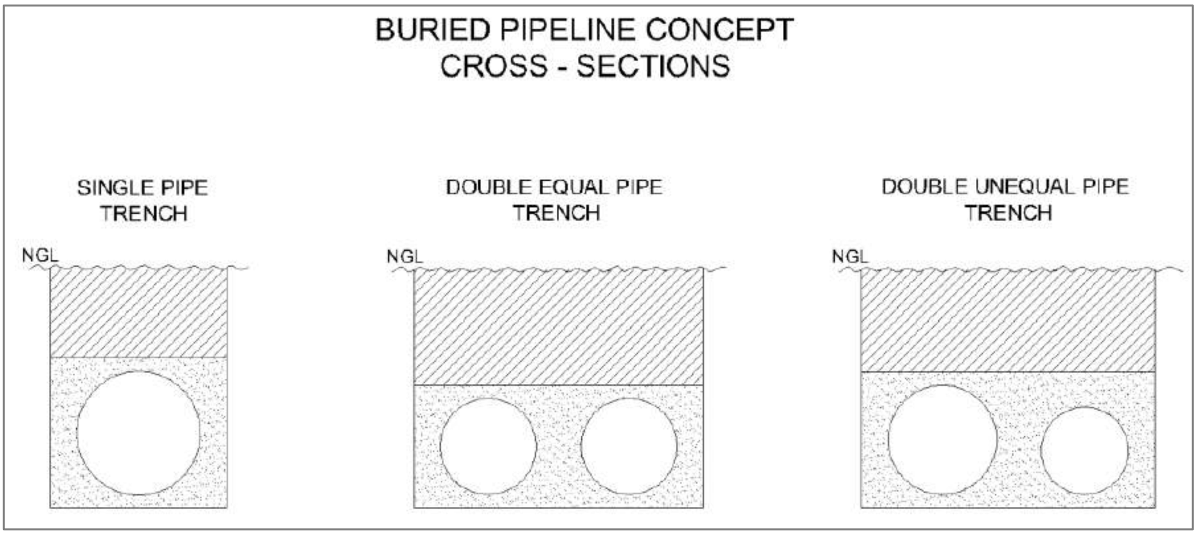


Figure 70: Cross Sections through Buried Pipeline Option

9.5.6.5 Discussions with Upper Mlazi Water User Association

At a meeting with Mr. E. Mapstone, the Chairman of the Upper Umlaas Irrigation Board that manages Mapstone Dam, Mr. Mapstone advised that all options to cross the dam with a bridge or pipeline above the dam water level were not supported as they created a security risk for the farmers by breaching the barrier created by Mapstone Dam.

Mr. Mapstone advised that the preferred method of crossing the dam was by burying the pipe though the dam. This would require the dam to be drained.

Mr. Mapstone proposed a methodology for draining the dam while mitigating the consequences to downstream irrigators. This would require the raw water module of the project to be commissioned prior to Mapstone Dam being drained. The uMWP raw water system would then maintain a supply to irrigators during the period that Mapstone Dam would be drained and in addition, would be used to refill the dam when the crossing is completed.

9.6 uMWP-1 Raw Water

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

The Raw Water component consists of the following (as shown in **Figures 71- 72**):

- Smithfield Dam on the uMkhomazi River, with a full supply level of 930 masl and consisting of an earth core rockfill main embankment and a zoned earthfill saddle embankment;
- 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, a concrete faced rockfill dam with a full supply level of 923 masl.

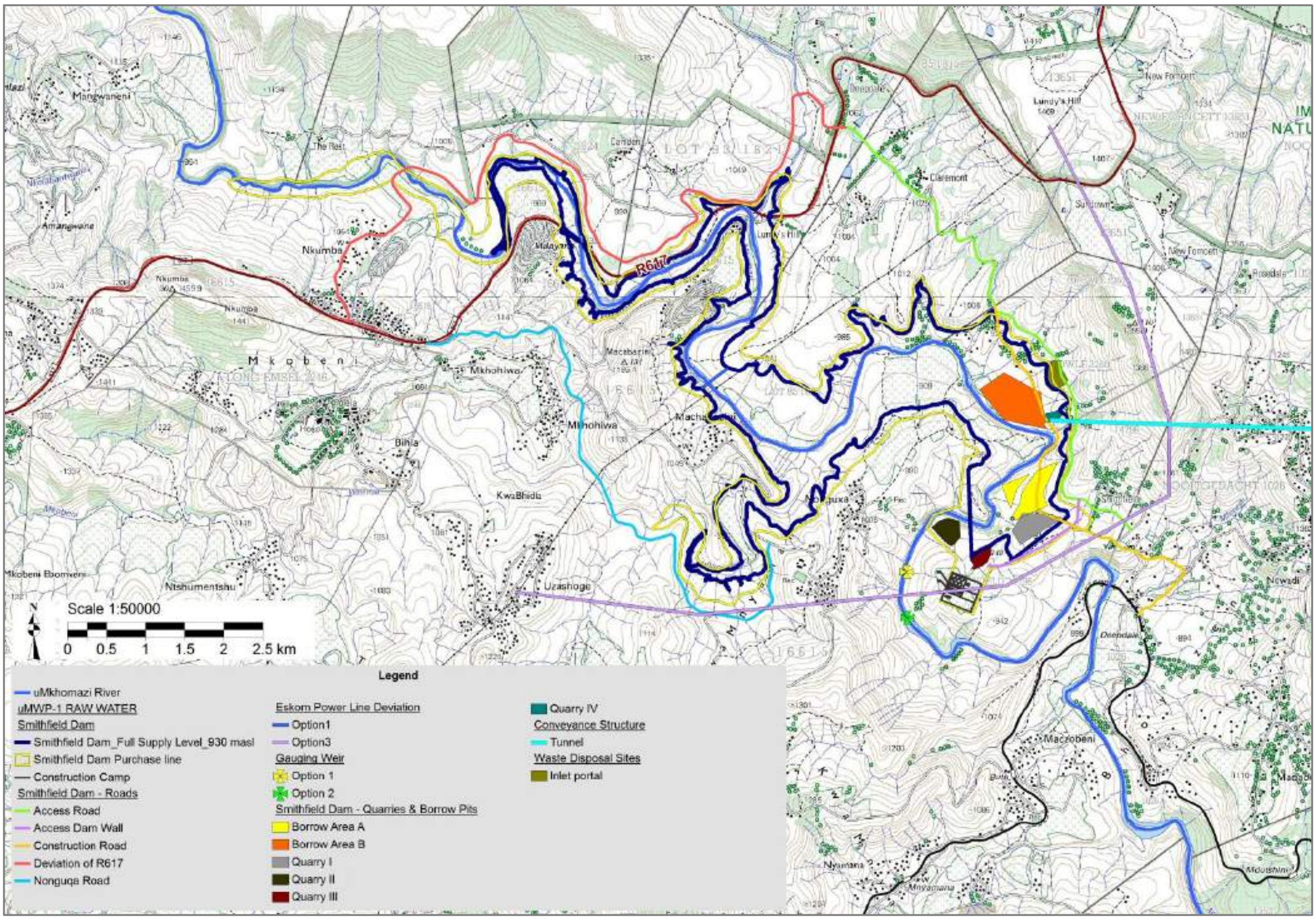


Figure 71: uMWP-1 Raw Water – western side

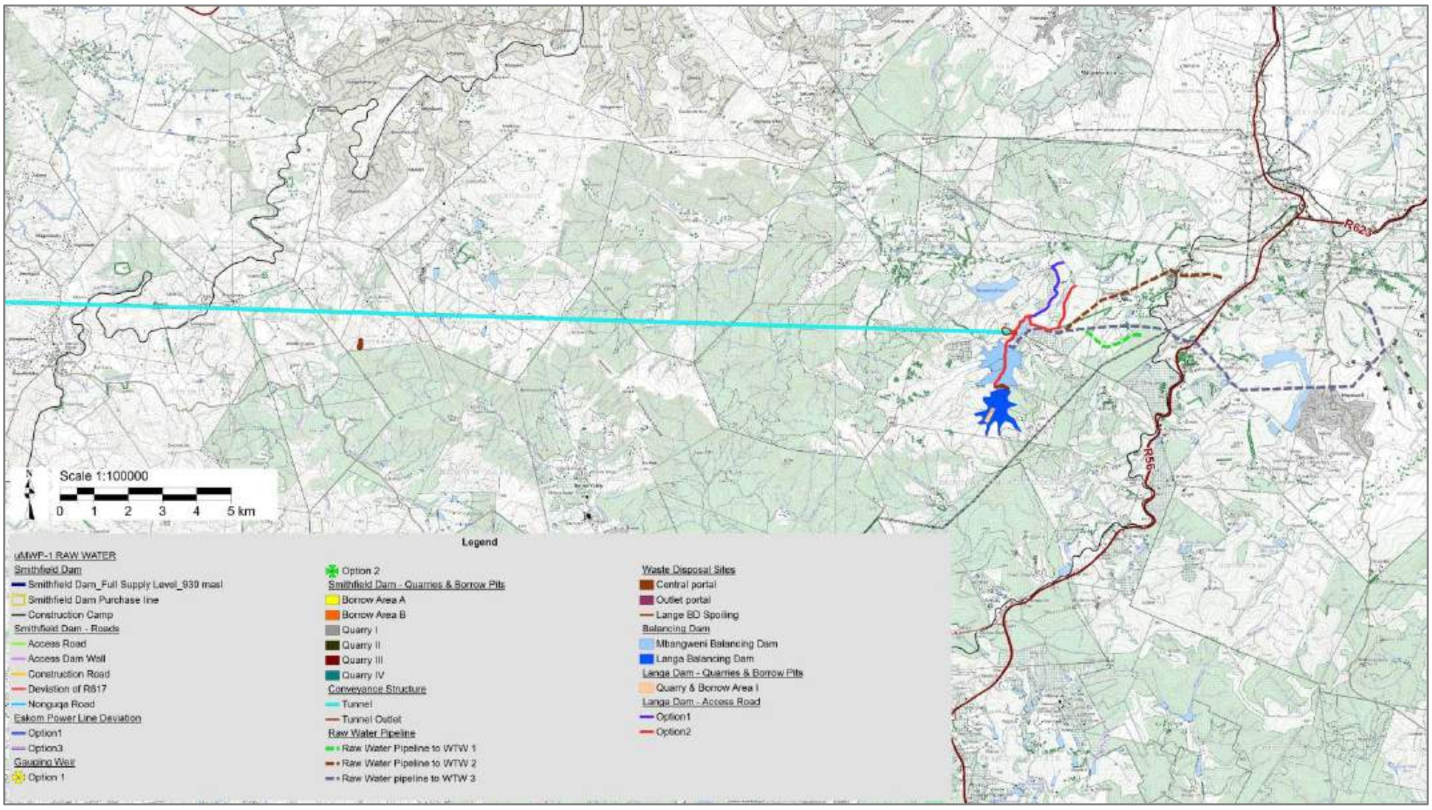


Figure 72: uMWP-1 Raw Water – eastern side

The location of the WTW will influence the final alignment of the raw water pipeline, as well as the proposed Hydropower Plant that will be situated along the conveyance structure from Smithfield Dam to the plant.

9.7 Alternatives Suggested by Interested and Affected Parties

This section provides an overview of certain alternatives that were identified by I&APs. Refer to the Comments and Response Report (**Appendix M**) for further discussions on alternatives identified during the Public Participation process.

9.7.1 Overall Scheme

Various concerns have been 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 Mkomazi-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.

9.7.2 Baynesfield Estate

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;
- Identification of an alternative to creating a 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 (covered in separate EIA for the uMWP-1 Raw Water component); and
- Identification of alternative access roads.

9.7.3 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 (covered in separate EIA for the uMWP-1 Raw Water component); and
- WTW site.

9.7.4 NCT Forestry Co-operative Limited

NCT Forestry Co-operative Limited suggested alternative sites for the proposed WTW (shown in **Figure 73**) in order to prevent any impacts to the timber plantation associated with the WTW Option 2 site. These suggested sites were assessed and the following feedback was received from the engineering team:

- The old bull station is not viable as its elevation of 840 msl is much lower than the required 872 msl.
- Atherstone Farm requires a considerable volume of fill across the site and access is not ideal. Almost the entire site will require imported fill and is therefore not considered viable.
- The “Open Area” to the north-east is unsuitable as the terrain is too steep, however the adjacent farmland has a suitable elevation and is accessible via district roads. It may however result in a 2.2 km increase in pipe length. This site was adopted as WTW Option 2.

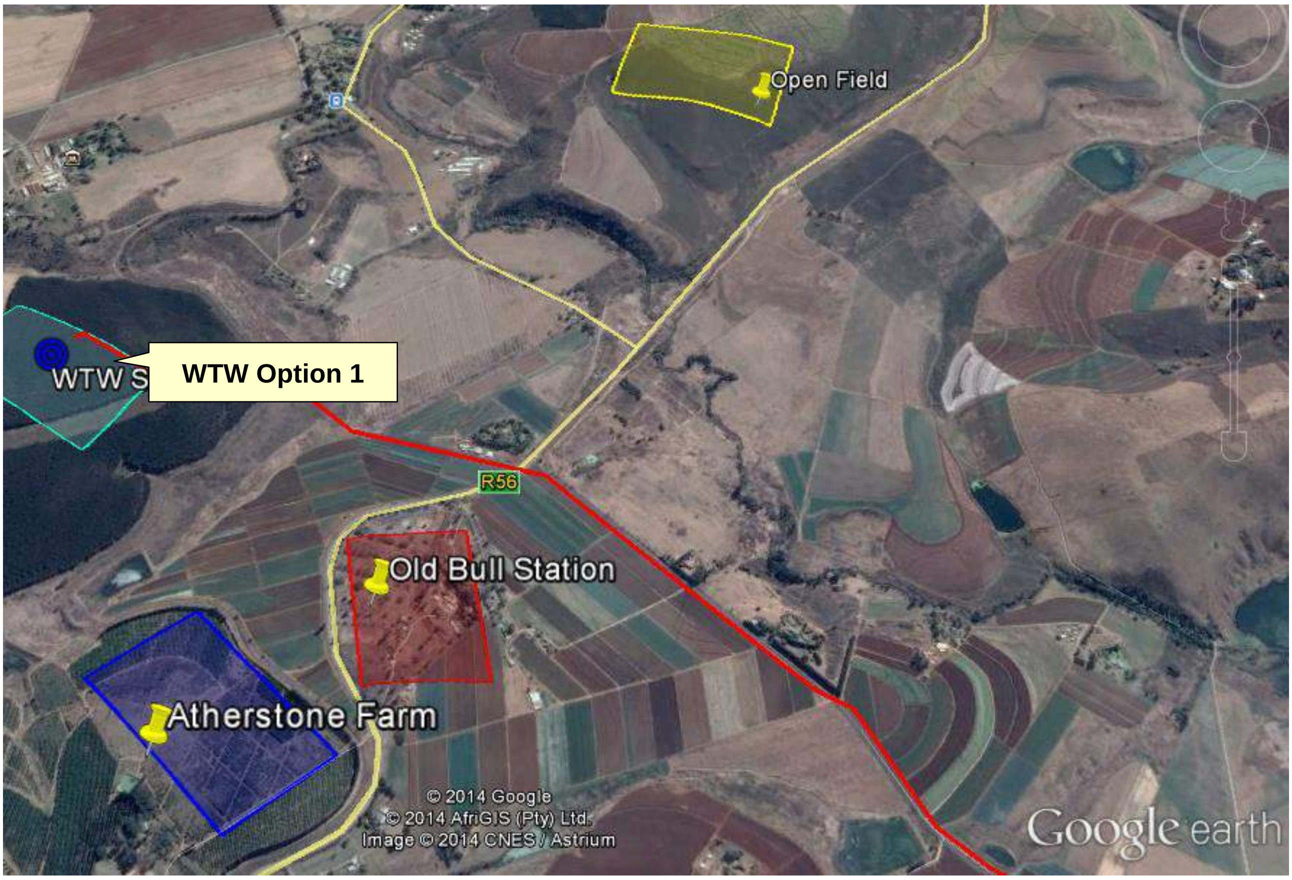


Figure 73: Alternative WTW sites suggested by NCT

9.7.5 Erf 34, 35 and 2-28 Umlaas Road

An alternative route to the potable water pipeline Option 1D was suggested by representatives of the landowner of the following properties: Erf 34, 35 and 2-28 Umlaas Road (refer to correspondence received from R. Cassimjee and S. Joshua contained in **Appendix K**).

According to these representatives, the current route would impact on future development of Erf 34 and 2-38 for mini-factories and/or warehouses. The suggested route, which is shown in **Figure 74**, was adopted as Option 1E.

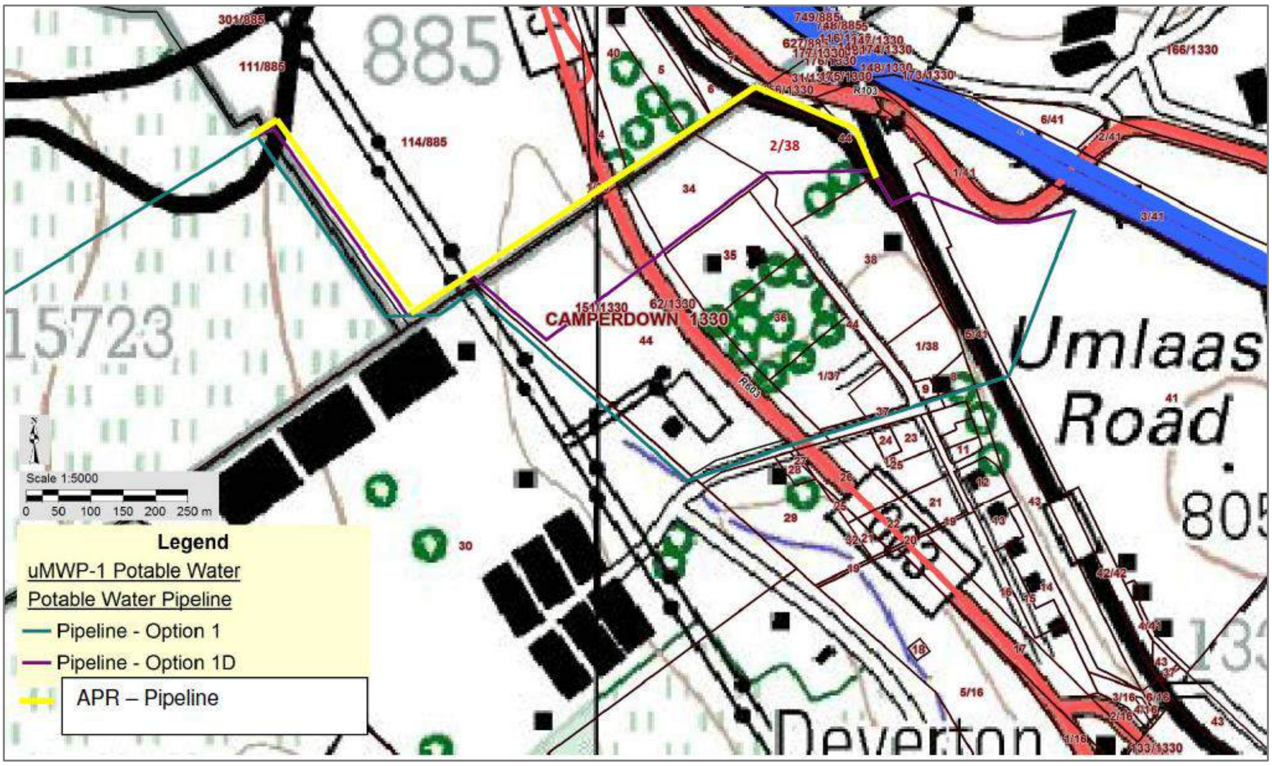


Figure 74: Alternative route (see yellow line) suggested by I&APs

9.7.6 *RCL Consumer Foods (Pty) Ltd*

RCL Consumer Foods (Pty) Ltd (previously known as Rainbow Farms (Pty) Ltd) recommended the following deviations to reduce impacts to existing chicken houses:

1. Pipeline route Option 1C identified, which represents a deviation to the alignment of route Option 1 on Portion 43 of the Farm Hopewell 881 and Portion 20 of the Farm Umlaas Poort 1174; and
2. Pipeline route Option 1D identified, which represents a deviation to the alignment of route Option 1 on Portion 0 of Farm 30.

Furthermore, two additional alternatives to the pipeline route in the Umlaas Road area were later suggested, as reflected in **Figure 75**. These routes serve to limit the potential impacts to the property Umlaas Road Erf 41, which was recently rezoned and received an Environmental Authorisation for the development of a warehouse.

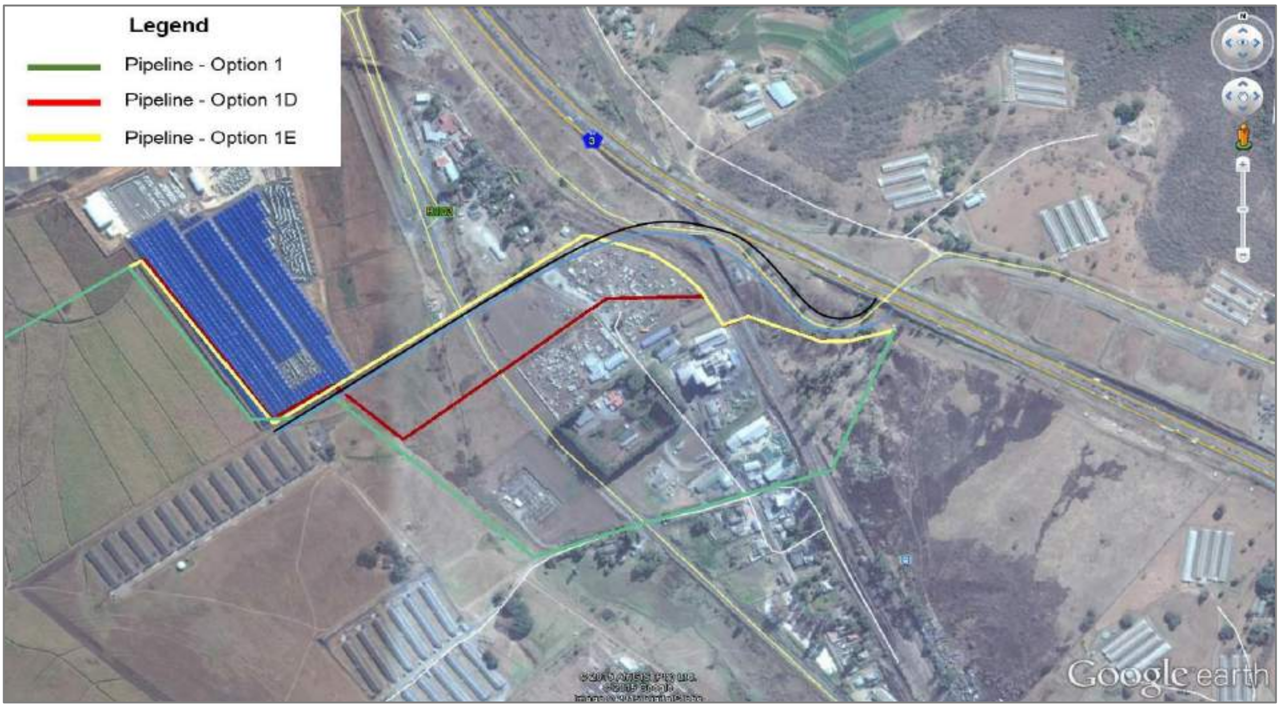


Figure 75: Alternative route (see black and blue lines) suggested by RCL

The technical feasibility of these new suggested routes were assessed and they were not deemed to be viable for the following reasons:

- An additional pipe-jack would be required at a road crossing, which would result in increased costs and additional approvals from KZN Department of Transport (DoT).
- Crossing an existing railway, where pipe jacking is not an option as there is insufficient space for a receiving pit on the eastern side of the railway crossing. Impractical to construct using open cut techniques due to the high cut embankments and the need to take the railway line out of operation during construction.
- Proximity to the National road (N3). A wayleave would be required; however, this is unlikely to be approved by SANRAL as the pipeline would be required to be benched into the N3 embankment, which could undermine the freeway layerworks construction and potentially lead to traffic hazard on the N3. There are also safety concerns during construction.
- Restricted working space: The narrow strip of land between the N3 and R103 would result in restricted working space, which presents a significant challenge for laying a large diameter pipeline.

A new route was identified, which is referred to as Option 1F (see **Figure 51**), and was included in the EIA as a new feasible alternative for the pipeline alignment.

9.8 uMWP-1 Project Life-cycle

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

9.8.1 Pre-feasibility and Feasibility Phases

Major activities that form part of the Pre-feasibility and Feasibility Phases include:

- Assessment of base conditions;
- Technical, economic and environmental screening of alternatives;
- Surveying;
- Sizing and costing of infrastructure; and
- Geotechnical investigations.

9.8.2 Pre-construction Phase

Major activities that form part of the pre-construction phase include:

- Negotiations and agreements with the affected landowners, stakeholders and authorities;
- Detailed engineering design;
- Detailed geotechnical investigations;
- Geophysical investigations;
- 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;
- Possible further phases of heritage site investigation and fencing of heritage sites;
- Procurement process for Contractors;
- 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;
- 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;
- 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;
- Confirmation of the location and condition of all buildings, assets and structures within the servitude; and
- Determining and documenting the road conditions for all identified haul roads.

9.8.3 Construction Phase

General activities associated with the construction phase for the WTW and potable water pipeline include the following:

- Site establishment;
- Relocation of infrastructure;
- Prepare access roads;
- Establish construction camp;
- Bulk fuel storage;
- Storage and handling of material;
- Construction employment;
- Site clearing;
- Excavation;
- Blasting;
- Establishment of and operations at crusher;
- Establishment of and operations at batching plant;
- Establishment of and operations at materials testing laboratory;
- Create haul roads;
- Concrete Works;
- Steel works;
- Mechanical and Electrical Works;
- Temporary river diversions for pipeline crossings;

- Electrical supply;
- Construction of WTW;
- Construction of pipeline;
- Cut and cover activities;
- Stockpiling (sand, crushed stone, aggregate, etc.);
- Waste and wastewater management;
- Relocation of graves, protected species, etc.; and
- Reinstatement and rehabilitation of construction domain (as necessary).

A more detailed description of the construction methodology follows.

9.8.3.1 Advanced Works

On a project of this magnitude, advanced works will be required to facilitate the smooth ramping up of the main construction contract. Depending on the type of advanced work activity, this work can be carried out by the main contractor or as a separate contract.

The main advanced work activities that will be required are:

- Pipe procurement. This includes the ordering and subsequent manufacturing and delivery of the steel pipes to the site.
- Clearing of sections of corridor. The corridor of construction consists of a 15 metre wide permanent servitude (for the single pipe option) and a further 30 metres of temporary working servitude. The sections of the corridor where construction is to commence initially should be cleared over the entire width and the area earmarked for receiving pipe should be levelled if necessary.
- Fencing of corridor. The sections of corridor prepared for construction should be fenced and access gates installed.
- Construction road. A temporary road will be constructed that will initially be used for trucks delivering pipes and later used for delivery of bedding material and transporting away of spoil material.
- Pipe delivery, offloading and stringing. It is envisaged that as each pipe is manufactured, it will be transported to site and placed on the right hand side of the construction road at the location where it is to be installed

- ❖ Coating and lining tests. Coating and lining integrity tests should be carried out on all pipe delivered. Defects are to be marked up and the pipe formally handed over to the contractor as free-issue.
- ❖ Services location. Location of services should be part of an advanced works contract just ahead of the main construction contract.

9.8.3.2 Main Construction Contract – Single Pipeline

For the single pipeline, the construction activities that will typically be required to follow the advanced work contract include the following:

- ❖ Topsoil will be removed to the required depth and stockpiled on the extreme left side of the trench (in the direction of flow).
- ❖ The trench will be excavated to the required depth with a large excavator (refer to the construction servitude diagram contained in **Appendix G** for an illustration of the typical trench geometry). The volume of material required for reinstatement as common backfill will be placed next to the topsoil stockpile.
- ❖ Imported bedding material will arrive in side-tipper trucks and will be tipped into the trench.
- ❖ After the bedding material is placed at the required levels, the pipe will be lowered onto the bedding with a side-boom, lined up and temporarily secured in position.
- ❖ The pipe will be welded, tested and coatings and linings repaired.
- ❖ Further bedding material will arrive in side-tipper trucks and will be placed and compacted around the pipe up to 300 mm above the crown of the pipe.
- ❖ The common backfill material stockpiled on the side of the trench will be placed above the bedding material layer and compacted.
- ❖ Topsoil will be returned to the affected area and rehabilitation activities will commence as the construction train progress.

Figure 76: Typical trench excavation and pipe installation activities

Additional construction activities associated with the pipeline include:

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

- ❖ Install final Cathodic Protection measures.
- ❖ Install AC mitigation measures.
- ❖ Install pipeline markers (concrete posts) at changes in direction and at regular intervals along the route.
- ❖ Rehabilitation.

Figure 78: **Typical views of reinstated (left) and rehabilitated (right) pipeline routes**

Watercourse crossings will generally consist of pipe sections encased in concrete in accordance with the relevant Umgeni Water 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.

Figure 79: Typical river crossing showing concrete encased pipe section

9.8.3.3 Main Construction Contract – Double Pipeline

Where two pipes are to be constructed, the construction procedure will change slightly to accommodate the second pipe. The differences from the Single Pipe option are:

- Two individual pipe trenches are envisaged, not a single, wider trench.

- The laying of each of the parallel pipes will be staggered, i.e. the construction front for the first pipeline will run ahead of the second one so that there is no interference between the construction fronts.
- Topsoil replacement and corridor reinstatement will take place when both pipelines are completed up to the common backfill level.
- Refer to drawing in **Appendix F**, which depicts the construction corridor for double pipeline construction.

9.8.4 Operational Phase

Aspects pertaining to the Operation and Maintenance of the WTW are discussed in **Section 9.4.7**.

Key activities to be undertaken as part of the operation and maintenance of the bulk water supply scheme include the following:

- WTW operation –
  - Raw water intake
  - Chemical dosing
  - Phase separation (Clarification and Filtration)
  - Sludge treatment process
  - Chemical storage, disinfection and final water storage
  - Administrative buildings
  - General housekeeping, security and biodiversity
- WTW mechanical, electrical and civil –
  - Routine planned maintenance;
  - Major breakdown repairs;
  - Minor breakdown repairs.
- Potable 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
- Ongoing consultation with directly affected parties.

9.8.5 Decommissioning Phase

Decommissioning is 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.

9.9 Preliminary Implementation Programme

The preliminary programme for the implementation the uMWP-1 project components is shown in **Figure 80**.

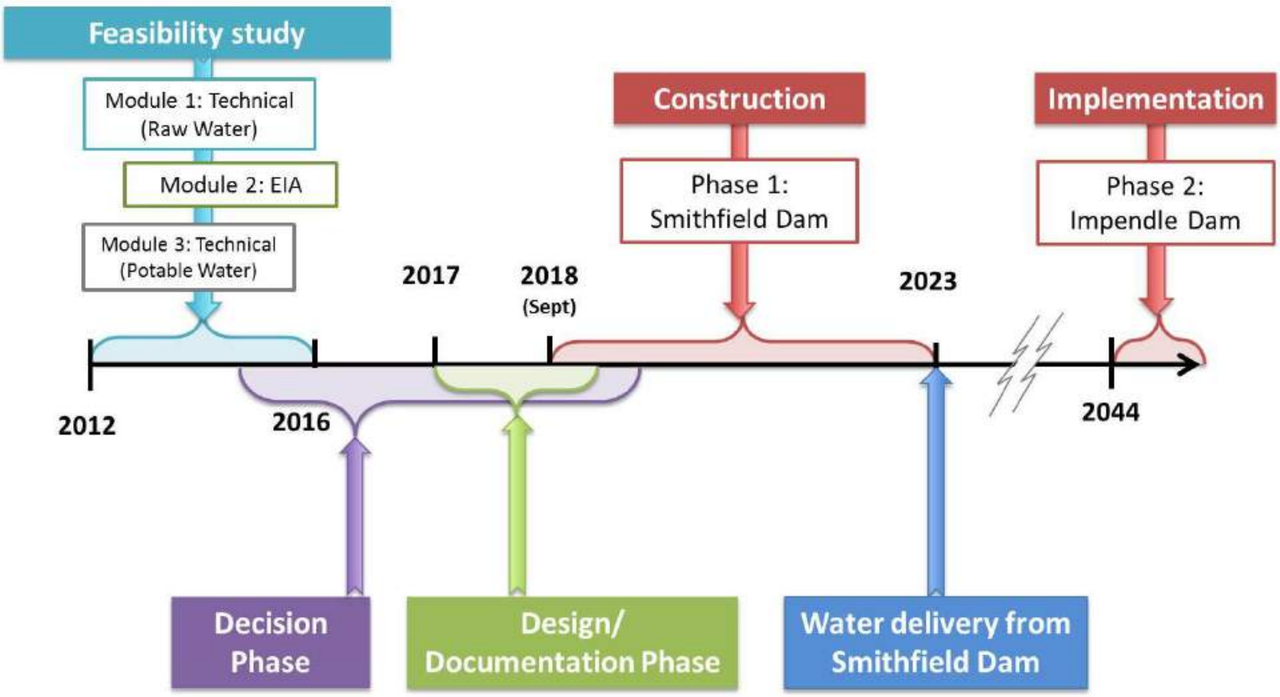


Figure 80: Preliminary Implementation Timeframes

Note that the finalisation of the programme will be affected by various factors, and must thus only be regarded as indicative.

9.10 Resources Required for Construction and Operation

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

9.10.1 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 use triggered in terms of Section 21 of the NWA must comply with DWS's requirements.

9.10.2 Sanitation

Sanitation services along the pipeline route will be required for construction workers in the form of chemical toilets, which will be serviced at regular intervals by the supplier. A temporary septic field/ tank system will be provided at the site camps and site offices. At the WTW camp site these facilities can be used into the operational phase at the offices for the WTW operators.

9.10.3 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. All the waste disposed of will be recorded.

Construction-related wastewater, which refers to any water adversely affected in quality through construction 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 the WTW residues and washwater during the operational phase of the plant is discussed under **Section 9.4.5**.

9.10.4 Potential Spoil Sites

Large volumes of spoil material (excess soil and rock) will be generated during the construction period that will be stored on site and will need to be disposed of. The volumes of spoil expected to be generated from the raw and potable water pipelines are 77000 m^3 and 260000 m^3 respectively.

Two potential spoil sites were identified as shown in **Figure 81**, which are described below.

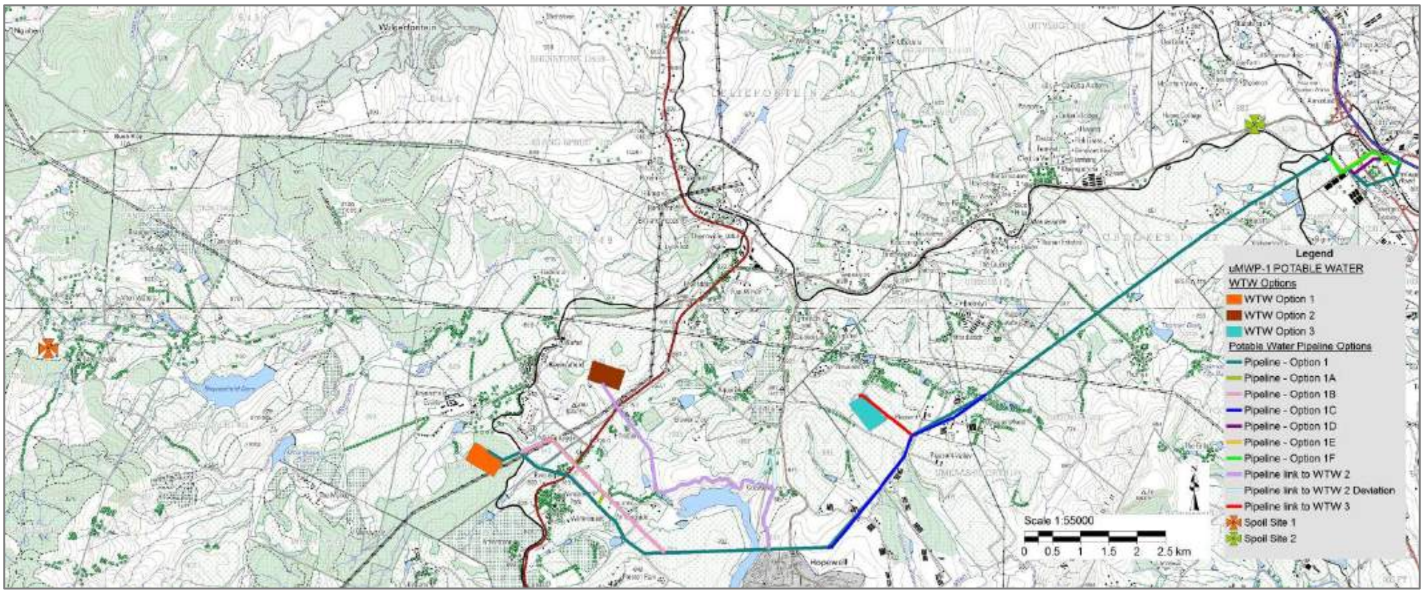


Figure 81: Locations of Proposed Spoil Sites

9.10.4.1 Proposed Spoil Site No. 1 - Baynesfield

Refer to **Figures 82** – **83**. This spoil site is located on Erf 847 Meyer's Hoek on the Baynesfield Estate. The site is currently a borrow pit.

Access to the site will be via Provincial road P334. The turn to P334 is located approximately 1.5 kilometres north-west from the P315 intersection with the R56 between Thornville and Atherstone. The site is located on the left hand side of the P334 approximately 9.5 kilometres from the P334 and P315 intersection. The spoil site can accommodate approximately 115000 m^3 of spoil material calculated on a right triangular wedge 125m long, 75m wide and 25m high.

Figure 82: **Aerial view of proposed Baynesfield Spoil Site**

Figure 83: **Photographs of proposed Baynesfield Spoil Site**

9.10.4.2 Proposed Spoil Site No. 2 - Manderston

Refer to **Figures 84 – 85** This spoil site is located on Erf 885 Portion 405 of Vaalkop and Dadelfontein. The site is used as a borrow pit.

Figure 84: Aerial view of proposed Manderston Spoil Site

Figure 85: Photograph of proposed Manderston Spoil Site

Access to the site will be via the P338 between Umlaas Road and Manderston and is located on the right hand side of the P338 when travelling from Umlaas Road to Baynesfield. The proposed site is located approximately 1.5 kilometres from the R603 and P338 intersection. The proposed site can accommodate approximately 45000m^3 of spoil material, calculated on a right triangular wedge 120m long, 50m wide and 15m high.

9.10.5 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.

All WTW sites have been assessed in terms of feasible access. The proposed access to the WTW sites will include selective upgrading of existing road(s) as well as creating new access road(s) to the plant (as required). The proposed access to the WTW optional sites is discussed in **Section 9.4.9.2**.

9.10.6 Electricity

Electricity will be obtained from diesel generators or temporary electricity connections during the construction phase. Electricity requirements for the operation of the scheme will be supplied by Eskom.

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.

9.10.7 Pipe Storage Yards, Contractor's Site Camps and Fabrication Yards

It is anticipated that the contractor's site camp and fabrication yard will be located on the same site. Several sites have been identified within close proximity to the proposed pipeline and WTW and a description of each site follows. The locations are shown in **Figure 86**.

Site Camp 1- Baynesfield – 3.3ha

This site camp is located on ERF 849 on the Baynesfield Estate. Access to the site will be via Provincial road P315 off the R56 between Thornville and Atherstone. A temporary intersection and access driveway can be constructed off the P315 approximately 650m from the R56/P315 intersection. The site is currently used for grazing of livestock. The site is set on level land and adequate space for a fabrication yard can be provided for at this site. Permission should be gained from the Joseph Baynes Board of Administration for occupation of the land for the duration of the construction activities.

Site Camp 2 –Hopewell – 2.6ha

The site camp is located on ERF 881 Portion 5 Hopewell. Access to the site will be via the R624 between Thornville and the Hopewell Township. A temporary intersection and access driveway can be constructed off the driveway to the Rainbow Farms. The site is currently used for grazing of livestock. Permission for occupation of the land for the duration of the construction activities should be gained from the land owners as well as Rainbow farms. The site is set on slightly sloping land and adequate space for a fabrication yard can be provided for at this site however noise restrictions may apply due to the close proximity to the chicken houses.

Site Camp 3- Manderston Site 1– 3ha

This site camp is located on Erf 1104 Portion 156 Uitzoek. Access to the site will be via Provincial road P120 off the P338 between Thornville and Atherstone. A temporary intersection and access driveway can be constructed off the P120 approximately 1km from the P120/P338 intersection. The site is currently used for grazing of livestock. The site is set on level land and adequate space for a fabrication yard can be provided for at this site. Permission for occupation of the land for the duration of the construction activities should be gained from the land owners.

Site Camp 4- Manderston Site 2– 3.8ha

This site camp is located on Erf 885 Portion 62 and Portion 203 of Vaalkop and Dadelfontein. Access to the site will be via the P338 between Umlaas Road and Manderston. A temporary intersection and access driveway can be constructed off the P338. The site is currently used for grazing of livestock. The site is set on slightly sloping land and adequate space for a fabrication yard can be provided for at this site. Permission for occupation of the land for the duration of the construction activities should be gained from the land owners.

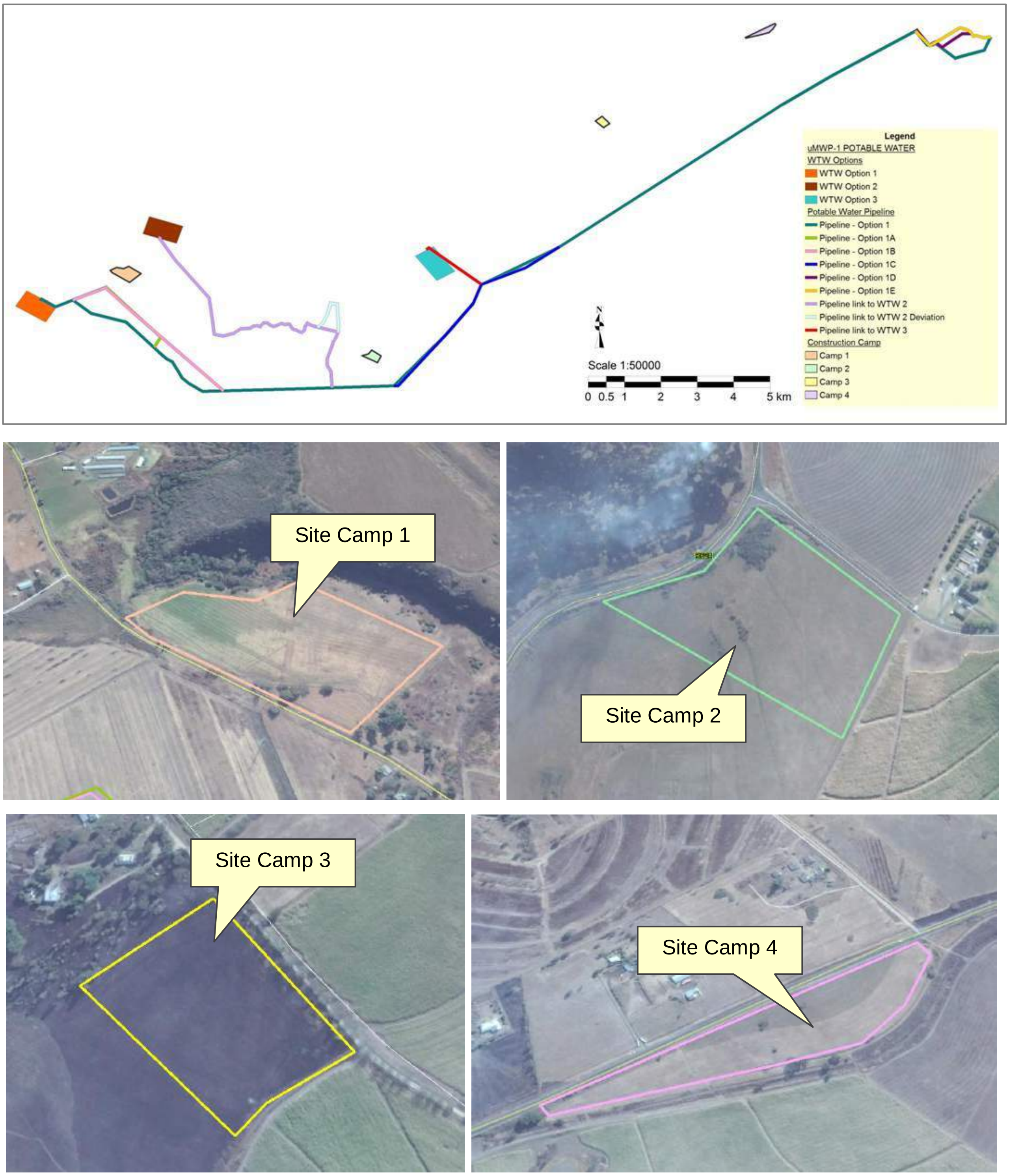


Figure 86: Proposed Site Camps and Fabrication Yards

9.10.8 Construction Workers

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

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.

According to DEAT (2002), the "environment" is regarded as the surroundings in which humans exist and which comprise:

1) The land, water and atmosphere of the earth;
2) Micro-organisms, plant and animal life;
3) Any part or combination of 1) and 2) and the interrelationships among and between them; and
4) The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that can influence human health and well-being.

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:

- WTW options; and
- Potable Water Pipeline options.

10.2 Land Use & Land Cover

10.2.1 General

The land cover in the study area is shown in **Figure 87**. The land use and cover for each of the major project components are explained further in the sub-sections to follow.

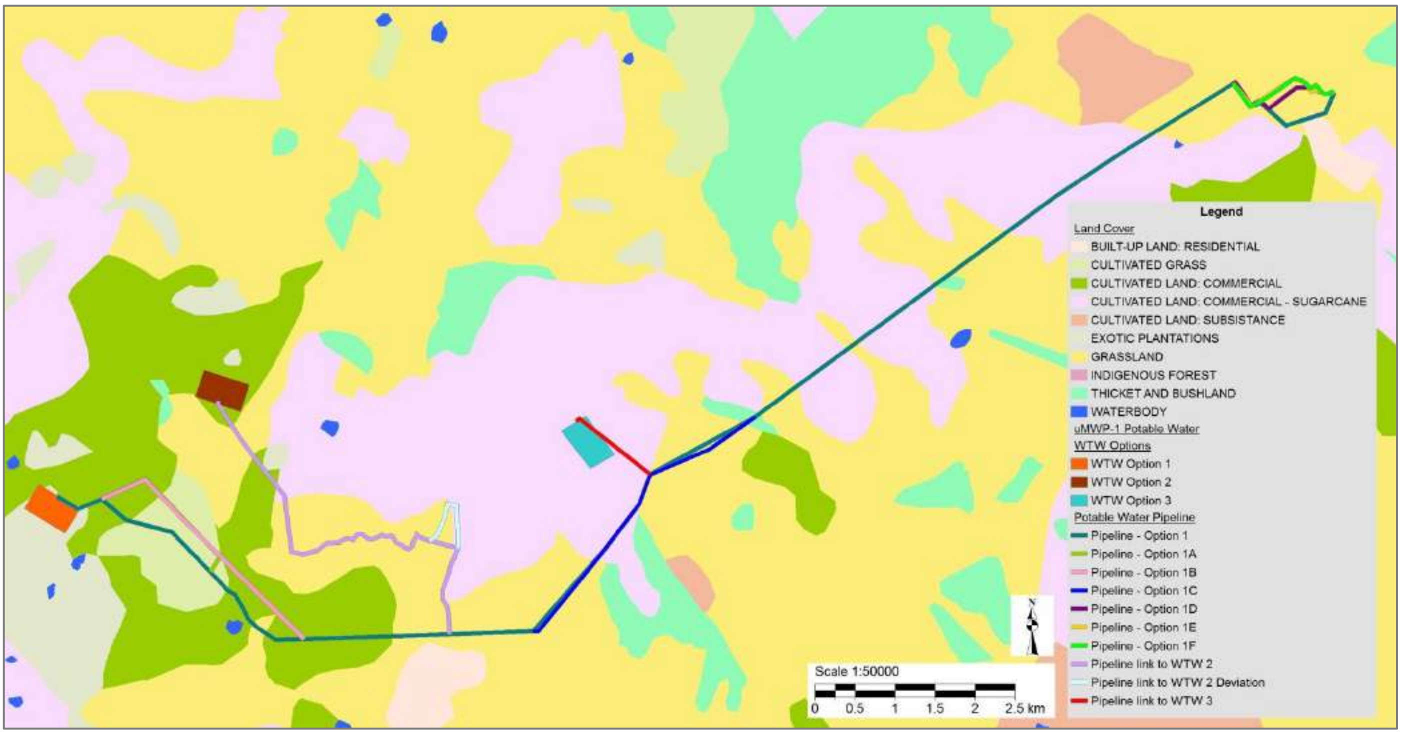


Figure 87: Land Cover

10.2.2 WTW Options

Refer to aerial views of the WTW options contained in **Figures 88 - 90**.

The proposed WTW Option 1 is situated on Baynesfield Estate, which is a diversified commercial farming operation, and lies within a timber plantation. Baynesfield 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.

WTW Option 2 is also located on Baynesfield Estate within an area that was previously cultivated with sugarcane. Grassland is situated to the south of this site. The site earmarked for WTW Option 3, which stretches over two private properties, is a sugarcane plantation.

Figure 88: **Aerial view of WTW Option 1**

Figure 89: **Aerial view of WTW Option 2**

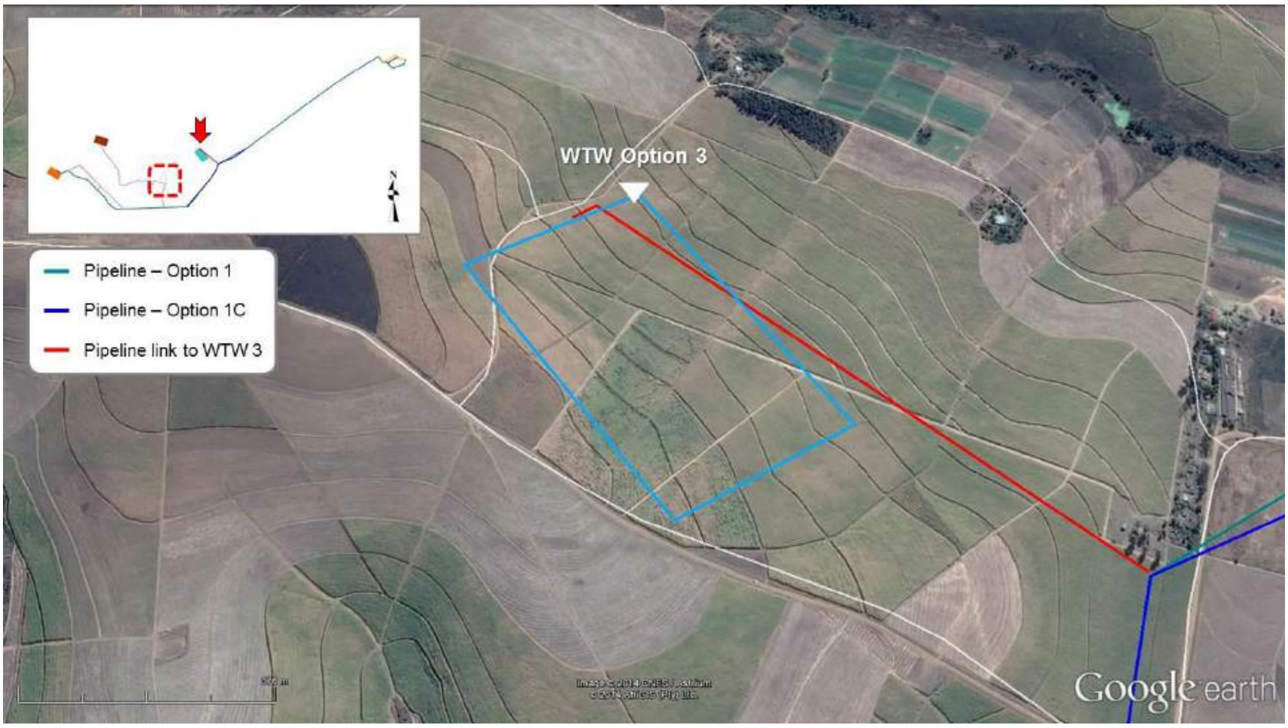


Figure 90: Aerial view of WTW Option 3

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 the WTW sites, as established as part of the Agricultural Impact Assessment, are listed in **Table 30** and shown in **Figure 91**.

Table 30: Land uses at alternative WTW sites (Index, 2015)

WTW Option	Land use	Area (ha)
WTW 1	ESKOM Servitude	0.37
	Forests	18.93
	Grazing	1.59
WTW 2	Crops	8.53
	Grazing	12.32
WTW 3	Crops (sugar cane)	21.07

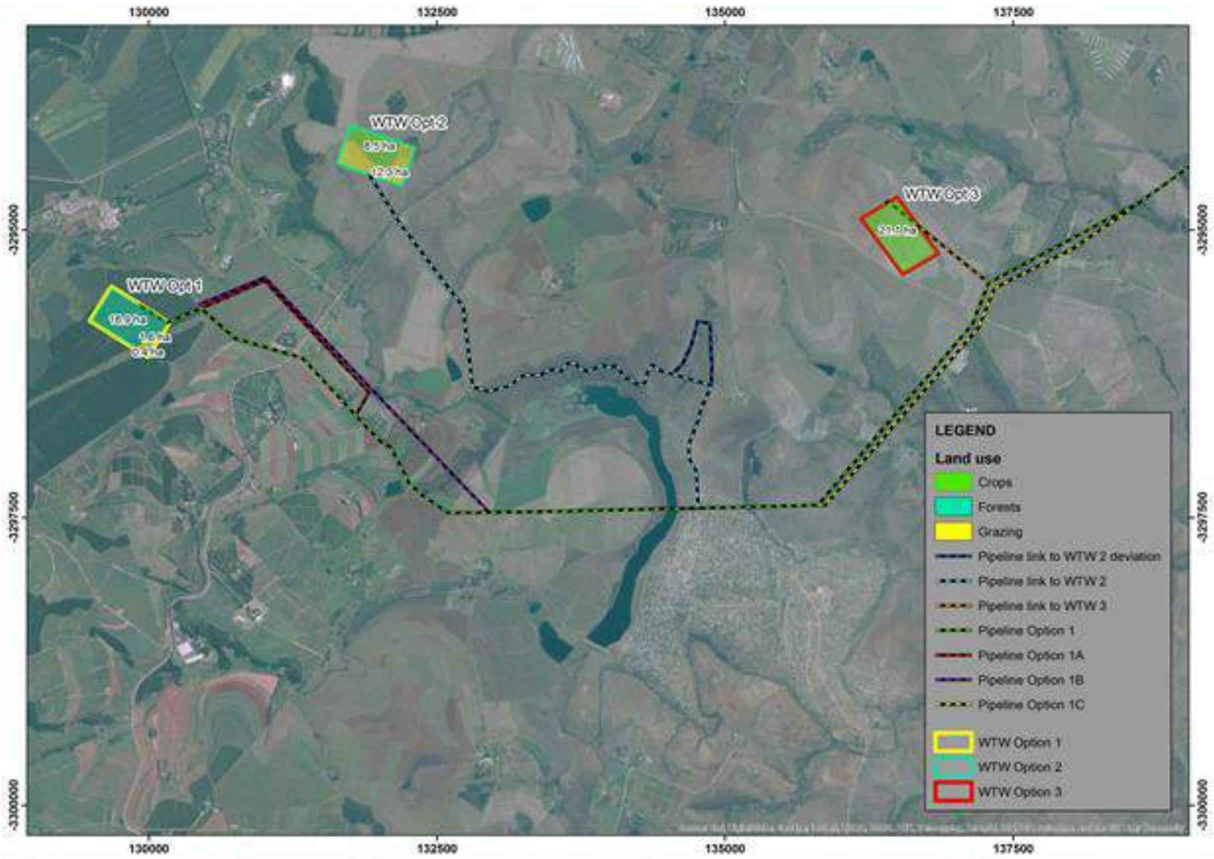


Figure 91: Land use – WTW sites (Index, 2015)

10.2.3 Potable Water Pipeline Options

Refer to aerial views of the potable water pipeline options contained in **Figures 34 – 36**. The potable water pipeline's final alignment will be dependent on the location of the WTW.

The initial western section of the Potable Water Pipeline Option 1 crosses cultivated land and timber plantation on Baynesfield Estate. From the R56, this pipeline passes more cultivated land until Mapstone Dam. Thereafter it traverses vacant land (grassland) and passes chicken houses belonging to Rainbow Farms. It then passes cultivated land mostly used for sugarcane production before entering the light industrial area of Umlaas Road.

Options 1A and 1B traverse cultivated land and vacant land (grassland). For most of its route Option 1C crosses a poultry farm and sugarcane plantation. Options 1D, 1E and 1F pass through vacant land and the Umlaas Road light industrial area. The pipeline link to

WTW Option 2 traverses cultivated land and vacant land (grassland). The deviation to this route crosses grassland. The link to WTW Option 3 traverses land that is under sugarcane plantation.

The land uses along the potable water pipeline routes, as established following a more detailed site appraisal as part of the Agricultural Impact Assessment, are listed in **Table 31** and shown in **Figure 92**.

Table 31: Land uses along Potable Water Pipeline Routes (Index, 2015)

Route / alternative	Field crops	Forest	Grazing	Industry	Poultry	River	Roads	Total (Metres)
WTW 1								
1	12 332	612	4 539			65	1 948	19 496
1A	1 932		234					2 166
1B	2 808	343	234					3 385
1C	566		2 756		368			3 690
1D			434	488				922
1E	171		330	578				1 079
WTW 2								
2A			357					357
2B			1 164					1 164
WTW 3								
3A	1 169							1 169

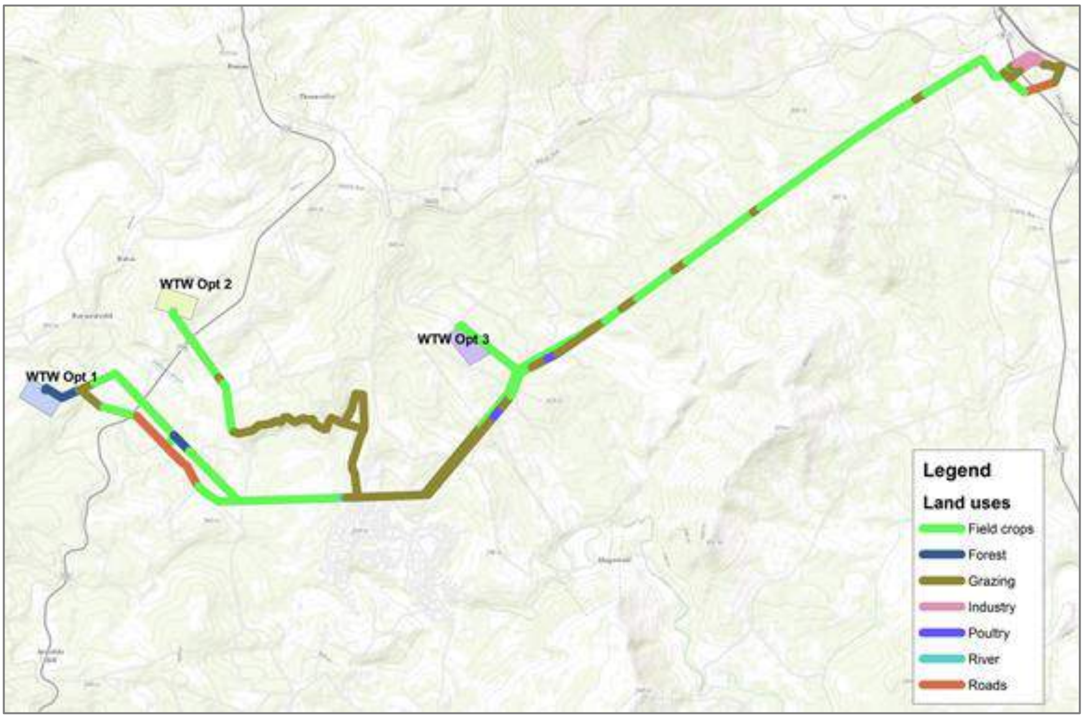


Figure 92: Land use – Potable Water Pipeline Routes (Index, 2015)

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 Raw Water 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 provided in **Tables 32 – 33**.

Table 32: 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 33: 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 monthly daily rainfall for the last ten years is tabulated below.

Table 34: 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 **Figure 93** 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.

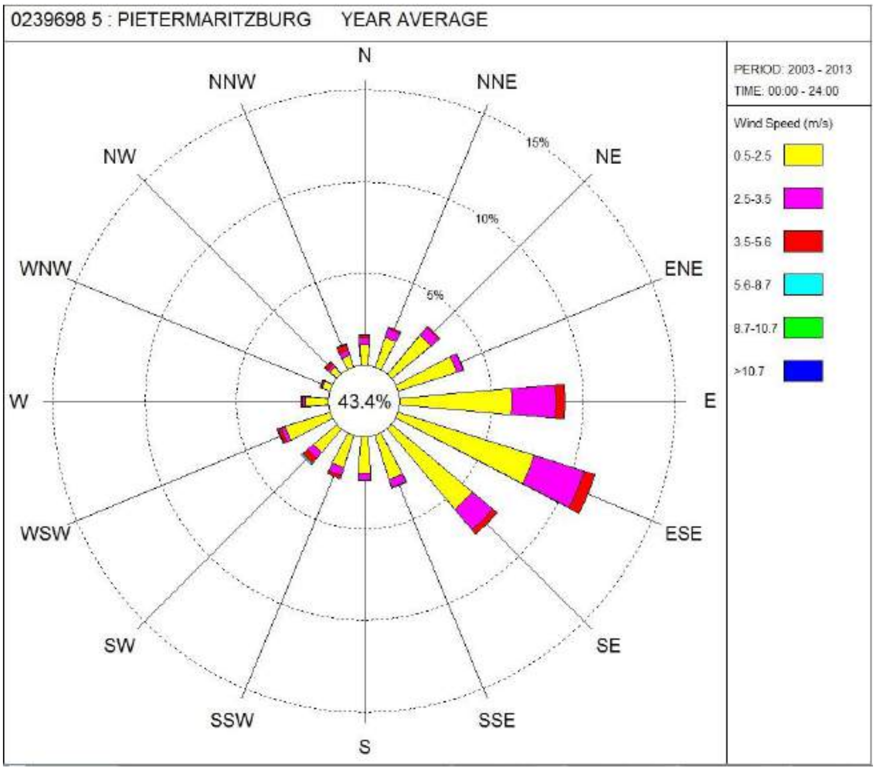


Figure 93: Wind rose for the Pietermaritzburg weather station

10.4 Geology & Soils

10.4.1 General

The simplified geology in the study area is shown in **Figure 94**. According to the 1:250 000 geological map the WTW Options 1 and 2, as well as the western section of the project area, are generally underlain by the Ecca Group and Pietermaritzburg Formation. The WTW Option 3, as well as the central and eastern sections of the project area, are underlain by the Dwyka Group.

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.

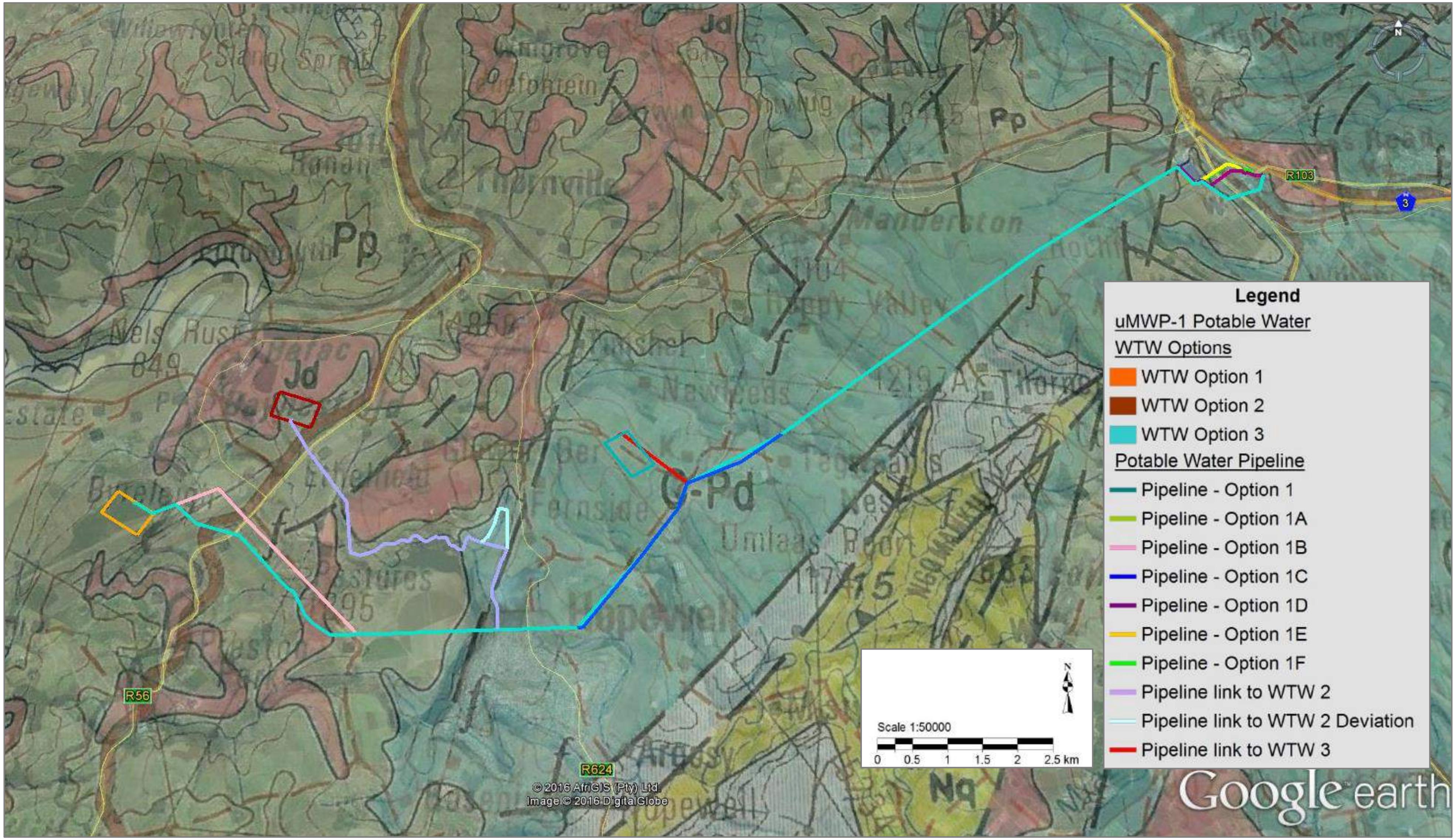


Figure 94: **Simplified geology**

As part of the Agricultural Impact Assessment (Index, 2015), a more detailed soil map was compiled which is shown in **Figure 95**. The predominant soil types are deep red and yellow sandy loam soil. They are classified as Hutton, Bainsvlei and Clovelly. WTW 2 consists of Hutton soil on the northern part and becomes shallower with rocks towards the south.

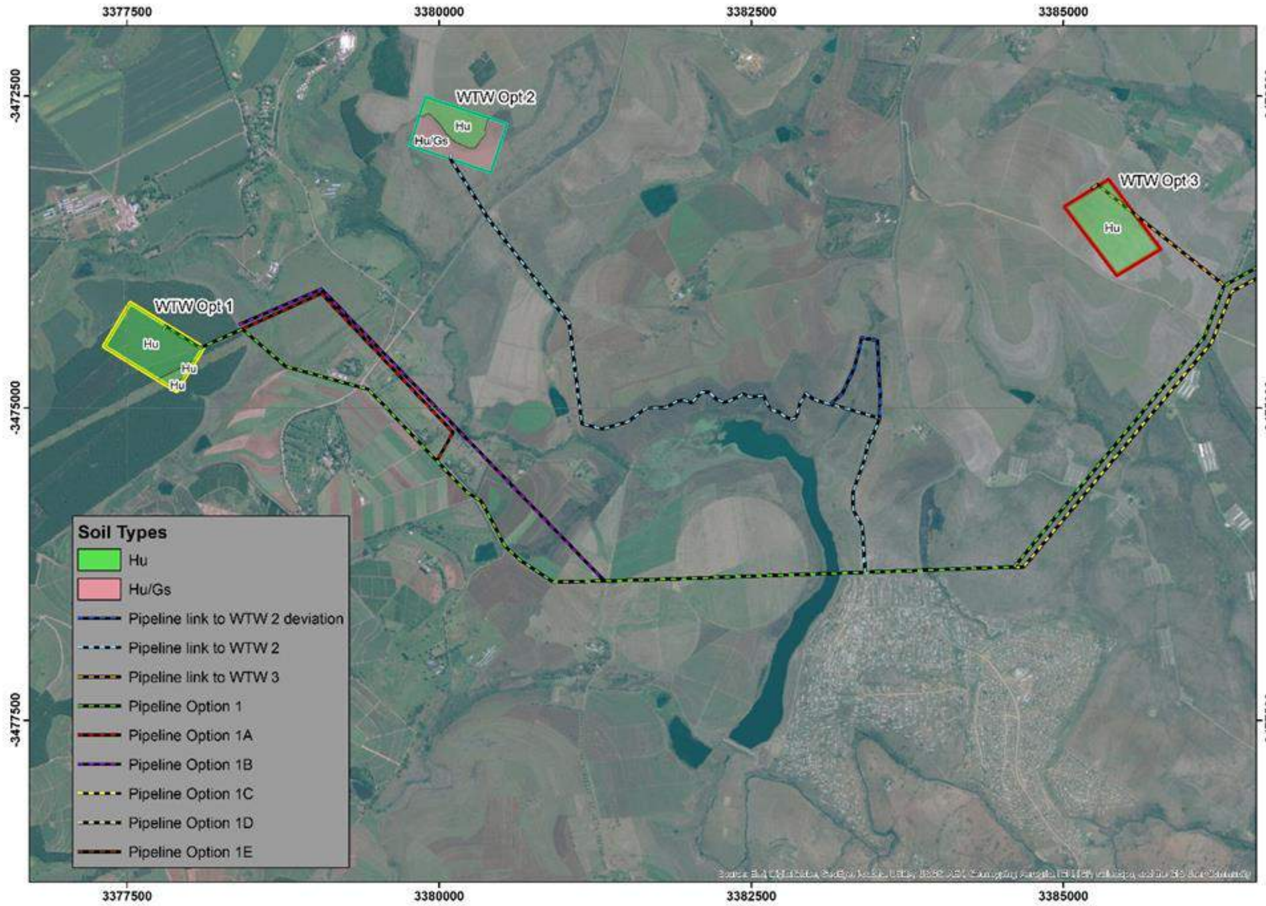


Figure 95: Soil map of the WTW areas (Index, 2015)

10.4.2 Geotechnical Investigations

Geotechnical investigations were undertaken as part of the Technical Feasibility Study. Some of the key findings include:

- All the materials at the WTW options 1 and 2 are low in potential expansiveness, while most of the materials contain a pinhole voided soil structure, which might be prone to collapse settlement upon wetting.

- No water seepage was encountered in any of the test pits. The presence of ferricrete is an indication of a fluctuating ground water table and therefore measures should be put in place to deal with possible groundwater.
- Foundation recommendations for WTW options 1 and 2 site are provided.
- Findings on the corrosiveness of the soils are provided.
- Three main soil types were encountered along the pipeline route, namely colluvial sandy clays (low potential expansiveness), residual shale (low potential expansiveness) and residual tillite (low to medium potential expansiveness).
- Pipe jacking will be required at various areas along the potable water pipeline routes.
- The material along the pipeline route was deemed as unsuitable for bedding material due to its high plasticity characteristics.
- Spoil from the pipe trench excavation is suitable for general backfilling.
- The soils along the pipeline routes are corrosive to mildly corrosive towards steel are cathodic protection is thus required.
- Recommendations are provided for the options associated with the crossing of Mapstone Dam.

10.5 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.

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).

Groundwater Resource Quality Objectives (RQOs) were determined as part of the Comprehensive Reserve and RQOs in the Mvoti to Umzimkulu Water Management Area (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. The EIA study area falls within the U60B quaternary catchment, which is located in GRU 28 of the Integrated Unit of Analysis (IUA) U6-1 UPPER MLAZI. Key findings of this study for this GRU include:

- Groundwater use in the IUA is minimal;
- The moderate borehole yields imply that over abstraction on a localised scale is possible and borehole abstraction rates should consider sustainable yields derived from pumping tests and aquifer recharge volumes;
- The Groundwater component of baseflow is only 9-17%, hence the potential of groundwater abstraction to impact on baseflow is limited to low;
- GRU 28 is of moderate aquifer vulnerability;
- The present status is A (unmodified);
- Groundwater quality is generally good;
- The Harvest Potential is greater than the aquifer recharge for U60B hence the sustainable abstractable volume is assumed to be 65% of aquifer recharge; and
- The groundwater RQOs are presented in **Table 35**.

Table 35: Narrative and Numerical RQOs (DWS, 2015)

GRU	Quat	Groundwater narrative RQO				Groundwater numerical RQO
		Abstraction	Baseflow	Water Level	Water Quality	
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

10.6 Topography

The terrain morphology of the project area is dominated by undulating hills and lowlands. The 20m contour intervals are also shown in **Figure 96**.

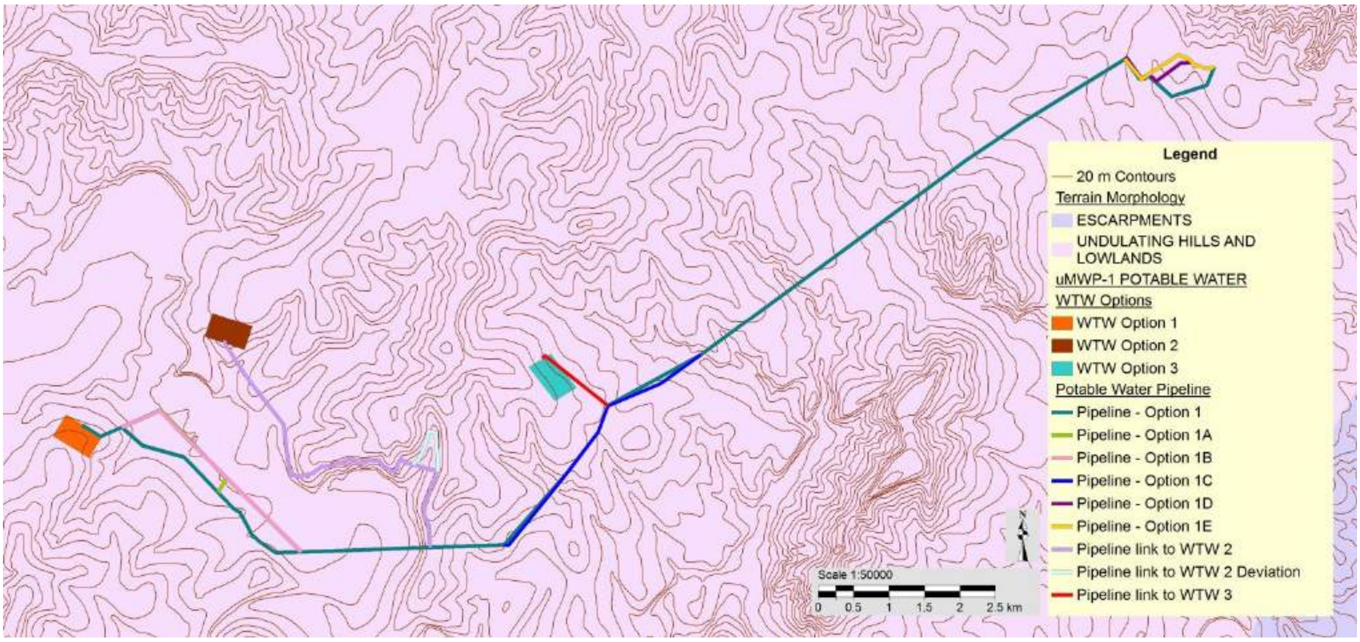


Figure 96: Terrain morphology and 20m contours

Figure 97: South-west view of terrain along option 1 pipeline route (Mapstone Dam in foreground)

The Option 1 pipeline route commences (from west to east) at an elevation of approximately 865 masl from the WTW Option 1. The pipeline termination point in Umlaas Road is situated at an elevation of approximately 790 masl. Particularly steep areas are encountered along pipeline route Option 1 and the link to WTW 2 to the east and north of Mapstone Dam, respectively.

Elevated areas are not preferred for the pipeline route due to the influence to the hydraulic gradient and the prevention of impacts to environmental features such as aesthetics and soil (erosion).

10.7 Surface Water

10.7.1 Affected Rivers and Streams

For the discussion to follow watercourses are considered as rivers, streams, natural channels (perennial and seasonal), wetlands and dams, as defined in the National Water Act (Act No. 36 of 1998).

The following watercourses are directly affected by the uMWP-1 Potable Water infrastructure (refer to **Figure 98**):

- From west to east, Option 1 of the potable water pipeline crosses 12 tributaries (and a number of drainage lines) of the uMlaza River, as well as the Mapstone Dam (see **Figure 99**) which is situated on the main stem of the uMlaza River;
- Options 1A, 1B and 1C of the pipeline route, as well as the link to the WTW Option 2, traverse tributaries of the uMlaza River;
- The proposed access roads to the WTW Options 1 and 2 cross tributaries of the uMlaza River.

The proximity of the WTW alternative sites to the nearest watercourses are as follows:

- WTW Option 1 – approximately 130m east and 480m south of tributaries of the uMlaza River;
- WTW Option 2 – possible encroachment into a watercourse in the south-western corner of the site; and
- WTW Option 3 – more than 1km to the north and south of tributaries of the uMlaza River.

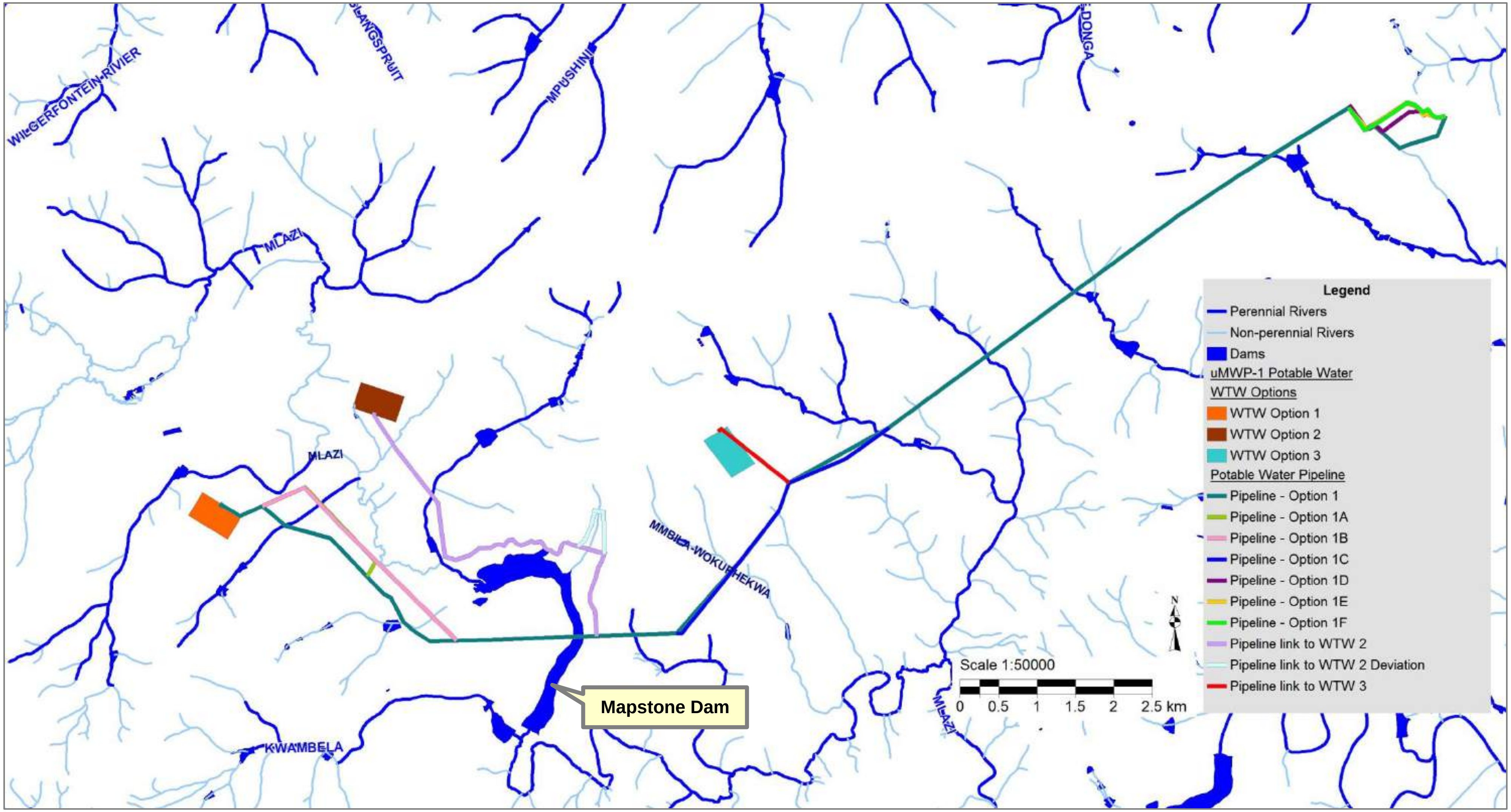


Figure 98: Watercourses in the study area

Figure 99: North-west (left) and south-west (right) view of Mapstone Dam near proposed crossing of pipeline route Option 1

10.7.2 Hydrology

The uMlaza River (also known as the Mlazi or uMlaza River) is located in the Mvoti to Umzimkulu Water Management Area (WMA) and the project area falls within the U60B and U60C quaternary catchments (see **Figure 100**). The uMlaza River originates south west of Pietermaritzburg at 1 500masl. In the upper uMlaza, the main land-use types are agriculture, forestry and small rural and peri-urban settlements. The river flows through the Baynesfield and Mapstone dams before entering the Tala Valley, an area of intense commercial agriculture and isolated forestry.

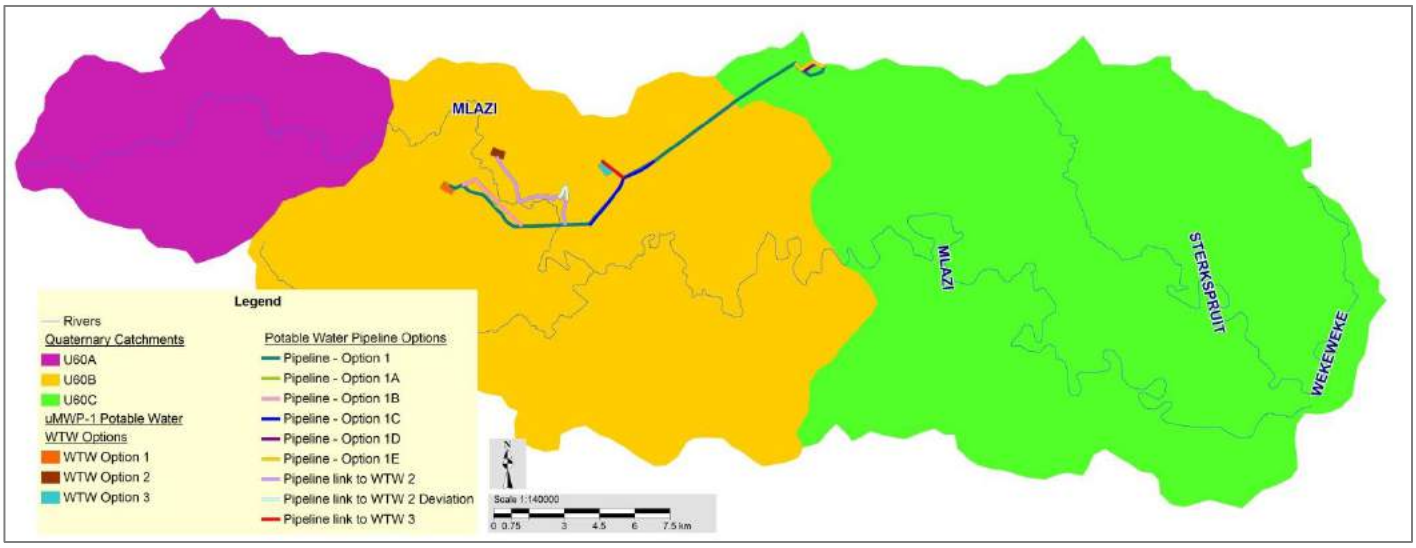


Figure 100: WMA & Quaternary Catchments

A breakdown of the hydro-meteorological characteristics of the upper uMlaza River catchment, focusing on quaternary catchments U60A (upstream) and U60B, is presented in **Table 36**.

Table 36: Hydro-meteorological characteristics of the upper uMlaza River catchment (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)*
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.

10.7.3 Water Use

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. 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. 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.

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 invasive alien plants (AIPs) on the water resources of the catchments is, however, small, with an associated annual water use of under 7 million m^3.

A hydrological assessment was undertaken of the uMkhomazi and upper uMlaza River catchments as part of the uMWP-1 Feasibility Study (DWA, 2013b). The water use estimates for the upper uMlaza river catchment (quaternary catchments U60A and U60B) are summarised in the table to follow (refer to **Figure 101**).

Table 37: Summary of final water use estimates for the upper uMlaza river catchment, at the 2008-development level (DWA, 2013b)

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)		
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.

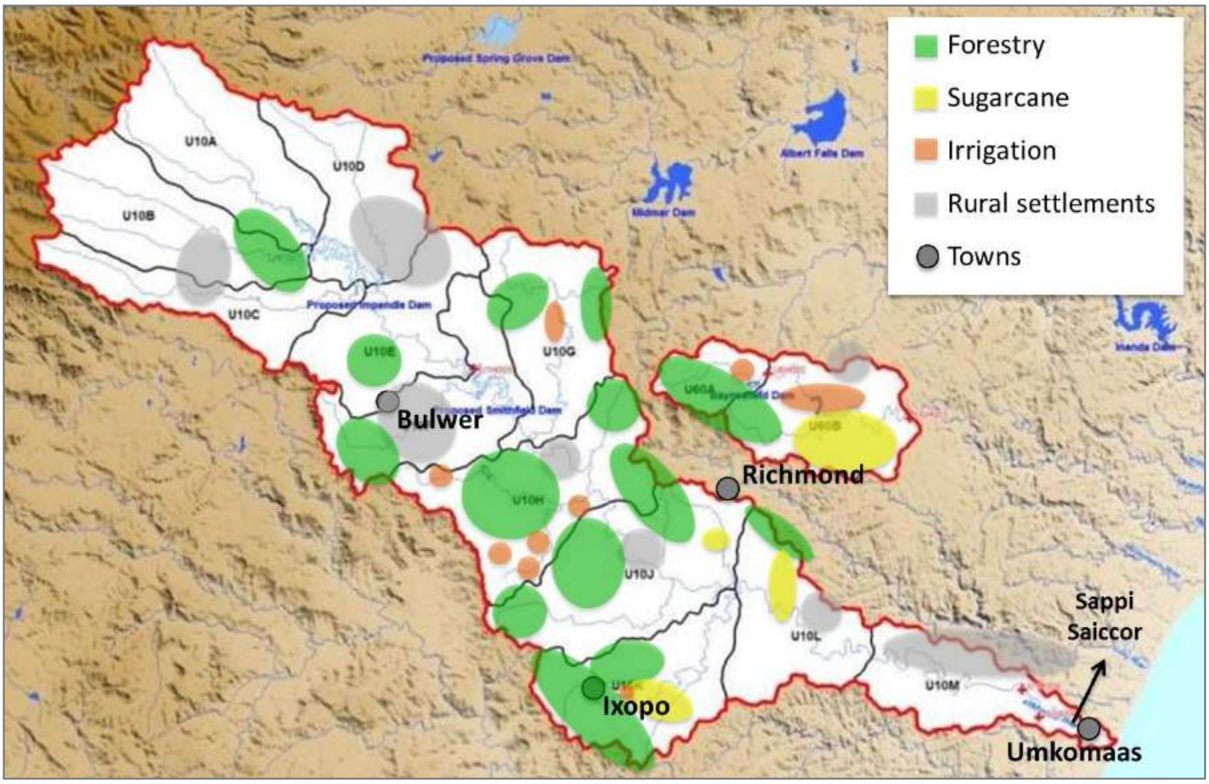


Figure 101: Major land use in relevant uMWP-1 catchments

10.7.4 Ecological Status

10.7.4.1 River Health Programme

The River Health Programme (RHP) notes the following with regards to the uMlaza River (WRC, 2002) (see **Figure 102**):

- **Water quality** in the upper uMlaza is Good,
- **Riparian habitat** is Good in the upper reaches, but invasive alien plants are a major problem especially in the lower reaches, despite control efforts. The riparian zone is also affected by heavy stock grazing;
- **Instream habitat** is Natural in the upper reaches aided by removal of alien plants from the banks.
- **Invertebrates** upstream of Shongweni Dam are in Good condition due to the presence of several pollution sensitive species;
- **Fish** are in Good condition but Fair in the middle reaches and Poor in the sea.

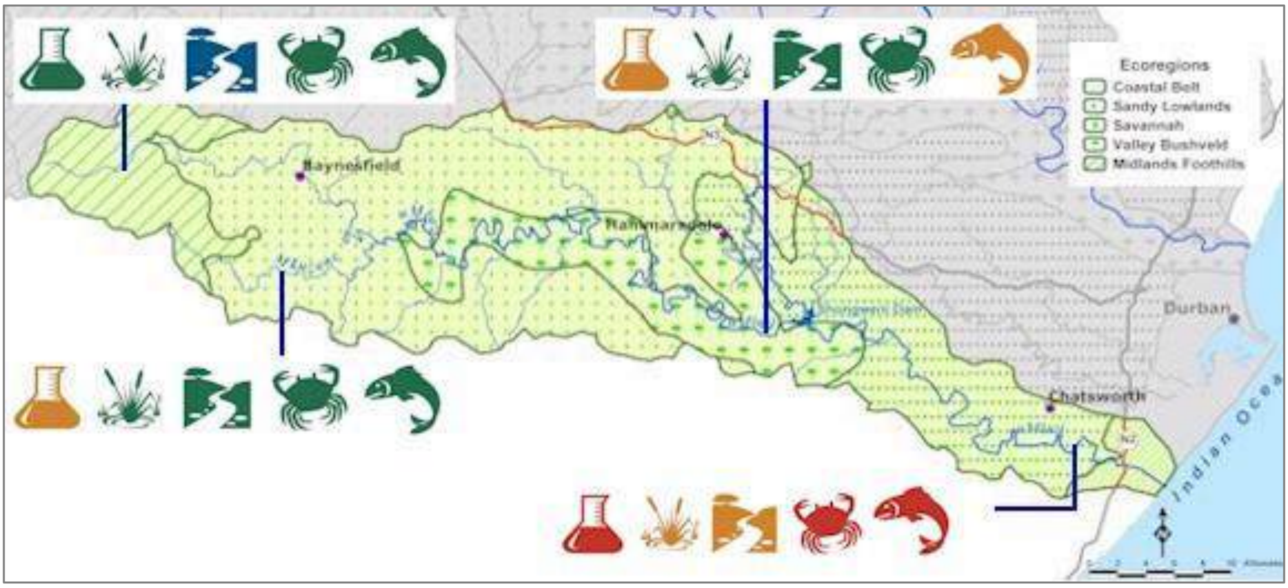


Figure 102: River health of uMlaza River (WRC, 2002)

According to the RHP (WRC, 2002), the drivers of river health in the upper catchment of the uMlaza River include the following:

- Regulation of river flow by impoundments;
- Abstraction for irrigation and water use by plantation forests;

- Excessive nutrient inputs (mainly by agricultural activities in the upper catchment) to the river leading to eutrophication (excessive nutrient enrichment of water);
- Rampant aquatic weed growth; and
- Sand mining for construction purposes.

10.7.4.2 Reserve Determination

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.

A Status Quo Report was prepared as part of the abovementioned 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 38** shows the PES per Sub Quaternary (SQ) river reaches that have bearing on uMWP-1.

Table 38: 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	Mkomazi	**C**	Non-flow: Sedimentation, overgrazing, erosion.
U10F-04528	Mkomazi	**B/C**	Non-flow: Sedimentation, riparian zone, erosion.
U60A-04533	Mlazi	C	Non flow[1]: Forestry, water quality, agriculture lands. Flow[2]: Instream dams – irrigation.

In the Upper Mlazi zone, which includes the area designated for the uMWP-1 balancing dam, the SQ has a C PES. Predominant impacts are non-flow related (forestry, agricultural activities, alien invasive vegetation and water quality).

10.7.4.3 Aquatic Impact Assessment

An Aquatic Impact Assessment was conducted (see **Appendix H2**) for the project. Refer to **Sections 11.1.2** and **12.4** for a synopsis of the study and a related impact assessment, respectively.

10.7.5 Water Quality

A water quality assessment was conducted for uMWP-1 by Umgeni Water. An extract from this study follows.

The aims of the water quality assessment were as follows:

- 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.

In the receiving uMlaza River catchment, water quality monitoring was set up in October 2012 at a monthly frequency at the following sites:

- RBY001 – uMlaza Baynesfield Dam inflow;
- DBY001 – Baynesfield Dam integrated; and
- RMBG001 – Mbangweni Dam inflow.

Since monthly monitoring only commenced in Oct-2012, only six samples have been considered for this assessment and as the statistics are based on few results, the findings must be viewed with caution. However, since the samples were taken in an above average summer rainfall period, they will generally be biased towards elevated results for determinants associated with significant rainfall-runoff events.

Findings include:

- All pH results ranged from 7 to 8.2, within the range of natural waters;
- *E. coli* counts were moderate with summer median values of 250 and 343 per 100 ml at the Mbangweni and Baynesfield Dams inflows respectively. 95th percentile *E. coli*

counts ranged between 350 and 662 per 100 ml. Significant in-dam improvement of bacteriological quality was recorded with median counts of 18 per 100 ml, and 95th percentile count of 98 per 100 ml at the Baynesfield Dam integrated sample point;

- Low conductivity results were recorded in the upper uMlaza catchment (< 8 mS/m), associated with low dissolved salt concentrations;
- Moderate total organic carbon results were recorded with median concentrations of 2.37 and 2.26 mg/l at the Mbangweni and Baynesfield Dams inflows respectively. A low median colour result of 3.95 °H was noted at both sites. However, the first flush of significant rainfall in the catchment, recorded elevated TOC concentrations and colour results of up to 4.75 mg/l and 11.8 °H respectively.
- Turbidity results collected in summer in the upper uMlaza catchment were moderate. The Mbangweni Dam inflow turbidity results (median 25.8 NTU, 95th percentile 45.4 NTU) were higher than the Baynesfield Dam inflow results (median 10.9 NTU, 95th percentile 27.1 NTU).
- In terms of nutrient trends, average summer soluble reactive phosphorus concentrations were 3.7 and 5.4 µg/l for the Baynesfield Dam inflow and Mbangweni Dam inflow respectively, indicating oligo-mesotrophic conditions. However, the average total phosphorus concentration was significantly higher at the Mbangweni Dam inflow (69 µg/l) compared to the Baynesfield Dam inflow (41 µg/l). Average summer inorganic nitrogen concentrations were calculated to be 0.6 and 0.5 mg/l at the Baynesfield Dam inflow and Mbangweni Dam inflow respectively, indicating mesotrophic conditions.
- In terms of toxic metals, all results were less than the analytical detection limit, with the exception of a single chromium result (9.65 µg/l) at the Baynesfield Dam inflow, significantly less than the SANS 241: 2011 limit of 50 µg/l for drinking water.

Overall the quality of water flowing into the proposed Langa balancing dam option (forms part of the infrastructure associated with the uMWP-1 Raw Water component, as shown in **Figure 8**), under abnormal operating conditions when the tunnel is being inspected or maintained, was good to satisfactory.

10.7.6 Riparian Habitat

As with the aquatic biota, the RHP (WRC, 2002) found the river health of the uMlaza River in the study area in terms of the riparian zone to be Good. The riparian area provides habitat for aquatic and terrestrial species, contributes towards maintaining the form of the river channel and serves as filters for sediment, nutrients and light.

The structure and function of riparian vegetation in the study area has been altered by vegetation removal, cultivation, erosion, sedimentation and invasion by alien vegetation within or close to the riparian zone.

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 **12.5**, respectively. In addition, an Aquatic and Riverine Assessment was also conducted (see **Appendix H2**) and **Sections 11.1.2** and **12.4** contain a synopsis of the study and a related impact assessment, respectively.

10.7.7 Wetlands

10.7.7.1 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.

10.7.7.2 Hydrological Assessment

As part of the uMWP-1 Feasibility Study's hydrological assessment (DWA, 2013b), 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;

- ❖ 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.

10.7.7.3 FEPA

The FEPA wetlands in the study area are shown in **Figure 103**. The following is noted:

- ❖ The WTW Option 2 site encroached on a NFEPA wetland;
- ❖ No NFEPA wetlands are traversed by the potable water pipeline route options; and
- ❖ There are no wetland clusters in the study area.

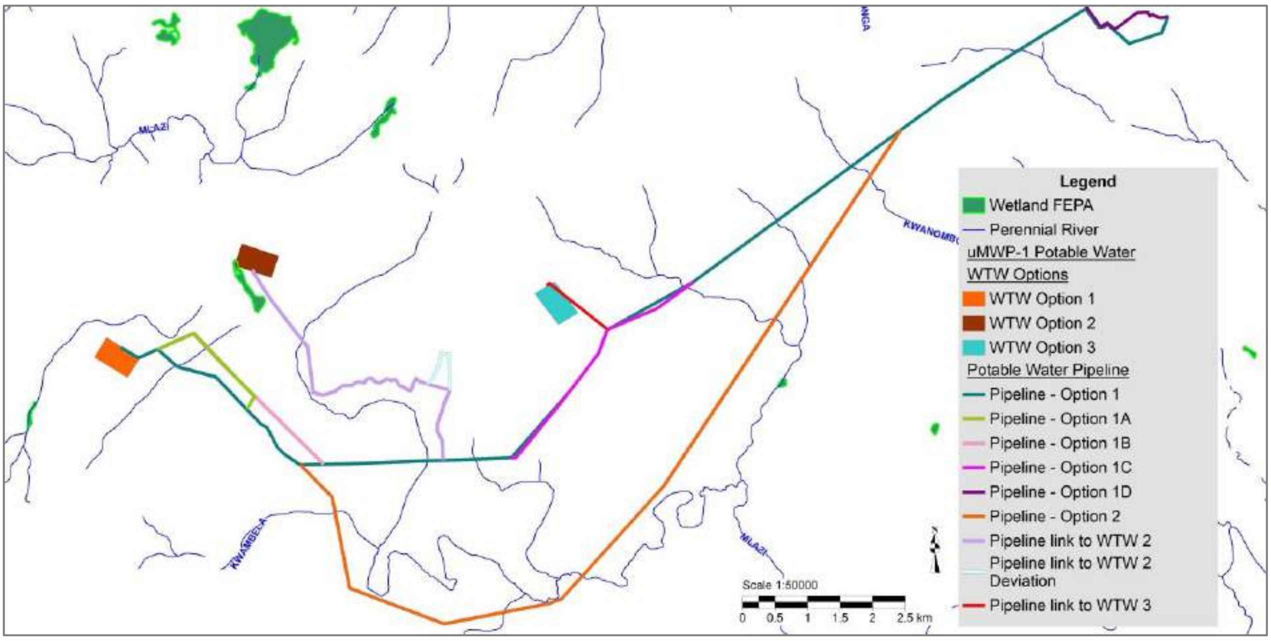


Figure 103: FEPA wetlands (Note: disregard Pipeline Option 2)

10.8 Terrestrial Ecology

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 11.7** and **12.11**, respectively.

10.8.1 Flora

10.8.1.1 General Description

According to Scott-Shaw and Escott (2011), the study area includes Grassland and Wetland Biomes (see **Figure 104**). The Grassland Biome is found mainly on the high central plateau of South Africa, and the inland areas of KwaZulu-Natal and the Eastern Cape. Grasslands are dominated by a single layer of grasses. Trees are absent, except in a few localised habitats and geophytes are often abundant (Low and Rebelo, 1996).

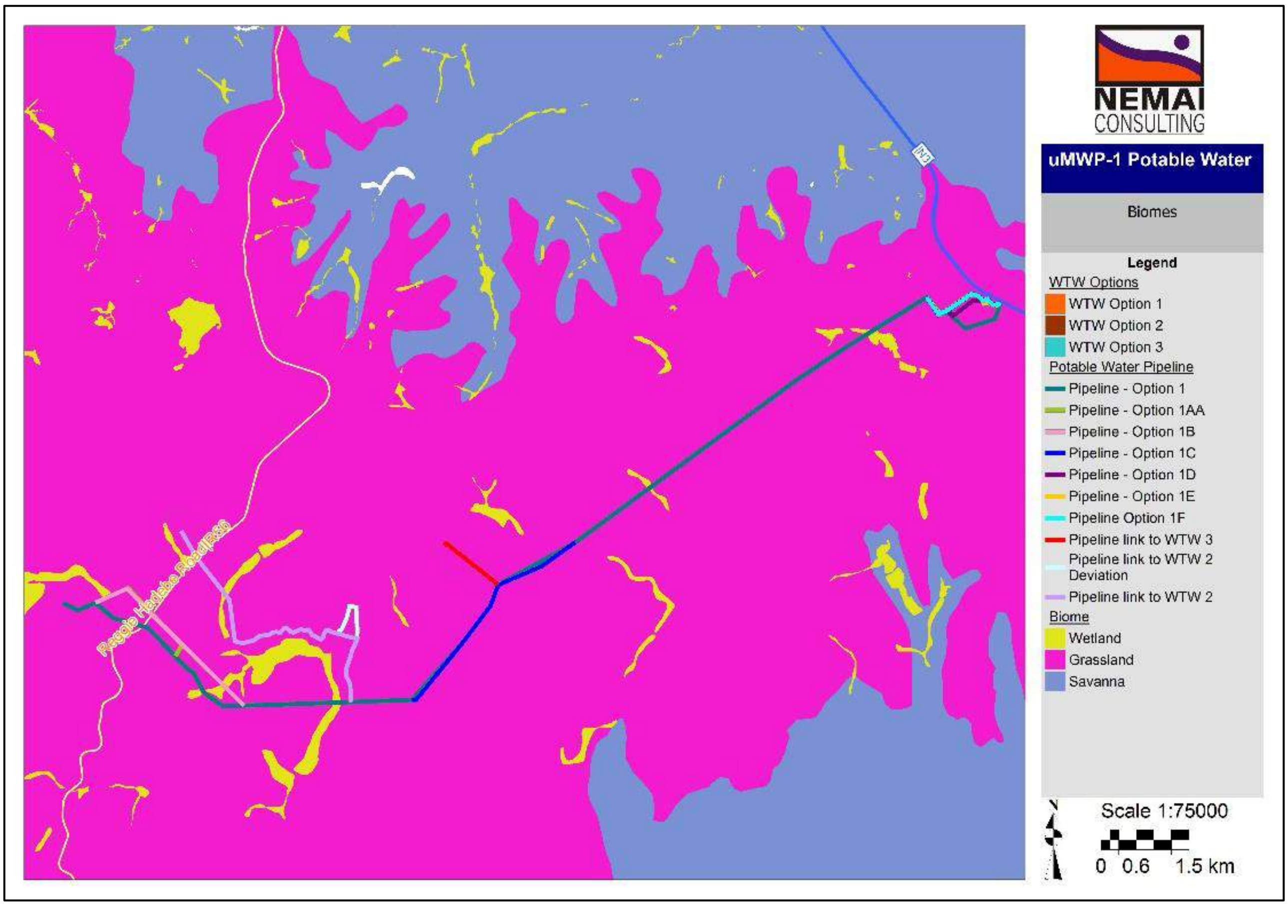


Figure 104: Biomes in project area

As shown in **Figure 105**, the project footprint falls within the following vegetation types (Scott-Shaw and Escott, 2011):

- Midlands Misbelt Grassland;
- Moist Coast Hinterland Grassland;
- Dry Coast Hinterland Grassland; and

❖ Alluvial Wetlands: Temperate Alluvial Vegetation.

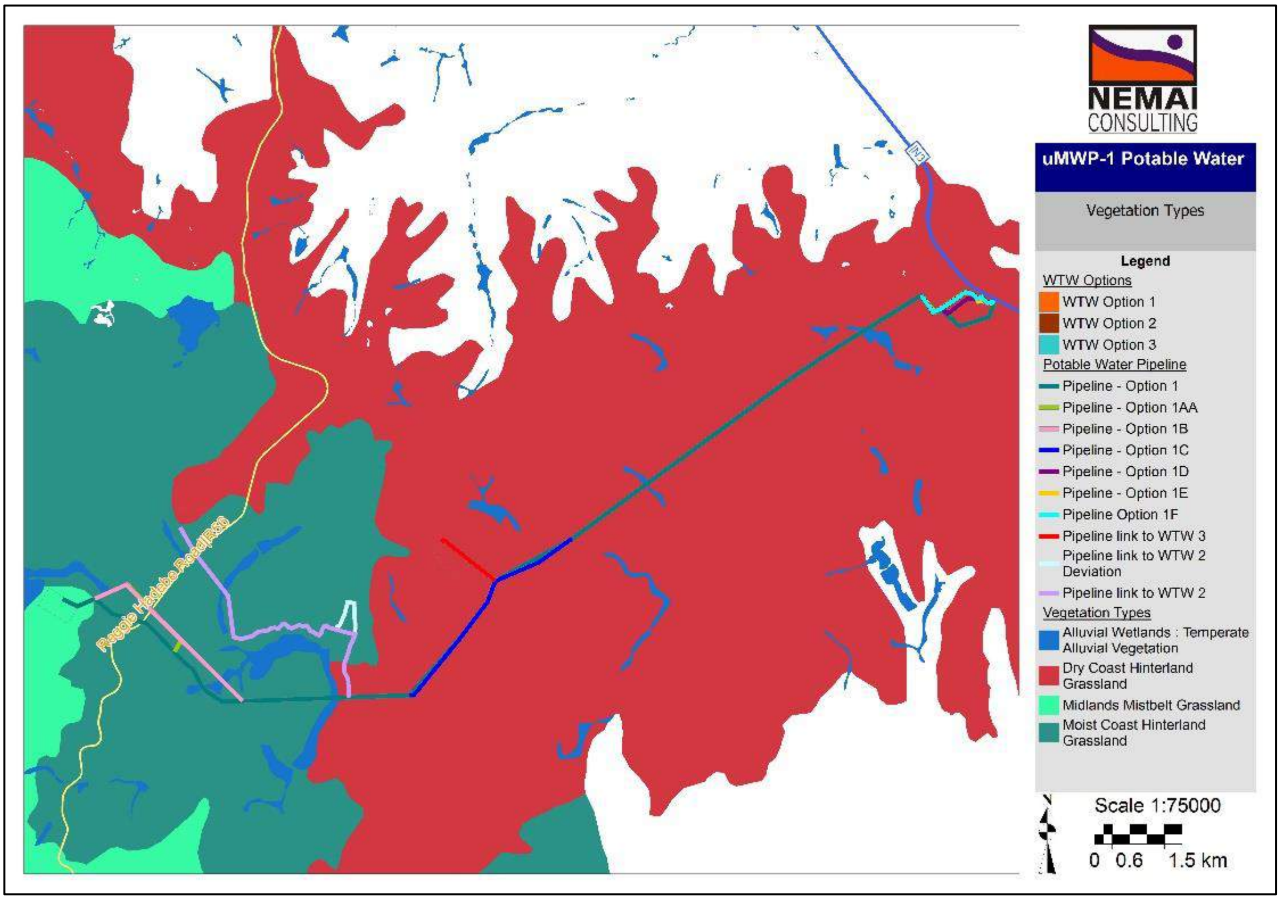


Figure 105: Vegetation Types in project area

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).**

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, 2011). 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, 2011).

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).

10.8.1.2 Plant Species

The proposed project site is located within 2930CB, 2930CD and 2930DA quarter degree squares in terms of the 1:50 000 grid of South Africa. 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 39 provides details on the Red Data plant species which have been recorded in the aforementioned grid cells, which could potentially be found within the project area.

Table 39: Threatened plant species recorded in grid cells 2930CB, 2930CD and 2930DA

Family	Species	Threat status	SA Endemic	Growth forms
QDS 2930CB				
Acanthaceae	*Thunbergia venosa* C.B.Clarke	Rare	No	Herb
Amaryllidaceae	*Clivia miniata* (Lindl.) Regel var. *miniata*	VU	No	Geophyte
Amaryllidaceae	*Crinum macowanii* Baker	Declining	No	Geophyte
Amaryllidaceae	*Nerine pancratioides* Baker	VU	No	Geophyte
Anacardiaceae	*Loxostylis alata* A.Spreng. ex Rchb.	Declining	No	Shrub, tree
Apocynaceae	*Brachystelma franksiae* N.E.Br. subsp. franksiae	VU	No	Herb, succulent
Apocynaceae	*Brachystelma gerrardii* Harv.	EN	No	Herb, succulent
Asphodelaceae	*Aloe cooperi* Baker subsp. *cooperi*	Declining	No	Herb, succulent
Asphodelaceae	*Aloe pruinosa* Reynolds	VU	No	Herb, succulent
Asteraceae	*Gerbera aurantiaca* Sch.Bip.	EN	No	Herb
Asteraceae	*Senecio dregeanus* DC.	VU	No	Herb
Asteraceae	*Senecio exuberans* R.A.Dyer	EN	No	Herb
Asteraceae	*Senecio umgeniensis* Thell.	Threatened	No	Herb
Celastraceae	*Elaeodendron croceum* (Thunb.) DC.	Declining	No	Tree
Colchicaceae	*Sandersonia aurantiaca* Hook.	Declining	No	Climber, geophyte, herb
Cornaceae	*Curtisia dentata* (Burm.f.) C.A.Sm.	NT	No	Shrub, tree
Cyatheaceae	*Alsophila capensis* (L.f.) J.Sm.	Declining	No	Tree
Dioscoreaceae	*Dioscorea brownii* Schinz	VU	No	Geophyte, herb, succulent
Fabaceae	*Crotalaria dura* J.M.Wood & M.S.Evans subsp. *dura*	NT	No	Dwarf shrub, herb
Hyacinthaceae	*Merwilla plumbea* (Lindl.) Speta	NT	No	Geophyte
Hypoxidaceae	*Hypoxis hemerocallidea* Fisch., C.A.Mey. & Avé-Lall.	Declining	No	Geophyte
Iridaceae	*Dierama pallidum* Hilliard	VU	No	Geophyte, herb
Iridaceae	*Moraea graminicola* Oberm. subsp. *graminicola*	NT	No	Geophyte, herb
Iridaceae	*Moraea hiemalis* Goldblatt	NT	No	Geophyte, herb
Lauraceae	*Cryptocarya myrtifolia* Stapf	VU	No	Tree
Rhizophoraceae	*Cassipourea gummiflua* Tul. var. *verticillata* (N.E.Br.) J.Lewis	VU*	No	Tree

Family	Species	Threat status	SA Endemic	Growth forms
QDS 2930CD				
Asteraceae	*Senecio umgeniensis* Thell.	Threatened	No	Herb
Hyacinthaceae	*Merwilla plumbea* (Lindl.) Speta	NT	No	Geophyte
Malvaceae	*Hermannia sandersonii* Harv.	VU	No	Dwarf shrub
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
Zamiaceae	*Encephalartos natalensis* R.A.Dyer & I.Verd.	NT	No	Shrub, tree
QDS 2930DA				
Amaryllidaceae	*Clivia gardenii* Hook.	VU	No	Geophyte
Amaryllidaceae	*Clivia miniata* (Lindl.) Regel var. *miniata*	VU	No	Geophyte
Apocynaceae	*Brachystelma franksiae* N.E.Br. subsp. *franksiae*	VU	No	Herb, succulent
Apocynaceae	*Brachystelma pulchellum* (Harv.) Schltr.	NT	No	Geophyte, succulent
Apocynaceae	*Schizoglossum peglerae* N.E.Br.	EN	No	Herb, succulent
Apocynaceae	*Woodia verruculosa* Schltr.	VU	No	Herb, succulent
Asteraceae	*Cineraria atriplicifolia* DC.	VU	No	Herb
Asteraceae	*Helichrysum pannosum* DC.	EN	No	Herb
Asteraceae	*Helichrysum woodii* N.E.Br.	Rare	No	Dwarf shrub
Asteraceae	*Senecio exuberans* R.A.Dyer	EN	No	Herb
Asteraceae	*Senecio umgeniensis* Thell.	Threatened	No	Herb
Fabaceae	*Argyrolobium longifolium* (Meisn.) Walp.	VU	No	Dwarf shrub
Fabaceae	*Crotalaria dura* J.M.Wood & M.S.Evans subsp. *dura*	NT	No	Dwarf shrub, herb
Fabaceae	*Indigofera hybrida* N.E.Br.	VU	No	Herb
Hyacinthaceae	*Pseudoprospero firmifolium* (Baker) Speta subsp. *natalensis*	VU	No	[No lifeform defined]
Hypoxidaceae	*Hypoxis hemerocallidea* Fisch., C.A.Mey. & Avé-Lall.	Declining	No	Geophyte
Iridaceae	*Dierama pallidum* Hilliard	VU	No	Geophyte, herb
Malvaceae	*Hermannia sandersonii* Harv.	VU	No	Dwarf shrub
Malvaceae	*Pavonia urens* Cav. var. *urens*	Threatened	No	Dwarf shrub, shrub
Rhizophoraceae	*Cassipourea gummiflua* Tul. var. *verticillata* (N.E.Br.) J.Lewis	VU*	No	Tree
Rosaceae	*Prunus africana* (Hook.f.) Kalkman	VU	No	Tree
Zamiaceae	*Encephalartos natalensis* R.A.Dyer & I.Verd.	NT	No	Shrub, tree
Zamiaceae	*Encephalartos woodii* Sander	EW	No	Tree

Note: NT=Near Threatened; VU=Vulnerable; EN=Endangered; EW=Extinct in the Wild

10.8.1.3 Plant life affected by project footprint

The status of the plant life in the areas affected by the Potable Water components is as follows:

❖ WTW Options –

- Little to no natural vegetation remains at the three WTW sites due to agriculture (Options 2 and 3) and timber plantation (Option 1); and

❖ Potable Water Pipeline Options –
- The majority of the pipeline routes traverse areas disturbed by agriculture. More natural areas (primarily grassland) exist adjacent to watercourses and on steep slopes.

During the field surveys, no threatened plant species were observed on site but only two (2) species of conservation importance were noted, namely *Hypoxis hemerocallidea* (Star flower/African potato) and *Boophane disticha* (Century plant). These two plant species were recorded on grasslands along Pipeline to Link WTW 2.

10.8.1.4 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.

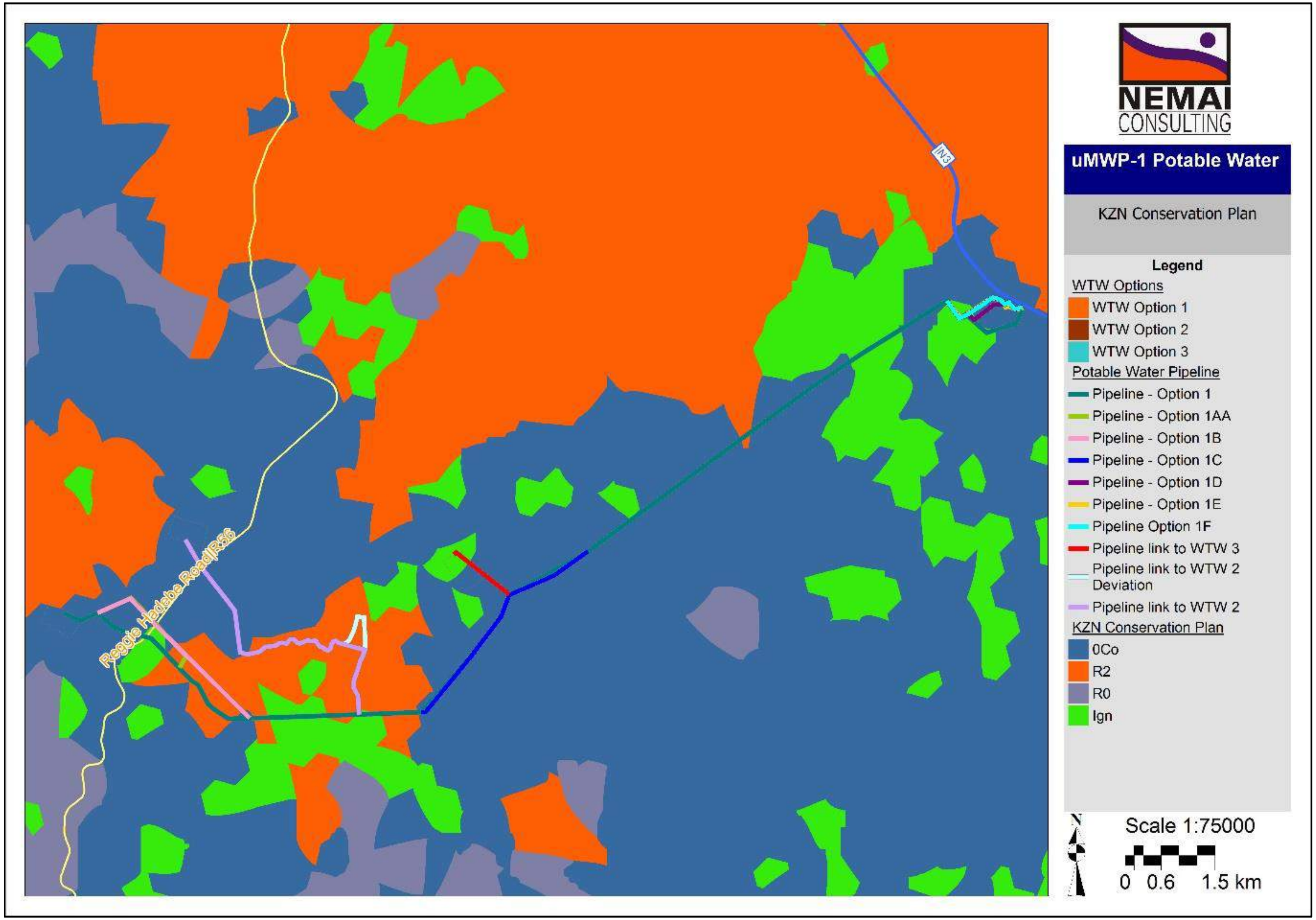
The above layers are informed by the outcomes of the KZN systematic conservation planning process, as well as several other datasets identifying CBA areas, including the National Threatened Ecosystems coverage’s, and the NFEPAs.

According to the KZN Provincial Biodiversity Plan (see **Figure 106**), the following can be deduced:

❖ WTW Options –
- The majority of WTW Option 1 site is situated in an area that is not of conservation importance, with the northern section falling in a CBA 1;
- WTW Option 2 is located in an area that is not of conservation importance;
- The WTW option 3 site lies within areas that are not of conservation importance (southern part) and 100% transformed (northern part);

❖ Potable Water Pipeline Options –
- Sections in the western, central and eastern parts of the Option 1 pipeline route traverse CBA 1;
- The eastern sections of the potable water route options predominantly cross areas that not of conservation importance (northern part) or 100% transformed;
- The south-eastern sections of the Options 1A and 1B routes traverse CBA 1;
- Option 1C traverses an area that is not of conservation importance;
- Options 1D, 1E and 1 F cross areas that are 100% transformed (western section) and not of conservation importance (eastern section);
- The southern section of the pipeline link to WTW Option 2 passes through CBA 1 and the deviation to this route falls entirely within CBA 1; and
- The pipeline link to WTW Option 3 traverses areas that not of conservation importance (southern section) or 100% transformed (northern section).

CBA 1 Mandatory are areas which are required to meet biodiversity conservation targets, and where there are no alternative sites available. **CBA 3 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),* ***R0*** *(CBA 3 Optimal),* ***R2*** *(CBA 1 Mandatory) and* ***Ign*** *(100% transformed based on 2005 land cover)*

Figure 106: KZN Provincial Biodiversity Plan in relation to the project area

10.8.1.5 Threatened Ecosystems

The following threatened ecosystems are affected by the project (see **Figure 107**):

❖ **Midlands Mistbelt Grassland** –
- South-eastern part of WTW Option 1;
- Small section of Option 1 potable water pipeline route;

❖ **Ngongoni Veld** –
- South part of WTW Option 2;
- Sections of all the potable water pipeline routes, except the link to WTW Option3.

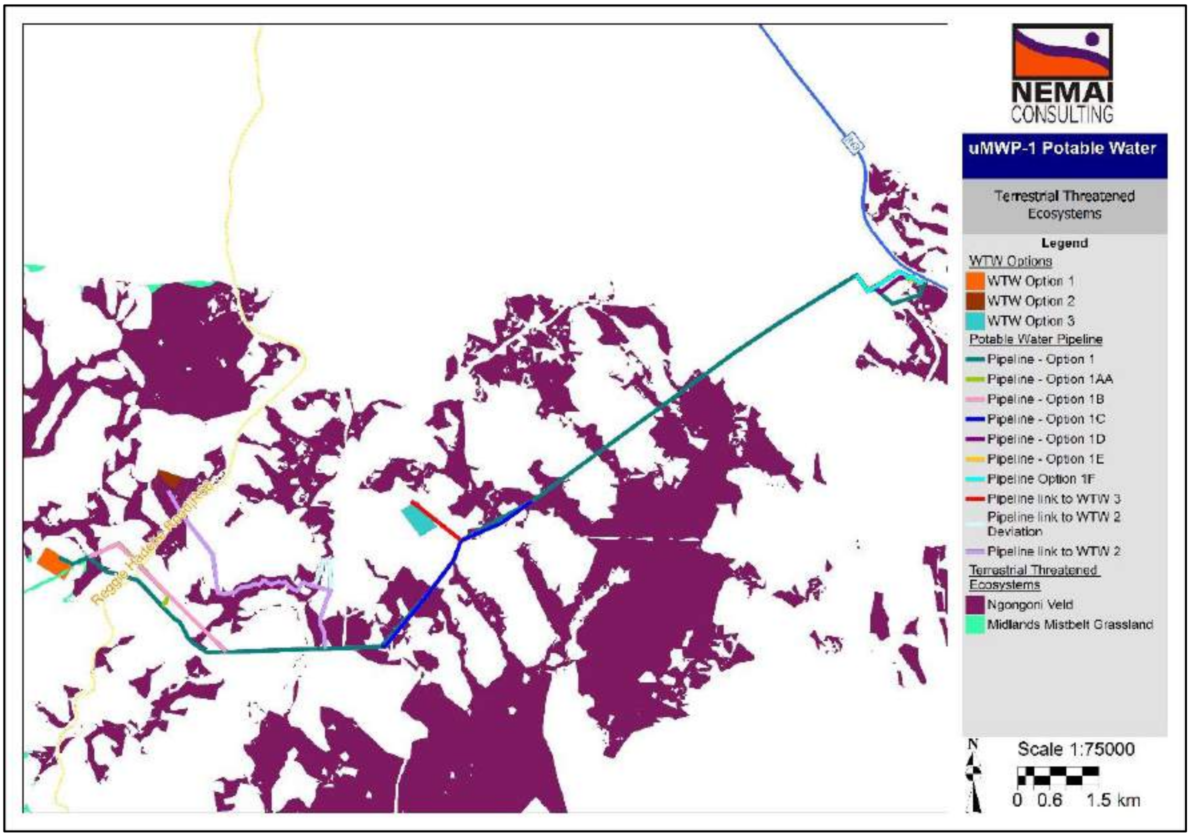


Figure 107: Threatened Ecosystems

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;
- 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, 2004 (Act No. 10 of 2004), a national list of ecosystems that are threatened and in need of protection was gazetted on 9 December 2011, Government Notice 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.

- **Midlands Mistbelt Grassland** vegetation type occurs in the KZNl 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)

10.8.1.6 Biodiversity Sector Plans

A Biodiversity Sector Plan has been developed for the uMgungundlovu DM (see **Figure 108**). 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, 2004.

Amongst others, the Biodiversity Sector Plan serves 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, Strategic Environmental Assessment and also EIAs.

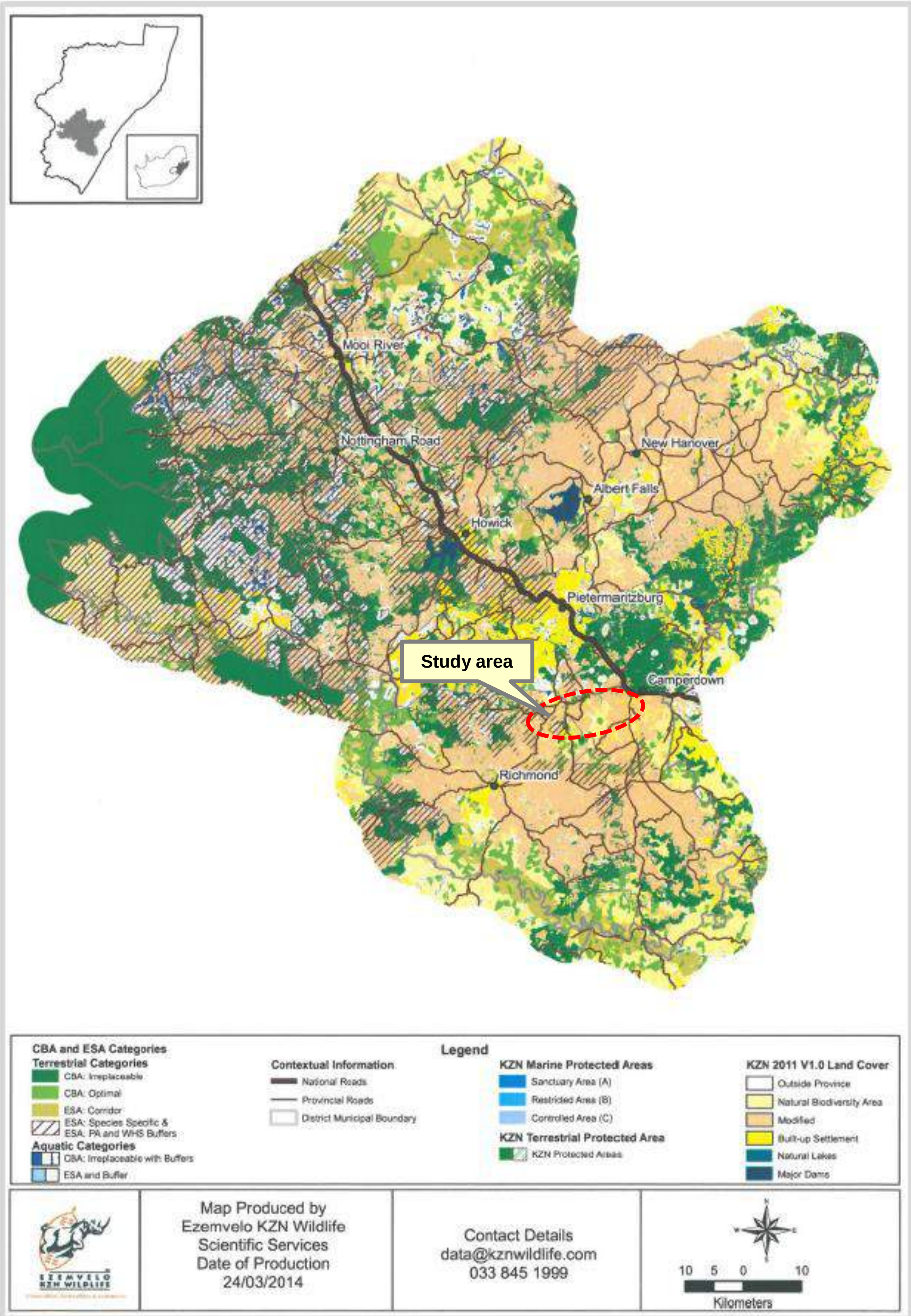


Figure 108: uMgungundlovu DM Biodiversity Sector Plan (EKZNW, 2014)

The uMgungundlovu DM Biodiversity Sector Plan shows the project infrastructure to include the following areas: Transformed, ESA and CBA 1.

10.8.2 Fauna

10.8.2.1 General

The Terrestrial Ecological Impact Assessment (**Appendix H1**) discusses the habitat available for species of conservation importance and the likelihood of occurrence of these species.

10.8.2.2 Mammals

According to the Animal Demography Unit (2015b), Oribi, Blue Duiker, Serval, Ground Pangolin, African White-tailed Rat, Honey Badger, Swinny's Horseshoe Bat, Lesser Long-fingered Bat, Schreibers's Long-fingered Bat, Geoffroy's Horseshoe Bat, Temminck's Myotis, Side-striped Jackal and Common Dasymys are mammal species of conservation importance known to occur in the region.

10.8.2.3 Reptiles

According to the South African Reptile Conservation Assessment (ADU, 2015c), Striped Harlequin Snake, Natal Black Snake, KwaZulu Dwarf Chameleon, Natal Midlands Dwarf Chameleon, Large-scaled Grass Lizard and Nile Crocodile are the reptiles' species of conservation importance known to occur in the region (grid cells).

10.8.2.4 Amphibians

According to Frog Atlas of Southern African (ADU, 2015a) for the grid cells 2930CB, 2930CD and 2930DA, the Red Data frog species that are known to occur in the region include Spotted Shovel-nosed Frog, Natal Leaf-folding Frog and Kloof Frog.

10.8.2.5 Avifauna

An Avifaunal Specialist 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 **12.7**, 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, especially Red Listed species, as this will have a bearing both on the expected frequency of the impacts and the significance of those impacts. Various data sources were used in determining the distribution and abundance of bird species in the study area, which are discussed below.

Southern African Bird Atlas Project 1 Data (SABAP 1) - Harrison *et al,* 1997 and SABAP2

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.

A full list of approximately 450 bird species recorded in the broader area within which this site falls was developed based on the two atlas projects. 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.

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.

The Potable Water Component was identified in the Scoping Phase as infringing on one IBA – SA078 – KwaZulu-Natal mistbelt grasslands. However the EIA Phase has discarded that WTW site option, so this is no longer as serious a consideration. SA078 consists of several smallish polygons which together amount to approximately 5 000 hectares (see **Figure 109**). The main criterion for identifying these areas was the presence of viable units of mistbelt grassland. Most of these polygons support Blue Swallows 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.

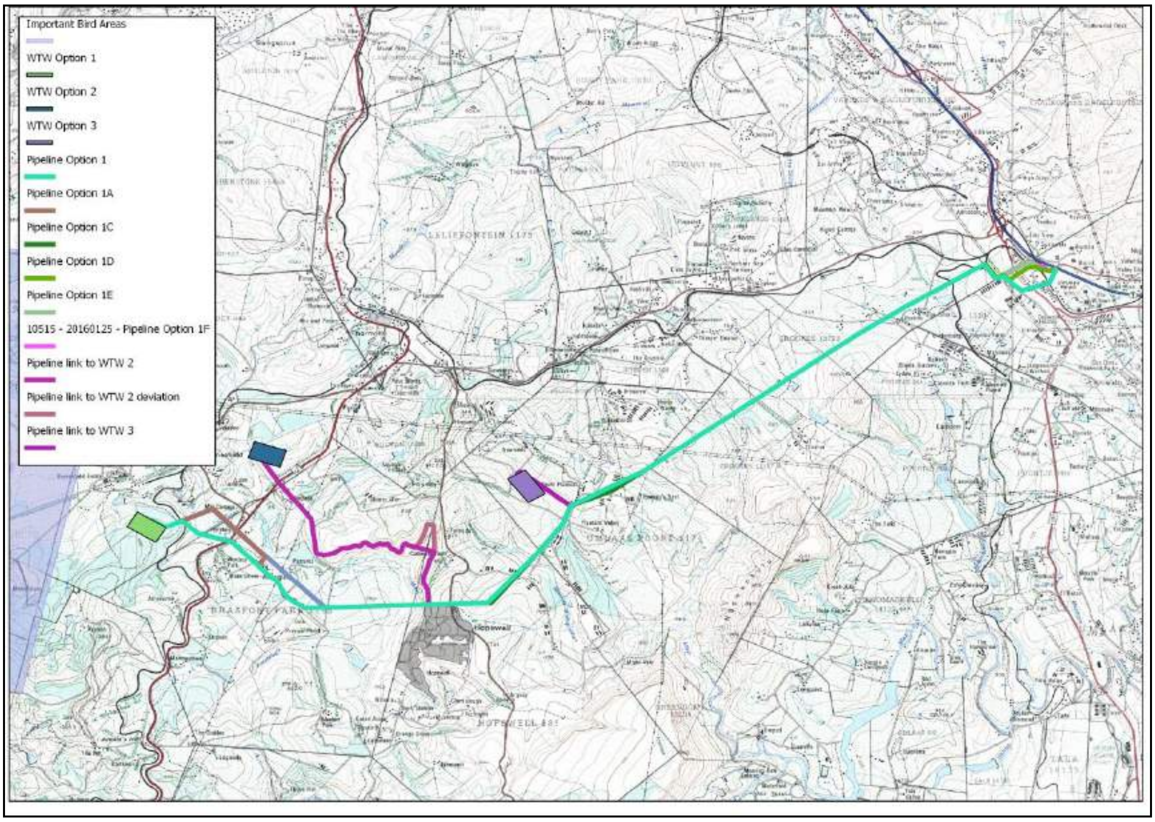


Figure 109: KwaZulu-Natal Mistbelt Grasslands - SA078 – Important Bird Area relative to the proposed project (Wildskies, 2015)

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 110** shows the relevant units for this project. Those units identified primarily on the basis of bird species are shown in coloured polygons according to species. These units were identified as important on the basis of Blue Crane, Wattled Crane (historic sites), Blue Swallow, 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 information in this data source is based on historic occurrence, and this species is considered unlikely to occur in these areas at present (Coverdale pers comm, 2014).

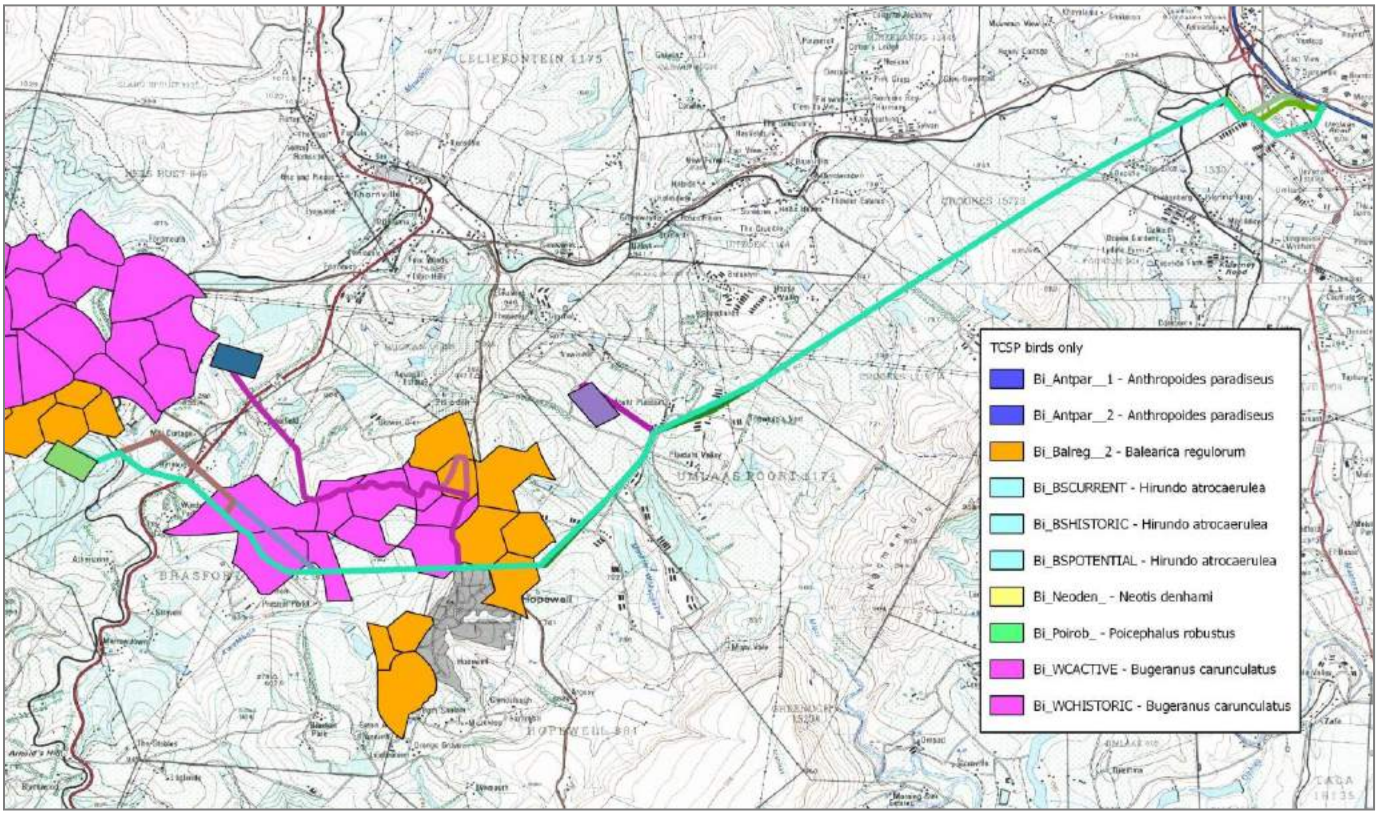


Figure 110: Terrestrial Systematic Conservation Plan – Bird polygons (EKZNW 2010)
(Dark blue = Blue Crane; Light blue = Blue Swallow; Orange = Grey Crowned Crane; Purple = Wattled Crane)

<u>EKZNW Blue Swallow habitat model (2014)</u>

The results of a Blue Swallow habitat modelling exercise conducted by EKZNW were examined to determine whether any such potential habitat exists in this study area. 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. No potential habitat was identified in the Potable Water Module study area.

<u>Relevant sightings during field work</u>

It is believed that the following Red Listed species could occur on site:

- Blue Swallow *Hirundo atrocaerulea* (Critically endangered);
- African Marsh Harrier *Circus ranivorus* (Endangered) -
- Blue Crane *Anthropoides paradiseus* (Near-threatened) -
- Grey Crowned Crane *Balearica regulorum* (Endangered)
- Black Harrier *Circus maurus* (Endangered)
- Lanner Falcon *Falco biarmicus* (Vulnerable)
- Secretarybird *Sagittarius serpentarius* (Vulnerable)
- White Stork *Ciconia ciconia* (BONN)

The Red Listed bird species, their preferred microhabitats and possible interactions with the proposed project are further assessed in the Avifaunal Specialist Study (see **Section 11.1.8**).

10.9 Protected Areas

The nearest protected area to the proposed project is the Impendle Nature Reserve, situated approximately 32km to the west of the WTW Option 1.

Known conservancies that are traversed by the project infrastructure from west to east include (see **Figure 111**):

- Baynesfield Conservancy; and
- Mkuzane Conservancy.

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).

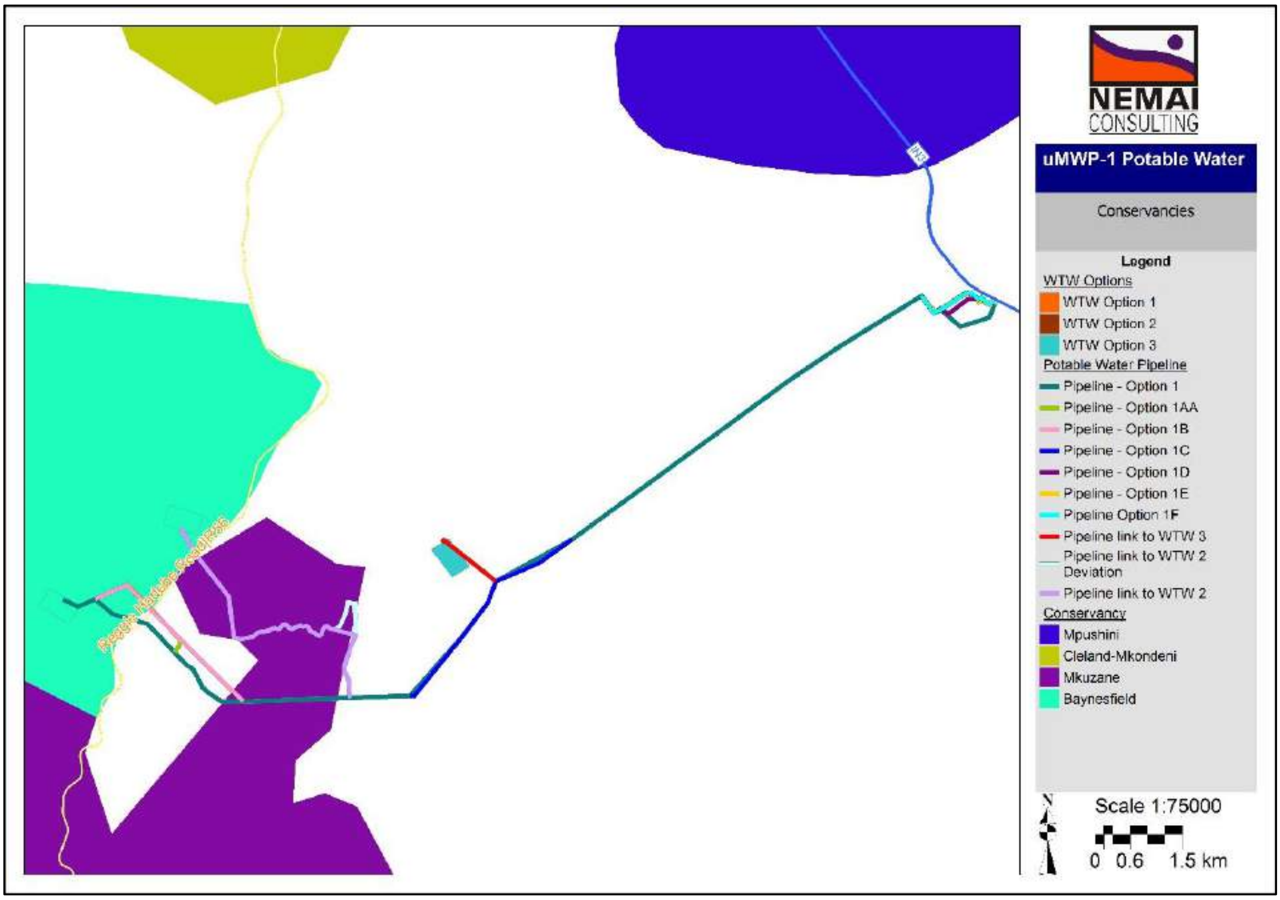


Figure 111: Protected area nearest to project area

10.10 Socio-Economic Environment

The following relevant specialist studies were conducted as part of the EIA:

- Socio-Economic Study (**Appendix H6**) - refer to the summary and impact assessment contained in **Sections 11.1.6** and **12.12**, respectively; and
- Social Impact Assessment (**Appendix H7**) - refer to the summary and impact assessment contained in **Sections 11.1.7** and **12.12**, respectively.

The sub-sections to follow provide the socio-economic context of the two Local Municipalities which are affected by the project footprint.

10.10.1 Richmond LM

Key statistics on the Richmond LM, based on the census 2011 data, follow:

- Total population - 65,793;
- Young (0-14) - 33,5%;
- Working Age (15-64) - 61,7%;
- Elderly (65+) - 4,7%;
- Dependency ratio - 62%;
- Sex ratio – 94;
- Growth rate - 0,4% (2001-2011);
- Population density - 52 persons/km^2;
- Unemployment rate - 26,3%;
- Youth unemployment rate - 33,2%;
- No schooling aged 20+ - 16,1%;
- Higher education aged 20+ - 4,2%;
- Matric aged 20+ - 21,7%;
- Number of households - 16,440;
- Average household size - 3,8;
- Female headed households - 48,8%;
- Formal dwellings - 54,7%; and
- Housing owned/paying off - 44,5%.

10.10.2 Mkhambathini LM

Key statistics on the Mkhambathini LM, based on the census 2011 data, follow:

- Total population - 63,142;
- Young (0-14) - 31,7%;
- Working Age (15-64) - 63,5%;
- Elderly (65+) - 4,8%;
- Dependency ratio - 57,6%;
- Sex ratio - 92,1;
- Growth rate - 0,67% (2001-2011);
- Population density - 71 persons/km^2;
- Unemployment rate - 26,8%;
- Youth unemployment rate - 34,1%;
- No schooling aged 20+ - 18,6%;
- Higher education aged 20+ - 5%;
- Matric aged 20+ - 20,6%;
- Number of households - 14,964;
- Average household size - 3,7;
- Female headed households - 45,5%;
- Formal dwellings - 48,9%; and
- Housing owned/paying off - 26,5%.

10.10.3 WTW and Potable Water Pipeline Options

Some notable socio-economic features in the project area include the following:

- WTW Options 1 and 2, as well as the first sections of potable water pipeline Options 1, 1A, 1B and link to WTW Option 2, are situated on Baynesfield Estate which is a diversified commercial farming operation. The timber land on the estate that is affected by the project infrastructure is leased to NCT Forestry Co-operative Limited;
- Pipeline Option 1 passes to immediate north of Hopewell;
- Pipeline Options 1, 1A, 1B, 1C, link to WTW 2 and link to WTW 3 affect cultivated land;
- Pipeline Options 1, 1C, 1D, 1E and 1F traverses Rainbow Farms property where the route passes chicken houses;

- Pipeline Options 1, 1D, 1E and 1F travel through the light industrial area of Umlaas Road; and
- Pipeline Option 1 is aligned alongside the D125, which is the primary access road into Umlaas Road.

10.11 Planning

According to the uMgungundlovu DM's SDF (see **Figure 112**), the WTW Option 2 site is located in an 'Agricultural Priority Area'. The eastern part of the pipeline route in the Umlaas Road area falls within the greater Camperdown / Cato Ridge Secondary Node, which is regarded as an urban centre with good existing levels of economic development and the potential for growth, serving the sub-regional economy and beyond. There are no clear designations for the remaining sections of the project footprint.

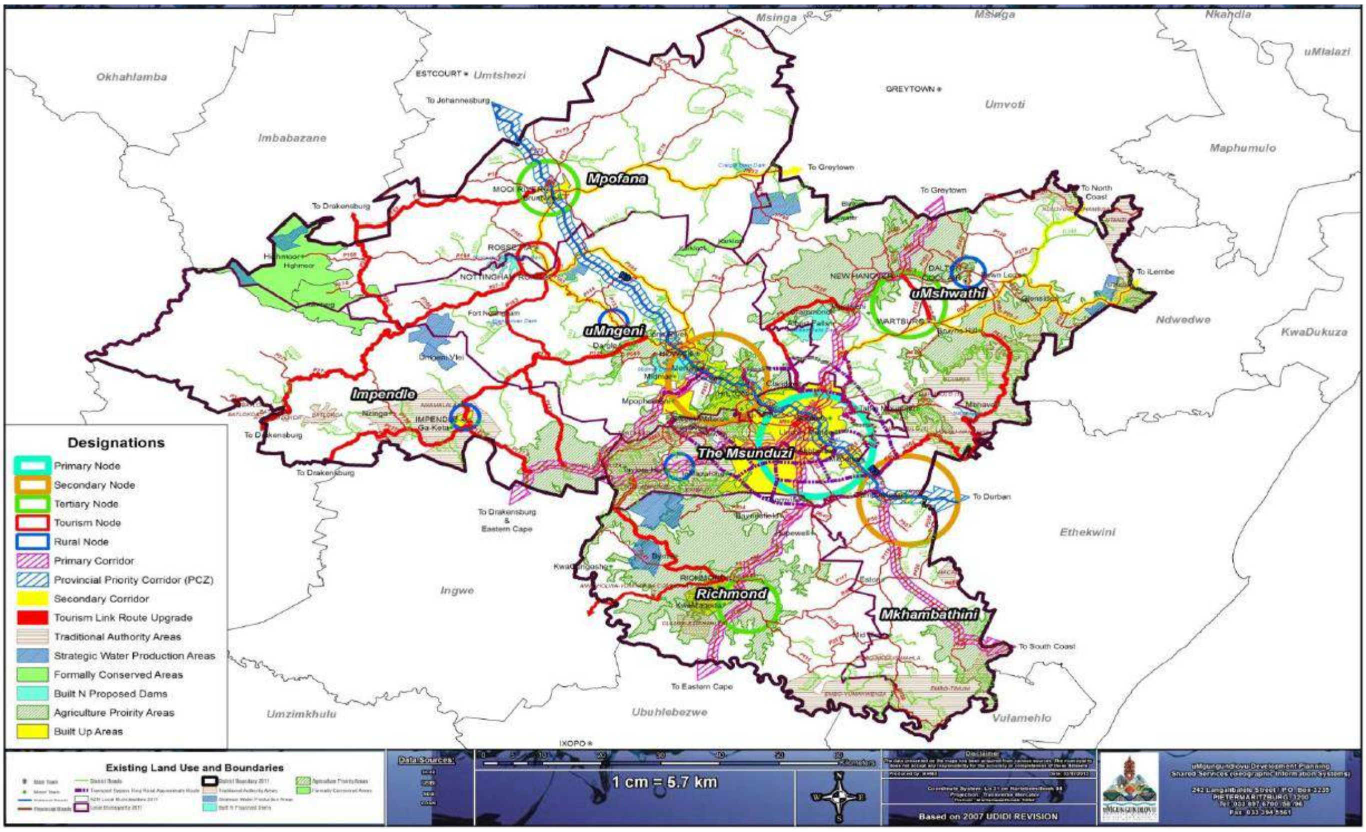


Figure 112: uMgungundlovu DM's SDF (uMgungundlovu DM, 2013)

Apart from the Camperdown / Cato Ridge Secondary Node in the east, the other nearest development nodes in the uMgungundlovu DM to the project area are Richmond (Tertiary

Node) to the south and the urban complex of Pietermaritzburg / Ashburton / Edendale (Primary Node) to the north).

According to the uMgungundlovu DM's SDF, the project crosses the R56 and R603 which are Primary Corridors that provide major linkages with the adjoining districts. The pipeline ties into the Western Aqueduct next to the N3, which is a Provincial Priority Corridor (PC2).

The uMgungundlovu DM (2013) notes the following with regards to the two affected local municipalities:

- 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 Mkhambathini LM has several competitive advantages emanating from its location to Pietermaritzburg and Durban and the adjoining Cato Ridge, which is an industrial node. Mkhambathini features the second highest concentration of poultry producers in the world, supported by a network of service suppliers, as well as beef farming. Agricultural production includes vegetables, maize and sugar cane.

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.

According to comments received from E. Donaldson (Mkhambathini LM), the uMWP-1 Potable Water component (in particular WTW B, which was subsequently discarded – see **Section 9.4.9**) will have the following potential impacts (amongst others):

- *Impact on Umlaas Road Light Industrial Development Node. There are a number of light industrial developments in the pipeline for the Umlaas Road area for which 186 ha was released; and*
- *The visual aspect in relation to the new Big 5 Mayibuye Game Reserve and its overseas tourist potential.*

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 in the western and central areas or the light industrial zone in the east.

10.12 Agriculture

10.12.1 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 **12.8**, respectively.

According to the Richmond LM's IDP (2013), WTW Option 1 falls within an area with a high agricultural potential. WTW Options 2 and 3 and the potable water pipeline are situated on land that is classified as having good agricultural potential.

The WTW Options 1 and 2, as well as the initial western sections of the potable water pipeline route Options 1, 1A, 1B and link to WTW Option 2, are situated on Baynesfield Estate. 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). 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.

The following is noted with regards to the encroachment of the project components into agricultural area:

- WTW Option 1 affects timber land on the Baynesfield Estate that is leased to NCT Forestry Co-operative Limited (see **Figure 113**);
- WTW Option 2 affects cultivated land on the Baynesfield Estate (see **Figure 114**);
- WTW Option 3 affects privately owned sugarcane plantation (see **Figure 115**);
- All the potable water pipeline routes traverse cultivated land (see **Figure 116**).

Figure 113: Timber plantation affected by WTW Option 1

Figure 114: Agricultural area affected by WTW Option 2

Figure 115: Agricultural area affected by WTW Option 3

Figure 116: Example of agricultural land affected by potable water pipeline route Option 1 (over Portion 6 of Brasfort Park 1295)

NCT Forestry Co-operative Limited noted the following concerns with regards to the possible loss of timber land by the project, with specific bearing on WTW Option 1:

- *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.*

10.13 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 cattle.

In the greater area, air quality is influenced by anthropogenic activities in urbanised areas such as 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 in the study area, which include human settlements, are noted in **Section 12.10.1**.

10.14 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 undulating hills and lowlands serves as noise attenuation features, although the ambient noise levels are regarded as insignificant.

Sensitive receptors to noise in the study area, which include human settlements, are noted in **Section 12.10.1**.

10.15 Historical and Cultural Features

10.15.1 General

According to the uMgungundlovu Strategic Environmental Assessment Status Quo Report (uMgungundlovu DM, 2012), the following provincial and landmark heritage sites occur within the Baynesfield area (all rated as High in terms of heritage significance):

- Baynes house;
- Old Nel's Rust dairy;
- First cattle dip; and
- Joseph Baynes Masoleum.

A Phase 1 Heritage Impact 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.

10.15.2 Archaeological

Although various archaeological sites occur in the greater Pietermaritzburg and Camperdown areas none are located in the project footprint.

10.15.3 Historical

10.15.3.1 Water Treatment Works

WTW Option 1:

The site is situated directly south of the Baynesfield Estate Museum and administration buildings. The area is highly disturbed by forestry activities including access roads, felling of trees, ploughing of fire-breaks, etc., therefore the possibility of finding intact significant heritage resources is regarded as very low.

The proposed site of the WTW is situated approximately 850 m south-west of the Joseph Baynes mausoleum (see **Figure 117**) which should not be impacted by the proposed project.

Figure 117: Joseph Baynes mausoleum (Jean & Prins, 2015)

WTW Option 2

The proposed location for this WTW's is situated on Portion 85 of the farm Nels Rust 849 which forms part of the Baynesfield Estate. Part of the site falls on an area that is used for the growing of maize and sugar cane and a section of the proposed site that is situated closer to the R56 Thornville road falls on undisturbed land.

Although no visible heritage resources were noted during the site visit, the undisturbed nature of sections of the site could result that heritage resources that can be found beneath the ground (archaeological remains, etc.) could be found and damaged or destroyed during construction activities.

WTW Option 3

The Stead family Church and cemetery were noted during the site inspection of the proposed location of WTW Option 3. Many of the graves are from the 19th Century and the church is older than 60 years.

The approximate centre of the cemetery is situated at 29°46'10.71" S: 30°25'10.77" E (see **Figure 118**). The church is situated at 29°46'09.40" S: 30°25'09.30" E. The proposed pipeline link to WTW Option 3 is situated approximately 30m west of the cemetery and church and Pipeline Option 1 is situated approximately 12m south east of the cemetery. The cemetery is overgrown with vegetation.

Figure 118: Grave and headstone of Mary Milne Stead (Jean & Prins, 2015)

Figure 119: Grave and headstone of Eleanor Pellen (Jean & Prins, 2015)

Figure 120: Stead family church (Jean & Prins, 2015)

There is a possibility that the graves and church may be damaged by the construction of the pipeline link to the WTW 3 and therefore it is recommended that a buffer of at least 30 m is placed around the site so that there is no movement or passage of people and vehicles between the church and cemetery and that construction activities are situated a suitable distance away from the area.

The location of WTW Option 3 is in an area that is used to grow sugar cane therefore the possibility of finding intact and significant heritage resources is deemed to be low.

10.15.4 Potable Water Pipeline

Option 1

The majority of the option crosses areas that are highly disturbed through the cultivation of various crops (sugar cane, maize, and vegetables), battery chicken farms and roads.

Where the route option passes the pipeline link to WTW 3, the pipeline is situated approximately 12m south east of the cemetery. It is recommended that the pipeline is moved a substantial distance from the cemetery and church complex.

Option 1A

Just before crossing the R56, the pipeline is situated about 170 m south west of St. Johns Church (Baynesfield Methodist Church) and graveyard (see **Figure 121**). The church and some of the graves in the cemetery are over 60 years and the church and cemetery are of heritage significance. The church and cemetery are situated at 29°46'22.06" S: 30°21'35.10" E.

Figure 121: St Johns Church (Baynesfield Methodist Church) and graves (Jean & Prins, 2015)

Option 1B

No heritage resources were found but it should be noted that the undisturbed areas were densely vegetated which limited visibility.

Option 1C

Route Option 1C crosses areas that are impacted by previous and current sugar cane and chicken farming and the possibility of finding intact heritage resources along the routes is low.

Route 1D

The area is relatively undisturbed but no heritage resources were identified.

Routes 1E & 1F

The area is relatively undisturbed but no heritage resources were identified.

Pipeline link to WTW 2

The pipeline travels passes within 50 m of an old building/structure that appears to be no longer used but is over 60 years and is therefore protected. The position of the structure is: 29°46'00.98"S 30°22'06.13E (see **Figure 122**).

Figure 122: Structure situated south-west of pipeline link to WTW 2 (Jean & Prins, 2015)

The area around the dam is in pristine condition with a possibility of cultural heritage resources been found during the construction of the pipeline.

Pipeline Link to WTW 2 Deviation

This area is undisturbed and care should be taken if this option is selected as there is a possibility of finding heritage resources in this area.

Pipeline Link to WTW 3

The proposed pipeline link to WTW Option 3 is situated approximately 30m west of the Stead family cemetery and church (see **Figure 123**). It is recommended that the pipeline is moved a substantial distance from the cemetery and church complex. **Figure 123** shows how close the pipeline is to the cemetery and church complex which is outlined in white.

Figure 123: Stead family cemetery and church complex in relation to pipeline route options (Jean & Prins, 2015)

10.15.5 Palaeontology

The project area lies in eastern margin of the Karoo Basin, in the Pietermaritzburg Formation and Dwyka Subgroup in particular, which are of early Permian Ecca age and Late Carboniferous respectively. These sediments are known to include fossil plants associated with the coal flora. 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 SAHRIS the area falls in the green area which means that there is a moderate risk of fossils occurring there and a desktop study is required. There are no records of fossils from this region on the ESI database or published (Anderson and Anderson, 1985; Plumstead, 1969).

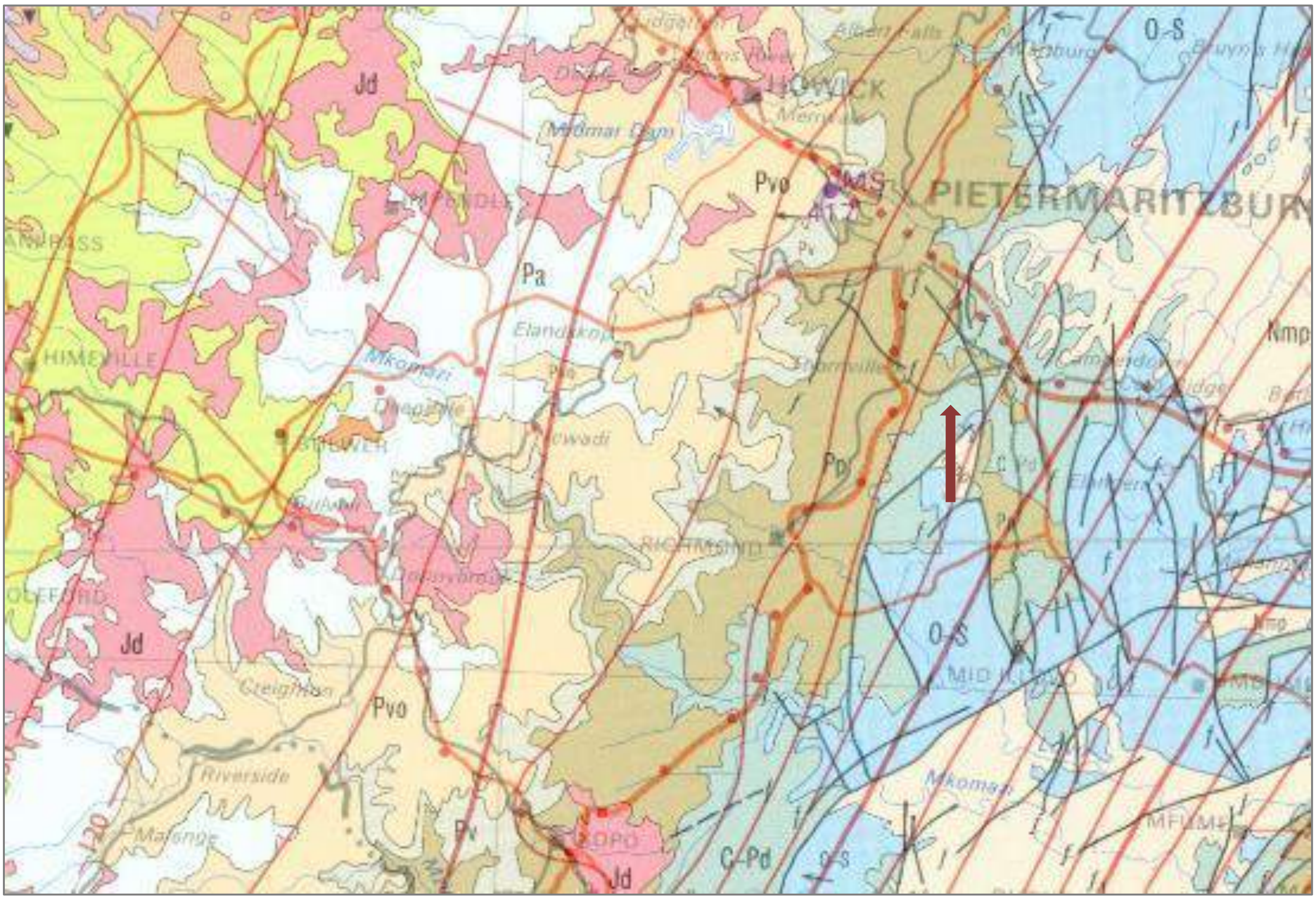


Figure 124: Geological map of area between Baynesfield & Camperdown in the general project area (Jean & Prins, 2015)

Table 40: Explanation of symbols (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
Pp	Pietermaritzburg	Shale	Permian 300-250 Ma
C-Pd	Dwyka	Tillite, sandstone, mudstone, shale	Carboniferous-Permian

No further palaeontological impact assessment is required for the potable water component as there are no records of fossils from the area. If, however, fossil plants are discovered during any excavations, a professional palaeontologist must be called to rescue them (after obtaining the appropriate AMAFA permit).

10.16 Existing Structures and Infrastructure

Buildings that occur in the study area, which were primarily identified on a desktop level via GIS and aerial imagery, are shown in **Figure 125**.

The potable water pipeline route options affect the following existing structures and infrastructure:

- The routes cross various public and private roads, power lines and telephone lines;
- Options 1, 1A, 1B, 1D, 1E and 1F cross railway lines;
- All the routes, except the link to WTW option 3 and the deviation to the link to WTW Option 2, travel past houses;
- Options 1, 1C, 1D, 1E and 1F travel past large buildings (mostly chicken houses on poultry farms);
- Option 1 crosses an existing Transnet Pipeline ø609,6mm pipeline in the Umlaas Road area; and
- In the Umlaas Road area Options 1, 1D, 1E and 1F pass buildings and premises used primarily for light industrial purposes.

The WTW Option 1 site is located within an existing power line servitude.

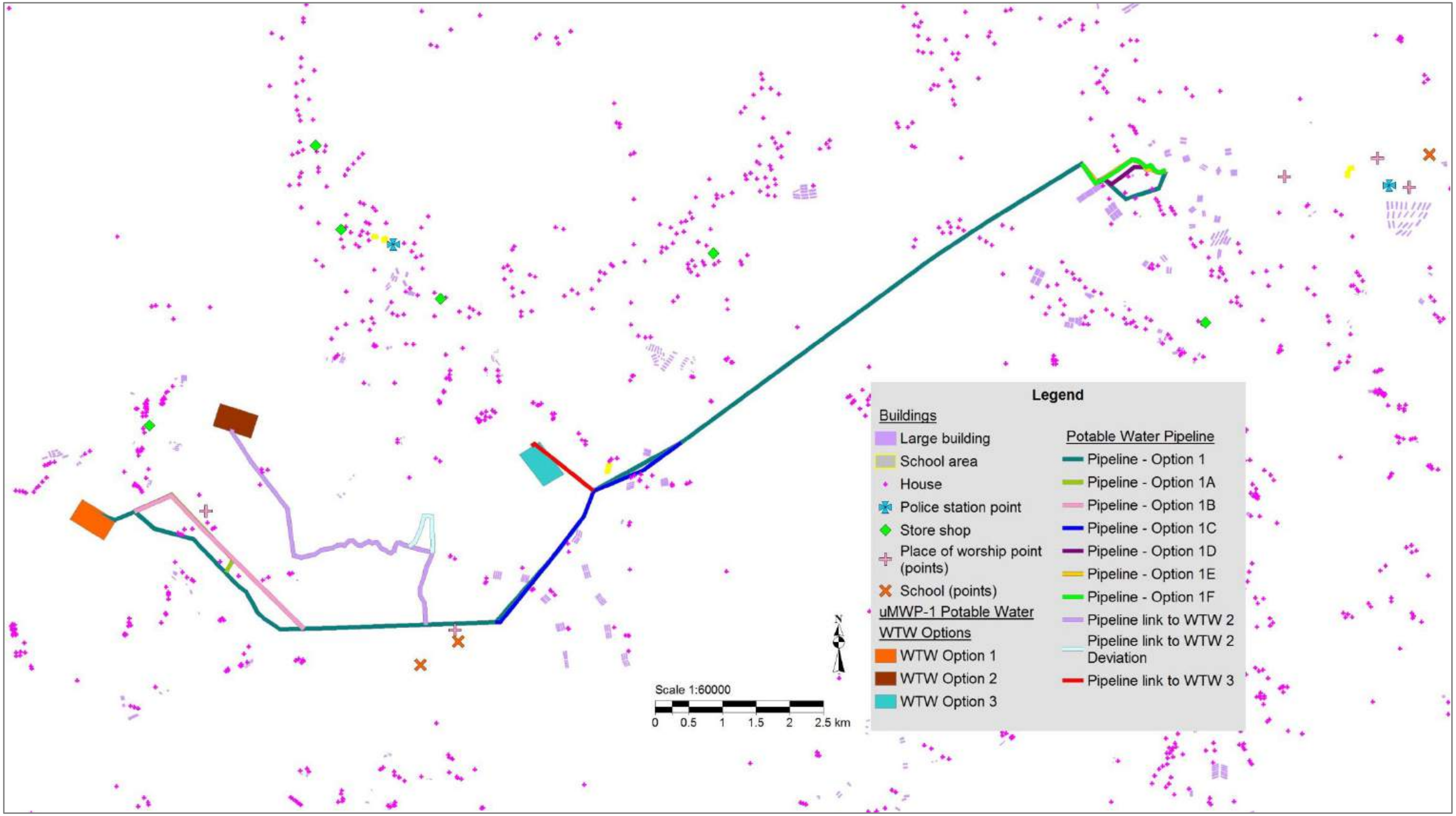


Figure 125: Existing structures

10.17 Land Claims

An enquiry was made with the Department of Rural Development and Land Reform (DRD&LR): Regional Land Claims Commission: KZN on the status of land claims in the project area. It was confirmed that claims for restitution in terms of the provisions of the Restitution of Land Rights (Act No. 22 of 1994) (as amended) have been lodged in respect of various properties that are affected by the uMWP-1 infrastructure (refer to **Figure 126**).

Each of the land claims form part of a broader claim per claimant. For more information on the land claims refer to the Socio-Economic Impact Assessment (**Appendix H6**). The land claims are from the following claimants:

- Funukubekwa Zungu, on behalf of the Nkumbuleni Community;
- Mr Norman Sibisi on behalf of the Baynesfield Land Claim Committee; and
- Thembu/Mkuzane.

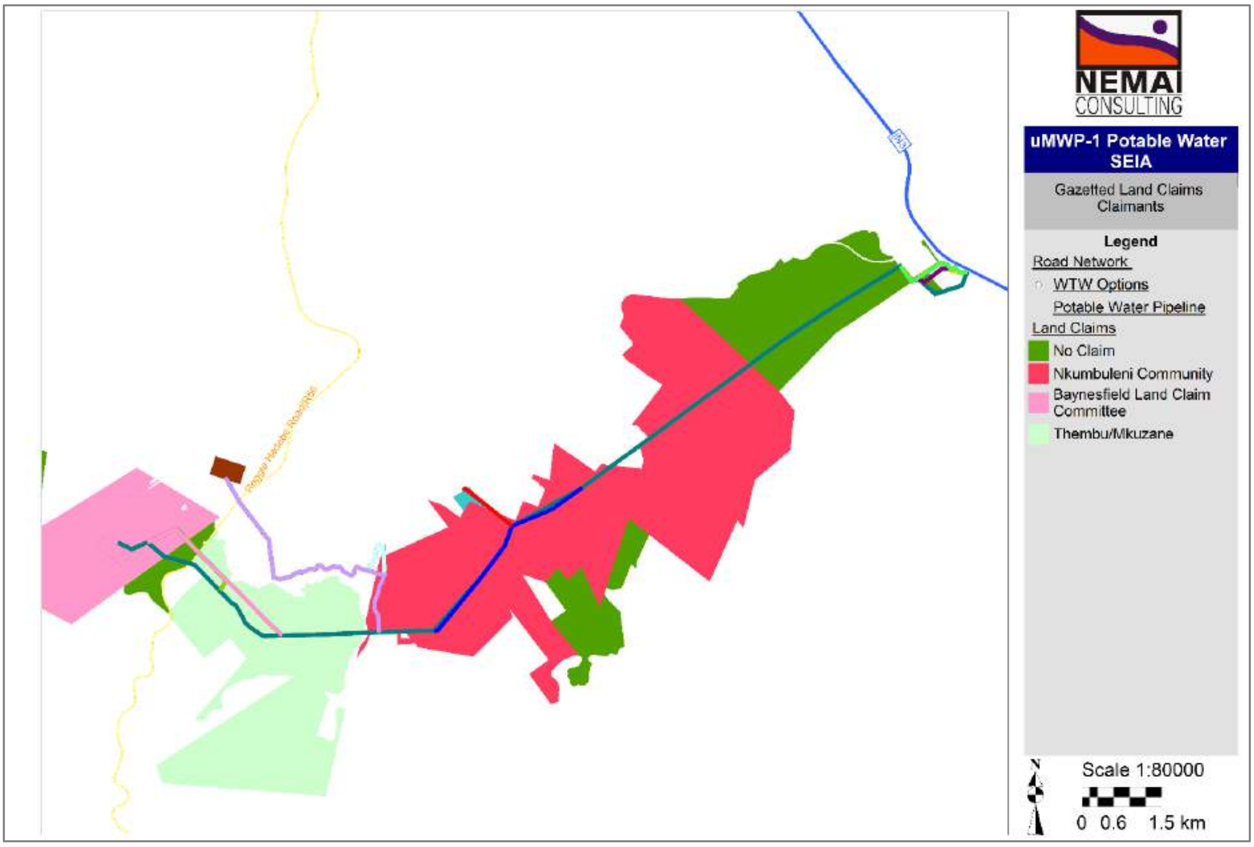


Figure 126: Land claims in project area (Nemai Consulting, 2016a)

10.18 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.

10.18.1 Water

The sources of water in the Richmond LM and Mkhambathini LM, based on Census 2011, are shown in **Table 41**.

Table 41: Sources of water - Richmond LM and Mkhambathini LM (Stats SA)

Source of water	Richmond LM	Mkhambathini LM
Regional/Local water scheme (operated by municipality or other water services provider)	55,1%	38,8%
Borehole	8,6%	14,7%
Spring	5,2%	5,3%
Rain water tank	1,2%	0,9%
Dam/Pool/Stagnant water	6,2%	7,5%
River/Stream	10,5%	17,7%
Water vendor	0,7%	2,4%
Water tanker	8,6%	10,6%
Other	4%	2,1%

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).

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.

No direct impacts to water infrastructure due to this project are anticipated.

10.18.2 Sanitation

The toilet facilities in the Richmond LM and Mkhambathini LM, based on Census 2011, are shown in **Table 42**.

Table 42: Toilet facilities - Richmond LM and Mkhambathini LM (Stats SA)

Toilet Facility	Richmond LM	Mkhambathini LM
None	7,4%	3%
Flush toilet (connected to sewerage system)	8,9%	12,6%
Flush toilet (with septic tank)	9%	7,7%
Chemical toilet	2,7%	18,4%
Pit toilet with ventilation	43,2%	30,9%
Pit toilet without ventilation	24,8%	22,4%
Bucket toilet	0,6%	0,5%
Other	3,5%	4,4%

Sanitation services along the pipeline route and in remote areas will be required for construction workers in the form of chemical toilets, which will be serviced at regular intervals by the supplier. A temporary septic field/ tank system will be provided at the residential labour camp and site offices, which can be used into the operational phase at the offices for the WTW operators.

Ablution facilities will also be provided as part of the permanent infrastructure for the operational phase at the offices for the WTW operators, which will include septic tanks.

No direct impacts to sewage infrastructure due to this project are anticipated.

10.18.3 Electricity

Energy sources in the Richmond LM and Mkhambathini LM, based on Census 2011, is shown in **Table 43**.

Table 43: Energy sources - Richmond LM and Mkhambathini LM (Stats SA)

	Richmond LM			Mkhambathini LM		
Energy Source	Cooking	Heating	Lighting	Cooking	Heating	Lighting
Electricity	61,1%	47,1%	81,5%	51,9%	43%	65,2%
Gas	2,6%	1,3%	0,2%	4%	1,7%	0,3%

	Richmond LM			Mkhambathini LM		
Energy Source	Cooking	Heating	Lighting	Cooking	Heating	Lighting
Paraffin	5%	1,6%	1%	10,4%	4,5%	1,7%
Solar	0,2%	0,2%	0,4%	0,2%	0,2%	0,3%
Candles	0%	0%	16,3%	0%	0%	31,7%
Wood	30,5%	38,7%	0%	33%	42,3%	0%
Coal	0,2%	0,4%	0%	0,2%	0,5%	0%
Animal Dung	0,1%	0,1%	0%	0%	0,2%	0%
Other	0,1%	0%	0%	0,1%	0%	0%
None	0,3%	10,6%	0,6%	0,3%	7,6%	0,7%

According to the Technical Feasibility Study Raw Water: Engineering Feasibility Design Report – Hydropower Assessment Report (DWA, 2014a), the predicted volumes and reliability of flow of water through the raw water tunnel offer the potential for coupling hydropower to the uMWP. A potential hydropower plant location was identified on the conveyance structure (tunnel and pipeline) just upstream of the proposed WTW, which is being assessed as part of the EIA for the uMWP-1 Raw Water component. This hydropower could be generated when the dam level is above the minimum operating level and there is excess head. The flow through this potential hydropower plant would be associated with the water transferred and would be regular and reliable. The potential use for the generated power, which may include supplying energy for the WTW's operational requirements, still needs to be explored.

Electricity will be obtained from diesel generators or temporary electricity connections during the construction phase.

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.

10.18.4 Transportation

The major road infrastructure in the study area is shown in **Figure 127**. The project will influence the road network as follows:

- Potable water pipeline routes –
  - Crossing of various public and private roads, including the following –

  - Options 1, 1A, 1B and link to WTW Option 2 – crossing of R56;
  - Option 1 – alignment alongside the D360;
  - Option 1 – crossing of R624;
  - Options 1 and 1C – crossing of P547;
  - Options 1, 1D, 1E and 1F – crossing of R603;
  - Option 1 – alignment alongside the D125;
- Use of private roads to cultivated areas and timber plantations, in order to reach construction sites.

Options 1, 1A and 1B of the potable water pipeline routes cross a railway line in the Baynesfield area. Options 1, 1D, 1E and 1F cross another railway line in the Umlaas Road area (see **Figure 127**).

During the construction period there will be a significant 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. 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 11.2.2** and **12.13**, respectively.

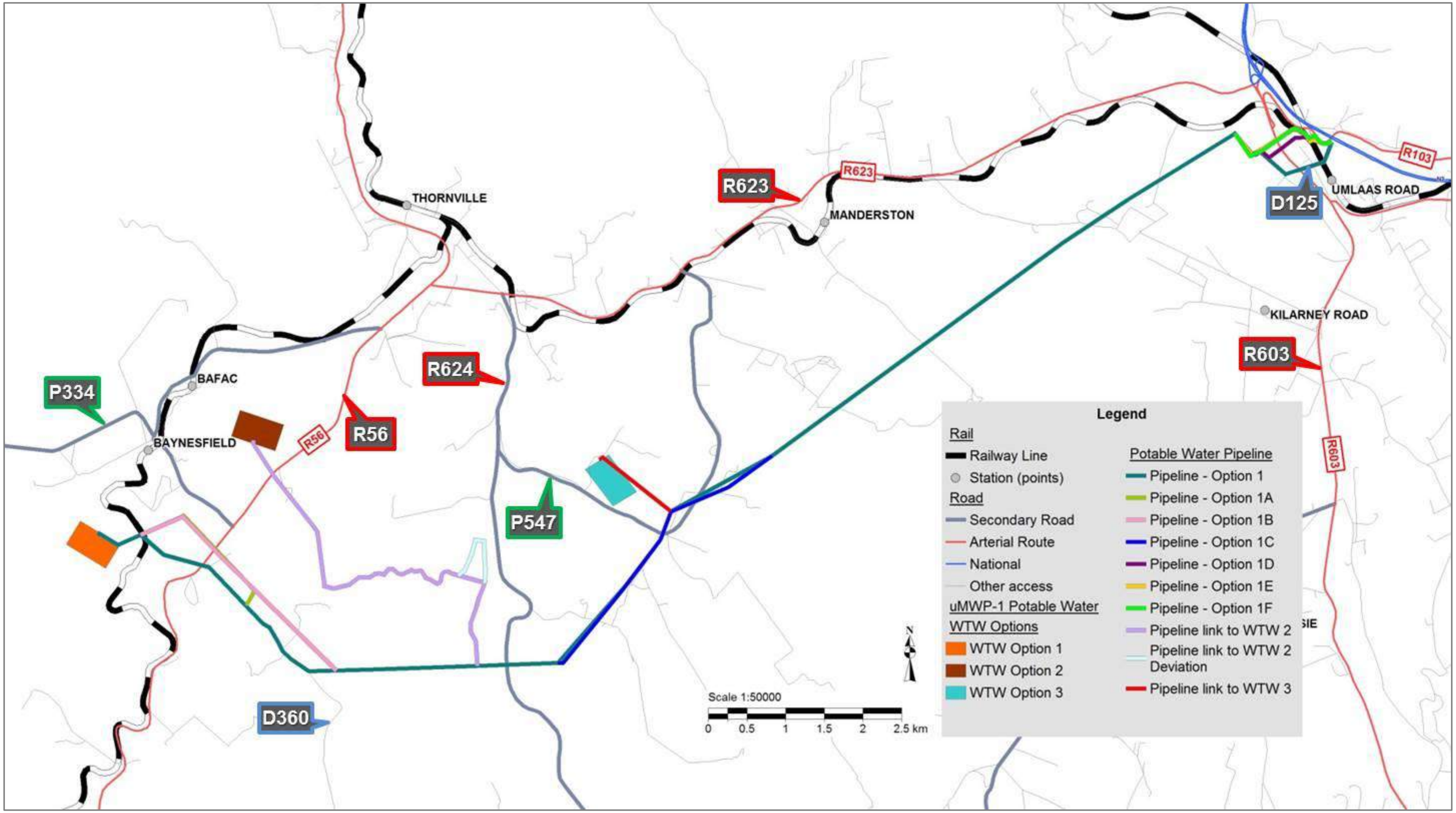


Figure 127: Transportation Network

10.18.5 Solid Waste

The types of refuse disposal in the Richmond LM and Mkhambathini LM, based on Census 2011, are shown in **Table 44**.

Table 44: Refuse disposal - Richmond LM and Mkhambathini LM (Stats SA)

Refuse Disposal	Richmond LM	Mkhambathini LM
Removed by local authority/private company at least once a week	15,5%	5,5%
Removed by local authority/private company less often	1,6%	1,6%
Communal refuse dump	1,4%	5%
Own refuse dump	73,4%	76,5%
No rubbish disposal	6,8%	10,3%
Other	1,4%	1,2%

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+ (Class B in terms of GN No. R 646). The Richmond Landfill Site, which is situated in the Richmond LM, is also permitted and is classified as G:S:B+ (Class C in terms of GN No. R 646).

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.

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). All the waste disposed of will be recorded.

The various options for the management of the residue produced at the WTW are discussed in **Section 9.4.5**.

10.19 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 **12.15**, respectively.

The sense of place of the study area is largely associated with commercial agriculture and forestry that dominate the landscape, as shown in **Figure 128**.

Figure 128: General view of study area conveying the sense of place

The area is afforded aesthetic appeal through topographical features such as undulating hills, valleys, grassland and watercourses. The undeveloped and rural state of the area further contributes to its visual qualities.

The Baynesfield area has a strong heritage character which is linked to the Heritage Centre at the Baynesfield Estate.

10.20 Tourism

Tourism-related features in the western part of the study area include the following:

- 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 Heritage Centre at the Baynesfield Estate offers tourism opportunities.
- The greater area holds aesthetic values which are associated with its landscape, watercourses and grassland habitats.

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 11.1.5** and **12.15**, 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; and
8. Avifauna Study.

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 – 11.1.8**), 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 H11** 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 - SACNASP ❖ Professional member - SAIEES ❖ Professional member - 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 entirely within the Grassland and Wetland biomes. It traverses four (4) vegetation types-namely Midlands Mistbelt Grassland, Moist Coast Hinterland Grassland, Dry Coast Hinterland Grassland and Alluvial Wetlands: Temperate Alluvial Vegetation. The following threatened ecosystems are affected by the project:

- *Midlands Mistbelt Grassland –*
  - *South-eastern part of WTW Option 1;*
  - *Small section of Option 1 potable water pipeline route;*
- *Ngongoni Veld –*
  - *South part of WTW Option 2; and*
  - *Sections of all the potable water pipeline routes, except the link to WTW Option3.*

Even though the Midlands Mistbelt Grassland vegetation type is listed as endangered, on the project area, this vegetation type is now highly transformed due to forestry and maize fields. Only small sections of this grassland exist on site.

According to the KZN Provincial Biodiversity Plan the following can be deduced:

- *Water Treatment Works (WTW) Options –*
  - *The majority of WTW Option 1 site is situated in an area that is not of conservation importance, with the northern section falling in a CBA 1;*
  - *WTW Option 2 is located in an area that is not of conservation importance;*
  - *The WTW option 3 site lies within areas that are not of conservation importance (southern part) and 100% transformed (northern part);*
- *Potable Water Pipeline Options –*
  - *Sections in the western, central and eastern parts of the Option 1 pipeline route traverse CBA 1;*
  - *In the central part of the overall project footprint, sections of the Option 2 pipeline route traverse CBA 1 and CBA 3;*
  - *The eastern sections of the potable water route options predominantly cross areas that not of conservation importance (northern part) or 100% transformed;*

- *The south-eastern sections of the Options 1A and 1B routes traverse CBA 1;*
- *Option 1C traverses an area that is not of conservation importance;*
- *Option 1D crosses areas that are 100% transformed (western section) and not of conservation importance (eastern section);*
- *Option 1E traverses areas that are 100% transformed (western section) and not of conservation importance (eastern section);*
- *Option 1F traverses areas that are 100% transformed (western section) and not of conservation importance (eastern section);*
- *The southern section of the pipeline link to WTW Option 2 passes through CBA 1 and the deviation to this route falls entirely within CBA 1; and*
- *The pipeline link to WTW Option 3 traverses areas that not of conservation importance (southern section) or 100% transformed (northern section).*

According to this plan, it is important to note that the areas designated as CBA Mandatory (CBA 1 and 2) are areas required to meet biodiversity targets for both biodiversity pattern and ecological process features, and no other options are available to meet this target. Whereas areas listed as CBA Optimal are areas that are the most optimal to meet the biodiversity conservation targets while avoiding high cost areas as much as possible.

The majority of the project area is located on privately owned land which is predominantly used for commercial farming and forestry. Patches of natural habitats were noted along the rivers and on the slopes. During the field surveys, no threatened species were observed on site but only two species of conservation importance were recorded on grasslands along Pipeline to Link WTW 2, notably Hypoxis hemerocallidea (Star flower/African potato)) and Boophane disticha (Century plant). These two plant species are listed as Declining (i.e. does not meet any of the five International Union for Conservation of Nature (IUCN) criteria and does not qualify for the categories Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline in the population). This means that the two plant species recorded must be removed prior construction to areas with suitable survival and growth-enabling conditions.

The proposed development areas consisted of suitable habitats such as rivers and grasslands for mammalian species. During the field assessments, there were some several small rodent species observed on the study area but the identity of these species could not be verified. Subsistence hunting and habitat transformation within the areas would limit the occurrence of sensitive species. Sugar cane is the major land use within the area, which means that small carnivores are persecuted by farmers and vast expanses of fencing that limit the natural movement of wild species also impacts on the conservation of many species within the region. Areas where smaller species could occur would be along the greenbelts associated with riparian vegetation that provide ecological corridors. 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, so around homesteads their numbers will be quite low. Due to high densities of livestock, these also pose considerable threat to wildlife, since high numbers of domesticated animals generally cause a displacement of game, as there is less suitable habitat available.

WTW 1 and WTW 2 fall within the Baynesfield Conservancy, which is responsible for the conservation of the natural environment of Baynesfield Estate. A species of conservation importance recorded in the area is Oribi and this species is listed as Endangered. It is known to favour grasslands on flat to gently undulating terrain, where there is both short grass and long grass during the same year. Oribi are considered to be highly vulnerable, and have the highest conservation importance rating of any ungulate in KZN. Suitable Oribi habitat is shrinking primarily as a result of habitat destruction due to cultivation, afforestation and urbanization.

The reptile assessment indicated that the grassland and riparian vegetation are of high importance to reptiles. In some sections of the study area increased habitat modification and transformation as well as increased human presence and associated disturbances (illegal reptile collecting, indiscriminate killing of all snake species, frequent fires) is *encountered. 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 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). During the field surveys, no reptile species of conservation importance were noted. However, according to the South African Reptile Conservation Assessment (ADU, 2015c), the six red data reptile species which were recorded in the grid cells 2930CB, 2930CD and 2930DA (Striped Harlequin Snake, Natal Black Snake, KwaZulu Dwarf Chameleon, Natal Midlands Dwarf Chameleon, Large-scaled Grass Lizard and Nile Crocodile) have a lower possibility of being found in the project area.*

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. Frog species recorded during the field surveys were common and of no conservation concern, namely Guttural Toad, Painted Reed Frog and Bubbling Kassina.

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 129**) was based on the following criteria:*

- *Critical Biodiversity Area 1 (High);*
- *Species of conservation importance (Hypoxis hemerocallidea and Boophane disticha) (Medium);*
- *Perennial river and its associated buffer zone (Medium); and*
- *Oribi and its habitat (High).*

Figure 129: 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).

After construction, any bare surfaces should be grassed as soon as possible in order to minimise time of exposure. Only locally occurring, indigenous grasses should be used for rehabilitation of the site, for example species such as Stenotaphrum secundatum, Dactyloctenium australe and Cynodon dactylon.

11.1.2 <u>Aquatic Impact Assessment</u>

The key issues and triggers identified during Scoping for the Aquatic Impact Assessment include:

- Impacts of scheme to uMlaza River;
- Impacts associated with watercourse crossings by potable water pipeline, access roads and other project infrastructure and activities;
- Damage to riparian habitat at river crossings; and
- 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.

<u>Materials and Methods</u>

*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 (see **Figure 130**).*

Figure 130: Various views of the survey habitat along the uMlaza River (Enviross, 2016)

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);*
  - *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 present ecological state of the wetlands were 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 reach of the uMlaza River is regarded as a C category, which translates to a moderately modified system. The results of the field survey indicated that the overall PES has remained unchanged. A summary of the various components is provided in ***Table 45****. Instream habitat integrity is considered fair (73.7%), which, together with relatively good water quality, allows for a fair macro-invertebrate score (63.9%). Many invertebrate taxa known to be sensitive to poor water quality were sampled, but in limited numbers, which is thought to be due to the low flow conditions of the river during the field survey. Riparian habitat and the vegetation components scores were relatively lower at 67.0% and 43.3%, respectively, which is largely driven by erosion within the catchment area, livestock grazing within the riparian zones and inclusion of invasive exotic vegetation.*

Table 45: Summary of the EcoStatus results for the section of the uMlaza River that would be impacted by the construction of the proposed activities (Enviross, 2016)

Component	EC (%)	Ecological Category
Index of Habitat Integrity		
Instream IHI	73.7%	C
Riparian IHI	67.0%	C
Fish Response Assessment Index	68.5%	C
Macro-invertebrate Response Assessment Index	63.9%	C
Vegetation Response Assessment Index	43.3%	D
ECOSTATUS		**C (Confidence: 3.5)**

Overall fish ecological integrity was also rated relatively low (68.5%) but this is considered to be due to the survey being limited to one sampling run and therefore there is a low confidence in the fish survey results. The system is known to be inhabited by species that are generally common, with a wide distribution range. The uMlaza River does have impoundments along its watercourse, which would impact fish species *distributions throughout the system. Only the eel species is not thought to be found within the survey reach. The EIA of the system remains within a High category.*

Figure 131: An aquatic macro-invertebrate species that is an indicator of good water quality sampled during the field survey (Heptageniidae) (Enviross, 2016)

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.

Wetlands

*The summary of the results of the EcoStatus of the wetlands within the different areas is presented in **Table 46**. These are dominated by seep zones and valley-bottom wetlands. They remain in a good ecological state.*

Table 46: Results from WETLAND-IHI for wetlands within the local area (Enviross, 2016)

Site	Vegetation	Hydrology	Geomorphology	Water quality	Overall PES
Western wetlands	56.6%	26.4%	43.8%	61.0%	**46.2%**
	D	E	D	C/D	**D**
Eastern wetlands	72.0%	35.0%	58.8%	60.7%	**58.6%**
	C	*E*	*C/D*	*C/D*	***C/D***

Wetlands associated with the western and central areas of the proposed development area include channelled valley-bottom wetlands associated with the watercourses as well as associated seep zones. These wetland areas have been mapped and are indicated in

***Figures 132 - 134**. This area is regarded as being located relatively high up within the catchment area, and therefore valley bottom wetland units are thought to dominate the watercourses. These watercourses gain momentum as they flow eastward and transform into aquatic riverine habitat, with less interaction with wetland units.*

*Wetland habitat units are encountered less as the watercourses mature toward the eastern part of the catchment area. Only one wetland complex is noted within this area. The wetland unit is a channelled valley-bottom wetland that is transformed through a series of impoundments along most of its watercourse. This was presumably done in order to provide irrigation water for surrounding croplands. The wetlands that will be impacted by the proposed pipelines are presented in **Figure 135**.*

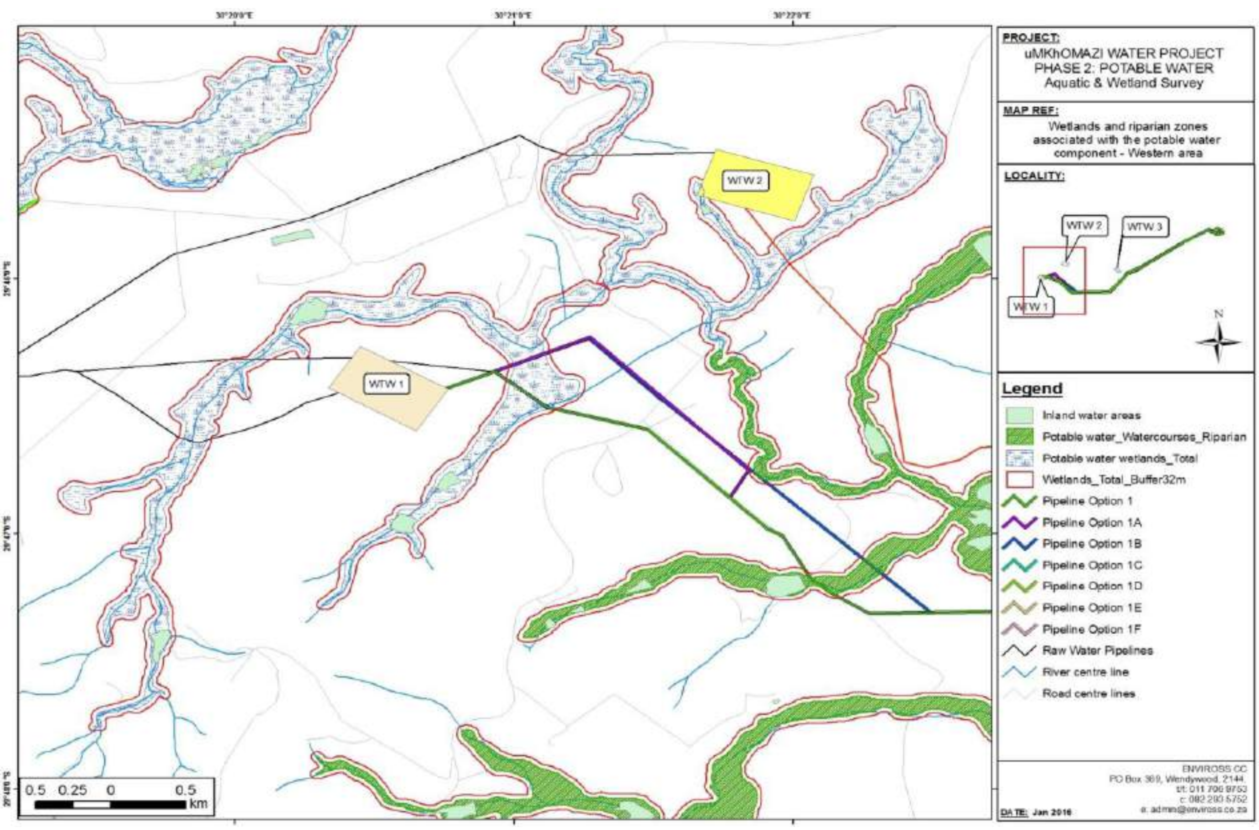


Figure 132: **Wetland and riparian zones associated with western area (Enviross, 2016)**

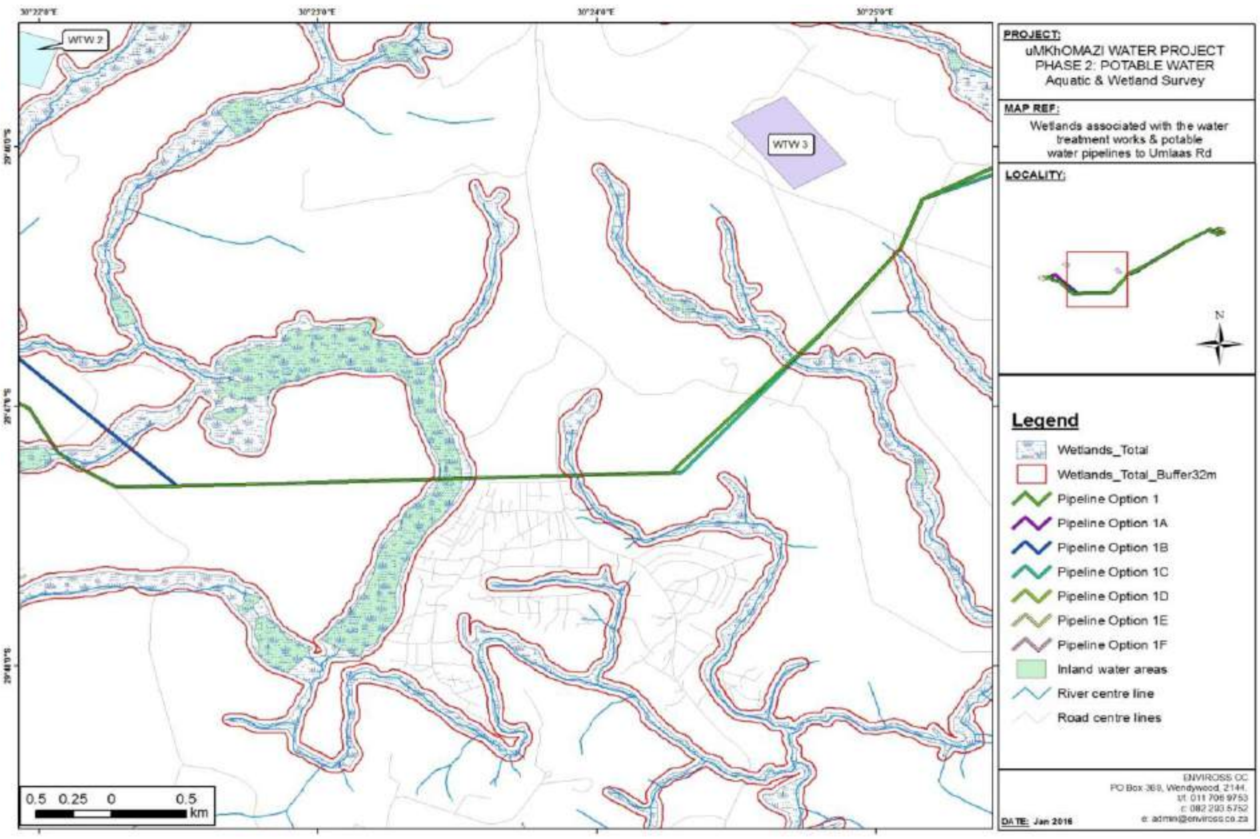


Figure 133: **Wetland and riparian zones associated with central area (Enviross, 2016)**

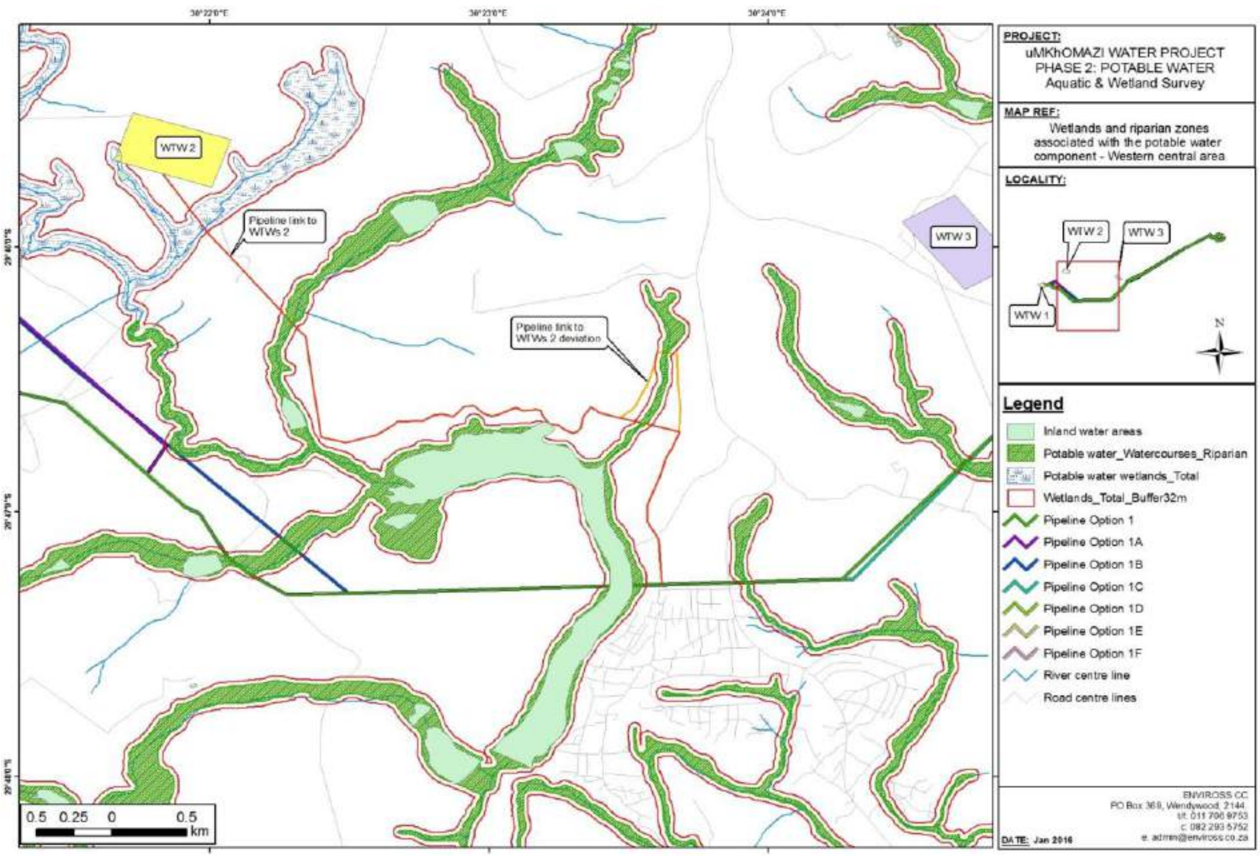


Figure 134: **Wetland and riparian zones associated with central area (Enviross, 2016)**

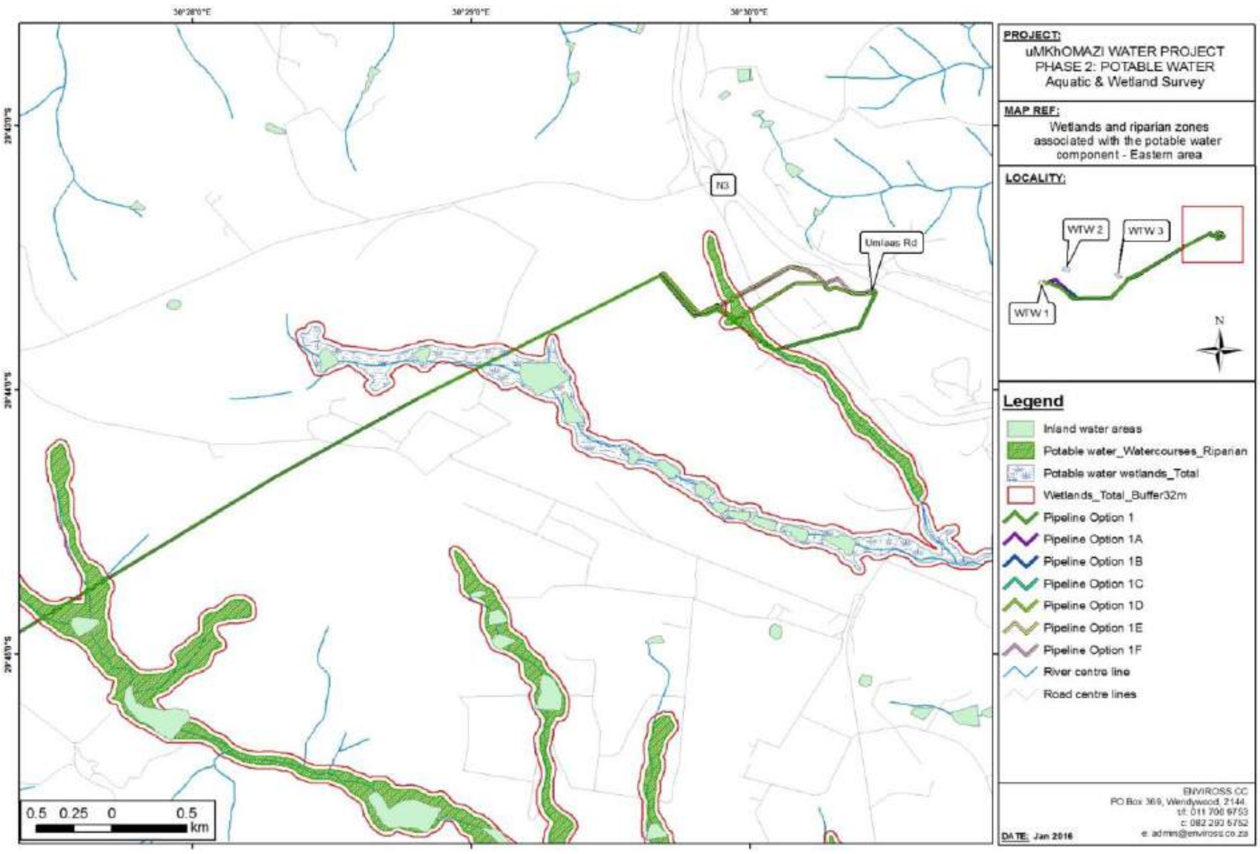


Figure 135: Wetland and riparian zones associated with eastern area (Enviross, 2016)

Riparian Zones

*The extent of the riparian zones pertaining to the watercourses that would be impacted by the proposed development activities have been mapped and are presented together with the wetland units in **Figures 132 - 135**. The proposed development seeks to cross through riparian zones with buried pipelines. The impacts can be readily mitigated and therefore an insignificant net loss of riparian vegetation would be lost.*

Sensitivity Zoning

The proposed development seeks to establish a WTW that has associated delivery pipelines from a raw water source to a distribution depot. The linear pipeline will inevitably have an interaction with linear habitat units such as watercourses, wetland complexes and riparian zones. It is these habitat units that have been designated as ecologically sensitive habitat features. Traversing surface water ecosystem habitats requires the implementation of mitigation measures in order to abate the overall long term ecological impacts that could potentially emanate from the trenching of pipelines. The ecological *sensitivity map therefore coincides with the watercourse, riparian, wetland and associated conservation buffer zones.*

Conclusions & Recommendations

A field survey was undertaken during July/August 2015 to assess the impact areas pertaining to the proposed uMWP-1 to ascertain the overall ecological integrity of the systems, to delineate the wetlands and to assess the overall ecological impacts to the surface water ecosystems that would be impacted by the proposed potable water component of the development activities. Upon completion of the survey the following general conclusions were drawn and some mitigation measures proposed:

- *The reach of the uMlaza 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 relatively high, however largescale catchment area transformation to accommodate forestry and agriculture, erosion within the catchment area and prominent exotic vegetation encroachment within riparian zones has degraded the overall PES of the associated systems. Even though there were transforming and degrading features present within the river reach, the overall EI) remains High;*
- *It is not thought that the proposed development activities will significantly impact the present Ecological Category of the uMlaza River;*
- *The wetlands associated with the survey area were noted to have been largely transformed due to surrounding land use characteristics, instream impoundments and exotic vegetation; and*
- *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.*

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 12.4.5**.

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; 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 conducted of the archaeological databases housed in the KwaZulu-Natal Museum and the available heritage literature covering the greater Pietermaritzburg was 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 4th and 9th of May 2015 where the proposed location options for the WTWs and the various pipeline routes were visited where there was ready access.*
- *Mr. C. Roseveare, on whose land WTW Option 3 is partially situated, kindly took the specialist to site and pointed out the Stead family church and graveyard.*

The area in which the Potable Water component of the uMWP is proposed is, in most part, highly disturbed with various agricultural activities (sugar cane-, maize-, vegetables, timber, chicken farming), together with residential areas (Hopewell), existing roads, etc.

During the site visit several significant cultural heritage sites were discovered including the Baynesfield Estate (museum and other buildings) and the Stead family church and cemetery. Some sites are more directly affected by the proposed infrastructure than others but all have been indicated on the heritage sensitivity map. Recommendations / mitigation measures have been provided to avoid impacting on these sites.

*There are a number of identified heritage sites within the project area that must be avoided by the project (refer to description in **Section 10.15**.). These sites must be protected during the construction phase through the establishment of suitable buffer areas around these sites. The sites are listed in **Table 47** and shown in **Figure 136**.*

Table 47: Identified heritage sites (Beater & Prins, 2015)

Description	Location	Protection	Significance	Mitigation
Stead family cemetery	29°46'10.71"S 30°25'10.77"E	Section 35 (1)	High	Buffer of 30m around cemetery; permanent fencing of cemetery Potable water pipeline is re-aligned away from cemetery Pipeline link to WTW 3 is re-aligned away from cemetery
Stead family church	29°46'09.40"S 30°25'09.30"E	Section 33	High	Buffer of 30m around church Potable water pipeline is re-aligned away from cemetery Pipeline link to WTW 3 is re-aligned away from cemetery
Baynesfield	29°46'22.06"S	Section 33 &	High	15m buffer around Church and

Description	Location	Protection	Significance	Mitigation
Methodist church & cemetery	30°21'35.10"E	Section 35 (1)		cemetery
Old farm structure	29°46'00.98"S 30°22'06.13"E	Section 33	Low-Medium	15 m buffer around structure

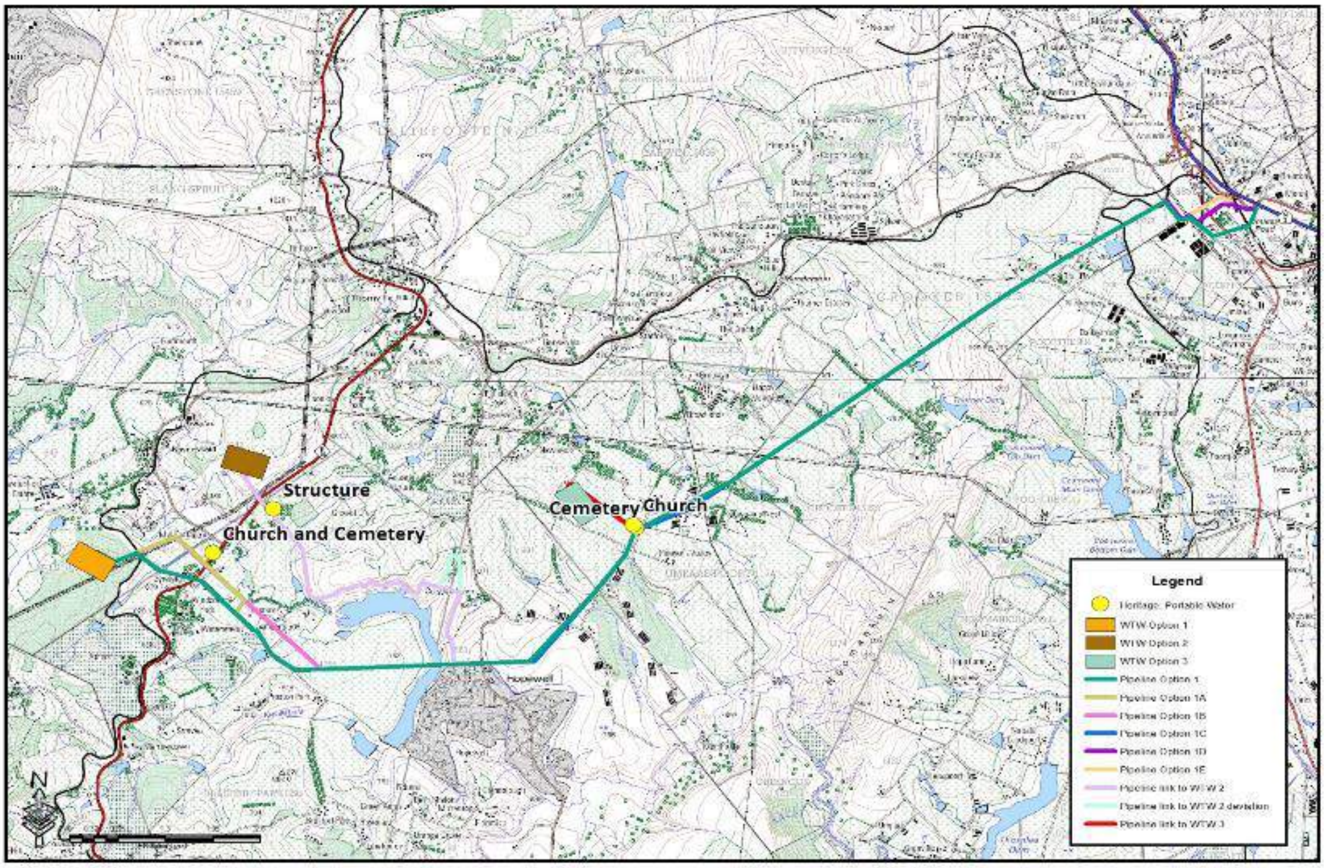


Figure 136: Heritage Sensitivity Map (Beater & Prins, 2015)

Although various archaeological sites occur in the greater Pietermaritzburg and Camperdown areas none are located in the footprint of the uMWP-1 Potable Water component.

According to the palaeo-sensitivity map produced by SAHRIS the area falls in the green area which means that there is a moderate risk of fossils occurring and a desktop study is required. There are no records of fossils from this region according to the desktop palaeontological assessment undertaken for this component of the project. Therefore, no further assessment is required for the potable water component because there are no *records of fossils from the area. If, however, fossil plants are discovered during any excavations, a professional palaeontologist must be called to rescue them.*

From a heritage perspective, the project can proceed as long as the recommended mitigation measures are taken into account including the alteration of some pipeline routes to avoid impacting on sensitive heritage sites.

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; 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****.*

The agricultural land uses along the pipeline routes are shown in ***Figures 137 – 141****.*

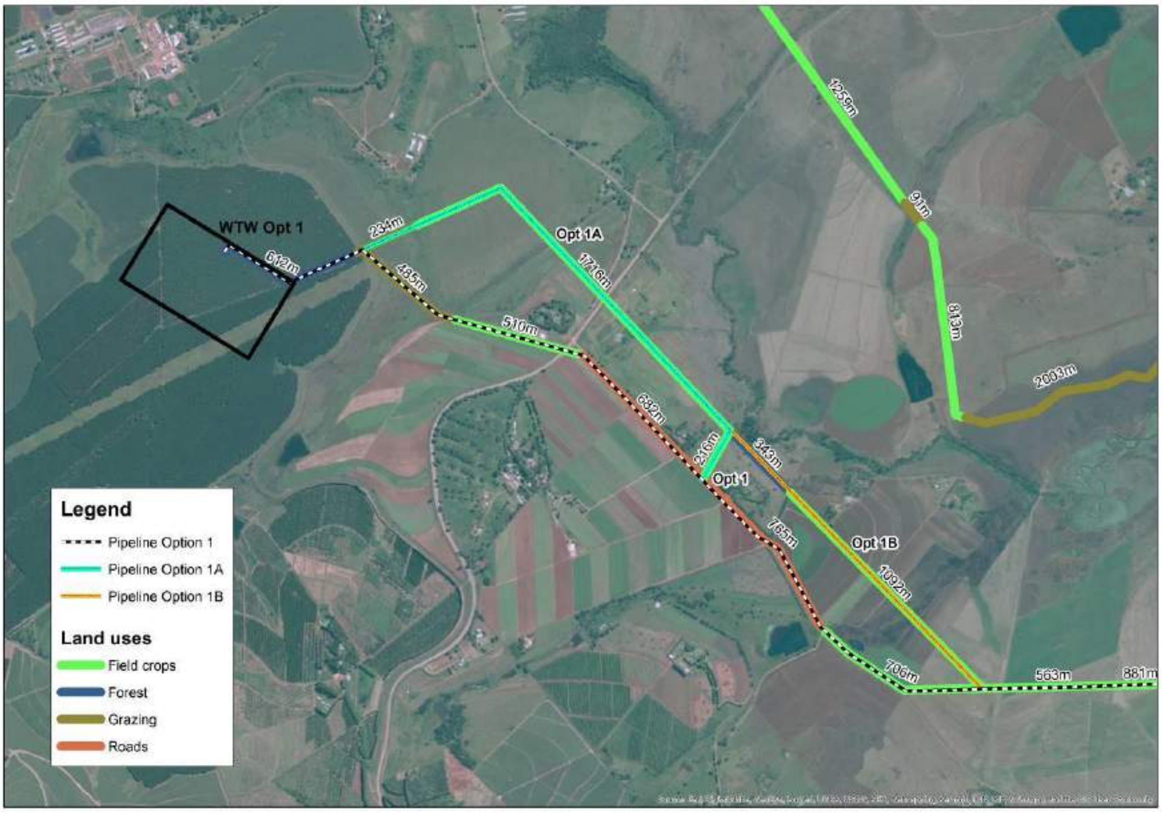


Figure 137: WTW 1: Land uses for Pipeline Options 1, 1A and 1B (Index, 2015)

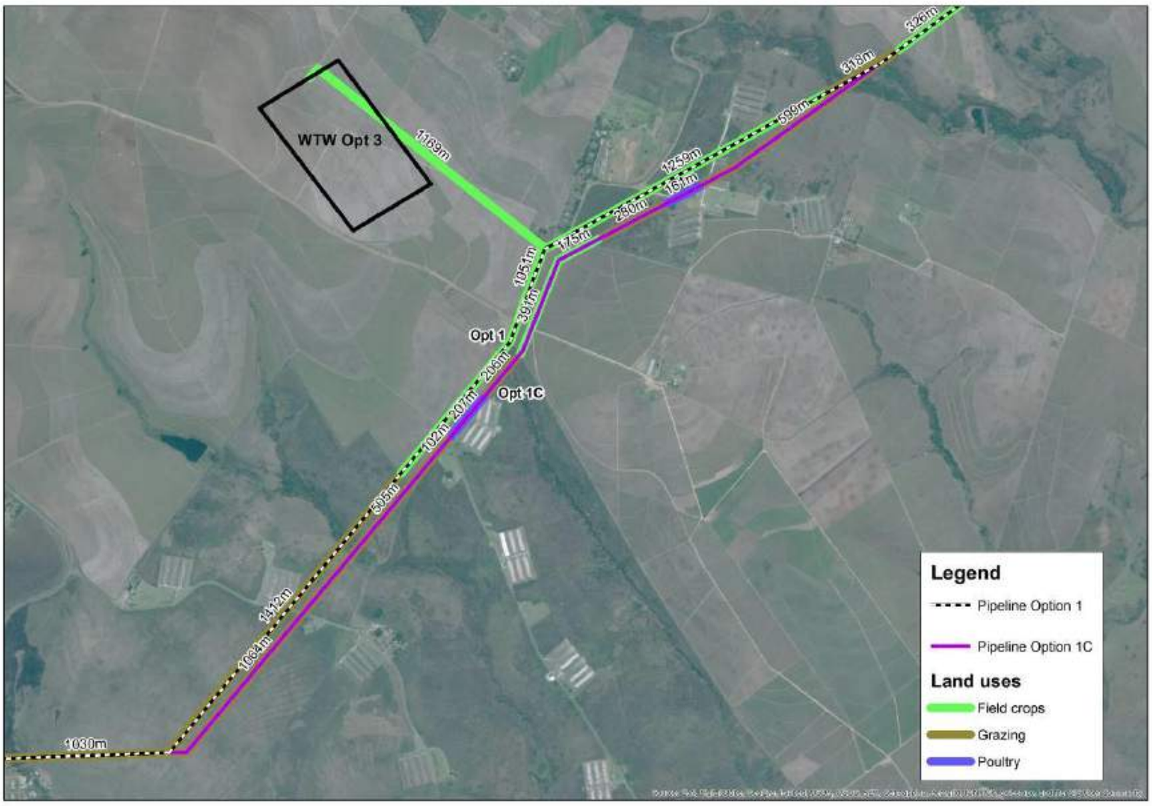


Figure 138: Land uses for Pipeline Options 1 and 1C (Index, 2015)

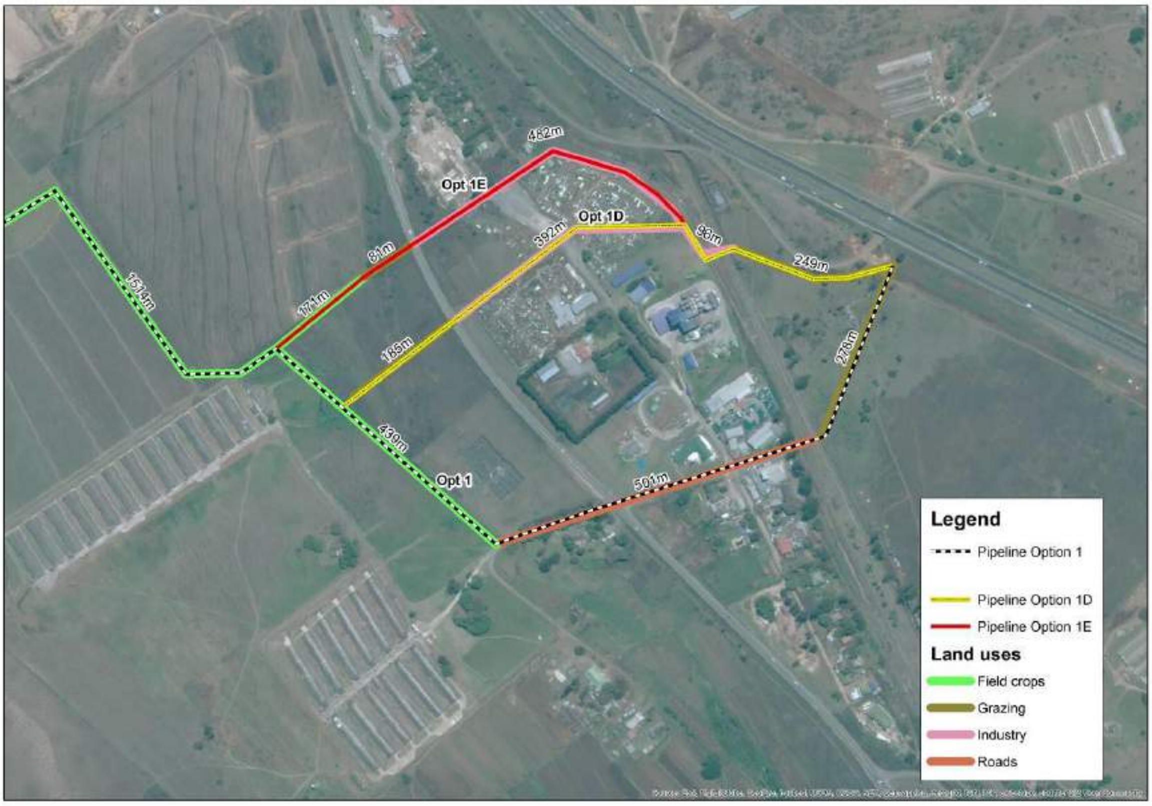


Figure 139: Land uses for Pipeline Options 1, 1D and 1E (Index, 2015)

Figure 140: Land uses for Pipeline link to WTW 2 and deviation (Index, 2015)

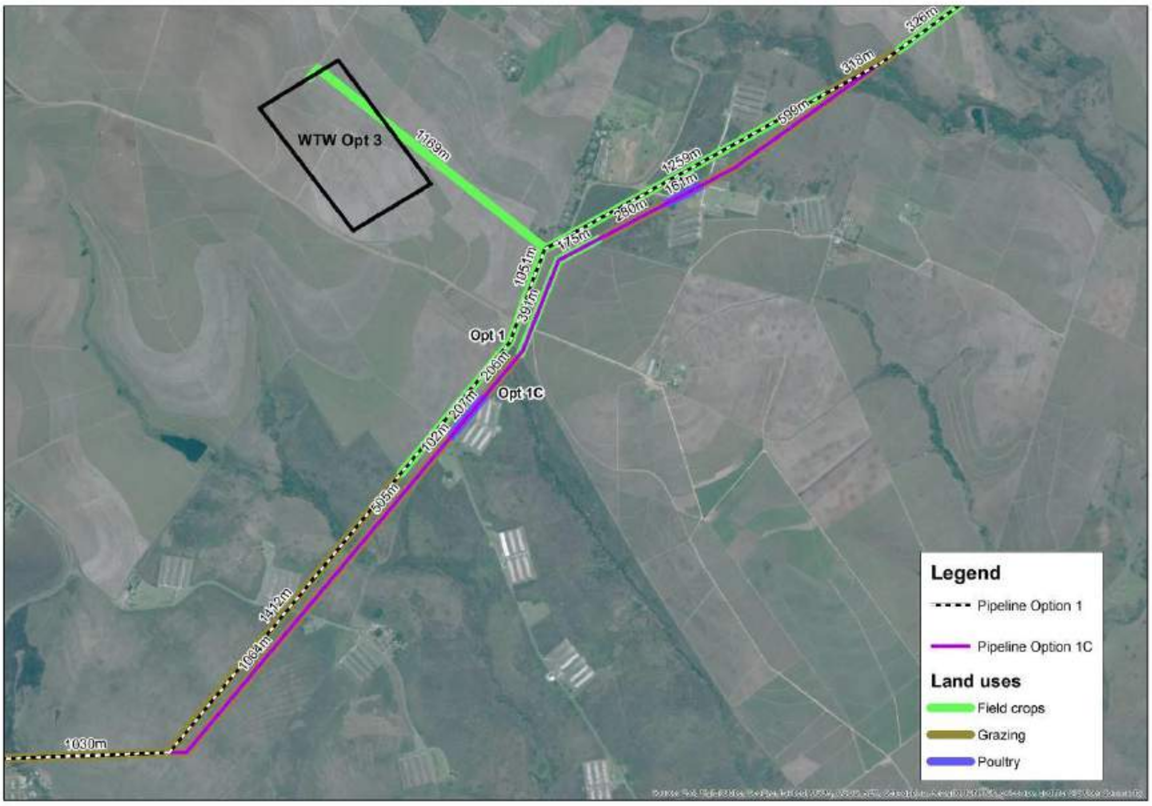


Figure 141: Land uses for Pipeline link to WTW 3 (Index, 2015)

A summary of impacts from an agricultural perspective follows:

❖ *WTW -*
- *The WTW will be a permanent structure and will therefore, have a permanent impact on agriculture.*
- *Option 2 is preferred because it will lead to loss of the least amount of high potential land. The loss of income will also be the lowest.*
- *The loss of high potential land cannot be mitigated.*

❖ *Alternatives pipeline alignments -*
- *The impact will be for one year. This is the period that soil will be unproductive or grazing will take to recover. The financial loss, therefore, is temporary.*
- *Option 1 is preferred.*
- *The deviation in 1C is recommended.*
- *The impact of installing the pipelines is low.*

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.*

*The two landscape types that occur in the study area are (refer to **Figure 142**):*

- *Baynesfield Agricultural - combination of all the agricultural farms that are scattered through the study area.*

- *Baynesfield Hinterland Grassland - consists of the Moist Coast Hinterland Grassland vegetation as well as the combination of all the undeveloped vegetation in the study area.*

Both landscape types have very similar topographical characteristics but are distinguished due to the difference in land use.

Figure 142: Landscape Types (Baynesfield Agricultural – top; Baynesfield Hinterland Grassland - bottom) (Axis Landscape Architecture, 2015)

Visual Quality

*The visual quality was individually assessed for the two landscape types, which includes the area within 5 km from the proposed site. The evaluation is summarised in **Table 48**.*

Table 48: Visual Quality of the Regional Landscape (Axis Landscape Architecture, 2015)

Landscape Type	Vividness	Intactness	Unity	Visual Quality
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 a GIS. As a result, all areas that are visible from the viewpoints are mapped and highlighted in a shaded colour. The areas that are shaded are expected to have views of the proposed WTW options.

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 effected environment. An analysis of ***Figures 143 - 145*** *indicates areas of high visibility in the different distant zones. These affected zones will be overlaid with the land-uses to gain knowledge of the other factors influencing visual exposure.*

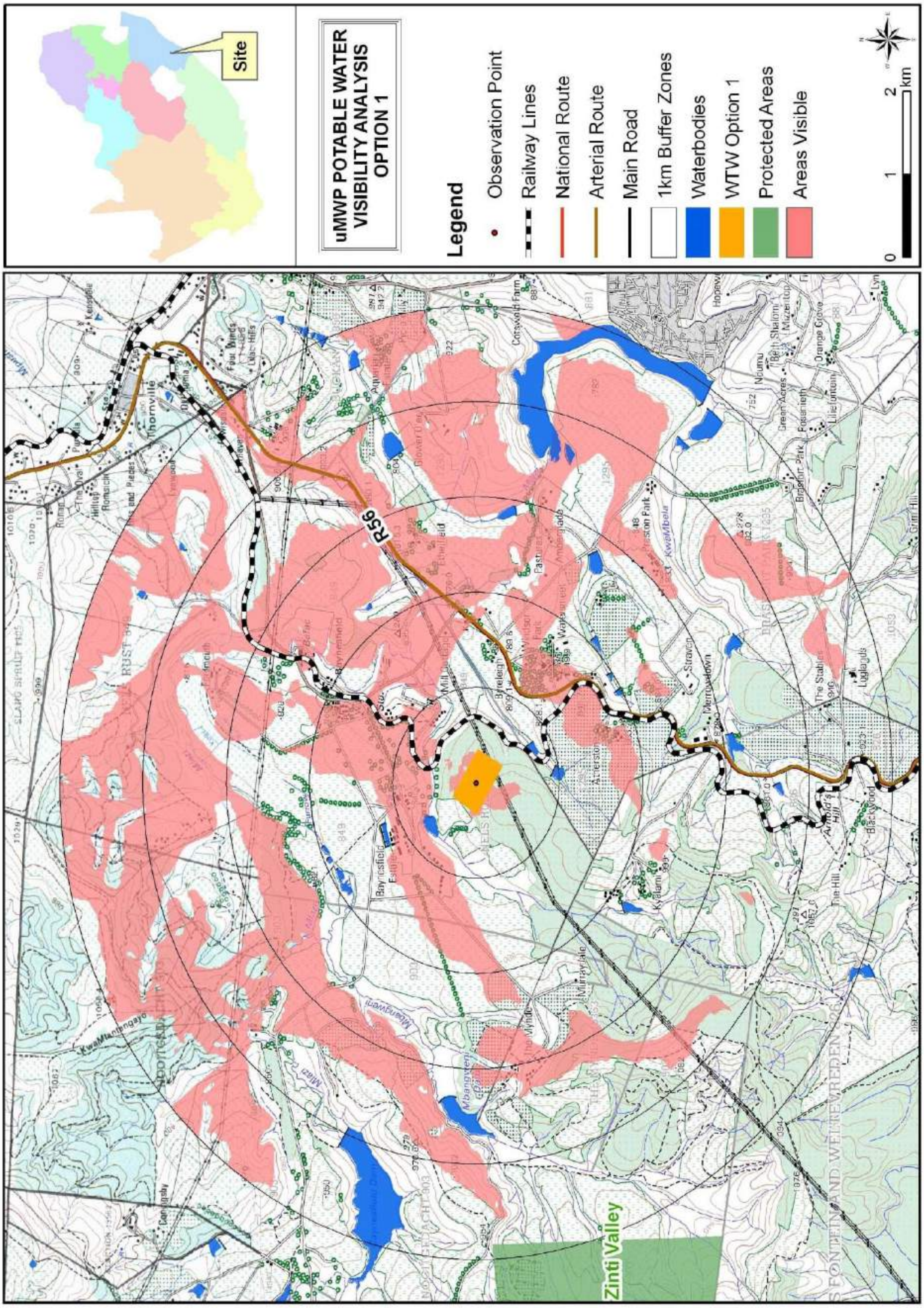


Figure 143: Visibility Analysis – WTW Option 1 (Axis Landscape Architecture, 2015)

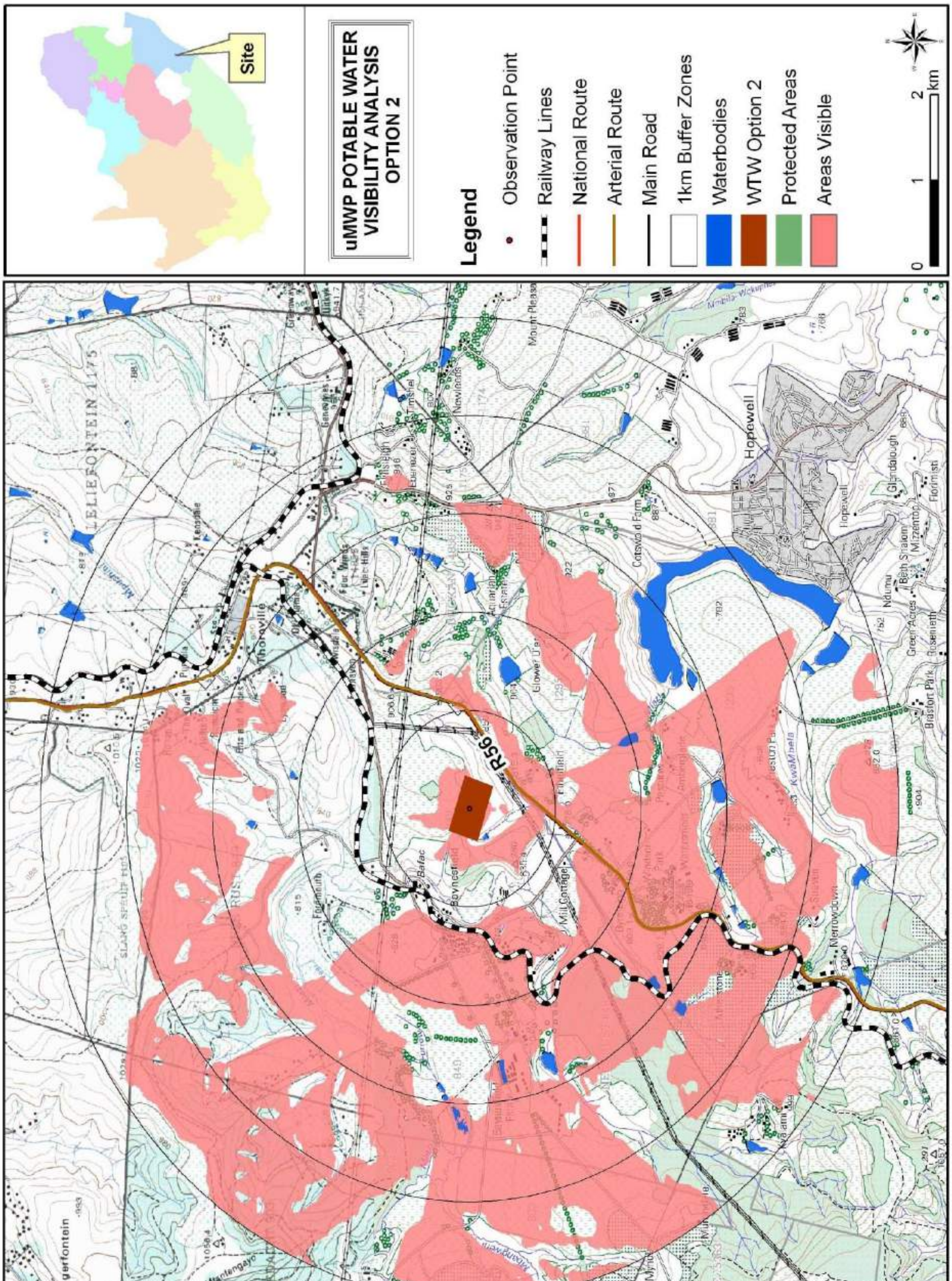


Figure 144: Visibility Analysis – WTW Option 2 (Axis Landscape Architecture, 2015)

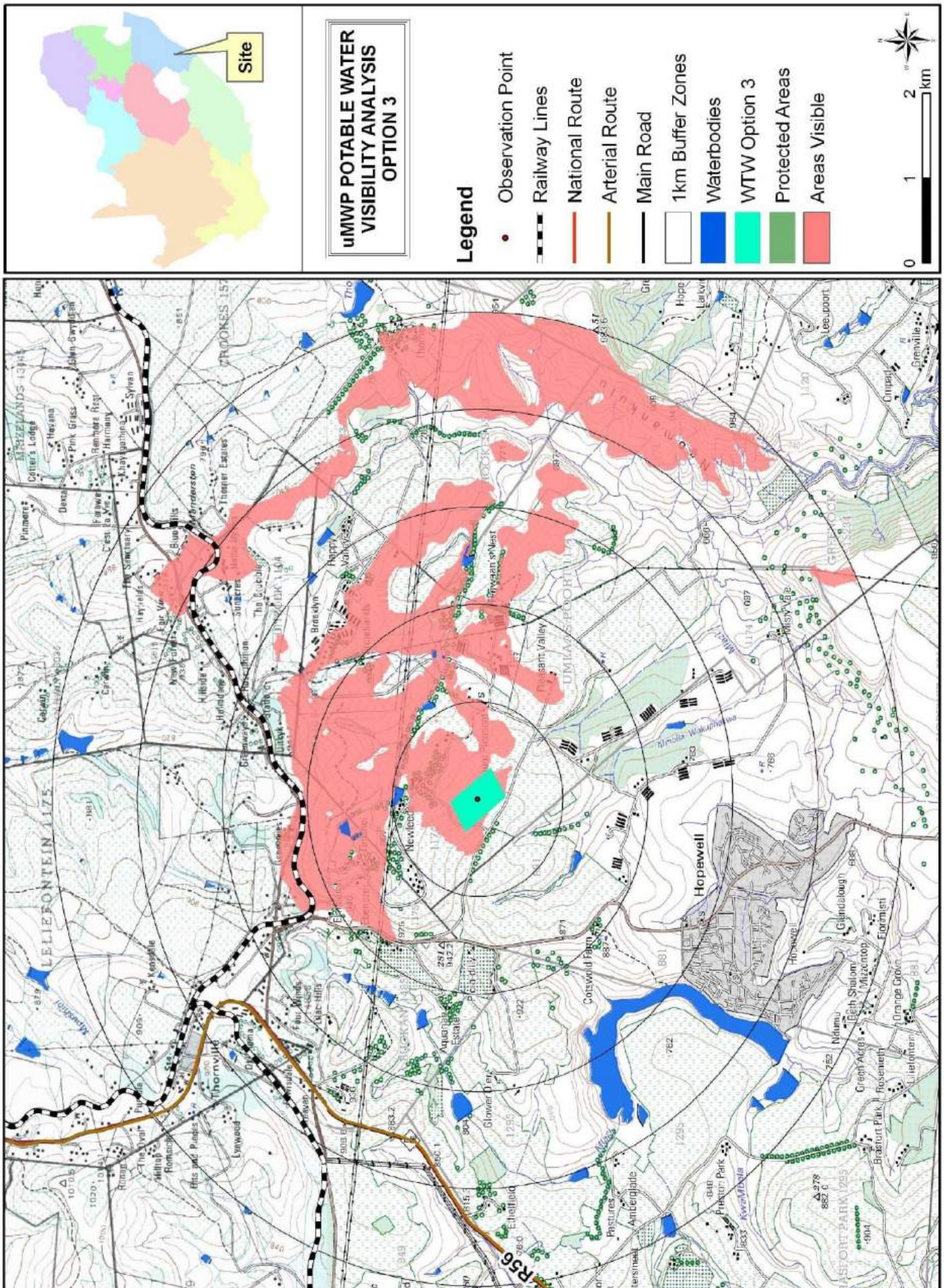


Figure 145: Visibility Analysis – WTW Option 3 (Axis Landscape Architecture, 2015)

<u>Landscape and Visual Impacts</u>

*The anticipated impacts are assessed under **Section 12.15** in terms of the following:*

- *Landscape impacts -*
  - *Loss of grassland;*
  - *Change in surface cover;*
- *Visual impacts -*
  - *Residents;*
  - *Recreational users/Tourists; and*
  - *Motorists.*

11.1.6 <u>Socio-Economic Impact Assessment</u>

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;
- 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 study 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 traditional leaders, *community members, and private farmers. Secondary data was accessed through South African Databases, available reports and articles, as well as internet searches.*

The profile of the baseline conditions includes determining the current status quo of the community, including information on a number of social and economic issues such as:

- *Demographic factors;*
- *Socio-economic factors such as income and population data;*
- *Access to services;*
- *Institutional environment;*
- *Social organisation (Institutional Context); and*
- *Statutory and* regulatory environment.

The determined impacts are clustered around a common issue and are assessed before and after mitigation. The identification of the socio-economic impacts associated with the project is issues-based, with the main headings referring to a common theme addressing several related impacts. Under each of these issues the specific impacts and potential mitigation strategies are discussed for pre-construction, construction, operation and decommissioning phases.

The project has the potential to significantly 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. 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.*

During the construction phase, there will be daily disruption to both famers and households. These impacts can be largely mitigated through a comprehensive set of EMPrs designed for this project as part of the EIA.

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:

- 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 district and local municipalities directly associated with the Potable Water component include:

- *uMgungundlovu District Municipality (DC22):*
  - *Mkambathini Local Municipality (KZN226) -*
    - *Wards 3 and 4;*
  - *Richmond Local Municipality (KZN227) -*
    - *Ward 3.*

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;*
- *Cultural impacts;*
- *Family and community impacts;*

- *Institutional, legal, political and equity impacts; and*
- *Gender relations impacts.*

The more severe social impacts are related to the construction of the WTW, which will result in the loss of arable land and will have a permanent impact on the sense of place of the area, particularly for residents within a 2 km radius of the plant. The construction of the pipeline will result in the temporary loss of the use of land stretching over a period of approximately one year which will have negative financial implications attached. The use of this land, however, will be regained once the soil has had time to recover, thus reducing the severity of the impact.

During construction there will be an increase in traffic along the R56 which will increase safety risks and add to the deterioration of these roads. In this regard it is pointed out in the Traffic Impact Assessment in reference to both the Raw and Potable Water components of the project that: "The additional traffic over the construction phase will increase the deterioration of the R617 and R56 pavements and will therefore require increased maintenance from the road authority. The negative impact on road deterioration is considered to be medium (R56) to low (R617)". The greatest increase in traffic associated with the project is, according to the findings of the traffic study, on the R56 at CTO 1106 in respect of average daily truck traffic. The traffic increase associated with the operational phase of the potable water component is minimal.

Conclusion and Recommendations

Although the focus of this report is on the Potable Water component of the project it cannot entirely be considered in isolation from the Raw Water component, as both components are inter-dependent. Due to this there will be a cumulative effect across the project area in respect of a number of impacts such as:

- *In migration of work seekers and workers during the construction phase that will have an impact on existing social networks and family structures.*
- *Creation of employment opportunities and the generation of income associated with the construction and operation of the project.*

- *Provision of improved water services to the Umgeni Water supply area as well as the potential to expand potable water supply to impoverished households located within the uMkhomazi Catchment Area.*
- *Potential to stimulate the economy in the area which, if achieved, would have significant social benefit.*

On a more area specific basis the Potable Water component of the project will result in:

- *A loss of arable land associated with the WTW options;*
- *Temporary loss of income associated with the potable pipeline routes; and*
- *A range of impacts associated with the previously mentioned social impact variables.*

In respect of the operational phase of the project it is also important to prepare communities for the withdrawal of the workforce and associated dispensable income that was spent amongst those communities during the construction phase of the project.

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 this study was as follows:

- *The various avifaunal data sets listed below 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 (Geographic Information System) layers and Google Earth.*
- *The potential impacts of the proposed facility on these species were described and evaluated.*
- *Recommendations were made for the management and mitigation of impacts.*

In simple terms, this study assessed 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.

Various data sources were used in determining the distribution and abundance of bird species in the study area, and are discussed in ***Section 10.8.2.5****.*

The Red Listed bird species, their preferred microhabitats and possible interactions with the proposed project were assessed and is presented in ***Table 49****.*

Table 49: Assessment of Red Listed bird species (Wildskies, 2015)

Common name	Species name	SABAP 1	SABAP 2	TAYLOR 2014	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	Several breeding pairs close enough to site to be relevant, but could utilise the site infrequently	Grassland	Disturbance Habitat destruction
Stork, Saddle-billed	*Ephippiorhynchus senegalensis*		X	E	LC	E	Unlikely	-	-
Parrot, Cape	*Poicephalus robustus*	X		E	LC	CE	Unlikely	-	-
Buttonquail, Blackrumped	*Turnix hottentotta*	X		VU	LC		Unlikely	-	-
Ground-Thrush, Spotted	*Zoothera guttata*	X		E	E		Unlikely	-	
Marsh-Harrier, African	*Circus ranivorus*	X	X	E	LC	Protected	Possible	Grassland, wetland	Disturbance Habitat destruction
Crane, Blue	*Anthropoides paradiseus*	X	X	NT	V	E	1 breeding pair close enough to site to be relevant, but unlikely to occur on site itself	Grassland, wetland, arable lands, dams	Disturbance Habitat destruction

Common name	Species name	SABAP 1	SABAP 2	TAYLOR 2014	IUCN 2012	TOPS	Likelihood of occurring on site	Preferred micro habitat	Possible impacts
Pipit, Short-tailed	*Anthus brachyurus*	X		VU	LC		Possible	Grassland	Disturbance Habitat destruction
Crane, Grey Crowned	*Balearica regulorum*	X	X	E	E	E	Probable in eastern parts close to balancing dam	Grassland, wetland, arable lands, dams	Disturbance Habitat destruction
Pigeon, Eastern Bronze-naped	*Columba delegorguei*	X		E	LC		Unlikely	-	-
Korhaan, White-bellied	*Eupodotis senegalensis*	X		VU	LC		Unlikely	-	-
Ibis, Southern Bald	*Geronticus calvus*	X	X	VU	V	V	Unlikely	-	-
Bustard, Denham's	*Neotis denhami*	X	X	VU	NT	Protected	Unlikely	-	-
Pelican, Pink-backed	*Pelecanus rufescens*	X	X	VU	LC	E	Unlikely	-	-
Finfoot, African	*Podica senegalensis*		X	VU	LC		Unlikely	-	-
Eagle, Martial	*Polemaetus bellicosus*	X	X	E	NT	V	Unlikely	-	-
Flufftail, Striped	*Sarothrura affinis*	X		VU	LC		Unlikely	-	-
Grass-Owl, African	*Tyto capensis*	X	X	VU	LC	V	Unlikely	-	-
Kingfisher, Half-collared	*Alcedo semitorquata*	X	X	NT	LC		Unlikely	-	-
Stork, Black	*Ciconia nigra*	X	X	VU	LC	V	Unlikely	-	
Harrier, Black	*Circus maurus*	X	X	E	V		Possible	Grassland, wetland	Disturbance Habitat destruction
Falcon, Lanner	*Falco biarmicus*	X	X	VU	LC		Probable	Grassland, arable land	Disturbance Habitat destruction Collision with overhead lines
Stork, Marabou	*Leptoptilos crumeniferus*	X		NT	LC		Unlikely	-	-
Blackcap, Bush	*Lioptilus nigricapillus*	X	X	VU	NT		Unlikely	-	-
Bustard, Black-bellied	*Lissotis melanogaster*	X	X	NT	LC		Unlikely	-	-
Jacana, Lesser	*Microparra capensis*	X		NT	LC		Unlikely	-	-
Stork, Yellow-billed	*Mycteria ibis*	X		E	LC		Unlikely	-	-
Pygmy-Goose, African	*Nettapus auritus*	X	X	VU	LC		Unlikely	-	-
Pelican, Great White	*Pelecanus onocrotalus*	X		NT	LC		Unlikely	-	-
Cormorant, Cape	*Phalacrocorax capensis*		X	E	NT		Unlikely	-	-
Flamingo, Lesser	*Phoenicopterus minor*	X	X	NT	NT		Unlikely	-	-
Flamingo, Greater	*Phoenicopterus ruber*	X	X	NT	LC		Unlikely	-	-
Secretarybird	*Sagittarius serpentarius*	X	X	VU	V		Possible	Grassland, arable land	Disturbance Habitat destruction

Common name	Species name	SABAP 1	SABAP 2	TAYLOR 2014	IUCN 2012	TOPS	Likelihood of occurring on site	Preferred micro habitat	Possible impacts
Eagle, African Crowned	*Stephanoaetus coronatus*	X	X	VU	NT		Unlikely	-	
Ground-Thrush, Orange	*Zoothera gurneyi*	X	X	NT	LC		Unlikely	-	
Stork, White	*Ciconia ciconia*	X	X	BONN			Probable	Grassland, wetland, arable land	Disturbance Habitat destruction

CE = Critically endangered; E = Endangered; VU = Vulnerable; NT = near-threatened, LC = least concern (Taylor 2014; IUCN, 2012); TOPS = Threatened or Protected Species List – under NEMA.

*The Avifaunal Sensitivity Map is shown in **Figure 146**. None of these areas are significant constraints for the location of the proposed infrastructure and they can all be managed.*

- *The IBA (light blue shading) in the far west is more of a constraint for the Raw Water Module than the Potable Module, particularly now that the option WTW A has been discarded.*
- *The areas in orange are identified for Grey Crowned Cranes by the KZNW 2010 exercise. The proposed project is unlikely to impact significantly on this species, but these areas must still be flagged as sensitive.*
- *The purple area is the Mapstone Dam and associated irrigated crop lands. This area is likely to be utilised regularly by species such as White Stork and Grey Crowned Crane amongst others. The Scoping Phase of this study recommended that this area be avoided entirely. However in the current EIA phase all alternatives presented for assessment require the dam to be crossed by the Potable Water Pipeline. Provided that more technical info on the dam crossing is provided for assessment, and a thorough avifaunal walk through of the area is done prior to construction, this is not anticipated to pose too much risk to avifauna.*
- *The dark blue areas indicate wetlands that will be crossed by the proposed infrastructure. These areas will need careful ground truthing in the avifaunal walk through phase. The most significant of these are in the extreme west, near Option 1 for the WTW, and in the far west where a fairly large wetland is crossed.*

It can be concluded that there are no significant constraints in terms of avifauna.

This project is situated in an area of generally high avifaunal sensitivity (based on the bird species recorded in the broader area), particularly in the western parts. This sensitivity resulted in this avifaunal study being conducted earlier in the EIA process than would *typically be the case. Fortunately much of the site is already transformed for agriculture and forestry, leaving little natural habitat for Red Listed bird species.*

The construction of the WTW does not in itself pose any significant threat to avifauna. It will inevitably remove a certain amount of habitat, but the three options for its placement are predominantly on transformed land.

The construction of the Potable Water Pipeline will also result in some habitat destruction and alteration. Fortunately most of the route is transformed habitat. The exception to this is several small wetlands and drainage lines that must be crossed by the pipeline.

Given the complexity and sensitivity of this project, and the still evolving placement of some infrastructure, it is strongly recommended that a thorough avifaunal walk-through be done on the site prior to construction. This exercise will provide a final check of all aspects and develop detailed mitigation measures where necessary.

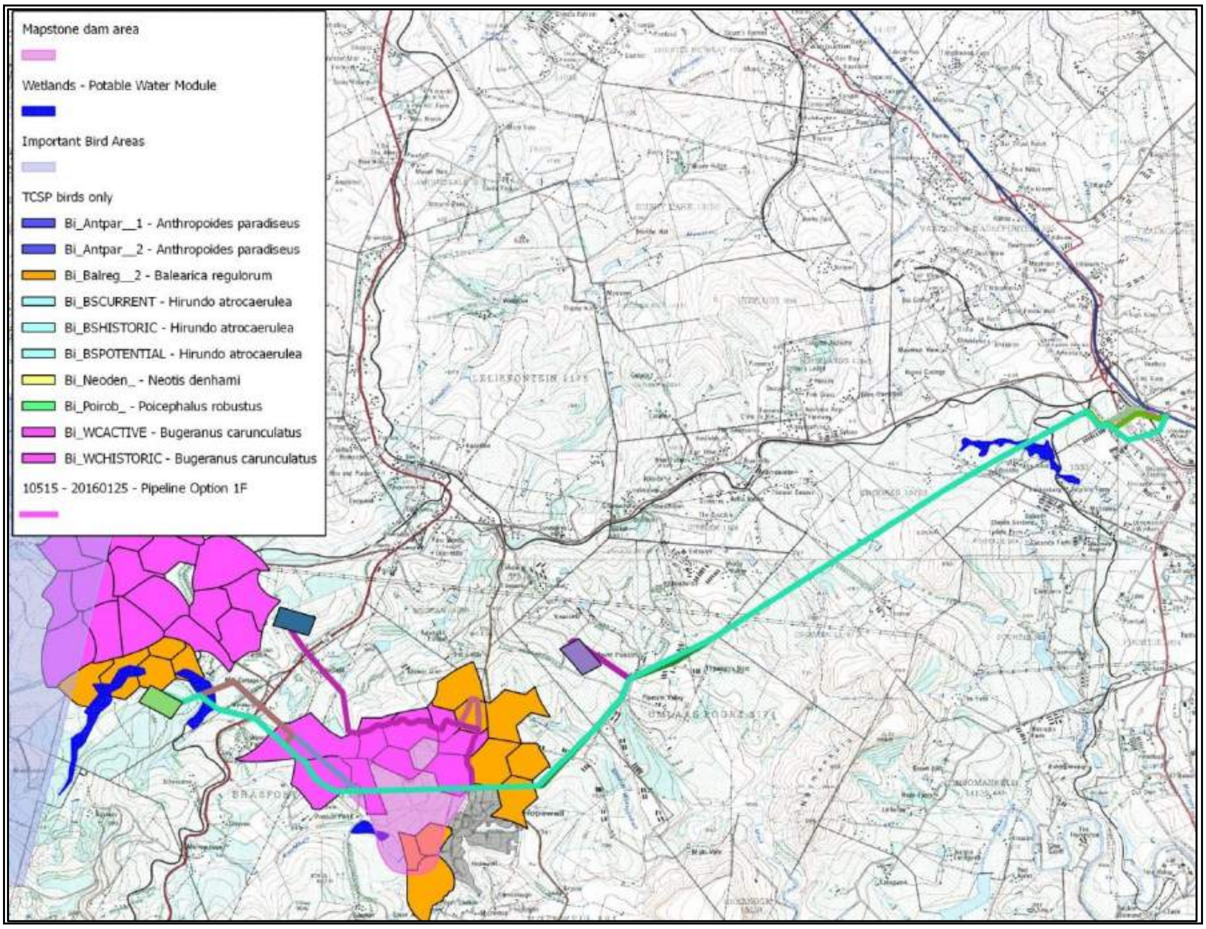


Figure 146: Avifaunal constraints (Wildskies, 2015)

11.2 Specialist Studies undertaken as part of the Technical Feasibility Study

A host of studies were also conducted as part of the uMWP-1 Technical Feasibility Study for the Raw Water and Potable Water components. Some of these studies that are of particular importance for the EIA include the following:

- Water Quality Analysis;
- Geotechnical Investigation;
- Economic Impact Assessment; and
- Traffic Impact Assessment.

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.

11.2.1 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 uMWP-1 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.

11.2.1.1 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.

11.2.1.2 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.

11.2.1.3 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 . In total 123 846 employment opportunities are generated through direct, indirect and induced activities over the same period.
- 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.

11.2.1.4 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.

11.2.2 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 overall 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 147**):

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.

The findings of the investigation are contained in **Section 12.13**.

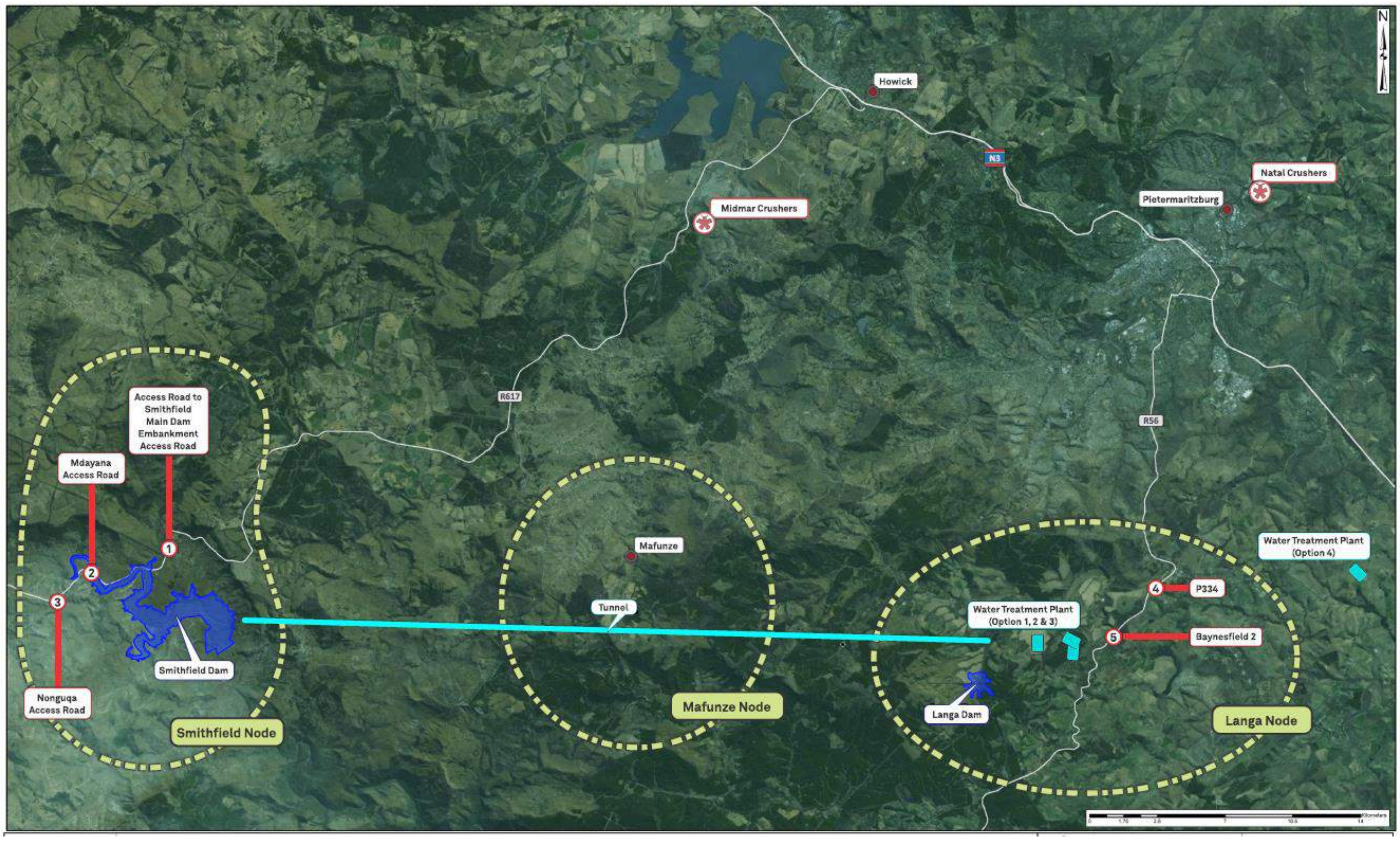


Figure 147: Traffic Impact Assessment study area (DWA, 2015b)

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 Potable 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 50**.

Table 50: 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 potable water pipeline). • Effects to resource quality (i.e. flow, in-stream and

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.	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.
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 –access roads, potable 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 storm water, hazardous material and sanitation.
12. The construction of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50 000 cubic metres or more, unless such storage falls within the ambit of activity 19 of Notice 545 of 2010.	• Impacts linked to the footprint of the reservoir associated with the WTW (200 m x 350 m x 10 m deep). • In order to reduce the area of land required for the WTW and potable water reservoir, it was proposed that the storage be constructed beneath the various WTW structures. • Findings of geotechnical investigations to be considered and recommendations to be implemented. • Management of spoil material to be created by earthworks. • Socio-economic impacts associated with construction activities.
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 and risks posed to human health through poor practices associated with onsite storage of dangerous goods during construction phase and associated with the operation of the WTW.
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 - access roads and potable 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.
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	• Impacts associated with access roads to the various sites (WTW, work fronts along pipeline,

Listed Activities	Potential Impact Overview
(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.	etc.). • Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species). • Traffic disruptions during construction. • 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 area associated with the construction footprint of the WTW and reservoir. • 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 agricultural land. • Socio-economic impacts associated with construction activities. • Impacts to existing infrastructure (e.g. power line servitude for WTW 1).
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.
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. • Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species). • Traffic disruptions. • Impacts to watercourses at crossings.
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.	• Impacts associated with type of phased activities. • Cumulative impacts.
GN No. R. 545 of 18 June 2010	
3. 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 more than 500 cubic metres.	• Pollution of bio-physical environment and risks posed to human health through poor practices associated with onsite storage of dangerous goods during construction phase and associated with the operation of the WTW (including Chlorine, Ammonium Hydroxide, Sodium Hydroxide).
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.	• Impacts associated with constructing new WTW and bulk water pipeline to allow for transfer of water from the uMkhomazi River to the uMlaza River, including physical footprint of conveyance infrastructure. • Note: Impacts associated with abstraction covered under EIA for uMWP-1 Raw Water EIA.
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 area associated with the construction footprint of the WTW and reservoir. • 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 agricultural land. • Socio-economic impacts associated with construction activities. • Impacts to existing infrastructure (e.g. power line

Listed Activities	Potential Impact Overview
	servitude for WTW 1).
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.	Possible occurrence of sensitive biodiversity features at affected areas. The areas earmarked for the WTW site options have been disturbed by historical and current forestry (WTW 1) and agriculture (WTW 2 and WTW 3).
4(a)(ii). The construction of a road wider than 4 metres with a reserve less than 13,5 metres.	Impacts associated with building access roads through sensitive, threatened or protected ecosystems.
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.	Pollution of sensitive, threatened or protected ecosystems through poor practices associated with onsite storage of dangerous goods.
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.	• The clearance of large tracts of indigenous vegetation. • Potential loss of sensitive fauna and flora species.
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.	Impacts to sensitive, threatened or protected ecosystems associated with infrastructure within watercourse(s) / within 32 m from watercourse(s), including access roads and potable 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.
19(a)(ii). The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre.	Impacts to sensitive, threatened or protected ecosystems associated with access roads to the various sites (construction and operational phases).
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 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 to sensitive, threatened or protected ecosystems associated with upgrade of existing bridge(s) along access road(s) 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 M**).

The consolidated issues raised by I&APs during Scoping, as contained in the Comments and Response Report, which have specific bearing on the uMWP-1 Potable Water component 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-
  - 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;
  - 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;
  - General impacts of project to fauna;
- Freshwater and estuarine ecology –
  - Impacts of bulk water infrastructure on catchment management and health;
  - 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;
- Storm water management;
- Steep gradient;
- Risks to existing structures;
- Risks to livestock, wildlife and public safety;
- Crime;
- Visual impacts;
- Impacts to The Baynesfield Estate Lodge;
- Traffic during operational phase;
- Concerns regarding previous access road options, which were subsequently discarded;

❖ 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;

❖ Agriculture and Forestry –

- Loss of timber land;
- Loss of agricultural land;
- Loss of grazing land;
- Compensation;
- Allowances for future agricultural activities within servitude;
- Impacts to chicken farms;

❖ 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;
- Employment opportunities;
- Skills transfer to construction workers;

- Benefits to local communities;

- Public participation –
  - Involvement in process;
  - Suggestion of additional parties to be consulted;
  - Commenting period for the Draft Scoping Report;
- Property –
  - Impacts to properties;
  - Proximity of WTW A (*discarded*) to residences;
  - Servitude specifications;
- Existing infrastructure –
  - Crossing of Transnet Pipeline's oil pipeline;
  - Servitude restrictions associated with existing infrastructure;
- Planning –
  - Impacts to Umlaas Road Light Industrial Development Node;
  - Servitude requirements and restrictions;
- Water use –
  - 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;
- Electrical requirements –
  - Electrical requirements of project;
  - Additional power lines through Baynesfield area;
- Waste management –
  - Management of spoil material to be generated during construction;
  - Management of sludge and washwater;
- Project timeframe;
- Future expansion of WTW; and
- Operation of the scheme.

These issues received further attention during the investigations in the EIA phase, including the environmental and technical specialist studies.

12.1.4 Project and High Level Environmental Activities

The uMWP-1 Potable Water component, including the associated infrastructure and activities, are listed in **Table 16**.

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 51**.

Table 51: Activities associated with uMWP-1 Potable Water Pre-construction Phase

Project Phase: Pre-construction
Project Activities
• Negotiations and agreements with the affected landowners (including Baynesfield Trust and private landowners), tenants, occupiers of land, stakeholders and authorities
• Initiate legal process required for land acquisition
• Detailed engineering design
• Detailed geotechnical investigations, including geophysical investigations
• 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
• Pipe procurement
• 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
• 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

Project Phase: Pre-construction
• 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
• Fencing of corridor
• 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
• 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
• 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 Pre-Construction 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 52**.

Table 52: Activities associated with uMWP-1 Potable 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

Project Phase: Construction
• Site clearing (as necessary)
• Excavation
• Blasting
• Create haul roads
• Temporary river diversion for pipeline crossings
• Electrical supply
• Pipe delivery, offloading and stringing
• Construction of pipeline
• Construct air and scour valves
• Construct access chambers
• Install final Cathodic Protection measures and AC mitigation measures
• Crossing of major roads and railway lines via pipe jacking
• Install pipeline markers
• Construction of WTW
• Cut and cover activities
• Stockpiling of material
• 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, medicinal plants, 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)
• Reinstatement and rehabilitation of construction domain
• Convene EMC Meetings
• On-going consultation with I&APs
• Other activities as per Construction 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 53**.

Table 53: Activities associated with uMWP-1 Potable Water Operational Phase

Project Phase: Operation
Project Activities
• WTW operation –
o Raw water intake

Project Phase: Operation
o Chemical dosing
o Phase separation (Clarification and Filtration)
o Sludge treatment process
o Chemical storage, disinfection and final water storage
o Administrative buildings
o General housekeeping, security and biodiversity
• WTW mechanical, electrical and civil –
o Routine planned maintenance
o Major breakdown repairs
o Minor breakdown repairs
• Raw Water Pipeline –
o Create access track along pipeline servitude
o Conduct routine maintenance inspections of the project infrastructure
o 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
o Undertake maintenance and repair works, where necessary
• On-going consultation with directly affected parties
• Comply with Operation and Maintenance Manual
• Adhere to Operating Rule
High Level Environmental Activities
• Erosion and alien invasive plants monitoring programme
• 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 impact*.

The environmental aspects that have been identified for the proposed uMWP-1 Potable Water component, which are linked to the project activities, are provided in **Table 54**. Note that only high level aspects are provided.

Table 54: Environmental Aspects - uMWP-1 Potable 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

Project Phase: Construction
• Damage to significant fauna
• Influence to resource quality of the uMlaza River and its tributaries 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
• Disturbance of heritage resources and cultural features
• Poor reinstatement and rehabilitation

Project Phase: Operation
Environmental Aspects
• Inadequate consultation with landowners/ tenants / occupiers of land
• Inadequate environmental and compliance monitoring
• Inadequate management of access, routine maintenance and maintenance works
• Inadequate management of vegetation
• Poor scouring practices for bulk water pipeline
• Inadequate management of light pollution from WTW
• Inadequate management of handling and storage of chemicals at WTW
• Inadequate management of storm water at WTW
• Release of sub-standard wastewater from the WTW during emergency situations
• Inadequate management of WTW residue and other waste types
• Uncontrolled emissions from chemical storage areas
• Failure to comply with health, safety and environmental specifications

12.1.6 Potential Significant Environmental Impacts

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 **significant** 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 Potable Water component, as listed in **Table 55** (construction phase) and **Table 56** (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, 2012);
- ❖ Project-related components and infrastructure (see **Sections 9.2 – 9.5**);

- Activities associated with the project life-cycle (i.e. pre-construction, construction, operation and decommissioning) (see **Section 9.8**);
- Proposed alternatives with regards to the Potable Water infrastructure;
- Nature and profile of the receiving environment and potential sensitive environmental features and attributes (see **Section 10**), which included a desktop evaluation (via literature review, specialist input, GIS, topographical maps and aerial photography) and site investigations;
- 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 12.1.3**); and
- Legal and policy context (see **Section 5**).

Table 55: Potential Significant Environmental Impacts – Construction Phase

Environmental Factor	Potential Issues / Impacts
Land Use	• Servitude restrictions • Loss of cultivated land and timber land within construction domain • Change of land use at WTW
Climate	• Greenhouse gas emissions
Geology	• Unsuitable geological conditions • Sourcing of construction material • Blasting • Disposal of spoil material
Topography	• Visual impact in river valleys • Erosion of affected areas on steep slopes
Soil	• Soil erosion • Soil compaction • Soil contamination • Loss of topsoil and fertile soil • Disturbance of contaminated soils during construction
Geohydrology	• Groundwater pollution due to spillages and poor construction practices • Intersection of pipeline trench with aquifers – localised impacts to groundwater flow through dewatering of excavations such as the lowering of the local water table • Water for construction purposes may be drawn from local boreholes • Potential increased groundwater recharge along cleared construction servitude
Hydrology	• Alteration of flow regimes at river crossings due to impediments and diversions
Water Quality	• Sedimentation from instream works, runoff from cleared areas and dewatering • Inflow of contaminated storm water • Release of contaminants from equipment and concreting activities at pipeline crossings • Water quality impacts due to spillages and poor construction practices
Aquatic Ecology	• Disruptions to aquatic biota community due to water contamination, alteration of flow and disturbance to habitat during construction (particularly relevant to

Environmental Factor	Potential Issues / Impacts
	construction activities that take place instream or in close proximity to watercourses) • Spread of noxious / declared weeds
Riparian & Instream Habitat	• Loss of riparian and instream vegetation within construction domain • Destabilisation of channel morphology at river crossings
Water use	• Water quality deterioration and disturbance to flow caused by construction activities may adversely affect downstream water users • Elevated sediment levels may damage downstream pumpstations and reticulation, where users abstract water from the watercourse • Water abstracted from watercourses for construction purposes • Impacts to water users associated with Mapstone Dam, depending on the nature of the crossing
Wetlands	• Various wetlands are affected by the project – ○ The WTW Option 2 site encroaches on a wetland. ○ Various potable water pipeline route options traverse wetlands. ○ Access roads to be upgraded or created for construction purposes may cross wetlands. • Impacts to wetland characteristics
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
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 • Use of private access roads and local road network • Impact to visual quality and sense of place • Light pollution
Agriculture	• Disruptions to farming operations as a result of construction-related use of existing access roads • Loss of cultivated land and timber land within construction domain • Loss of fertile soil through land clearance • Loss of grazing land within construction domain • Risks to livestock
Air Quality	• Excessive dust levels • Greenhouse gas emissions
Noise	• Localised increases in noise during construction
Historical & Cultural Features	• Damage to heritage resources through construction activities • Disruptions to tourism activities at the Heritage Centre, Baynesfield Estate
Existing Structures & Infrastructure	• Crossing of existing infrastructure (e.g. power lines, telephone lines, pipelines, railway lines) • Pipeline passes in close proximity to existing structures (such as dwellings, chicken houses)

Environmental Factor	Potential Issues / Impacts
Transportation	• Increase in traffic on the local road networks • Disruptions to road users as a result of construction • Damage to roads used by heavy construction vehicles and plant • Various road crossings along potable water pipeline - public and private roads affected • Railway line crossings • Creation of temporary and permanent access roads
Solid Waste	• Waste generated from site preparations (e.g. plant material) • 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
Tourism	• Influence to tourism activities at Baynesfield

Table 56: Potential Significant Environmental Impacts – Operational Phase

Environmental Factor	Potential Issues / Impacts
Land Use	• Servitude restrictions • Permanent loss of cultivated land and timber land • Permanent change of land use at WTW
Geology	• Unsuitable geological conditions
Topography	• Visual impact • Erosion of affected areas on steep slopes
Geohydrology	• Degradation of pipeline structure over time – leaching of contaminants • Groundwater pollution due to leaching of contaminated runoff from WTW

Hydrology	• Altered flow regimes at river crossings (dependent on permanent flow impediments such as pipeline encasement and tie-in at banks)
	• Possible permanent pipe bridge over Mapstone Dam
	• Water releases –
	  ○ Pipeline testing and commissioning
	  ○ Scouring events
	  ○ Pipeline ruptures

Water Quality	• Release of water during pipeline testing and commissioning to watercourses could lead to elevated sediment levels • Release of contaminated storm water from WTW to the receiving environment • Discharge at scour valves - potable water (containing residual chlorine) released to watercourses

Aquatic Ecology	• Disturbance to aquatic biota due to water quality deterioration caused by contaminated runoff from WTW entering a watercourse, release of potable water from the pipeline, and sedimentation (maintenance works, scouring events)
	• Potential permanent impacts caused at river crossings –
	  ○ Loss of aquatic habitat
	  ○ Impacts to migration of aquatic biota

Riparian & Instream Habitat	• Release of water (pipeline testing and commissioning, scouring events, pipeline ruptures) to watercourses could cause erosion • Permanent loss of riparian and instream vegetation at river crossings

Environmental Factor	Potential Issues / Impacts
	• Erosion of channel at areas that were disturbed during construction • Exposed pipeline
Wetlands	• Permanent impacts to wetland characteristics (*see above issues pertaining to hydrology, water quality, aquatic ecology and habitat*)
Terrestrial Ecology	• Possible permanent loss of significant flora and fauna species • Servitude through grassland areas • Proliferation of exotic vegetation
Socio-economic Environment	• Use of local road network for operation and maintenance purposes • Impact to visual quality and sense of place associated with WTW • Light pollution from WTW • Health and safety risks associated with WTW, linked to MHI status
Planning	• Servitude restrictions • Sterilisation of land for conflicting development
Agriculture	• Permanent loss of cultivated land due to pipeline aboveground structures (chambers, markers) and WTW (dependent on site selected) • Permanent loss of timber land at WTW and along pipeline servitude (dependent on WTW site selected) • Use of farm roads for operation and maintenance purposes
Noise	• Noise from WTW operations
Transportation	• Use of local road network for operation and maintenance purposes
Aesthetics	• Visual quality and sense of place could be adversely affected by WTW

The cumulative impacts are discussed in **Sections 12.17**.

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 (see **Sections 12.21 – 12.15**), 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 57**). 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.

Table 57: 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.

In the case of the specialist studies, some of the impact assessment methodologies deviated from the approach shown in **Table 57**. However, the quantitative basis for these specialist evaluations of the impacts to specific environmental features still satisfied the intention of the EIA.

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).

The proposed mitigation of the impacts associated with uMWP-1 Potable 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 EMPrs (contained in **Appendix I**) provide 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

Box 1:	**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 EMPrs (as well as the EIA findings and environmental authorisation) lies with the project proponent (i.e. Umgeni Water).

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.

Due to the extent of the overall project, the EMPrs shown in **Table 58** (contained in **Appendix I**) were developed to deal with the various key components of the project.

Table 58: Suite of Project EMPrs

Project Life-cycle	Description	Responsibility for Implementation
PRE-CONSTRUCTION EMPr		
Pre-construction phase	Managing of impacts associated with those activities (and related environmental aspects) that take place prior to construction of the project infrastructure.	Umgeni Water
CONSTRUCTION EMPrs		
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.	Umgeni Water
OPERATIONAL EMPr		
Operational phase	Managing of impacts associated with those activities (and related environmental aspects) that take place as part of the operation of the bulk water supply scheme.	Umgeni Water

The following considerations and assumptions accompany the compilation of the EMPrs:

❖ The EMPrs are 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 EMPrs to be successful and effective;
- **Flexible and responsive -** The implementation of the EMPrs needs to be responsive to new and changing circumstances. The EMPr report is a dynamic "living" document that will need to be updated regularly throughout the duration of the project life-cycle.

❖ Compliance with the EMPrs must be audited in terms of the requirements specified in the EIA Regulations.

❖ Any changes to the EMPrs 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 EMPrs.

❖ The EMPrs provide the framework for the overarching environmental management requirements for the project life-cycle. Following detailed design and planning, the EMPrs may need to be revised to render the management actions more explicit and accurate to the final project specifications.

❖ The EMPrs 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.

❖ The Operational EMPr will be supplemented with procedures developed by Umgeni Water for various operational tasks, such as:

- Off-loading and storage of chemicals;
- Handling of chemicals;
- Chemical dosing (e.g. lime, ammonia, bentonite, coagulant);
- Sludge and backwash plant operation;
- Cleaning of tanks and equipment;
- Incident Management Protocol; and

- Emergency Response Plan.

❖ Although every effort has been made to ensure that the scope and level of detail of the EMPrs 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 EMPrs may be regarded as generic to make provision for activities that may take place as part of the overall project.

It is recommended that a Rehabilitation Management Plan be developed, which should include additional measures identified during construction to supplement the reinstatement and rehabilitation provisions included in the EMPr for the construction phase (if necessary).

12.2 Land Use

12.2.1 General

The negotiations with the landowners for the registration of the servitudes or acquisition of land will be undertaken by Umgeni Water, 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.

A 15 metre wide permanent servitude and a further 45 metre wide temporary construction servitude was identified for the potable water pipeline. The following servitude conditions will apply:

❖ Permanent access to 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;

❖ Farming activities (stock and crop farming, ono-obtrusive to pipeline) can continue within the servitude area after construction, taking cognisance of the need for permanent access to the pipeline servitude; and

❖ No encroachment of infrastructure (buildings) or the establishment of trees will be allowed as roots may compromise the stability of the pipeline.

Observations regarding land uses affected by the project include the following:

- WTW Option 1 lies within a timber plantation and WTW Options 2 and 3 affect cultivated land;
- Sections of the potable water pipeline routes traverse cultivated land and timber plantations with possible disturbances during the construction phase;
- Sections of the potable water pipeline routes pass residential dwellings and disturbances may be experienced during the construction phase; and
- A section of the Pipeline Option 1 route travels to the immediate north of Hopewell.

Impacts associated with land use were indirectly assessed as part of the specialist studies (e.g. Agricultural Impact Assessment, Socio-economic Impact Assessment and Social Impact Assessment).

12.2.2 Impact Assessment

Environmental Feature	**1. Land Use**
Relevant Alternatives & Activities	**WTW and pipeline**
Project life-cycle	**Construction & operational phases**
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Land acquisition and servitude restrictions	1.1. Before construction commences, a negotiator from Umgeni Water will engage with the affected landowners to secure servitude rights. 1.2. Umgeni Water 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	**WTW and pipeline**
Project life-cycle	**Construction & operational phases**
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Loss of land used for agricultural purposes	2.1. Control access to construction domain. 2.2. Compensation to be market-based. Compensation will also be informed by guidelines which are developed by Umgeni Water as well as other government departments (e.g. Department of Agriculture).

	+/- Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Before Mitigation	-	local	high	permanent	almost certain	2
After Mitigation	-	local	low	permanent	almost certain	1

12.3 Geology, Geohydrology and Soils

12.3.1 General

Geotechnical investigations indicated that good conditions could be expected for pipe laying operations with some occurrence of rock that may require blasting. The soils encountered at the potable water pipeline and alternative pipeline route are corrosive to mildly corrosive towards steel. The pipeline will therefore require cathodic protection. Only limited geotechnical investigations could be undertaken at the preferred WTW due to lack of access. Although the limited investigations did not highlight any problems, further investigations are recommended. Geotechnical investigations undertaken for the proposed Mapstone Dam crossing indicated good founding conditions for all crossing options.

Groundwater may be impacted by the project as follows:

- Potential disturbance of the aquifer from blasting;
- The approximate depth of the pipeline trench during construction will be four metres. Confirmation required on whether aquifers will be intersected;
- Potential contamination of groundwater during the construction stage;
- Impacts to groundwater caused by the operation of the WTW, including the improper management of the dangerous goods (chemical storage and loading areas) and sludge; and
- Appropriate management required of shallow groundwater at river crossings and waterlogged areas, which will include the suitable dewatering of excavations.

Excess spoil material (soil and rock) will be generated as part of the bulk earthworks associated with the construction phase of the project. Spoil material will be dealt with as follows.

1. In the first instance, it should be a requirement of the construction contract to use as much excavated material as possible for backfilling of the pipeline.
2. The pipeline bedding and selected fill specifications should be relaxed as far as practically possible to allow the maximum excavated material to be reused without compromising the integrity of the pipeline.

3. After maximising the options above, excess spoil material could be used to rehabilitate existing borrow pits.
4. Spoil material could also be offered to farmers for use on their farms.

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 storm water management and stabilisation of the cut and fill areas. The EMPrs include suitable storm water 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).

12.3.2 Impact Assessment

Environmental Feature	**3. Geology & Soils**
Relevant Alternatives & Activities	**WTW and pipeline**
Project life-cycle	**Construction & operational phases**
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Soil erosion on steep slopes.	3.1. 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. 3.2. Install suitable buttressing to prevent future erosion of the structures of the watercourses affected by construction, if required. 3.3. 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, etc.).

	+/- Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Before Mitigation	-	local	medium-high	short-term	likely	2
After Mitigation	-	local	low	short-term	unlikely	1

Environmental Feature	4. Groundwater
Relevant Alternatives & Activities	WTW and pipeline
Project life-cycle	Construction phases
Potential Aspects & Impacts	Proposed Management Objectives / Mitigation Measures
Contamination of groundwater by poor construction practices.	4.1. Suitable protection of groundwater during excavations. Implement mitigation measures suggested as part of the geotechnical investigations for managing groundwater. 4.2. 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. 4.3. 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	medium-high	short-term	likely	2
After Mitigation	-	local	low	short-term	unlikely	1

Environmental Feature	5. Groundwater
Relevant Alternatives & Activities	WTW
Project life-cycle	Operational phase
Potential Aspects & Impacts	Proposed Management Objectives / Mitigation Measures
Pollution of groundwater caused by the operation of the WTW.	5.1. Suitable stormwater management to ensure separation of clean and dirty water. 5.2. Suitable storage and transportation of WTW residue. 5.3. Avoid discharging sludge and spent backwash water to either a natural water body or into the environment. Washwater recovery system to be employed at the WTW. 5.4. Strict control over storage of hazardous substances, which include: a. Containers must be situated in an area which is constructed and maintained to prevent any release from entering a water supply, sanitary sewer or storm water system, or from contaminating any other area. b. Containers must be stored within a building or area outside of a building which is fenced and posted to restrict access and warn of the materials stored within. c. Containers must be clearly marked or labelled in accordance legal requirements. d. Containers must be kept in segregated storage which, in the event of a spill or release, will prevent chemical reactions or fires. Chemicals must also be stored apart from food for people or animals. e. Certain records and documents must also be kept including MSDSs, an inventory of chemicals (hazardous substances) in storage, records of spills, leaks or unaccountable inventory discrepancies, inspection and maintenance records for leak detection and containment systems at the facility and an emergency response plan in relation to chemicals stored on site. f. Suitable personal protective equipment to be available.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	medium-high	short-term	likely	2
After Mitigation	-	local	low	short-term	unlikely	1

Consider further findings from geotechnical investigations during project design phase and incorporate mitigation measures (as relevant).

12.4 Surface Water

12.4.1 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**.

12.4.2 Water Use

12.4.2.1 General

Water uses associated with the project include 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.

12.4.2.2 Impact Assessment

Environmental Feature	**6. Surface Water - Water Use**
Relevant Alternatives & Activities	**WTW and pipeline**
Project life-cycle	**Construction & operational phases**
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Impacts to lawfully entitled water users	6.1. Manage water quality during construction. 6.2. Existing water use entitlements not to be affected. 6.3. Construction activities to avoid pumping equipment situated along watercourses. 6.4. Ensure that water is made available for the downstream irrigators during the crossing of Mapstone Dam, in consultation with the Upper Umlaas Irrigation Board.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	regional	high	short-term	almost certain	3
After Mitigation	-	regional	low	short-term	unlikely	1

12.4.3 Water Quality

12.4.3.1 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); and
- Dewatering without filtering of sediments.

During the operational phase surface water may be impacted by the following aspects associated with the WTW:

- Poor management of storm water and washwater;
- Improper storage and transportation of residue and waste; and
- Discharges during emergency situations.

Scour valves, which will be located at certain low points along the potable water pipeline route and will release water during shutdowns, repairs and maintenance events, will release washout water to nearby watercourses. Water released from the scour valves will be purified water and in particular the chlorine content will higher than what exists in the natural waters of the receiving watercourses. The receiving watercourses' flow will also be affected by the water releases, which could influence the morphology. The scour outlets will be designed to limit the erosion caused by the escaping water.

12.4.3.2 Impact Assessment

Environmental Feature	7. 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).	7.1. Conduct water quality monitoring (baseline and during construction) at suitable up- and downstream sites on major watercourses affected by project infrastructure (e.g. potable water pipeline, roads, etc.), as necessary. 7.2. All diffuse pollution sources to be managed to prevent pollution of the watercourses in the project area. 7.3. Storage area and ablution facilities to be located 50m from edge of riparian habitat. 7.4. 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. 7.5. Implement suitable stormwater measures during construction to manage ingress of runoff into watercourses. 7.6. 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. 7.7. 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	8. Surface Water - Water Quality
Relevant Alternatives & Activities	WTW
Project life-cycle	Operational phase
Potential Aspects & Impacts	Proposed Management Objectives / Mitigation Measures
Contamination of surface water through discharges from WTW under emergency situations.	8.1. All discharges to comply with legal requirements associated with the National Water Act (Act No. 36 of 1998), and in particular Section 21(f) and 21(g) water uses. 8.2. Make provision for discharges in the Incident Management Protocol and Emergency Response Plan (as relevant). 8.3. Undertake water quality monitoring to assess impact of discharge.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	regional	medium-high	long-term	moderate	3
After Mitigation	-	regional	low	long-term	moderate	1

12.4.4 Aquatic Ecology

12.4.4.1 Pre-Construction & Construction Phases

These phases of the proposed development activities usually result in the greatest ecological impacts. The indiscriminate use of heavy machinery by uninformed operators leading to the unnecessary destruction of habitat is perceived to be one of the leading causes of needless ecological degradation coupled to developments. Careful planning, basic education of operators and on-site management will enable the impacts to be significantly reduced.

The nature of the proposed development activities will result in many impacts being unavoidable. Aspects such as riparian habitat destruction and loss of wetland habitat are inevitable consequences of the proposed development activities. Other impacts can, however, be significantly reduced by ecologically-sensitive construction methods and the following of a carefully planned EMPr. By keeping the footprint of the impacts reduced to a minimum by only allowing heavy machinery to operate on designated access roadways and by avoiding the unnecessary degradation of habitat within areas adjacent to the actual construction areas, the ecological impacts can be greatly reduced.

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 (pipeline crossing points) of the proposed infrastructure. The reinstatement of the watercourse substrates, including underlying soil layers will be important in mitigating this impacting feature. Correct site reinstatement must also ensure unaltered hydrological regimes and hydraulic characteristics of the watercourses in order to abate erosion.

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 and livestock watering.

Riparian vegetation impacts

Only isolated and local impacts to riparian habitat will occur at the pipeline crossing points. 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. Destruction of the riparian vegetation will also lead to a reduction on the flood attenuation capacity of a system, leading to increased erosion of riverbanks and the general transformation of the aquatic environment. This impacting feature can be readily mitigated by revegetating the banks within indigenous and local floral species, or by making use of geotextiles.

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.

Notes on mitigation measures when trenching through wetlands

The proposed pipeline is a linear development and therefore it is inevitable that watercourses and wetland units will be impacted. As it is recommended that the pipeline is entrenched through wetland habitat rather than be suspended on concrete pillars, certain mitigation measures will apply.

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.

Loss of wetland habitat

This is not thought to be a significant impact as the riparian habitat will only be impacted at the actual pipeline crossing points. Indiscriminate destruction of habitat outside of the actual footprint area should not be allowed.

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.

12.4.4.2 Operational Phase

The operational phase of the development should include follow-up surveys of the aquatic habitats to determine the extent of functionality of the mitigation measures provided for during the construction phases. Ongoing monitoring will also identify if any accidental discharges are having significant impacts on the system. The pipelines will also be subject to routine inspections and maintenance, which would necessitate excavations to take place. The impacts associated with this will be similar to the construction phase, albeit at a more local scale.

Aquatic habitat features

The potential contamination of the surface waters from accidental spillages will lead to the depletion of ecologically sensitive aquatic biota. This will lead to transformation of the aquatic species community structures. Maintenance of the WTW and associated pipelines will result in filtration residues and silts that may land up impacting the nearby watercourses. Residual materials and wastes should be adequately protected whilst stored on site and then removed for further processing or discarded at a registered disposal site.

Further potential impacts that will affect the aquatic environment would be the poor management of erosion. Depending on the scale, this could potentially lead to siltation and smothering of the aquatic habitat, with eventual displacement of aquatic species.

Biodiversity impacts

The potential for exotic vegetation encroachment within the riparian zones following the site disturbances through the construction activities is regarded as high, but remains a feature that can be readily mitigated. Management and control of exotic vegetation encroachment will ensure protection of the riparian zones and the retention of natural biodiversity features. Encroachment of exotic vegetation will also negatively affect avifaunal diversity within the area as well as leading to aggravated erosion of riverbanks. This is therefore an important aspect that requires active management. Follow-up surveys should be conducted in order to identify potential development of these impacts to the biodiversity.

Soil erosion

Poor outfall designs (such as from pipeline return flows, culverts, stormwater outfalls, etc.) will increase the potential for soil erosion and the consequential smothering of aquatic habitat. Careful planning by engineers and careful attention to design specifications by construction crews are vital features to successfully mitigating this aspect.

12.4.4.3 Impact Assessment

The information to follow was extracted from the Aquatic Impact Assessment (Enviross, 2016).

Table 59: Potable water pipeline impact significance ratings - preconstruction and construction phases (Enviross, 2016)

PRE-CONSTRUCTION AND CONSTRUCTION PHASEs									
Activity	**Nature of Impact**	**Impact type**	**Extent**	**Duration**	**Potential Intensity**	**Likeli-hood**	**Rating**	**Mitigation***	**Interpretation**
Destruction of aquatic habitat as a direct consequence of the infrastructure construction footprint.	Direct Impact:	Existing	2	1	2	1	5 - MOD	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. This is not a permanent feature as the impact can be mitigated.	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.).
	Aquatic habitat will be impacted where pipelines have to cross through aquatic habitat.	Cumulative	2	2	2	1	6 - MOD		Cumulative impacts are low as the site falls within a largely rural region where infrastructure development is at a minimum.
		Residual	1	1	1	0.5	2 - LOW		Residual impacts can be successfully mitigated with correct site reinstatement and rehabilitation.
Clearing of riparian vegetation to accommodate access to the site and clearing of construction footprint.	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; Utilise single access roads only; Avoid indiscriminate destruction of riparian habitat.	Rivers within the area suffer limited transformation of the riparian zones already.
	Riparian vegetation will have to be removed to allow access for heavy earthmoving equipment, vehicles, etc.	Cumulative	2	2	2	1	6 - MOD		Cumulative loss of riparian habitat is limited due to rural setting of the region.
		Residual	1	1	1	0.5	2 - LOW		With mitigation the impacts to the riparian zones can be minimised and rehabilitated with limited residual impacts remaining.
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;	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;	Cumulative	3	2	2	0.5	6 - MOD		Degradation of water quality is a world-wide feature induced by anthropogenic activities.

PRE-CONSTRUCTION AND CONSTRUCTION PHASEs									
Activity	**Nature of Impact**	**Impact type**	**Extent**	**Duration**	**Potential Intensity**	**Likeli-hood**	**Rating**	**Mitigation***	**Interpretation**
	Fuel leaks from equipment will impact water quality within the area.	Residual	1	1	2	0.5	2 - LOW	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.	Little to no residual impacts to water quality should occur if mitigation measures are properly implemented.

Table 60: WTW impact significance ratings - preconstruction and construction phases (Enviross, 2016)

PRE-CONSTRUCTION AND CONSTRUCTION PHASEs									
Activity	**Nature of Impact**	**Impact type**	**Extent**	**Duration**	**Potential Intensity**	**Likeli-hood**	**Rating**	**Mitigation***	**Interpretation**
Development of a WTW in or near wetland habitat that may destroy surface water ecosystem functionality.	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; Utilise single access roads only; Avoid indiscriminate destruction of wetland habitat.	Limited infrastructure development within wetland areas has taken place. Exotic vegetation has largely transformed wetland and riparian zones throughout the catchment area.
	Option 3 is the only WTW that will not have a direct impact on wetlands or watercourses. Option 2 has the greatest association, Option 1 less so.	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 (agriculture).
		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.

Table 61: Potable water pipeline impact significance ratings - operational phase (Enviross, 2016)

OPERATIONAL PHASE									
Activity	**Nature of Impact**	**Impact type**	**Extent**	**Duration**	**Potential Intensity**	**Likeli-hood**	**Rating**	**Mitigation**	**Interpretation**
Pipeline inspections and routine maintenance will require excavations and site disturbances that will have similar impacts to the construction phase, excepting at the local scale.	Direct Impact:	Existing	1	1	2	1	4 - MOD	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. This is not a permanent feature as the impact can be mitigated.	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).
	Aquatic habitat will be impacted where pipelines have to cross through aquatic habitat.	Cumulative	1	2	2	1	6 - MOD		Cumulative impacts are low as the site falls within a largely rural region where infrastructure development is at a minimum.
		Residual	1	1	1	0.5	2 - LOW		Residual impacts can be successfully mitigated with correct site reinstatement and rehabilitation.
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 62: WTW impact significance ratings - operational phase (Enviross, 2016)

OPERATIONAL PHASE									
Activity	**Nature of Impact**	**Impact type**	**Extent**	**Duration**	**Potential Intensity**	**Likeli-hood**	**Rating**	**Mitigation**	**Interpretation**
Flushing of pipelines and by product residues from the filtration process that will flush into the aquatic systems	Direct Impact:	Existing	1	1	2	1	4 - MOD	Filtration residues should be stored and periodically discarded at registered land fill sites.	This impact could lead to significant siltation of the watercourses.
	Flushing of pipelines and cleaning maintenance of the WTW will lead to residues entering into the watercourses.	Cumulative	1	2	2	1	6 - MOD		At present, no cumulative impact exists of this nature within the area.
		Residual	1	1	1	0.5	2 - LOW		Appropriate handling and removal of these residues will lead to limited residual impacts remaining.

12.4.5 *Hydrology*

12.4.5.1 General

Watercourses in the uMlaza River system are directly affected by the following uMWP-1 Potable Water infrastructure:

- Watercourse crossings along the potable water pipeline Options 1, 1A, 1B and 1C, as well as the link to the WTW Option 2;
- Option 1 of the potable water pipeline crosses Mapstone Dam;
- Access roads to WTW Options 1 and 2; and
- WTW Option 2 – possible encroachment into a watercourse in the south-western corner of the site.

Watercourse crossings will generally consist of pipe sections encased in concrete in accordance with the relevant Umgeni Water criteria. An earthen berm (coffer dam) and temporary bypass canal will be constructed to divert the water around the construction site. The trench will be excavated across the dry river channel. Provision will be made for concrete bedding and encasement of the pipeline. Thereafter the channel will be reinstated and the flow returned to normal.

The affected watercourses need to be reinstated and rehabilitated to prevent future erosion. This may include employing hard and soft engineering techniques, as required. Rehabilitation measures are also included in the EMPr.

12.4.5.2 Impact Assessment

Environmental Feature	**9. 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	9.1. Minimise influence to downstream flow regime when diverting and impeding flow for temporary river crossings or for any other purposes. 9.2. Prevent possible erosion caused by temporary in-stream diversion. Install suitable buttressing / stabilisation structures to protect the pipeline and prevent future erosion, if required (e.g. concrete encasement and reno mattress installations). 9.3. 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. 9.4. 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

12.5 Flora - General

12.5.1 General

Vegetation will be lost in areas that are to be cleared for the project infrastructure. 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, namely *Hypoxis hemerocallidea* (Star flower/African potato) and *Boophane disticha* (Century plant). For flora species, the following factors need to be considered (amongst others) as part of this plan:

- 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).

12.5.2 *Impact Assessment*

Environmental Feature	10. Flora
Relevant Alternatives & Activities	WTW and pipeline
Project life-cycle	Pre-construction, construction & operational phases
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Loss of vegetation of conservation significance through construction activities.	10.1. Search, rescue and relocation of red data, protected and endangered species and medicinal plants. 10.2. All relevant approvals to be obtained prior to relocation of red data, protected and endangered flora species and medicinal plants. 10.3. Any protected plants or trees in proximity to construction areas that will remain, should be clearly marked and must not be disturbed. 10.4. Adequate re-instatement and rehabilitation of areas disturbed by the construction activities.
Loss of topsoil	10.5. 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.
Proliferation of exotic vegetation in disturbed areas	10.6. 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). Eradication method to be approved by the Project Manager. 10.7. To prevent unnecessary alien plant infestations, an alien plant monitoring and eradication programme needs to be in place, at least until the disturbed areas have recovered and properly stabilised.
Loss of medicinal plants and firewood	10.8. Search, rescue and relocation to include medicinal plants. 10.9. Trees felled should be made available to the local surrounding community, as far as practical. 10.10. No trees to be felled for fuel purposes.
Soil contamination and vegetation disturbance due to fuel and chemical spills.	10.11. Employ on site personnel responsible for preventing and controlling potential soil pollution through fuel and oil leaks and spills. 10.12. Natural water bodies must not be used to wash out construction vehicles, concrete mixers, or for domestic ablutions. 10.13. Make sure construction vehicles are maintained and serviced to prevent oil and fuel leaks. 10.14. 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.
Damage to plant life outside of the proposed development areas.	10.15. Construction activities should be restricted to the development footprint area. All workers must be trained before construction commences.

Rehabilitation of site after construction	10.16. Bare surfaces should be grassed as soon as possible after construction to minimise time of exposure. Locally occurring, indigenous runner grasses should be used, for example *Stenotaphrum secundatum*, *Dactyloctenium australe* and *Cynodon dactylon*. Where runners cannot be locally sourced from natural areas within a 50 km radius, then a sterile variety of Couch Grass (*Cynodon dactylon*) can be commercially sourced and planted. 10.17. 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. 10.18. The rehabilitated and seeded areas must be harrowed after spreading the topsoil and fertilizer uniformly. 10.19. Inspect rehabilitated area at three monthly intervals during the first and second growing season to determine the efficacy of rehabilitation measures. 10.20. Take appropriate remedial action where vegetation establishment has not been successful or erosion is evident. 10.21. 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

12.6 Fauna - General

12.6.1 General

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. Refer to the findings of the Terrestrial Ecological Impact Assessment in **Section 11.1.1**.

It is recommended that search, rescue and relocation be conducted taking into consideration red data, protected and endangered fauna species (amongst others). In this regard, attention will be given to the red data mammal species, namely Oribi. 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 EMPrs include measures to manage the potential adverse impacts to fauna associated with the construction activities.

12.6.2 *Impact Assessment*

Environmental Feature	**11. Fauna**
Relevant Alternatives & Activities	**WTW and pipeline**
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.	11.1. Search, rescue and relocation of red data, protected and endangered species. 11.2. 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.
Disturbance of animals found on site during construction	11.3. 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. 11.4. Captured animals to be safely released to a similar representative habitat. 11.5. In order to prevent cases where fauna may fall into excavations, it is strongly recommended that suitably designed barriers or covers are used when excavated pits remain open. 11.6. Proper access control to be maintained to prevent livestock from accessing construction areas.
Habitat lost during clearing for the construction works.	11.7. 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.
Rehabilitation of the site after construction activities	11.8. 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

12.7 Avifauna

12.7.1 *General*

Findings from the Avifauna Study (Wildskies, 2015) follow.

Habitat destruction during construction

During the construction phase of almost any development, some habitat destruction and alteration inevitably takes place. This happens with the construction of the development itself, access roads, and associated infrastructure. Birds rely on habitat to meet their needs for foraging, drinking, resting, commuting and breeding. Of these it is perhaps breeding habitat which is most important to protect, although this varies between bird species.

Specific to this uMWP-1 Potable Water Module project, the most significant potential for impact on habitat is with the larger components of infrastructure divided into the following components:

- The WTW itself will take up a reasonable area of land. The current proposed positions for this facility are comprised predominantly of transformed land (Options 1 and 3 full transformed, Option 2 approximately 60%), which diminishes the importance of this habitat somewhat.
- Potable water pipeline - key areas of concern are wetland and drainage lines' crossings. Due to the highly transformed nature of most of the servitude, and the relatively small area taken up by this infrastructure, this impact is not anticipated to be of high significance.
- Construction of access road infrastructure and other minor components are all considered likely to have relatively small impact on habitat. Most of the site is already transformed, with very little natural vegetation remaining. This diminishes the importance of any impacts on this habitat.

Disturbance of birds during construction & operation

The construction and maintenance activities can impact on birds through disturbance, particularly during bird breeding activities. Particular project activities of concern include general vehicular movement, operating machinery and any other activities which result in noise or increased human activity in an area. Once again the project is divided into the below components:

- The WTW construction activities could result in disturbance of Blue Crane and Blue Swallow if Option 1 is utilised (approximately 6km from the Blue Swallow breeding area, and 4km from the Blue Crane breeding site). This disturbance is however likely to be of fairly low significance relative to the background existing disturbance levels in the area through the intensive farming activities.
- The construction of the potable water pipeline could have an effect on avifauna in the wetland areas and drainage lines but this is not anticipated to be of high significance.

It is recommended that an avifaunal walk through be conducted on the final route to determine whether any sensitive bird species are breeding nearby, and to generally ground-truth the final infrastructure placement.

12.7.2 Impact Assessment

Environmental Feature	12. Avifauna
Relevant Alternatives & Activities	WTW and pipeline
Project life-cycle	Construction & operational phases
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Habitat destruction during construction of proposed development	12.1. 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.

WTW	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	Low	Permanent	Almost certain	1
After Mitigation	-	local	Low	Permanent	Almost certain	1

Potable Water Pipeline	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	Medium	Permanent	Almost certain	1
After Mitigation	-	local	Medium	Permanent	Almost certain	1

Environmental Feature	13. Avifauna
Relevant Alternatives & Activities	WTW and pipeline
Project life-cycle	Construction & operational phases
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Disturbance of birds during the construction & operation of proposed development	13.1. 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.

WTW	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	Low	Short term	Moderate	1
After Mitigation	-	local	Low	Short term	Moderate	1

Potable Water Pipeline	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	Low	Short term	Likely	1
After Mitigation	-	local	Low	Short term	Likely	1

12.8 Agriculture

12.8.1 General

From the Scoping exercise the following impacts in terms of agriculture in the study area where identified:

- WTW Option 1 affects timber land on the Baynesfield Estate that is leased to NCT Forestry Co-operative Limited;
- WTW Option 2 affects cultivated land on the Baynesfield Estate;
- WTW Option 3 affects privately owned sugarcane plantation;
- Disruptions to farming operations as a result of construction-related use of access roads in the Baynesfield area; and
- Impacts to arable land during construction (clearing within the temporary servitude) and operational phase (permanent servitude restrictions). Agricultural practices will be able to proceed on top of the potable water pipeline within the servitude, with certain limitations (non-obtrusive to pipeline).

NCT Forestry Co-operative Limited noted the following concerns with regards to the possible loss of timber land by the project, with specific bearing on WTW Option 1:

- *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. The outcome of the impact assessment is shown in **Table 66**.

12.8.2 WTW

The WTW will be a permanent structure that will sterilise the land. It will therefore have a permanent impact on agriculture, unlike the pipelines, which will be buried and then the land returned to its former use. The impact description is shown in the table to follow.

Table 63: Agricultural Impact description – WTW (Index, 2015)

WTW Site	Loss of high production land	Loss of income
WTW 1	20,5 hectares high potential land that will be lost. It is under pine forest	R877 302 will be lost per annum. This loss is significant It is the highest loss of the different options.
WTW 2	8,5 hectares of high potential land will be lost	R69 001 will be lost per annum. This is the least of the three options.
WTW 3	21,7 hectares of high potential land will be lost	R119 076 will be lost per annum.

12.8.3 Potable Water Pipeline

In order to compare the different alternative pipeline alignments, the potential income from farming for the total route was calculated.

The assumptions are as follows:

- The construction period for laying the pipes is 3 months;
- The impact will be for one year. This is the period that soil will be unproductive or grazing will take to recover; and
- The financial loss, therefore, is temporary.

Table 64 assesses the impact of the construction of the pipeline for only those portions of land that will be directly influenced.

Table 64: Land use affected by pipeline (Index, 2015)

Route / alternative	Field crops	Forest	Grazing	Industry	Poultry	Roads	Total (metres)
WTW OPTION 1							
Option 1 [a]	510		485			682	1 677
Alternative 1A	1 932		234				2 166
Option 1	1 216		485			1 447	3 148
Alternative 1B	2 808	343	234				3 385
Option 1	2 310		1 412				3 722
Alternative 1C	566		2 756		368		3 690

Route / alternative	Field crops	Forest	Grazing	Industry	Poultry	Roads	Total (metres)
Option 1	439		278			501	1 218
Alternative 1D			434	488			922
Alternative 1E	171		330	578			1 079
LINK TO WTW 2							
Alternative 2A			357				357
Alternative 2B			1 164				1 164
LINK TO WTW 3							
3A	1 169						1 169

[a] *Refers to only the portion of Option 1 that is compared with the alternative routes*

Table 65: Projected income from farming activities for pipeline routes (Index, 2015)

Route / alternative	Discussion	Financial impact
WTW OPTION 1		
Alternative 1A	Will traverse more arable land and therefore, will lead to loss of both high potential land and farming income. The loss will be temporary and last for the duration of construction and the period that it takes the soil to settle.	R22 611
Alternative 1B	Will traverse more arable land and therefore, will lead to loss of both high potential land and farming income.	R73 009
Alternative 1C	The main impact will be the poultry houses that will not be affected.	>R4m/y
Alternative 1D	This option is preferred to Route 1 because no arable land will be affected. The loss of income will also be smaller.	-R6 575
Alternative 1E	This option is preferred to Route 1 because no arable land will be affected. The loss of income will also be smaller.	-R4 237
LINK TO WTW 2		
Alternative 2A	This is the proposed route.	
Alternative 2B	Alternative 2B effectively reroutes the pipeline and will be an additional 807 metres of grazing land.	R4 166
LINK TO WTW 3		
3A	There is only one route to link WTW 3 to the pipeline	

A summary of potential impacts include:

- ❖ Loss of high potential arable land -
  - There will be no permanent loss of farming land. The impact is small.
- ❖ Loss of income -
  - The loss of income will be for a period of one year, or until the ground recovers from the construction.
  - The loss of income is largest for Option 1A and 1B. The other deviations have an insignificant impact.

12.8.4 Access roads to WTW

Road alignments are only indicated to determine the financial impact for each option. A route was used that would have the least impact on farming activities. In WTW 1 and 2, the road will follow the pipeline. With WTW3, there is an existing road that traverses the site.

Installing the pipeline will have a temporary impact that would last for the construction period and a short period thereafter. The soil will, however, already be disturbed and from a farming perspective, it could be sensible to construct a road adjacent to the route.

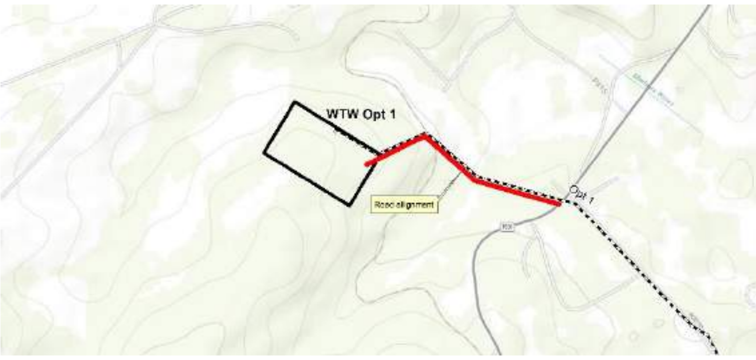
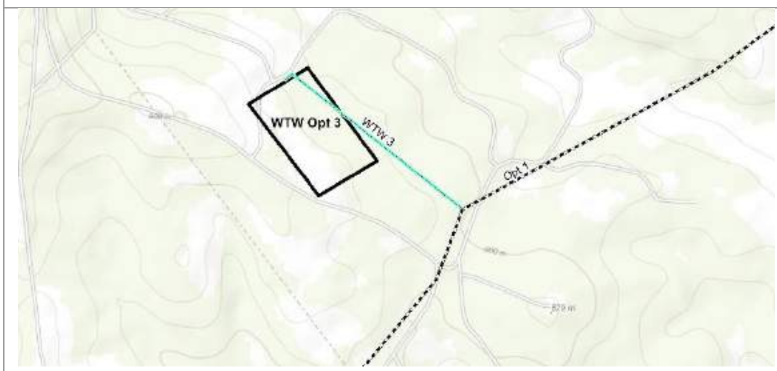
	**WTW 1:** ❖ Follows the pipeline route with access from Road R56. ❖ Impacts: • 612m forest • 485m grazing • 510m field crops ❖ Land would already have been cleared. ❖ Financial loss: R 100 908 per year
	**WTW 2:** ❖ Follows the pipeline route with access from Road R56. ❖ Impact: • 562m field crops ❖ Financial loss: R 9 448 per year
	**WTW 3:** ❖ Follows the pipeline route with access from a rural road. ❖ Impact: • No land lost ❖ Financial loss: None

Table 66: Agricultural Impact Assessment (Index, 2015)

	Potential impact	Proposed Management Objectives / Mitigation Measures	Extent	Magnitude	Duration	Probability	Significance	Area lost	Annual value of loss (permanent)	Value of loss (short term)
1	**WATER TREATMENT WORKS**									
1.1	The WTW site									
A	Loss of high potential arable land									
	Before mitigation									
	Option 1	Permanent loss of 18,9ha forests	Local	High	Permanent	Certain	3	18.9	R 874 566	
	Option 2	Permanent loss of 8,5ha arable land	Local	High	Permanent	Certain	3	8.5	R 69 001	
	Option 3	Permanent loss of 21,1ha arable land	Local	High	Permanent	Certain	3	21.1	R 118 076	
	After mitigation									
	Option 1, 2 and 3	On a national level, no mitigation possible, on a local level, replace the land lost or compensate farmer								
B	Loss of grazing land									
	Before mitigation									
	Option 1	Permanent loss of grazing land	Local	High	Permanent	Certain	3	1.6	R 2 736	
	Option 2	Permanent loss of grazing land	Local	High	Permanent	Certain	3	12.3	R 21 199	
	Option 3	Permanent loss of grazing land	Local	High	Permanent	Certain	3	0	R 0	
	After mitigation									
	Option 1	No mitigation possible								
	Option 2	No mitigation possible								
	Option 3	No mitigation possible								
1.2	The WTW access road									
A	Loss of high potential arable land									

	Potential impact	Proposed Management Objectives / Mitigation Measures	Extent	Magnitude	Duration	Probability	Significance	Area lost	Annual value of loss (permanent)	Value of loss (short term)
	Before mitigation Option 1 Option 2 Option 3 After mitigation Option 1, 2 and 3	 Permanent loss of arable land Permanent loss of arable land Permanent loss of arable land No mitigation possible	 Local Local Local	 High High High	 Permanent Permanent Permanent	 Certain Certain Certain	 3 3 3	 3.37 1.69 0.00	 R 93 397 R 9 448 R 0	
B	Loss of grazing land Before mitigation Option 1 Option 2 Option 3 After mitigation Option 1, 2 and 3	 Permanent loss of grazing land Permanent loss of grazing land Permanent loss of grazing land No mitigation possible	 Local None None	 High	 Permanent	 Certain	 3	 1.455	 R 7 511	
2	**THE WTW TO CAMPERDOWN PIPELINE ROUTE**									
A	Loss of farming land (arable and grazing) Before mitigation WTW 1, 2 and 3 After mitigation WTW 1, 2 and 3	 Temporary loss of high potential land. Compensate the farmer for the temporary loss. Keep the construction period as short as possible. Keep dust levels as low as possible. Change the rout to one with the lowest impact.	 Local Local	 Low Low	 Temporary Temporary	 Certain Certain	 1 1	 0.00 0.00		 R 857 878 R 844 447

	Potential impact	Proposed Management Objectives / Mitigation Measures	Extent	Magnitude	Duration	Probability	Significance	Area lost	Annual value of loss (permanent)	Value of loss (short term)
3	**CROSSING THE MAPSTONE DAM**									
A	Loss of high potential arable land	Will not impact on farming					0	0		

12.9 Historical and Cultural Features

12.9.1 General

The project could lead to the destruction or damage of heritage and cultural features as a result of construction activities. A Phase 1 Heritage Impact Assessment was conducted in accordance with the KZN Heritage Act (Act No. 4 of 2008). The heritage and cultural resources identified as part of this study are discussed in **Sections 10.15** and **11.1.3**.

A Heritage Management Plan for the uMWP-1 Potable 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.

12.9.2 Impact Assessment

Environmental Feature	**14. Cultural heritage**
Relevant Alternatives & Activities	**WTW and pipeline**
Project life-cycle	**Construction & operational phases**
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Destruction or damage to cultural heritage sites including graves, buildings older than 60 years, etc.	14.1. During construction, if any heritage resources are found (chance finds) the following protocol must be followed: a. All work must stop in the vicinity of the find. b. The Contractor or ECO must be informed and the find barricaded off to prevent further interference or damage. c. Amafa must be informed and a registered heritage specialist must be appointed to undertake an assessment of the find. d. Depending of what is found and the significance thereof, the specialist will advise on the way forward. e. If the resource needs to be removed/altered/destroyed then the necessary permit/s must be obtained from Amafa. f. Only once the specialist gives the go-ahead can work commence in the area. g. Under no circumstance can heritage material be destroyed or removed from the site. h. 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	-	local	medium	short-term	likely	3
After Mitigation	-	local	low	short-term	unlikely	1

Environmental Feature	**15. Cultural heritage**
Relevant Alternatives & Activities	**WTW**
Project life-cycle	**Construction & operational phases**
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Damage/destruction of Stead family church and cemetery near WTW 3	15.1. The Stead family cemetery and church must have a 30 m buffer around it to avoid any impacts by the construction of the pipelines. 15.2. All buffer areas must be respected especially in terms of the pipeline link to WTW Option 3 which could impact on a cemetery and church that are significant heritage sites protected in terms of the NHRA and KwaZulu-Natal Heritage Act. 15.3. Buffer areas must be barricaded off with highly visible danger tape or other method so that the buffer area is clearly visible to all construction personnel. 15.4. Permanent fencing around the Stead family church and cemetery must be considered by the Applicant in order that operational activities such as maintenance and repair of the WTW and pipeline do not impact on the heritage resources.

	+/- Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Before Mitigation	-	local	medium	short-term	likely	3
After Mitigation	-	local	low	short-term	unlikely	1

Environmental Feature	**16. Cultural heritage**
Relevant Alternatives & Activities	**Pipeline Option 1**
Project life-cycle	**Construction & operational phases**
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Damage or destruction of Stead family cemetery	16.1. It is recommended that Pipeline Option 1 be moved further away (south-eastwards) from the Stead family cemetery to avoid impacting on the graves that are of heritage significance and protected by section 36 of the NHRA. 16.2. It is not recommended that application is made to remove the graves as the graves and church are closely linked. 16.3. A proposed buffer area of 30m around the cemetery and church must be implemented. The 30 m buffer area must be barricaded off with highly visible danger tape or barricading so that the buffer area is clearly visible to all construction personnel 16.4. Permanent fencing around the Stead family church and cemetery must be considered by the Applicant in order to ensure that operational activities such as maintenance and repair of the pipeline do not impact on the heritage resources.

	+/- Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Before Mitigation	-	local	medium	short-term	likely	3
After Mitigation	-	local	low	short-term	unlikely	1

Environmental Feature	17. Cultural heritage
Relevant Alternatives & Activities	Pipeline Options 1A, 1B, 1C, 1D, 1E and 1F
Project life-cycle	Construction & operational phases
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Damage to St. Johns Church and cemetery (Methodist Church of Baynesfield	17.1. The construction of either Option 1A or Option 1B must not impact on the church and cemetery which are significant heritage sites that are protected by the NHRA. 17.2. A proposed buffer area of 15 m around the church grounds must be implemented. The 15 m buffer must be barricaded off with highly visible danger tape or other method so that the buffer area is clearly visible to all construction personnel.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	low	short-term	unlikely	3
After Mitigation	-	local	low	short-term	remote	1

Environmental Feature	18. Cultural heritage
Relevant Alternatives & Activities	Pipeline Option link to WTW 2
Project life-cycle	Construction & operational phases
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
• Destruction or damage to cultural heritage sites including graves, buildings older than 60 years, etc.	18.1. If WTW 2 is chosen as the preferred site, once it is decided which of the alignments are to be used, a heritage specialist must be appointed to undertake a follow-up assessment of the alignment especially in the area immediately north of Mapstone dam and the watercourse to ensure that no heritage sites will be impacted by construction activities.
• Damage or destruction of protected structure	18.2. The construction of the pipeline link must not damage the structure located at 29°46'00.98"S/ 30°22'06.13E. 18.3. It is recommended that if WTW 2 is selected, a 15m buffer be placed around the structure to avoid any construction activities impacting on the site. 18.4. The 15 m buffer must be barricaded off with highly visible danger tape or other method so that the buffer is clearly visible to all construction personnel.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	medium	short-term	unlikely	3
After Mitigation	-	local	low	short-term	remote	1

Environmental Feature	19. Cultural heritage
Relevant Alternatives & Activities	Pipeline Option link to WTW 3
Project life-cycle	Construction & operational phases
Potential Aspects & Impacts	Proposed Management Objectives / Mitigation Measures
Damage or destruction of Stead family church and cemetery	19.1. It is recommended that the pipeline link be moved further away (south-westwards) from the Stead family cemetery and church to avoid impacting on the heritage resources that are of heritage significance and protected by sections 34 and 36 of the NHRA. 19.2. A proposed buffer area of 30m around the cemetery and church must be implemented. The 30 m buffer area must be barricaded off with highly visible danger tape or other method so that the buffer area is clearly visible to all construction personnel 19.3. Permanent fencing around the Stead family church and cemetery must be considered by the Applicant in order to ensure that operational activities such as maintenance and repair of the pipeline link does not impact on the heritage resources.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	high	short-term	likely	3
After Mitigation	-	local	low	short-term	unlikely	1

Environmental Feature	20. Cultural heritage
Relevant Alternatives & Activities	Pipeline – Crossing of Mapstone Dam
Project life-cycle	Construction phase
Potential Aspects & Impacts	Proposed Management Objectives / Mitigation Measures
Destruction or damage to cultural heritage sites including graves, buildings older than 60 years, etc.	20.1. Once it is established which technique is to be used for crossing the dam, a heritage specialist must go to site prior to construction to assess the impact on the banks of the dam. 20.2. Follow protocol established for chance finds of heritage resources.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	low	short-term	moderate	3
After Mitigation	-	local	low	short-term	unlikely	1

Environmental Feature	21. Archaeological Sites and Artefacts
Relevant Alternatives & Activities	WTW and pipeline
Project life-cycle	Construction phase
Potential Aspects & Impacts	Proposed Management Objectives / Mitigation Measures
Destruction or damage to archaeological sites and artefacts	21.1. Follow protocol established for chance finds of archaeological sites and artefacts.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	N/A	N/A	N/A	unlikely	0
After Mitigation	-	N/A	N/A	N/A	unlikely	0

Environmental Feature	22. Palaeontology
Relevant Alternatives & Activities	WTW and pipeline
Project life-cycle	Construction phase
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Destruction or damage to fossils unearthed during construction	22.1. Follow protocol established for chance finds of fossils. 22.2. During construction, if any fossils are found (chance finds) the following protocol must be followed: a. All work must stop in the vicinity of the find b. The Contractor or ECO must be informed and the find barricaded off to prevent further interference or damage c. Amafa must be informed and a registered palaeontologist must be appointed to undertake an assessment of the find. d. Depending of what is found and the significance thereof, the specialist will advise on the way forward. e. If the fossils found need to be removed, the necessary permit/s must be obtained from Amafa before removal takes place. f. Only once the specialist gives the go-ahead can work commence in the area g. Under no circumstance may fossils be destroyed or removed from the site

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	medium	short-term	unlikely	3
After Mitigation	-	local	low	short-term	remote	1

12.10 Air Quality

12.10.1 General

The following observations are made with regards to sensitive noise and dust receptors in the study area:

- WTW options –
  - Dwellings on the Farm Nels Rust 849 (Zakhe Training Institute), accessed from the P315 road - approximately 550m to the north-east of WTW Option 1;
  - Dwellings on Portions 65 and 85 on the Farm Nels Rust 849 - approximately 760m to the west of WTW Option 2;
  - Dwellings on Portion 36 of the Farm Umlaas Poort 1174 - approximately 400m to the north of WTW Option 3;
  - Dwellings on the Remainder of the Farm New Leeds 17871 - approximately 510m to the north-east of WTW Option 3;
- Potable water pipeline options –

- Dwellings on farms located alongside the pipeline routes that are closer than 500m, which include the following properties –
  - The Farm Nels Rust 849;
  - Portions 1, 6, 20, 22, 30, 43, 44, 47 and the Remainder of the Farm Brasfort Park1295;
  - Residences in the northern part of Hopewell;
  - Portions 5, 6, 11, 13, 43, 65 – 69, 71, 72 and 73 of the Farm Hopewell 881;
  - Portions 4, 10, 13, 20, 21, 22, 27 and 33 of the Farm Umlaas Poort 1174;
  - The Farm Morning Sun 17790;
  - Portions 3 and 6 as well as the Remainder of the Farm Crookes 15723;
  - Portion 30 of the Farm Camperdown 1330;
- Chicken houses are situated alongside the pipeline routes on the following farms –
  - Portions 6, 13 and 43 of the Farm Hopewell 881;
  - Portions 10, 20 of the Farm Umlaas Poort 1174; and
  - Portion 30 of the Farm Camperdown 1330.

Potential impacts during the construction phase include:
- ❖ Dust will be generated during the construction period from various sources, including blasting, earthworks, stockpiles, use of haul roads and access roads, transportation of spoil material and general construction activities on site; and
- ❖ Exhaust emissions from vehicles and equipment.

Potential sources of air pollution during the operational phase of the WTW include unmitigated storage and use of dangerous goods (chlorine and other chemicals) and the use of the emergency back-up generator. Due to the remote location of the WTW and the nature of the treatment process, no significant emissions or odour problems are anticipated. No residential areas of dwellings are situated in close proximity to the WTW alternative sites.

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.

12.10.2 Impact Assessment

Environmental Feature	**23. 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	23.1. 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. 23.2. Speed limits to be strictly adhered to. 23.3. The Contractor will take preventative measures to minimise complaints regarding dust nuisances (e.g. screening, dust control, timing, pre-notification of affected parties). 23.4. 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.

	+/- Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Before Mitigation	-	local	medium	short-term	likely	2
After Mitigation	-	local	low	short-term	unlikely	1

Environmental Feature	**24. Air Quality**
Relevant Alternatives & Activities	**WTW**
Project life-cycle	**Construction phase**
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
Excessive dust levels as a result of construction activities	24.1. 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. 24.2. Speed limits to be strictly adhered to. 24.3. The Contractor will take preventative measures to minimise complaints regarding dust nuisances (e.g. screening, dust control, timing, pre-notification of affected parties). 24.4. 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.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	medium	short-term	likely	2
After Mitigation	-	local	low	short-term	unlikely	1

12.11 Noise & Vibration

12.11.1 General

Sensitive noise receptors are noted in **Section 12.10.1**.

During construction, localised increases in noise will be caused by blasting, 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.

Major construction activities will occur in the Baynesfield area, which will be associated with the uMWP-1 Raw Water (tunnel outlet, hauling of spoil material to the waste disposal site and the construction of the balancing dam and raw water pipeline) and Potable Water (WTW and potable water pipeline) components. This may cause a nuisance to the surrounding homesteads located on The Mynde Farm and Kyalami Farm.

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.

12.11.2 Impact Assessment

Environmental Feature	**25. 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.	25.1. The provisions of SABS 1200A will apply to all areas within audible distance of residents. 25.2. Working hours to be agreed upon with Project Manager, so as to minimise disturbance to landowners/occupiers and community members. 25.3. Construction activities generating output levels of 85 dB or more will be confined to normal working hours. 25.4. Noise preventative measures (e.g. screening, muffling, timing, pre-notification of affected parties) to be employed. 25.5. Blasting operations to be controlled to ensure sound pressure levels are kept below the generally accepted 'no damage' level of 140 decibels. 25.6. Survey potentially affected structures prior to and after blasting. 25.7. 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	**26. 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.	26.1. Monitoring and management of vibrations. 26.2. Vibrations to remain within set limits. 26.3. Identify blast and vibration attenuation features. 26.4. Develop vibration limits for sensitive avifauna species in consultation with EKZNW and avifauna specialist. 26.5. Vibrations to be monitored (baseline and during construction). Sampling locations to consider major noise sources and sensitive receptors. 26.6. 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

12.12 Socio-Economic Environment

12.12.1 General

Possible impacts to the socio-economic environment include (amongst others):

- Construction phase –
  - Loss of agricultural land – WTW Options 2 and 3;
  - Loss of timber land – WTW Option 1;
  - Disruptions to farming practices – pipeline routes;
  - Use of local road network by construction vehicles;
  - Risk to safety and security of local residents;
  - Risk to livestock;
  - Nuisance from dust and noise;
  - Visual impacts; and
  - 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).
- Operational phase –
  - Permanent loss of arable land at the selected WTW site;
  - Impact to visual quality and sense of place of area affected by WTW;
  - Use of local roads to WTW for collection and disposal of sludge, delivery of materials, and general staff access;
  - Light and noise pollution from WTW; and
  - Servitude restrictions for potable water pipeline.
- 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.

12.12.2 Social Impact Assessment

The following impacts were identified as part of the Social Impact Assessment (Dr Neville Bews & Associates, 2016):

- Health and social well-being related impacts -
  - 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.
- Quality of the living environment impacts -
  - Disruption of daily living;
  - Increased population density and crowding;
  - Reduced adequacy of community social infrastructure;
  - Reduced adequacy of physical infrastructure; and
  - Reduction in perceived quality of life.
- Economic and material well-being impacts -
  - Increase in employment opportunities;
  - Increased opportunities for SMMEs; and
  - 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).
- Cultural impacts -
  - Refer to findings of Heritage Impact Assessment (Beater & Prins, 2015) for sensitive cultural heritage sites.
  - 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; and
    - Changes in movement patterns.
- 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.

- Institutional, legal, political and equity impacts -
    - Increased demand on existing infrastructure facilities and social services;
    - Attitude formation towards project.
- Gender relation impacts -
  - Cultural resistance towards women; and
  - Division of labour.

12.12.2.1 Impact Assessment

Environmental Feature	**27. Health and Social Well-Being**
Relevant Alternatives & Activities	**Potable Water Component – Water Treatment Works and associated pipeline infrastructure**
Project life-cycle	**Construction & operational phases**

Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Annoyance, dust and noise	27.1. Apply the dust suppression and noise reduction mitigation measures recommended in the EMPr.
Increase in crime	27.2. Ensure that construction workers are clearly identifiable. All workers should carry identification cards and wear identifiable clothing.
	27.3. Fence off all construction sites and control access to these sites.
	27.4. Clearly mark any hazardous areas and regularly monitor these areas to ensure that they are avoided by people and animals.
	27.5. Liaise with the South African Police Services (SAPS) and Community Policing Forums to ensure that construction sites are monitored.
	27.6. Encourage local people to report any suspicious activity associated with the construction sites.
	27.7. Prevent loitering within the vicinity of the construction camp as well as construction sites.
Increased risk of HIV and AIDS	27.8. 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	27.9. Communicate the limitation of opportunities created by the project through the Traditional Authorities (*related to Raw Water component*) and Ward Councillors.
Presence of construction workers	27.10. 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	27.11. Ensure all construction equipment and vehicles are properly maintained at all times.
	27.12. 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.
	27.13. 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.
	27.14. Make staff aware of the dangers of fire during regular tool box talks.
	27.15. Ensure all construction equipment and vehicles are properly maintained at all times.

Water Treatment Works						
	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

Potable Water Pipeline						
	Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Construction Phase						
Before Mitigation	Negative	Local	Medium	Short term	Almost certain	2
After Mitigation	Negative	Local	Low	Short term	Almost certain	2
Operational Phase						
Before Mitigation	Negative	Local	Low	Long term	Unlikely	1
After Mitigation	Negative	Local	Low	Long term	Unlikely	1

Environmental Feature	**28. Quality of the living environment (Liveability)**
Relevant Alternatives & Activities	**Potable Water Component – Water Treatment Works and associated pipeline infrastructure**
Project life-cycle	**Construction & operational phases**

Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Disruption of daily living	28.1. Ensure that, at all times, people have access to their properties as well as to social facilities such as schools, churches, transport and shops.
	28.2. Investigate and consult local communities on the need to provide suitable access points around for people and animals around the construction sites.
Increased population density and crowding	28.3. Liaise with the appropriate local authorities to ensure that they are aware of the increase of population.
	28.4. See mitigation measures that apply to social and physical infrastructure below
Reduced adequacy of community social infrastructure	28.5. 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
	28.6. Where damage has been reported regularly follow up to ensure rapid repair ensues.
Reduced adequacy of physical infrastructure	28.7. Regularly monitor the effect that construction is having on infrastructure and immediately report any damage to infrastructure to the appropriate authority.
	28.8. Where damage has been reported regularly follow up to ensure rapid repair ensues.
Reduction in perceived quality of life	28.9. Appoint a Professional Service Provider to establish and facilitate an independent forum for communication and liaison
	28.10. Ensure that this forum is representative and consists of representatives of the Traditional Authorities (*related to Raw Water component*), municipalities, ward councillors and communities to address any concerns or grievances that community members may have regarding the project. This forum will from here on be referred to as 'The Forum' under other sections of this report.
	28.11. 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.
	28.12. Establish channels of communication between local communities and contractors to ensure that construction workers behave in a manner acceptable to these local communities.
	28.13. Put procedures and regulations in place to control loitering and the construction of informal dwellings in the vicinity of the construction sites.

Water Treatment Works						
	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
	Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Potable Water Pipeline						
Construction Phase						
Before Mitigation	Negative	Local	Medium	Short term	Almost certain	2
After Mitigation	Negative	Local	Low	Short term	Almost certain	2
Operational Phase						
Before Mitigation	Negative	Local	Low	Long term	Unlikely	1
After Mitigation	Negative	Local	Low	Long term	Unlikely	1

Environmental Feature	**29. Economic and material well-being**
Relevant Alternatives & Activities	**Potable Water Component – Water Treatment Works and associated pipeline infrastructure**
Project life-cycle	**Construction & operational phases**
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Increase in employment opportunities	29.1. Local residents should be recruited to fill semi- and unskilled jobs. 29.2. Women should be given equal employment opportunities and encouraged to apply for positions 29.3. 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	29.4. A procurement policy promoting the use of local business should, where possible, be put in place to be applied throughout the construction phase.

Water Treatment Works						
	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
	Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Potable Water Pipeline						
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

Environmental Feature	30. Cultural
Relevant Alternatives & Activities	Potable Water Component – Water Treatment Works and associated pipeline infrastructure
Project life-cycle	Construction & operational phases

Potential Impact	Proposed Management Objectives / Mitigation Measures
Diminished cultural integrity	30.1. Sensitise construction workers from outside the area to the traditions and practices of local communities.
	30.2. 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	30.3. 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.
	30.4. Follow the mitigation measures suggested by the Heritage Specialist.
Changes in movement patterns	30.5. Wherever possible reinstate access to sites of cultural importance.
	30.6. Follow the mitigation measures suggested by the Heritage Specialist.

Water Treatment Works						
	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
	Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Potable Water Pipeline						
Construction Phase						
Before Mitigation	Negative	Local	Medium	Short term	Almost certain	2
After Mitigation	Negative	Local	Low	Short term	Almost certain	2
Operational Phase						
Before Mitigation	Negative	Local	Low	Long term	Unlikely	1
After Mitigation	Negative	Local	Low	Long term	Unlikely	1

Environmental Feature	31. Family and community
Relevant Alternatives & Activities	Potable Water Component – Water Treatment Works and associated pipeline infrastructure
Project life-cycle	Construction & operational phases

Potential Impact	Proposed Management Objectives / Mitigation Measures
Disruption to family structures and social networks	31.1. Include a section in the induction programme for incoming construction workers that covers local traditions and practices.
	31.2. 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.
	31.3. Provide a communication channel via The Forum through which local communities can voice their experiences and expectations of construction workers.
	31.4. 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.
	31.5. Provide a communication channel via The Forum through which local communities can voice their experiences and expectations of construction workers.
Changed attitudes towards	31.6. A formal accessible grievance procedure should be implemented and communicated to communities.

Potential Impact	Proposed Management Objectives / Mitigation Measures
local communities and the level of satisfaction with the neighbourhood	31.7. Address all grievances swiftly, fairly and in a transparent manner.
	31.8. Provide swift and honest feedback in response to all queries.

Water Treatment Works						
	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	1
After Mitigation	Negative	Regional	Low	Long term	Unlikely	1
	Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Potable Water Pipeline						
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	Rare/Remote	1
After Mitigation	Negative	Regional	Low	Long term	Rare/Remote	1

Environmental Feature	32. Institutional, legal, political and equity
Relevant Alternatives & Activities	**Potable Water Component – Water Treatment Works and associated pipeline infrastructure**
Project life-cycle	**Construction & operational phases**
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Increased demand on existing infrastructure facilities and social services	32.1. Ensure that the receiving environment is prepared and has adequate infrastructure, facilities and social services to support both the influx of workers.
	32.2. Swiftly address any grievance raised concerning service delivery in a transparent and equitable manner.
	32.3. Regularly monitor the effect that the project is having on existing infrastructure facilities and social services within the area.
Attitude formation towards project	32.4. Promptly deal with any raised expectations amongst communities regarding perceived benefits, through a process of communication and consultation.
	32.5. Promptly address any concerns raised by the public in a transparent manner.
	32.6. Where necessary always provide prompt and clear feedback to communities.

Water Treatment Works						
	Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Construction Phase						
Before Mitigation	Negative	Local	Medium	Short term	Likely	2
After Mitigation	Negative	Local	Low	Short term	Likely	2
Operational Phase						
Before Mitigation	Negative	Local	Low	Long term	Likely	2
After Mitigation	Negative	Local	Low	Long term	Likely	2
	Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Potable Water Pipeline						
Construction Phase						
Before Mitigation	Negative	Local	Low	Short term	Likely	2
After Mitigation	Negative	Local	Low	Short term	Likely	1
Operational Phase						
Before Mitigation	Negative	Local	Low	Long term	Likely	1
After Mitigation	Negative	Local	Low	Long term	Likely	1

Environmental Feature	33. Gender relations
Relevant Alternatives & Activities	Potable Water Component – Water Treatment Works and associated pipeline infrastructure
Project life-cycle	Construction & operational phases
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Division of labour	33.1. Ensure that gender differences are taken into account when hiring staff.
	33.2. When providing staff facilities ensure that gender differences are taken into account.

Water Treatment Works						
	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	1
Operational Phase						
Before Mitigation	Negative	Regional	Low	Long term	Likely	2
After Mitigation	Negative	Regional	Low	Long term	Likely	1
	Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Potable Water Pipeline						
Construction Phase						
Before Mitigation	Negative	Regional	Medium	Short term	Almost certain	2
After Mitigation	Negative	Regional	Low	Short term	Almost certain	1
Operational Phase						
Before Mitigation	Negative	Regional	Low	Long term	Likely	1
After Mitigation	Negative	Regional	Low	Long term	Likely	1

12.12.3 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:

- Construction of the new WTW and bulk water pipeline to allow for transfer of water;
- Access roads to the various sites – either upgrading of existing roads or building of new roads to facilitate access to the sites by the construction equipment;
- "Dangerous goods" that are likely to be associated with the greater project, include the following:
  - Fuel stores for construction purposes;
  - Goods used for the operation of the sub-station(s); and
  - WTW operations.
- Zoning status of land affected by project infrastructure to be confirmed. Land earmarked for WTW to be rezoned.

The following potentially significant impacts of the project are assessed:

- Impact on income;
- Job creation and skills development;
- Safety and security;
- Construction impacts -
  - Induced Migration;
  - Health;
  - Impact on road conditions;
  - Dust, noise and disturbance; and
  - Land claims.

12.12.3.1 Impact Assessment

The tables to follow were extracted from the Socio-Economic Impact Assessment (Nemai Consulting, 2016a).

Environmental Feature	**34. Impact on Income**
Relevant Alternatives & Activities	**Construction activities. Acquisition of land**
Project life-cycle	**Pre-construction**

Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Loss of income from the acquisition of land	34.1. All negotiations and payments relating to compensating affected landowners should be conducted and concluded before construction begins. 34.2. Those landowners who will be required to sell their property to Umgeni Water must be compensated for any business that is operating on the premises. 34.3. 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. 34.4. Negotiations should take place between the landowner and Umgeni Water for any compensation of potential income denied as a result of the servitude agreements.
Impact on downstream users of the dam from the draining of Mapstone Dam	34.5. An extensive communication plan for downstream users must be drafted and adhered to. 34.6. Farmers must be notified at least one season before the draining of the dam to allow for adequate planning. 34.7. All negotiations and payments relating to compensation should be concluded before construction begins. 34.8. The impact on farms must be assessed by an independent agricultural specialist. 34.9. Farmers must have the opportunity to conduct their own impact study at their own cost. 34.10. Negotiations must be in the transparent and well documented. 34.11. Compensation must be provided for every season affected by the draining of the Mapstone Dam. 34.12. For every additional season the farmers are affected, compensation should be based on the principle of the first season. 34.13. Umgeni Water is encouraged to establish a committee or forum to assist with the negotiations and communication with farmers.

Potential Impact	Proposed Management Objectives / Mitigation Measures
Impact on workers	34.14. Where possible, project alternatives that result in a loss of income must be avoided by the project. 34.15. Communication with farmers must take place to see how employees will be affected by the project. 34.16. Where possible, Umgeni Water must obtain the services of a specialist to determine if job losses can be avoided. 34.17. Where job losses are absolutely required, these families must be engaged with extensively. 34.18. Workers must be absorbed in the construction phase of the project. 34.19. Identification of opportunities for displaced workers in the operational phase must take place. The necessary training must be provided. 34.20. All workers displaced by the construction of the uWMP-1 must be absorbed into the operations of the system to ensure that no person is left worse off as a result of the project.

	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Regional	Medium	Medium term	Likely	3
After Mitigation	Negative	Regional	Medium	Medium term	Likely	2

Environmental Feature	**35. Impact on small business**
Relevant Alternatives & Activities	**Construction activities**
Project life-cycle	**Construction**

Potential Impact	Proposed Management Objectives / Mitigation Measures
Impact on small businesses	35.1. Construction and other materials to be sourced from local suppliers to boost the regional economic and drive the creation of more sustainable jobs 35.2. SMME opportunities should be provided to everyone on an equal basis. Where possible, Umgeni Water should support and encourage the development of SMMEs and local or regional suppliers. 35.3. Where possible, procurement should come from local and regional business so that the profits stay in the area, increasing economic activity. 35.4. Umgeni Water 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	**36. Impact on job creation and skills development**
Relevant Alternatives & Activities	**Construction activities**
Project life-cycle	**Construction phase**

Potential Impact	Proposed Management Objectives / Mitigation Measures
Skills transfer	36.1. Umgeni Water must develop a skills development program for the duration of the construction activity. 36.2. Beneficiaries of educational programs should be residents who live close to the project area. 36.3. The selection process should be transparent 36.4. In order to increase the size of local employment, women should also be employed.
Increased employment	36.5. Preferential treatment to local job seekers before employing labour from outside. 36.6. One hundred percent of unskilled employment during the construction phase

Potential Impact	Proposed Management Objectives / Mitigation Measures
	should come from local labourers who live in the study area. 36.7. In order to increase the size of local employment, women should also be employed. 36.8. The selection process should be transparent 36.9. Where possible, labour intensive methods should be used.
Indirect employment	36.10. 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	Medium term	Likely	3

Environmental Feature	**37. Safety and Security**
Relevant Alternatives & Activities	**Crossing of Mapstone Dam**
Project life-cycle	**Operational phase**
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Safety and security	37.1. Should the steel suspension bridge, conventional steel pipe bridge and pipe supported on concrete piers options be chosen, the engineering team must look at long term solutions to prevent access across these structures. 37.2. Solution to be approved by the owners of the Mapstone and Roseveare Farms. 37.3. Erect signage and fences to deter theft.

	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Positive	Local	Medium	Short term	Likely	2
After Mitigation	Positive	Local	Medium	Medium term	Likely	3

Environmental Feature	**38. Construction Impacts**
Relevant Alternatives & Activities	**All components**
Project life-cycle	**Construction Phase**
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Impact on Traffic	38.1. Ensure that the necessary signage and traffic measures are implemented for safe and convenient access to the site. 38.2. Ensure that access roads do not get built up with mud or sand. 38.3. Construction machinery drivers are to travel at appropriate speeds and have flashing lights. 38.4. Applicable speed limits as set on regional roads must be observed at all times. 38.5. The number of vehicles present on site must be limited to the minimum.
Increase in Dust	38.6. Dust and disturbance can be mitigated through the use of appropriate dust suppression mechanisms. 38.7. Where sensitive crops are affected by dust, Umgeni Water should conduct a feasibility study to tar the roads.
Influx of workers	38.8. Umgeni Water must make a public announcement that imported labour will not take place on the project. 38.9. Contractors and sub-contractors must have strict conditions that prevent the importing of semi and unskilled labour without prior justification and approval 38.10. The contractor must work closely with the traditional authorities and local government to ensure that identification and recruitment processes are fair and transparent 38.11. Family style accommodation should be provided where possible

Potential Impact	Proposed Management Objectives / Mitigation Measures
	38.12. Employment of females and youth is encouraged to ensure the empowerment of the most vulnerable to unemployment and poverty.
Safety and security	38.13. Erect signage and fences to deter theft.
Land claims could affect servitudes	38.14. Early consultation between the project authorities, DRD&LR and relevant stakeholder to take place to allow sufficient time before construction.

	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Local	Medium	Medium term	Likely	3
After Mitigation	Negative	Local	Medium	Short term	Likely	2

12.13 Traffic & Access Roads

12.13.1 General

All pipelines referred to will be installed below-ground, apart from the section that crosses Mapstone Dam which includes a bridge option. All major roads and railway lines will be crossed via pipe jacking (trenchless technology).

The findings of the Traffic Impact Assessment (DWA, 2015b), which relate to the overall uMWP-1 (Raw Water and Potable Water components) 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.

12.13.2 Impact Assessment

Environmental Feature	39. Traffic & Access Roads
Relevant Alternatives & Activities	All construction activities that affect the existing road network
Project life-cycle	Construction & operational phases
Potential Aspects & Impacts	**Proposed Management Objectives / Mitigation Measures**
• Inadequate road conditions • Disruptions to existing road users • Safety risks • Crossing main roads • Increase in dust levels • Road maintenance	39.1. 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. 39.2. The access roads need to provide sufficient width for heavy vehicles to navigate around curves in the road. 39.3. 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. 39.4. 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. 39.5. The payloads delivered by heavy vehicles need to be recorded and audited to prevent overloading of heavy vehicles. 39.6. Abnormal load permits must be acquired for the transport of abnormal loads. 39.7. Traffic accommodation to South-African Road Traffic Signs Manual standards where any construction affects an existing road. 39.8. Time restrictions for delivery vehicles through built-up and socially sensitive areas. 39.9. 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. 39.10. 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.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	medium-high	short-term	almost certain	3
After Mitigation	-	local	low	short-term	moderate	1

12.14 Existing Structures and Infrastructure

12.14.1 General

All pipelines referred to will be installed below-ground, apart from the section that crosses Mapstone Dam which includes a bridge option. All major roads and railway lines will be crossed via pipe jacking (trenchless technology).

Potential impacts of the project to existing structures and infrastructure include:

- Disruptions to services;
- Disruptions to traffic at road crossings and where pipeline routes follow existing road alignments (e.g. D360 and D125 for Option 1);
- 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; and
- Servitude restrictions (temporary and permanent). 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.

It is noted that the alternative alignments of the potable water pipeline were identified to mitigate impacts to existing structures, based on input received from affected landowners.

As part of the land acquisition process, suitable compensation measures will need to be identified for the affected landowners, and the process will adhere to all statutory requirements. 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 servitudes;
- 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.

12.14.2 Impact Assessment

Environmental Feature	40. 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	40.1. Identify, record and protect existing services 40.2. Conform to requirements of relevant service providers (e.g. KZN DoT, Telkom, Eskom, water, sewerage). Services coordination and wayleave approvals to be undertaken with the relevant custodians of the infrastructure. 40.3. Ensure access to infrastructure is available to service providers at all times. 40.4. 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. 40.5. Notify landowners of any disruptions to essential services. 40.6. Deviate landowners' existing services (e.g. reticulation, irrigation lines), where possible, to accommodate construction activities. 40.7. 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

12.15 Aesthetic Qualities and Tourism

12.15.1 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. Visual impacts will be caused by the various activities associated with the construction phase as well as the permanent project components, namely the WTW and to a much lesser extent the aboveground features of the pipeline (chambers, markers).

As mentioned in **Section 9.4.4.2**, it is intended that the proposed uMkhomazi WTW operations will be similar to that of the Midmar WTW. A photograph taken approximately 700m to the south-east of the Midmar WTW is provided in **Figure 148** in order to convey the potential visibility of the plant from the surrounding area.

Figure 148: View of Midmar WTW

Observations on the visibility of the proposed WTW alternative sites include the following:

- Option 1 –
  - Visible from residential dwellings to the north-east (approximately 550m away);
  - Visible from the R56 and P334;
  - Potential screening by timber plantation;
- Option 2 –
  - Visible from residential dwellings to the west (approximately 760m away);
  - Visible from the R56 and P334;
  - Potential screening by surrounding timber plantations;
- Option 3 –
  - Visible from residential dwellings to the north (approximately 400m away) and north-east (approximately 510m away); and
  - Visible from the R624.

The EMPr includes measures to manage visual impacts and to rehabilitate areas affected by construction activities.

The findings from the Visual Impact Assessment (Axis Landscape Architecture, 2015) are discussed in **Section 11.1.5** and presented in the impact assessment to follow.

12.15.2 Impact Assessment

Environmental Feature	**41. Visual Quality**
Relevant Alternatives & Activities	**All construction activities that affect the project area's visual quality**
Project life-cycle	**Construction phase**
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Reduction in visual quality due to construction activities.	41.1. On-going housekeeping to maintain a tidy construction area. 41.2. The site will be shielded / screened to minimise the visual impact, where practicable. 41.3. Where practicable, development designs to compliment the natural surroundings in order to preserve a sense of place. 41.4. In general, no slopes steeper than 1(V):3(H) are permitted in cut-and-fill areas, unless otherwise specified by the Project Manager. Steeper slopes require protection. New slopes must mimic the natural slopes and topography, where possible. 41.5. The areas disturbed 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.

	+/- 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

Environmental Feature	**42. Visual Quality**
Relevant Alternatives & Activities	**WTW and pipeline**
Project life-cycle	**Operational phase**
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Reduction in visual quality due to operational activities.	42.1. Monitor the re-growth of invasive vegetative material on the pipeline servitude and at the WTW site. 42.2. On-going maintenance of infrastructure. 42.3. Monitoring of erosion. Reinstatement and rehabilitation of affected areas. 42.4. Adequate waste management at WTW.

	+/- Impacts	**Extent**	**Magnitude**	**Duration**	**Probability**	**Significance**
Before Mitigation	-	local	medium	permanent	likely	2
After Mitigation	-	local	low	permanent	unlikely	1

Environmental Feature	**43. Visual Quality**
Relevant Alternatives & Activities	**WTW Option 1**
Project life-cycle	**Construction and operational phases**
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Reduction in visual quality due to WTW Option 1	43.1. Acquire additional timber land around WTW Option 1 to utilise screening offered by existing pine trees.

	+/- Impacts	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	-	local	medium	permanent	almost certain	2
After Mitigation	-	local	low	permanent	likely	1

The impacts assessment for the visual quality and associated attributes is supplemented by the evaluation conducted as part of the Visual Impact Assessment (Axis Landscape Architecture, 2015) in the tables to follow, which is based on:

- *Extent - international (very high = 5), national (high = 4), regional (medium = 3), local (low = 2) or site only (very low = 1);*
- *Duration - very short (0-2 yrs = 1), short (2-5 yrs = 2), medium (5-15 yrs = 3), long (>15 yrs = 4), and permanent (= 5);*
- *Magnitude - None (= 0), minor (= 1), low (= 2), medium/moderate (= 3), high (= 4) and very high (= 5);*
- *Probability - none (= 0), improbable (= 1), low probability (= 2), medium probability (= 3), high probability (= 4) and definite (= 5);*
- *Status (positive, negative or neutral);*
- *Reversibility - reversible (= 1), recoverable (= 3) and irreversible (= 5);*
- *Significance - is calculated by combining the criteria in the following formula: S=(E+D+M)P;*
- *The significance weighting for each potential visual impact (as calculated above) is as follows -*
  - *<30 points: Low (where the impact would not have a direct influence on the decision to develop in the area);*
  - *31-60 points: Medium/moderate (where the impact could influence the decision to develop in the area); and*
  - *>60: High (where the impact must have an influence on the decision to develop in the area).*

Environmental Feature	44. Landscape Impacts: Loss of grassland
Relevant Alternatives & Activities	WTW and pipeline
Project life-cycle	Construction phase
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
• Removal of grassland during construction phase • Removing landscape elements that are fundamental in establishing a valued landscape character	44.1. 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)	Permanent (5)	Definite (5)	50
After Mitigation	Negative	Local (2)	Low (2)	Medium (3)	Highly (4)	28

Environmental Feature	45. Landscape Impacts: Change in surface cover
Relevant Alternatives & Activities	WTW and pipeline
Project life-cycle	Operational Phase
Potential Impact	**Proposed Management Objectives / Mitigation Measures**
Adding additional land uses that alter the agricultural character of the site and cause a loss of open space and the sense of place	45.1. Maintain the landscape to a high aesthetic standard to retain a high visual quality for visitors and observers. 45.2. 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. 45.3. 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)	28
After Mitigation	Negative	Local (2)	Moderate(3)	Short (2)	Highly (4)	28

Environmental Feature	46. Visual Impacts: Potential impact on farms and settlements
Relevant Alternatives & Activities	WTW and pipeline
Project life-cycle	Construction and operational phases
Potential Impact	**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	46.1. Keep the construction sites and camps neat, clean and organised in order to portray a tidy appearance; 46.2. 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)	28
After Mitigation	Negative	Local (2)	Low(2)	Short (2)	Moderate (3)	18

Environmental Feature	**47. Visual Impacts: Potential impact on local and international tourists**
Relevant Alternatives & Activities	**WTW and pipeline**
Project life-cycle	**Construction and operational phases**
Potential Impact	**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	47.1. Keep the construction sites and camps neat, clean and organised in order to portray a tidy appearance; 47.2. 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)	21
After Mitigation	Negative	Local (2)	Low(2)	Short (2)	Low(2)	12

Environmental Feature	**48. Visual Impacts: Potential impact on motorists using local and major routes**
Relevant Alternatives & Activities	**WTW and pipeline**
Project life-cycle	**Construction and operational phases**
Potential Impact	**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	48.1. Keep the construction sites and camps neat, clean and organised in order to portray a tidy appearance; 48.2. 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)	12
After Mitigation	Negative	Local (2)	Low(2)	Short (2)	Low (2)	12

12.16 'No-Go' Impacts

12.16.1 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 Local Municipality 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 demands 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 could suppress development with related socio-economic implications; and
- Over-utilisation of water resources could adversely affect the ecological functioning of the Mgeni System.

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 uMkomazi-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 uMkomazi-Mgeni Transfer Scheme is not commissioned but water demand 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.

❖ ***<u>Augmentation Scenario (Smithfield or Impendle)</u>***

Unconstrained economic growth occurs within the study area and the uMkomazi-Mgeni Transfer Scheme is commissioned according to the time frame specified by Umgeni Water. In addition, water demand is managed by the relative authorities. Impacts include the following:

- Cumulative gross geographic product (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.

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

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

In contrast, should the proposed uMWP-1 not go ahead, any potentially significant environmental issues associated with the project 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.

12.16.2 <u>Economic Impact Assessment</u>

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.

12.16.3 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.

12.17 Cumulative Impacts

Box 2:	**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 Potable 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.

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**).

The potable water pipeline routes may impact on properties that are already traversed by existing infrastructure (e.g. oil line, power lines, bulk water pipelines, etc.). These properties will thus have a network of infrastructure with the associated servitude restrictions, and with various parties requiring access for future inspection and maintenance. Multiple servitudes will also increase the area that is sterilised for other conflicting developments.

During construction there will be traffic-related impacts to the local road network. The combined construction periods for the uMWP-1 Raw Water and Potable Water components will possibly place a significant burden on the roads in the Baynesfield area, where there will be an overlap between these two project footprints. The associated impacts may include traffic disruptions and deterioration of road conditions. The Traffic Impact Assessment (DWA, 2015b) considered the cumulative impact associated with the overall uMPW-1.

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.

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 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 watercourses that will be affected by the pipeline crossings may already be disturbed by anthropogenic influences, such as water quality deterioration by farming practices (e.g. nutrient-rich runoff) and erosion caused by grazing cattle. The project's construction activities may exacerbate impacts to the water quality and channel stability of the affected watercourses.

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.

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.

Social cumulative impacts, as identified in the Social Impact Assessment (Dr Neville Bews & Associated, 2016), include the following:

- The area is poor with a high degree of malnutrition and food insecurity particularly within the rural areas of the province. The project provides an opportunity to address this poverty by creating jobs and transferring skills, albeit over a short term;
- Although the influx of a relatively large work force may exacerbate the crime situation in some areas, particularly opportunistic crime, the creation of employment opportunities also has the potential to reduce poverty driven crime;
- There will be a permanent loss of land associated with WTW which will not occur in respect of the pipeline as the pipeline will be submerged allowing the land to be returned to its former use;
- 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;

- The sense of place will be permanently altered in the vicinity of the WTW;
- The increase in 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;
- 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. This will result in result in a number of impacts that will last over a long period;
- 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; and
- 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.

Other potential cumulative impacts associated with the project, considering the current state of the environment in the study area, could include:

- Abstraction of water for construction purposes;
- Release of sediment laden water to watercourses;
- Various sources of dust and particulate matter will be associated with the construction phase;
- Vulnerability to crime, which is already of grave concern to the local farming community, may be worsened during construction;
- Loss of prime agricultural land or loss of fertile soil;
- Loss of timber land, with existing restrictions on permitted timber plantations in the catchment;
- An additional power line and a substation may need to be constructed to supply the electrical requirements of the WTW; and
- Fragmentation of grassland habitat if the areas affected by construction activities are not rehabilitated adequately.

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 12.16**. 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 Mkomazi-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 (uMWP-1) be taken forward to the next phase of investigation in a detailed Feasibility Study.

13.4 Technical Feasibility Study

The location of WTW and the associated potable water pipeline routes are inter-dependent therefore the process of selecting a feasible WTW location cannot be separated from the process of selecting a feasible pipeline route. Two main criteria were used to route pipelines and locate the WTW sites. The first was that pipeline routes and WTW sites were selected so as to meet the requirement for gravity flow throughout the system. The second main criterion was that as far as possible, the earthworks for the WTW sites needed to have closely balanced cut and fill.

A comparison of the project options by the engineering team responsible for the Technical Feasibility Study is provided in T**able 67**.

Table 67: Technical Team's Preferred Options (1 = most preferred)

Components	Alternatives	Rating	Motivation
WTW	Option 1	1	❖ Associated pipelines are the least expensive. ❖ It has the most equally balanced earthworks cut and fill.
	Option 2	2	❖ High spoil volume thus higher cost. ❖ Associated pipelines are slightly more expensive. ❖ Difficult terrain through which the pipeline would be required to be constructed. Detailed investigations indicated that benched platforms of up to 39 metres in width and 29 metres in height would be required to facilitate construction along the pipeline from this WTW option.
	Option 3	3	❖ High import volume thus higher cost. ❖ Associated pipelines are the most expensive.
Potable water pipeline – Western Section	Option 1	3	❖ Most number of bends thus increases cost and impacts on pipeline hydraulics. ❖ Construction on primary access road thus no access for landowners. ❖ Objections from landowners.
	Option 1A	2	❖ High number of bends thus increases cost and impacts on pipeline hydraulics. ❖ Construction on a portion of primary access road thus no access for landowners.
	Option 1B	1	❖ Least number of bends. ❖ Avoids construction on primary access road.
Potable water pipeline – Central Section	Option 1	2	❖ Construction close to buildings. ❖ Livestock may be affected by noise. ❖ Objection from landowner.
	Option 1C	1	❖ Avoids constructing close to buildings.
Potable water pipeline – Eastern Section	Option 1	4	❖ Construction on primary access road thus no/limited access for business owners.
	Option 1D	2	❖ Avoids construction on primary access road. ❖ Received objections from landowners.
	Option 1E	3	❖ Avoids construction on primary access road. ❖ Route passes through a new treatment plant. ❖ Received objections from landowners.
	Option 1F	1	❖ Avoids construction on primary access road.
Crossing of Mapstone Dam	Steel Suspension Bridge	4	❖ Most expensive option. ❖ Security risk for farmers. ❖ Bridge requires maintenance. ❖ Pipe and bridge susceptible to vandalism. ❖ Construction will have limited impact on farming activities. ❖ No need to empty dam. ❖ Easy access for pipe maintenance.
	Conventional Steel Pipe Bridge	3	❖ Second most expensive option. ❖ Security risk for farmers. ❖ Bridge requires maintenance. ❖ Pipe and bridge susceptible to vandalism. ❖ Relatively inexpensive if dam is drained. ❖ Easy access for pipe maintenance.

Components	Alternatives	Rating	Motivation
	Pipe Supported on Concrete Piers	2	❖ Second most expensive option. ❖ Security risk for farmers. ❖ Bridge requires maintenance. ❖ Pipe and bridge susceptible to vandalism. ❖ Relatively inexpensive if dam is drained. ❖ Limited access for pipe maintenance.
	Pipe Buried in Dam Basin	1	❖ Least expensive option. ❖ Dam serves as security barrier to farmers. ❖ Requires dam to be drained for construction. ❖ Man-access for maintenance will be difficult and dangerous. ❖ Mr. Mapstone advised that the preferred method of crossing the dam was by burying the pipe though the dam. This would require the dam to be drained. Mr. Mapstone proposed a methodology for draining the dam while mitigating the consequences to downstream irrigators. This would require the raw water module of the project to be commissioned prior to Mapstone Dam being drained. The uMWP raw water system would then maintain a supply to irrigators during the period that Mapstone Dam would be drained and in addition, would be used to refill the dam when the crossing is completed.

13.5 Specialist Studies

Tables 68 – 72 summarise the findings of the various relevant specialists in terms of their respective preferences (1 = most preferred) 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.

A simplified summary of the specialists' and technical team's preferences to the project alternatives is provided in **Table 73**. A diagram depicting the alternatives assessed is provided in **Figure 149**.

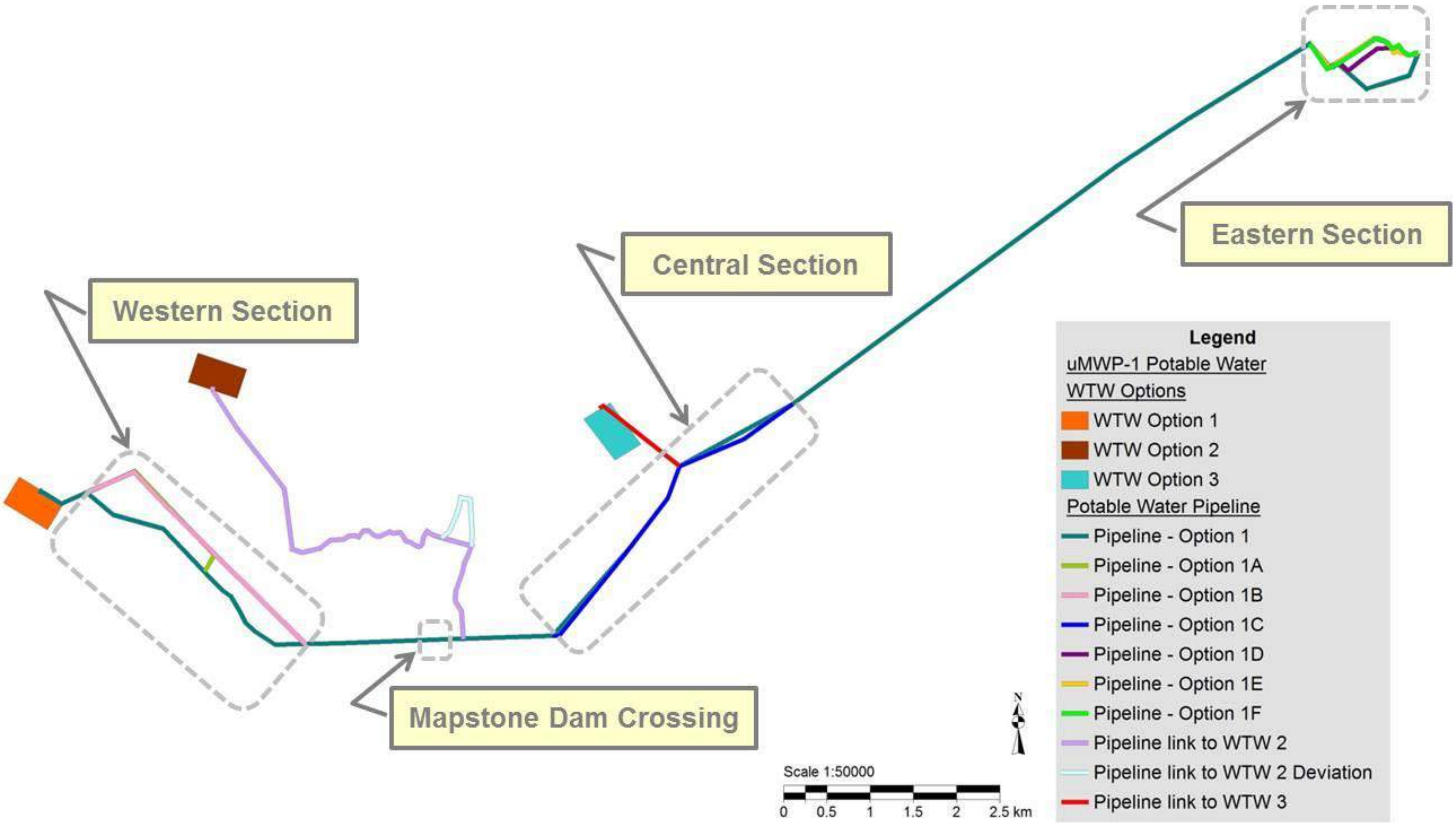


Figure 149: **Diagram of alternatives assessed (including WTW Sites, Pipeline Route and Crossing of Mapstone Dam)**

Table 68: Preferred Options recommended by Specialists for WTW (1 = most preferred)

Component	Alternatives	TEIA		AqIA		AIA		HIA	
WTW	Option 1	1	The majority of WTW Option 1 site is situated in an area that is not of conservation importance, with the northern section falling in a CBA 1. The section denoted as CBA 1 is now transformed by forestry, maize fields and exotics.	2	Located near surface water resources	-		1	Area is heavily impacted by tree plantation.
	Option 2	3	Even WTW Option 2 is located in an area that is not of conservation importance as it falls within a maize field (mostly associated with weeds), natural grassland still occurs on site which could harbour plant species of conservation importance and also serve as important habitat for animal species. A watercourse is also noted near this site	3	Has the greatest association with surface water ecosystems.	1	Lowest impact as far as loss of land and income is concerned.	3	Proposed area is less disturbed than Options 1 and 3
	Option 3	2	The WTW option 3 site lies within areas that are not of conservation importance (southern part) and 100% transformed (northern part) and this is because of the sugarcane plantation, which consists mainly of weeds and alien plant species.	1	Is located the furthest from surface water ecosystems.	-		2	Area is heavily impacted by sugar cane farming; less preferred than 1 due to potential impact of pipeline link on protected heritage sites
		SEIA		**SIA**		**VIA**		**AS**	
	Option 1	2	Impact on timber plantation.	3	Impact on timber plantation. Loss of land and attached income potential higher than Option 2 but less than Option 3.	2		2	Acceptable
	Option 2	1	Impact on sugar cane area on Baynesfield Farm. This option is slightly more preferred than Option 1 due to easier accessibility from the main road.	1	Impact on previous sugarcane farm. Least loss of income.	3		3	Not preferred. Some natural grassland on site, plus pipeline route from there to join Pipeline Option 1 is in natural veld, steep slopes, drainage lines and close to dam – i.e. more sensitive than other routes
	Option 3	3	Smaller commercial farming operations are more sensitive to shocks to the economy, their property and land. The implications on jobs and income for Roseveare Farm will be greater than the impact on the other landowners.	2	Impact on sugar cane farm. Loss of land and attached income potential.	1	WTW 3 is the preferred option due to less visual exposure	1	Most preferred. Fully transformed land, furthest from Baynesfield.

Table 69: Preferred Options recommended by Specialists for Potable Water Pipeline Route - Western Section (1 = most preferred)

Component	Project Area	Alternatives	TEIA		AqIA		AIA		HIA	
Potable Water Pipeline - Alignment	Western Section	Option 1	1	This route passes mostly through the agricultural land and mostly follows the existing gravel road.	-	No preference.	1	Will traverse less arable land and therefore, will lead to less loss of both high potential land and farming income.	1	Much of the pipeline crosses disturbed areas; routing of the pipeline needs to be adjusted to avoid Stead family cemetery.
		Option 1A	2	This route crosses over cultivated land, traversing a power line servitude, a railway line and a watercourse along the way.	-		-	The loss will be temporary and last for the duration of construction and the period that it takes the soil to settle.	2	Crosses more undisturbed areas than Option 1 increasing risk of impacting unidentified heritage sites
		Option 1B	3	This pipeline route will pass through two watercourses (important biodiversity habitat)	-		-		2	Crosses more undisturbed areas than Option 1 increasing risk of impacting unidentified heritage sites
			SEIA		**SIA**		**VIA**		**AS**	
	Western Section	Option 1	2	Traverses timber plantation, watercourse and cultivated land.	1	Routed through plantation, watercourse, cultivated land. Preferred option due to lower agricultural and heritage impact.	-	N/A	1	Along existing linear infrastructure – road
		Option 1A	1	Deviation onto vacant land. This route is preferred as is minimised the impact on productive land.	2	Deviation onto vacant land. Less financial impact than 1B from agricultural perspective.	-	N/A	2	Partly along above road
		Option 1B	3	Deviation onto vacant land and agricultural land thus having an implication on income of farmers.	3	Highest financial loss from agricultural perspective.	-	N/A	3	Not along road

Table 70: Preferred Options recommended by Specialists for Potable Water Pipeline Route - Central Section

Component	Project Area	Alternatives	TEIA		AqIA		AIA		HIA	
Potable Water Pipeline - Alignment	Central Section	Option 1	-	No preference. The two routes cross similar habitat.	-	No preference.	2		2	Very close to chicken houses
		Option 1C	-		-		1	Route limits impacts to poultry farm.	1	Further from chicken houses
			SEIA		**SIA**		**VIA**		**AS**	
	Central Section	Option 1	2	Route affects productive land and existing structures.	2	Very close to chicken houses.	-	N/A	-	No preference.
		Option 1C	1	Deviated around productive land and structures and is therefore preferred.	1	Minimises impact on Rainbow Chicken Farm. Distance from chicken houses.	-	N/A	-	

Table 71: Preferred Options recommended by Specialists for Potable Water Pipeline Route - Eastern Section (1 = most preferred)

Component	Project Area	Alternatives	TEIA		AqIA		AIA		HIA	
Potable Water Pipeline - Alignment	**Eastern Section**	Option 1	1	Most sections of pipeline route follows an existing road	-	No preference.	2		3	Longest option; increased risk on heritage resources
		Option 1D	2	Less natural habitats/vegetation will be disturbed on this route as it passes through properties	-		1	Less farming land affected.	2	Longer than 1E hence increasing risk of impacts on heritage resources
		Option 1E	3	These routes include more natural habitats/vegetation as compared to Option 1D.	-				1	Straighter option, shorter distance reduces risks on heritage resources
		Option 1F			-					Very similar to 1E hence is also a preferred option
			SEIA		**SIA**		**VIA**		**AS**	
	Eastern Section	Option 1	3	Deviated away from the business and follows property boundaries.	1	Least impact on surrounding commercial properties.	-	N/A	-	No preference.
		Option 1D	4	Most costly and cuts through a farm boundary resulting in a substantial loss of income.	4	Fatal flaw identified by the socio-economic study as this option renders an entire property undesirable for development.	-	N/A	-	
		Option 1E	2	Pipeline deviation borders the property boundaries. Although servitude agreements will impact income, the impact on future development is minimised.	2	As it is in line with both the agricultural, heritage choices and as per the socio-economic report the on future development will not be as severe as Option 1D.	-	N/A	-	
		Option 1F	1	Pipeline deviation borders the property boundaries. Although servitude agreements will impact income, the impact on future development will not be as severe as the other options.	2	Consistent with the socio-economic preference.	-	N/A	-	

Table 72: Preferred Options recommended by Specialists for Crossing of Mapstone Dam (1 = most preferred)

Component	Alternatives	TEIA		AqIA		AIA		HIA	
Crossing of Mapstone Dam	Steel Suspension Bridge	2	No preference.	-	No preference.	-	No preference.	3	A 20 metre allowance on either side of the dam is required which could lead to impacts on heritage resources
	Conventional Steel Pipe Bridge			-		-		2	Concrete piers have to be situated outside 1:100 year flood line therefore at least one pier per bank will need to be built on the banks of the dam
	Pipe Supported on Concrete Piers			-		-		3	Concrete supports have to be situated 20 m apart; at least 3 concrete supports will be required on the western bank and one on the eastern bank
	Pipe Buried in Dam Basin	1	Minimal ecological impacts.	-		-		1	Limited impact on land especially if welding is done on surface of dam and pipe sunk to basin
		SEIA		**SIA**		**VIA**		**AS**	
	Steel Suspension Bridge	4	The long term safety and access impacts of the bridge options render them undesirable.	-	No preference.	-	N/A	2	Less intrusive onto water surface. Suspension cables may pose collision risk to birds.
	Conventional Steel Pipe Bridge	3		-		-	N/A	1	Less intrusive onto dam basin – approx. 5 piers.
	Pipe Supported on Concrete Piers	2		-		-	N/A	3	Disturbance of dam basin by approx. 11 piers, drilling etc.
	Pipe Buried in Dam Basin	1	Will result in major short-term impacts including the potential loss of a season of crop and has significant cost implications. Thereafter there will be no impact.	-		-	N/A	4	Requires draining of dam, not preferred.

Table 73: Summary of alternatives referred by specialists and technical team

<table>
<tr><th>Components</th><th>Alternatives</th><th>TEIA</th><th>AQIA</th><th>AIA</th><th>HIA</th><th>SEIA</th><th>SIA</th><th>VIA</th><th>AS</th><th>TFS*</th></tr>
<tr><td rowspan="3">WTW</td><td>Option 1</td><td>✓</td><td></td><td></td><td>✓</td><td></td><td></td><td></td><td></td><td>✓</td></tr>
<tr><td>Option 2</td><td></td><td></td><td>✓</td><td></td><td>✓</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>Option 3</td><td></td><td>✓</td><td></td><td></td><td></td><td></td><td>✓</td><td>✓</td><td></td></tr>
<tr><td rowspan="3">Potable water pipeline – Western Section</td><td>Option 1</td><td>✓</td><td rowspan="3">-</td><td>✓</td><td>✓</td><td></td><td>✓</td><td rowspan="3">-</td><td>✓</td><td></td></tr>
<tr><td>Option 1A</td><td></td><td></td><td></td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>Option 1B</td><td></td><td></td><td></td><td></td><td></td><td></td><td>✓</td></tr>
<tr><td rowspan="2">Potable water pipeline – Central Section</td><td>Option 1</td><td rowspan="2">-</td><td rowspan="2">-</td><td></td><td></td><td></td><td></td><td rowspan="2">-</td><td rowspan="2">-</td><td></td></tr>
<tr><td>Option 1C</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td rowspan="4">Potable water pipeline – Eastern Section</td><td>Option 1</td><td>✓</td><td rowspan="4">-</td><td></td><td></td><td></td><td>✓</td><td rowspan="4">-</td><td rowspan="4">-</td><td></td></tr>
<tr><td>Option 1D</td><td></td><td rowspan="3">✓</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Option 1E</td><td></td><td rowspan="2">✓</td><td></td><td></td><td></td></tr>
<tr><td>Option 1F</td><td></td><td>✓</td><td></td><td>✓</td></tr>
<tr><td rowspan="4">Crossing of Mapstone Dam</td><td>Steel Suspension Bridge</td><td></td><td rowspan="4">-</td><td rowspan="4">-</td><td></td><td></td><td rowspan="4">-</td><td rowspan="4">-</td><td></td><td></td></tr>
<tr><td>Conventional Steel Pipe Bridge</td><td></td><td></td><td></td><td>✓</td><td></td></tr>
<tr><td>Pipe Supported on Concrete Piers</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Pipe Buried in Dam Basin</td><td>✓</td><td>✓</td><td>✓</td><td></td><td>✓</td></tr>
</table>

* TFS = Technical Feasibility Study

13.6 Comparative Impacts of Alternatives

13.6.1 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**) (with the successful adoption of the suggested mitigation measures).

Note that the ticked (✓) blocks in the tables indicate the preferred option for each environmental feature. In some instances no obvious preference exists which may imply that there is no discernible differences with regards to impacts posed by options. Blocks marked with an "x" denote those options that are least preferred due to potential significant impacts posed.

13.6.2 WTW

A high level comparison of adverse impacts associated with the WTW Options follow.

Table 74: Comparative Adverse Impacts – WTW Options

Environmental Feature / Attribute	WTW		
	Option 1	**Option 2**	**Option 3**
Land Use	Affects timber land on the Baynesfield Estate that is leased to NCT Forestry Co-operative Limited.	Affects cultivated land on the Baynesfield Estate.	Affects privately owned sugarcane plantation.
	-	-	-
Geology & Soils	Most equally balanced earthworks cut and fill.	High spoil volume. The pipeline link to WTW 2 would need to be benched into the side of the slope within a very specific elevation range.	High import volume.
	✓	x	
Topography	Slopes to the north-east.	Slopes to the south. Difficult terrain, north of Mapstone Dam, through which the pipeline link to WTW 2 would be required to be constructed.	Slopes to the north-east.
	✓	x	✓
Surface Water	Nearest watercourses: ❖ <250m to the north; ❖ <400m to the south-east; ❖ <300m to the north-west. Watercourse crossing along access road.	Nearest watercourses: ❖ South-western point of WTW site encroaches on a watercourse; ❖ <160m to the north-west; ❖ <400m to the south-east. Watercourse crossing along access road. Possible encroachment into a watercourse in the south-western corner of the site. Pipeline link to WTW does not cross Mapstone Dam, but there is one additional watercourse crossing along pipeline link.	Nearest watercourses: ❖ <550m to the north; ❖ <450m to the south-west.
			✓
Terrestrial Ecology - General	Located on transformed land.	Located on transformed land.	Located on transformed land.

Environmental Feature / Attribute	WTW Option 1	WTW Option 2	WTW Option 3
		South-western point of WTW site encroaches on a watercourse. Pipeline link traverses sensitive areas (steep slopes, grassland, watercourse). Species of conservation importance identified along pipeline link WTW 2.	
	✓	x	✓
Avifauna	Construction activities could result in disturbance of Blue Crane and Blue Swallow (approximately 6km from the Blue Swallow breeding area, and 4km from the Blue Crane breeding site).	Some natural grassland on site. Pipeline link traverses sensitive areas (steep slopes, grassland, watercourse).	Furthest from Baynesfield.
		x	✓
Agriculture	Permanent loss of 18,9ha timber plantation. Access through cultivated land.	Permanent loss of 8,5ha arable land. Access through cultivated land. Lowest impact as far as loss of land and income is concerned.	Permanent loss of 8,5ha arable land. Access through cultivated land.
		✓	
Heritage Resources	Earmarked site disturbed – low probability of presence of heritage resources.	Earmarked site disturbed – low probability of presence of heritage resources. Pipeline link to WTW 2 runs close to a structure which is believed to be older than 60 years. The pipeline link also crosses large tracts of undeveloped land where unidentified heritage sites could be affected.	Earmarked site disturbed – low probability of presence of heritage resources. Potential impact of pipeline link to heritage resources. Stead family church and cemetery near site.
	✓	x	
Socio-Economic Aspects	Dwellings on the Farm Nels Rust 849 (Zakhe Training Institute), accessed from the P315 road - approximately 550m to the north-east. Loss of land and attached income potential.	Dwellings on Portions 65 and 85 on the Farm Nels Rust 849 - approximately 760m to the west. Loss of land and attached income potential.	Dwellings on Portion 36 of the Farm Umlaas Poort 1174 - approximately 400m to the north. Dwellings on the Remainder of the Farm New Leeds 17871 - approximately 510m to the north-east. Loss of land and attached income potential.
		✓	

Environmental Feature / Attribute	WTW		
	Option 1	Option 2	Option 3
Existing Structures & Infrastructure	Affects power line servitude to the south-east. Access road may affect agricultural infrastructure.	WTW and access road may affect agricultural infrastructure.	WTW and access road may affect agricultural infrastructure.
	-	-	-
Road Network & Access	Access via Provincial road P315 off the R56. The intersection of the R56 and P315 will be upgraded. A new access road off provincial road P315 will be constructed. The new access road will be 1.2km long. WTW and access road affect private farms tracks.	Access via Provincial road P334 off the R56. A new intersection and access road is proposed approximately 1.9km west from the R56/P334 intersection. The new access road to the WTW will travel in a southerly direction for approximately 1.1km. Pipeline link to WTW 2 crosses the R56. WTW and access road affect private farms tracks.	Access via provincial road R624. New intersection to provincial road P547. Approximately 530m of the existing P547 road will be realigned and the road pavement will be upgraded. A new intersection will be positioned approximately 800m east of the R624 and P547 intersection. The access road to the WTW will commence at the proposed intersection and travel in a northerly direction for approximately 450m before turning right to enter the proposed WTW. WTW and access road affect private farms tracks.
	-	-	-
Visual Quality	Visible from residential dwellings to the north-east (approximately 550m away). Visible from the R56 and P334. Potential screening by timber plantation.	Visible from residential dwellings to the west (approximately 760m away). Visible from the R56 and P334. Potential screening by surrounding timber plantations.	Visible from residential dwellings to the north (approximately 400m away) and north-east (approximately 510m away). Visible from the R624.
	-	-	-
Technical	Most equally balanced cut and fill volumes. Associated pipelines are the least expensive.	High spoil volume thus higher cost. Associated pipelines are slightly more expensive.	High import volume thus higher cost Associated pipelines are the most expensive.
	✓		
I&APs comments	Concerns raised by NCT Forestry Co-operative Limited over loss of timber land.	Concerns raised by landowner over loss of arable land.	Concerns raised by landowner over loss of arable land.
	-	-	-

13.6.3 Potable Water Pipeline Route

A high level comparison of adverse impacts associated with the potable water pipeline routes in the western, central and eastern sections is presented in **Tables 75**, **76** and **77**, respectively.

Table 75: Comparative Adverse Impacts – Potable Water Pipeline Route - Western Section

Environmental Feature / Attribute	Potable Water Pipeline Route - Western Section		
	Option 1	**Option 1A**	**Option 1B**
Land Use	Primarily affects cultivated land.	Primarily affects cultivated land.	Primarily affects cultivated land.
	-	-	-
Geology & Soils	Similar potential impacts to geology and soils. Recommendations from geotechnical investigations to be employed.		
	-	-	-
Topography	Similar potential impacts to topography. Proper rehabilitation required for areas affected by construction activities.		
	-	-	-
Surface Water	Similar potential impacts to surface water in terms of watercourse crossings along routes.		
	-	-	-
Terrestrial Ecology - General	Area along route disturbed by agriculture and existing road. Route mostly follows the existing gravel road.	Area along route disturbed by agriculture.	Area along route disturbed by agriculture.
	✓		
Avifauna	Area along route disturbed by agriculture and existing road. Route mostly follows the existing gravel road.	Area along route disturbed by agriculture.	Area along route disturbed by agriculture.
	✓		
Agriculture	Follows D360, with less loss of arable land.	Will traverse more arable land.	
	✓		
Heritage Resources	Area along route disturbed by agriculture and existing road.	Area along route disturbed by agriculture. Crosses more undisturbed areas than Option 1 increasing risk of impacting unidentified heritage sites.	
	✓	-	-
Socio-Economic Aspects	Less loss of arable land.	Will traverse more arable land.	
	✓		
Existing Structures & Infrastructure	All routes cross a railway line and travel past houses and agricultural structures. Similar potential impacts to existing structures and Infrastructure.		
	-	-	-
Road Network & Access	Alignment alongside the D360. Crosses R56.	Crosses R56. Crosses private farms tracks.	Crosses R56. Crosses private farms tracks.

Environmental Feature / Attribute	Potable Water Pipeline Route - Western Section		
	Option 1	**Option 1A**	**Option 1B**
	Crosses private farms tracks.		
	-	-	-
Visual Quality	Similar potential impacts to visual quality of area. Proper rehabilitation required for areas affected by construction activities.		
	-	-	-
Technical	Most number of bends thus increases cost and impacts on pipeline hydraulics. Construction on primary access road thus no access for land owners. Objections from land owners.	High number of bends thus increases cost and impacts on pipeline hydraulics. Construction on a portion of primary access road thus no access for land owners	Least number of bends. Avoids construction on primary access road.
			✓
I&APs comments	*See concerns raised with route Option 1 under other options.*	Route suggested by landowners to minimise impacts associated with pipeline route Option 1.	Route suggested by landowners to minimise impacts associated with pipeline route Option 1.
			✓

Table 76: Comparative Adverse Impacts – Potable Water Pipeline Route - Central Section

Environmental Feature / Attribute	Potable Water Pipeline Route - Central Section	
	Option 1	**Option 1C**
Land Use	Primarily affects sugarcane land.	Primarily affects sugarcane land.
	-	-
Geology & Soils	Similar potential impacts to geology and soils. Recommendations from geotechnical investigations to be employed.	
	-	-
Topography	Similar potential impacts to topography. Proper rehabilitation required for areas affected by construction activities.	
	-	-
Surface Water	Similar potential impacts to surface water in terms of watercourse crossings along routes.	
	-	-
Terrestrial Ecology - General	Area along route disturbed by agriculture. No discernible difference with regards to impacts posed by options to terrestrial ecology.	
	-	-
Avifauna	Area along route disturbed by agriculture. No discernible difference with regards to impacts posed by options to avifauna.	
	-	-
Agriculture	Primarily affects sugarcane land. Passes nearer to chicken houses on Portion 43 of the Farm Hopewell 881 and Portion 20 of the Farm Umlaas Poort 1174.	Primarily affects sugarcane land. Deviation recommended by landowner to minimise impacts to chicken houses.

Environmental Feature / Attribute	Potable Water Pipeline Route - Central Section	
	Option 1	Option 1C
	x	✓
Heritage Resources	Area along route disturbed by agriculture. Both route travel past the Stead family church and cemetery. Similar potential impacts to heritage resources.	
	-	-
Socio-Economic Aspects	Nearer to chicken houses.	Deviation requested by affected landowner to limit impacts to chicken houses.
	x	✓
Existing Structures & Infrastructure	Route travels past chicken houses on poultry farm. Nearer to chicken houses.	Route travels past chicken houses on poultry farm.
	x	✓
Road Network & Access	Alignment alongside the D360. Crosses R56. Crosses private farms tracks.	Crosses R56. Crosses private farms tracks.
	-	-
Visual Quality	Similar potential impacts to visual quality of area. Proper rehabilitation required for areas affected by construction activities.	
	-	-
Technical	Construction close to buildings. Livestock may be affected by noise. Objection from land owner.	Additional bends in pipeline route and slightly longer pipeline route. Avoids constructing close to buildings.
		✓
I&APs comments	*See concerns raised with route Option 1 under other options.*	Route suggested by RCL to minimise impacts to chicken houses due to proximity of pipeline route Option 1.
	x	✓

Table 77: Comparative Adverse Impacts – Potable Water Pipeline Route - Eastern Section

Environmental Feature / Attribute	Potable Water Pipeline Route - Eastern Section			
	Option 1	Option 1D	Option 1E	Option 1F
Land Use	Crosses through light industrial area of Umlaas Road. Affects land earmarked for mini-factories and/or warehouses.			
	-	-	-	-
Geology & Soils	Similar potential impacts to geology and soils. Recommendations from geotechnical investigations to be employed.			
	-	-	-	-
Topography	Similar potential impacts to topography. Proper rehabilitation required for areas affected by construction activities.			
	-	-	-	-
Surface Water	Longest overall footprint in watercourse.	Similar potential impacts to surface water in terms of watercourse crossings along routes.		
	x	-	-	-
Terrestrial Ecology - General	Area along route disturbed by agriculture and development in Umlaas Road Area. No discernible difference with regards to impacts posed by options to terrestrial ecology.			
	-	-	-	-

Environmental Feature / Attribute	Potable Water Pipeline Route - Eastern Section			
	Option 1	Option 1D	Option 1E	Option 1F
Avifauna	Area along route disturbed by agriculture and development in Umlaas Road Area. No discernible difference with regards to impacts posed by options to avifauna.			
	-	-	-	-
Agriculture	Passes nearer to chicken houses on Portion 0 of Farm 30.	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.		
	x	-	-	-
Heritage Resources	Area along route disturbed by agriculture and development in Umlaas Road Area.	Area along route disturbed by agriculture and development in Umlaas Road Area.	Area along route disturbed by agriculture and development in Umlaas Road Area. Straighter option, shorter distance reduces risks on heritage resources	
			✓	
Socio-Economic Aspects	Disruption to main access road during construction.	Deviation requested by affected landowner.	Deviation requested by affected landowner.	Refinement of route, based on deviations requested by affected landowners.
	x			✓
Existing Structures & Infrastructure	Crosses a railway line. Route travels past chicken houses on poultry farm. Route nearest to chicken houses. Passes newly built car ports on Erf 885 Portion 114 of the Farm Vaalkop and Dadelfontein no. 885.	Crosses a railway line. Route travels past chicken houses on poultry farm. Passes newly built car ports on Erf 885 Portion 114 of the Farm Vaalkop and Dadelfontein no. 885.	Crosses a railway line. Route travels past chicken houses on poultry farm. Passes newly built car ports on Erf 885 Portion 114 of the Farm Vaalkop and Dadelfontein no. 885. Route passes through a new treatment plant.	Crosses a railway line. Route travels past chicken houses on poultry farm. Passes newly built car ports on Erf 885 Portion 114 of the Farm Vaalkop and Dadelfontein no. 885. Passes near to electrical substation.
	x		x	✓
Road Network & Access	Alignment alongside the D125. Crosses R603.	Crosses R603.	Crosses R603.	Crosses R603.
	x	-	-	-
Visual Quality	Construction activities will be highly obtrusive as this route follows the D125, which is the main access to Umlaas Road	Similar potential impacts to visual quality of area. Proper rehabilitation required for areas affected by construction activities.		
	x	-	-	-
Technical	Construction on	Additional bends in	Additional bends	Additional

Environmental Feature / Attribute	Potable Water Pipeline Route - Eastern Section			
	Option 1	Option 1D	Option 1E	Option 1F
	primary access road thus no/limited access for business owners.	pipeline route. Avoids construction on primary access road. Received objections from land owners.	in pipeline route. Avoids construction on primary access road. Route passes through a new treatment plant. Received objections from land owners.	bends in pipeline route. Avoids construction on primary access road.
	x			✓
I&APs comments	*See concerns raised with route Option 1 under other options.*	Route suggested by RCL to minimise impacts to chicken houses due to proximity of pipeline route Option 1.	Route suggested by landowner to minimise impact on future development of Erf 34 and 2-38 for mini-factories and/or warehouses.	Route identified, following comments received from RCL, to minimise impact on future development of Umlaas Road Erf 41 for a warehouse.
	x			✓

13.6.4 Crossing of Mapstone Dam

A high level comparison of adverse impacts associated with the options associates with the crossing of Mapstone Dam is presented in **Table 78**.

Table 78: Comparative Adverse Impacts – Crossing of Mapstone Dam

Environmental Feature / Attribute	Crossing of Mapstone Dam			
	Steel Suspension Bridge	Conventional Steel Pipe Bridge	Pipe Supported on Concrete Piers	Pipe Buried in Dam Basin
Land Use	Similar potential impacts to land use. Agricultural land to west and north-east, and Hopewell to the east.			
	-	-	-	-
Geology & Soils	Rock anchoring required for suspended structures.			Pipe trench excavations along the dam floor will be, in fully saturated clayey soils and the trench sides will have to be sloped accordingly. Area to be dewatered during construction. Pipeline to be concrete encased.

Environmental Feature / Attribute	Crossing of Mapstone Dam			
	Steel Suspension Bridge	Conventional Steel Pipe Bridge	Pipe Supported on Concrete Piers	Pipe Buried in Dam Basin
	-	-	-	-
Topography	Similar potential impacts to topography. Proper rehabilitation required for areas affected by construction activities.			Requires dam to be drained.
	-	-	-	-
Surface Water	Similar potential impacts.			Requires dam to be drained.
	-	-	-	-
Terrestrial Ecology - General	Permanent obstruction over waterbody.			Draining of dam will lead to temporary loss of aquatic and riparian habitat offered by the impoundment. In terms of long-term impacts, this option is preferred.
				✓
Avifauna	Less intrusive onto water surface. Suspension cables may pose collision risk to birds.	Less intrusive onto dam basin – approx. 5 piers.	Disturbance of dam basin by approx. 11 piers, drilling etc.	Draining of dam will lead to temporary loss of aquatic and riparian habitat offered by the impoundment.
		✓		
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.			Option preferred by Upper Umlaas Irrigation Board, as long as downstream irrigators are supplied with water during period when dam is drained.
	-	-	-	-
Heritage Resources	Potential impacts to heritage resources where construction activities will disturb the dam's shoreline.			
	-	-	-	-
Socio-Economic Aspects	Safety and security risk, as people may try to cross over the dam by using the bridge structure.			-
				✓
Existing Structures & Infrastructure	No direct impacts anticipated in terms of existing structures and infrastructure.			
	-	-	-	-
Road Network & Access	No direct impacts anticipated in terms of existing structures and infrastructure. Construction traffic on local road network.			
	-	-	-	-
Visual Quality	Permanent visual impact.			Visual impact only significant during construction.
				✓
Technical	Most expensive option. Security risk for	Second most expensive option. Security risk for	Second most expensive option. Security risk for	Least expensive option. Dam serves as

Environmental Feature / Attribute	Crossing of Mapstone Dam			
	Steel Suspension Bridge	Conventional Steel Pipe Bridge	Pipe Supported on Concrete Piers	Pipe Buried in Dam Basin
	farmers. Bridge requires maintenance. Pipe and bridge susceptible to vandalism. Construction will have limited impact on farming activities. No need to empty dam. Easy access for pipe maintenance.	farmers. Bridge requires maintenance. Pipe and bridge susceptible to vandalism. Relatively inexpensive if dam is drained. Easy access for pipe maintenance.	farmers. Bridge requires maintenance. Pipe and bridge susceptible to vandalism. Relatively inexpensive if dam is drained. Limited access for pipe maintenance.	security barrier to farmers. Requires dam to be drained for construction. Man-access for maintenance will be difficult and dangerous.
				✓
I&APs comments	Options not preferred by Upper Umlaas Irrigation Board, as they create a security risk for the farmers by breaching the barrier created by Mapstone Dam.			Option preferred by Upper Umlaas Irrigation Board, as long as downstream irrigators are supplied with water during period when dam is drained.
	x			✓

13.7 BPEOs Selection

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:

- WTW Site –
  - WTW Option 1;
- Potable water pipeline route –
  - **Western section** - Option 1B;
  - **Central section** - Option 1C;
  - **Eastern section** - Option 1F;
- Crossing of Mapstone Dam –
  - Pipe Buried in Dam Basin.

A layout diagram of the selected scheme, showing cadastral boundaries, is included in **Figure 150**.

Figure 150: Layout diagram indicating BPEOs for project components

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 Umgeni Water 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 Potable Water component is governed by NEMA and Government Notice No. R. 543 of 18 June 2010. **Figure 151** 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.

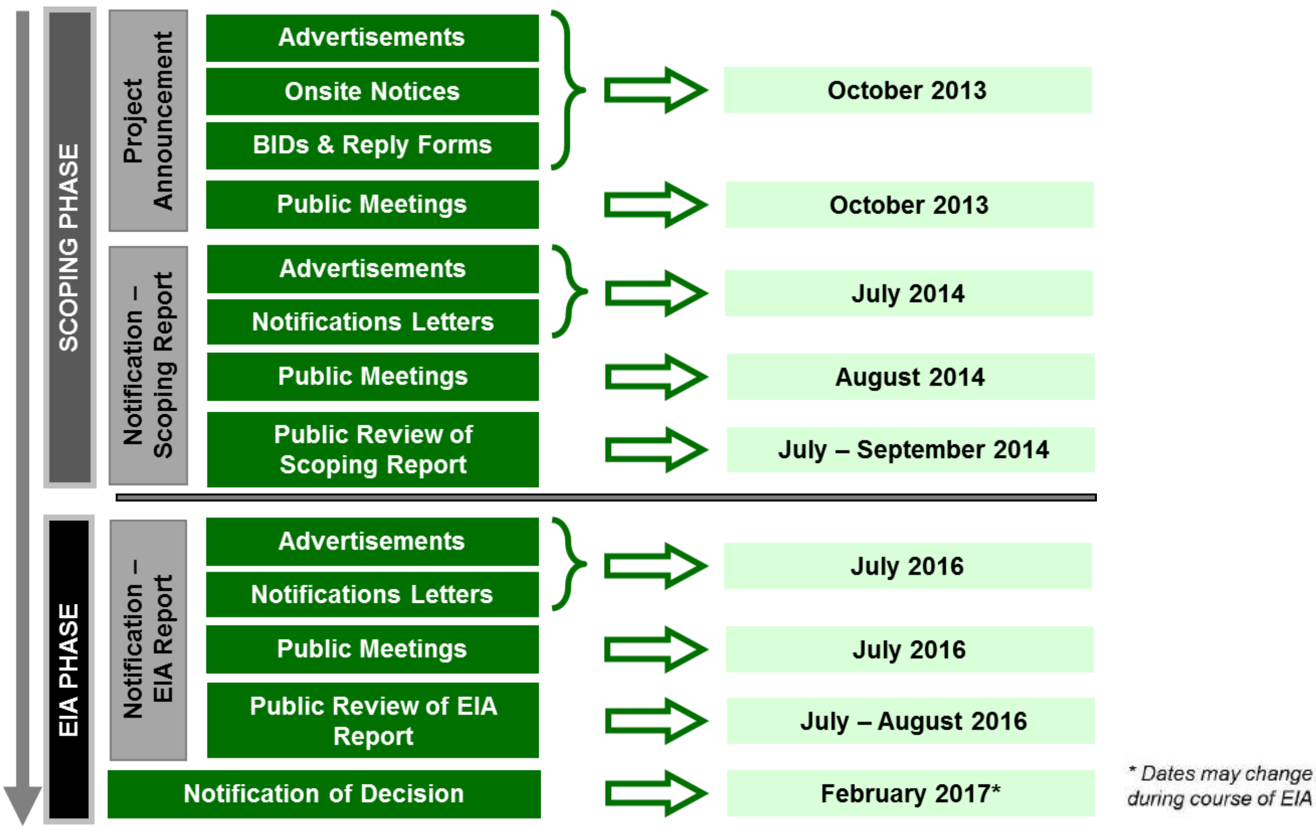


Figure 151: Outline of Public Participation Process

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 M**) 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. 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 79**. A 40-day review period (from 4 July – 15 August 2016) was provided.

Table 79: 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;
- Department of Cooperative Governance and Traditional Affairs (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 were convened to present the draft uMWP-1 Raw Water and Potable Water EIA Reports are provided in **Table 80**.

Table 80: Details of public meetings to be held to present the uMWP-1 draft 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 N** (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 Comments and Responses Report (contained in **Appendix M**).

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 (some shown in in **Figure 152**) for which mitigation measures are included in the EIA Report and EMPrs:

- All watercourses in the project area, which includes the uMlaza River and its tributaries (including drainage lines), are regarded as sensitive and require suitable protection from the construction and operational activities. All activities of the project life-cycle to comply with the National Water Act (Act No. 36 of 1998).
- Known heritage resources situated in relative close proximity to the project infrastructure, which need to be suitably safeguarded, include the following:
  - Stead family cemetery (29°46'10.71"S; 30°25'10.77"E);
  - Stead family church (29°46'09.40"S; 30°25'09.30"E); and
  - Baynesfield Methodist church & cemetery (29°46'22.06"S; 30°21'35.10"E).
- Although the majority of the project area is disturbed, protected fauna and flora species may occur in certain areas (wetland crossings), which need to be protected against the project's potential adverse impacts. All project activities to comply with the National Environmental Management: Biodiversity Act (Act No. 10 of 2004), National Forests Act (Act No. 84 of 1998) and Natal Nature Conservation Ordinance (15 of 1974) in this regard. Sensitive species to be identified as part of the pre-construction survey. If relocation is not required, then these species and their habitat need to be adequately protected from construction activities.
- This project is situated in an area of generally high avifaunal sensitivity (based on the bird species recorded in the broader area), particularly in the western parts. However, much of the site is already transformed for agriculture and forestry, leaving little natural habitat for red listed bird species.
- Commercial agriculture is the primary land use in the western and central parts of the project area, and the majority of the infrastructure is situated on cultivated land. Construction and operational activities need to be planned and coordinated in consultation with the affected farmers.

- Through the options selected it was attempted to minimise the impacts to the future desired land use in the Umlaas Road Light Industrial Development Node. Firm guidance was also received from multiple I&APs in this regard, which lead to the refinement of the pipeline route options in this area.
- A particularly steep area is encountered along pipeline route Option 1 to the east of Mapstone Dam. Measures need to be implemented to prevent erosion at all steep areas (including along access roads).
- All traffic and pedestrians on the public roads are regarded as sensitive and measures need to be implemented to safeguard these road users. To minimise impacts to the transportation network, all major roads and railway lines will be crossed via pipe jacking.
- 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 on the Baynesfield Estate, and suitable mitigation measures need to be implemented to suppress dust caused by construction activities in this area.
- All existing infrastructure and structures are regarded as sensitive and need to be safeguarded from construction activities until they have been relocated, where avoidance is not possible.
- Prevent construction-related nuisance to sensitive socio-economic receptors. The noise and air quality monitoring programme needs to take cognizance of these sensitive receptors, which include –
  - The homesteads located on The Mynde Farm and Kyalami Farm;
  - The Hopewell community;
  - Dwellings situated in close proximity to the pipeline route;
  - Chicken houses situated alongside the pipeline route; and

- Businesses and residential areas in the Umlaas Road area, situated in close proximity to the pipeline route.

❖ 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.

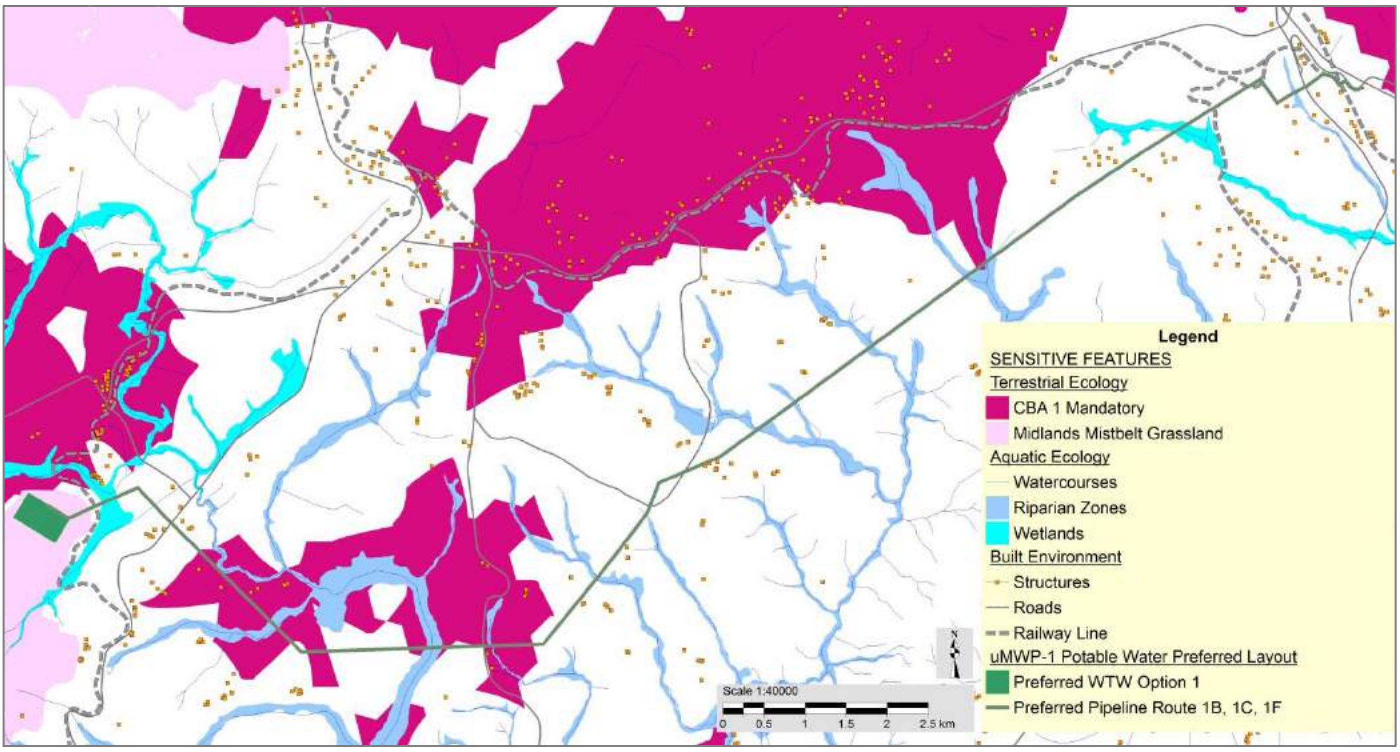


Figure 152: Sensitivity Map

The sensitivity map shown in **Figure 152** needs to be made available to the implementation team (including the Project Manager, Environmental Control Officer and Contractor) in GIS format to allow for further consideration and adequate interpretation at an appropriate scale. The map must be supplemented with the findings of the environmental sensitivity walk down survey.

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 (refer to discussions in Scoping Report). 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 project infrastructure is mostly located on privately-owned properties that are primarily used for agricultural practices (western and central sections) and light industrial purposes (eastern section). Following thorough engagement with the affected landowners as part of the public participation process as well as specialist studies, all the concerns were identified and included in the EIA's recommendations and mitigation measures. Of particular importance is that the land acquisition and compensation process needs to adhere to all legal requirements, in negotiation with the affected landowners.

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. WTW –
   a. WTW Option A was discarded for the following reasons -
      i. To avoid loss of cultivated land on Baynesfield Estate;
      ii. Various concerns were raised by the local community with regards to the location of this site;
      iii. To prevent encroachment into the Important Bird Area – SA078 – KZN mistbelt grasslands;
2. Potable Water Pipeline –
   a. Western section - Pipeline Option 1 was deviated based on recommendations from the affected landowners, which lead to the identification of Options 1A and 1B;
   b. Central section - Pipeline Option 1 was deviated based on recommendations from the affected landowners, which lead to the identification of Options 1C;
   c. Eastern section - Pipeline Option 1 was deviated based on recommendations from the affected landowners, which lead to the identification of Options 1D, 1E and 1F;
3. Mapstone Dam crossing –

a. Based on the concerns raised by the Upper Umlaas Irrigation Board with regards to security risks associated with a bridge structure, the option to bury the pipe in the dam basin was identified with the proviso that the downstream irrigators would be supplied with water during the period when the dam is drained.

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;
- 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 (air quality, water quality, noise, traffic, social);
- Conduct further baseline environmental studies for environmental monitoring programme;
- 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 Pre-Construction EMPr;

❖ **Construction phase** –

- 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, medicinal plants, 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);
- Reinstatement and rehabilitation of construction domain;
- Convene EMC Meetings;
- On-going consultation with I&APs;
- Other activities as per Construction EMPr;

❖ **Operational phase** –

- Erosion and alien invasive plants monitoring programme;
- 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:

❖ WTW Site – WTW Option 1;

❖ Potable water pipeline route –

- Western section - Option 1B;
- Central section - Option 1C;
- Eastern section - Option 1F; and

❖ Crossing of Mapstone Dam – Pipe Buried in Dam Basin.

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 suite of EMPrs, 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 Potable Water component:

1. 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.
2. Acquire additional timber land around WTW Option 1 to utilise screening offered by existing pine trees. For the WTW the construction domain needs to be contained within the site boundary to avoid disturbance outside of the eventual plant's footprint. All external areas that are not associated with permanent infrastructure and the operation of the scheme need to be adequately rehabilitated.
3. Ensure compliance with RCL's biosecurity protocols in relation to the construction and maintenance of the pipeline on their properties.
4. Ensure that a suitable water source is in place to supply water to the irrigators downstream of Mapstone Dam, in consultation with the Upper Umlaas Irrigation Board, for the period during which their normal supply will be influenced by the construction of the pipeline within the basin.

5. Ensure that acceptable flow is maintained in uMlaza River downstream of Mapstone Dam during the construction of the pipeline within the basin.
6. Reconfigure the layout of the WTW Option 1 site to avoid the power line servitude, as far as possible, in further consultation with Eskom.
7. Land acquisition and compensation process needs to adhere to all legal requirements, in negotiation with the affected landowners. This process must commence timeously prior to the construction phase.
8. Construction and operational activities need to be planned and coordinated in consultation with the affected farmers in order to minimise impacts on crop production.
9. Seek concession through DWS, as the proponent for uMWP-1 Raw Water, to increase permissible timber production in the uMlaza River catchment.
10. Establish an Environmental Monitoring Committee (EMC) in the pre-construction phase, with suitable representation of authorities, stakeholders and I&APs.
11. Specific attention will need to be paid to managing impacts to road users for all public roads (including the R56, D360, R624, P547, R603, D125) 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.
12. The current WTW sludge management option entails the disposal of the residue from the plant at a suitably registered landfill. If one of the other options becomes more favourable at a later stage of the project life-cycle, all the necessary environmental approvals will need to be sought by Umgeni Water.
13. The EIA assumed that there will not be any discharge from the WTW under normal operating conditions, based on the technical specifications of the plant. Should this change, or for any emergency discharges, Umgeni Water will need to ensure compliance with all associated legal requirements which includes the National Water Act (Act No. 36 of 1998), and in particular Section 21(f) and 21(g) water uses.
14. It is recommended that a Rehabilitation Management Plan be developed, which should include additional measures identified during construction to supplement the reinstatement and rehabilitation provisions included in the EMPr for the construction phase (if necessary).
15. 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 EMPrs and Environmental Authorisation.

16. Recommendation from the Avifauna Study (Wildskies, 2015) –
    a. Given the complexity and sensitivity of this project it is strongly recommended that a thorough avifaunal walk-through be done on the site as part of the site specific EMP just prior to construction. This exercise will provide a final check of all aspects and develop detailed mitigation measures where necessary.
17. Recommendation from the Terrestrial Ecological Impact Assessment (Nemai Consulting, 2016b) –
    a. Conduct search, rescue and relocation for sensitive species.
18. 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.
19. Recommendations from the Aquatic Impact Assessment (Enviross, 2016) include-
    a. 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;

b. Emergency procedures must be in place to timeously mitigate any accidental spillages and to isolate the impacting features as far as possible;
c. 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;
d. 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;
e. 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;
f. 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;
g. Adequate toilet facilities must be provided for all construction crews to negate informal ablutions taking place within riparian zones;
h. Fires within the riparian zones should be prohibited; and
i. 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.

16 REFERENCES

Animal Demography Unit, 2015a. FrogMAP Virtual Museum. Accessed at http://vmus.adu.org.za/?vm=FrogMAP on 2015-05-25.

Animal Demography Unit, 2015b. MammalMAP Virtual Museum. Accessed at http://vmus.adu.org.za/?vm=MammalMAP on 2015-05-25.

Animal Demography Unit, 2015c. ReptileMAP Virtual Museum. Accessed at http://vmus.adu.org.za/?vm=ReptileMAP on 2015-05-25.

Axis Landscape Architecture, 2015. Proposed uMkhomazi Water Project Phase 1 - Potable Water Component - KwaZulu Natal. Visual Impact Assessment. Axis Landscape Architecture, Pretoria.

Beater, J and Prins, P, 2015. Proposed uMkhomazi Water Project Phase 1, Potable Water Component. Phase 1 Heritage Impact Assessment.

Brownlie, S, 2005. Guideline for involving biodiversity specialists in EIA processes: Edition 1. CSIR Report No ENV-S-C 2005 053 C. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town.

Camp, K, 1999. The Bioresource Groups of KwaZulu-Natal. Mistbelt. In: Mucina, L. and Rutherford, M.C. (eds) (2006) The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia19*, South African National Biodiversity Institute, Pretoria.

Coverdale, B, 2014. Personal communication. Ezemvelo KZN Wildlife Animal Scientist – Birds and mammals.

DEA, 2010a. Companion to the EIA Regulations 2010. Integrated Environmental Management Guideline Series 5. Department of Environmental Affairs (DEA), Pretoria.

DEA, 2010b. Public Participation 2010. Integrated Environmental Management Guideline Series 7. Department of Environmental Affairs (DEA), Pretoria.

DEA&DP, 2010a. Guideline on Alternatives, EIA Guideline and Information Document Series. Western Cape Department of Environmental Affairs & Development Planning (DEA&DP), Cape Town.

DEA&DP, 2010b. Guideline on Need and Desirability, NEMA EIA Regulations Guideline and Information Document Series. Western Cape Department of Environmental Affairs & Development Planning (DEA&DP), Cape Town.

DEAT, 2002. Scoping, Integrated Environmental Management, Information Series 2, Department of Environmental Affairs and Tourism (DEAT), Pretoria.

Dr. Neville Bews & Associates, 2016. Environmental Impact Assessment for the Proposed UMkhomazi Water Project Phase 1 – Potable Water Component. Social Impact Assessment. Dr. Neville Bews & Associates, Johannesburg.

DWAF, 1999a. Mkomazi/Mooi-Mgeni Transfer Scheme Pre-Feasibility Study, Mkomazi-Mgeni Transfer Scheme. Main Report. Report No. 2787/7856. Department of Water Affairs and Forestry (DWAF), Pretoria.

DWAF, 1999b. Mkomazi/Mooi-Mgeni Transfer Scheme Pre-Feasibility Study, Mkomazi-Mgeni Transfer Scheme. Supporting Report No 1, Reconnaissance Investigations. Report No: Report No 2787a/7856. Department of Water Affairs and Forestry (DWAF), Pretoria.

DWAF, 2004. Eastern Regional Internal Strategic Perspective: Mvoti to Mzimkulu Water Management Area. Report No. P WMA 11/000/00/0304. Department of Water Affairs and Forestry (DWAF), Pretoria.

DWAF, 2005. Groundwater Resource Assessment Phase II. Department of Water Affairs and Forestry (DWAF), Pretoria.

DWAF, 2009. Mooi-Mgeni River Transfer Scheme Phase 2: Feasibility Study. Spring Grove Dam & Appurtenant Works. Environmental Impact Report. Report No. 2006-352, Prepared by BKS for the Department of Water Affairs and Forestry.

DWA, 2012. The uMkhomazi Water Project Phase 1: Module 1: Technical Feasibility Study Raw Water - Environmental Screening Report, Report No. P WMA 11/U10/00/3312/1. Department of Water Affairs (DWA), Pretoria.

DWA, 2013a. Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: Status quo assessment, IUA delineation and biophysical node identification. Prepared by: Rivers for Africa eFlows Consulting (Pty) Ltd. Department of Water Affairs (DWA), Pretoria.

DWA, 2013b. The uMkhomazi Water Project Phase 1: Module 1: Technical Feasibility Study Raw Water. Hydrological Assessment of the uMkhomazi River Catchment Report. Report No. P WMA 11/U10/00/3312/2/1. Department of Water Affairs (DWA), Pretoria.

DWA, 2013c. The uMkhomazi Water Project Phase 1: Module 1: Technical Feasibility Study Raw Water. Hydrological Assessment of the uMkhomazi River Catchment Report. Supporting Document 1: Groundwater Resources of the uMkhomazi Catchment and Interaction with Surface Water. Report No. P WMA 11/U10/00/3312/2/1/1. Department of Water Affairs (DWA), Pretoria.

DWA, 2014a. The uMkhomazi Water Project Phase 1: Module 1: Technical Feasibility Study Raw Water. Engineering Feasibility Design Report – Hydropower Assessment Report, Report No. P WMA 11/U10/00/3312/3/7. Department of Water Affairs (DWA), Pretoria.

DWA, 2014b. The uMkhomazi Water Project Phase 1: Module 1: Technical Feasibility Study Raw Water - Water Requirements and Return Flows Report, Report No. P WMA 11/U10/00/3312/2/2. Department of Water Affairs (DWA), Pretoria.

DWS, 2015. Classification of Water Resources and Determination of the Comprehensive Reserve and Resource Quality Objectives in the Mvoti to Umzimkulu Water Management Area: Volume 3: Groundwater Resource Quality Objectives. Department of Water and Sanitation (DWS), Pretoria.

Enviromap CC, 1999. KZN Town and Regional Planning Suite of Reports. An Inventory of the Wetlands in the Mkomazi Catchment of KwaZulu-Natal, Pretoria, South Africa: Town & Regional Planning Commission.

Escott, B, Livingstone, TC, Elliott, F, Nxele, B, Harris, J & Jewitt, D, 2013. Conservation Planning Terms for the EKZNW Spatial Planning Products. Version 1.3. Last edited 19 January 2013

EKZNW, 2010. Terrestrial Systematic Conservation Plan: Minimum Selection Surface (MINSET). Unpublished GIS Coverage [tscp_minset_dist_2010_wll.zip], Biodiversity Conservation Planning Division, Ezemvelo KZN Wildlife, P. O. Box 13053, Cascades, Pietermaritzburg, 3202.Avian Power Line Interaction Committee (APLIC). 1994. Mitigating Bird Collisions with Power Lines: The State of the Art in 1994. Edison Electric Institute. Washington D.C.

EKZNW, 2014. uMgungundlovu Biodiversity Sector Plan, V1.0, Unpublished Report of Ezemvelo KZN Wildlife, Biodiversity Conservation Planning Division. Ezemvelo KZN Wildlife (EKZNW), Pietermaritzburg.

Enviross, 2016. Proposed uMkhomazi Water Project. Potable Water Component, Kwazulu-Natal. Aquatic & Wetland Baseline Ecological Integrity & Potential Impact Surveys. Enviross, Johannesburg.

Harrison, JA, Allan, DG, Underhill, LG, Herremans, M, Tree, AJ, Parker, V and Brown, CJ (eds), 1997. The atlas of southern African birds. Vol. 1&2. BirdLife South Africa: Johannesburg.

Index, 2015. Agricultural Impact Assessment for uMWP-1 Potable Water. Index, Pretoria.

Keatimilwe, K and Ashton, PJ, 2005. Guideline for the review of specialist input in EIA processes: Edition 1. CSIR Report No ENV-S-C 2005 053 B. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town.

Lochner, P, 2005. Guideline for Environmental Management Plans. CSIR Report No ENV-S-C 2005-053 H. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town.

Low, AB and Rebelo, AG, 1996. Vegetation of South Africa, Lesotho and Swaziland. Department of Environmental Affairs and Tourism, Pretoria

Mucina, L and Rutherford, MC (eds), 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African Biodiversity Institute, Pretoria.

Münster, F, 2005. Guideline for determining the scope of specialist involvement in EIA processes: Edition 1. CSIR Report No ENV-S-C 2005 053 A. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town.

Nemai Consulting, 2016a. uMkhomazi Water Project Phase 1: Environmental Impact Assessment. Socio-Economic Impact Assessment. Nemai Consulting, Johannesburg.

Nemai Consulting, 2016b. uMkhomazi Water Project Phase 1: Environmental Impact Assessment. Terrestrial Fauna and Flora Assessment Report. Nemai Consulting, Johannesburg.

Rutherford, MC, Mucina, L, Lotter, MC, Bredenkamp, GJ, Smit, JHL, Scott-Shaw, R, Hoare, DB, Goodman, PS, Bezuidenhout, H, Scott, L, Ellis, F, Powrie, LW, Siebert, F, Mostert, TH, Henning, BJ, Venter, CE, Camp, KGT, Siebert, SJ, Matthews, WS, Burrows, JE, Dobson, L, van Rooyen, N, Schmidt, E, Winter, PJD, du Preez, PJ, Ward, RA, Williamson, S and Hurter, PJH, 2006. Savanna Biome. In: L. Mucina & M.C. Rutherford (eds). The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19: 510-511. South African National Biodiversity Institute, Pretoria.

SANBI, 2009. Draft Threatened Ecosystems in South Africa: Descriptions and Maps. Department of Environmental Affairs and Tourism. Pretoria.

Scott-Shaw, CR and Escott, BJ (eds), 2011. KwaZulu-Natal Provincial Pre-Transformation Vegetation Type Map – 2011. Unpublished GIS Coverage [kznveg05v2_1_11_wll.zip], Biodiversity Conservation Planning Division, Ezemvelo KZN Wildlife, P. O. Box 13053, Cascades, Pietermaritzburg, 3202.

Umgeni Water, 2013. uMkhomazi Water Project Phase 1. Water Quality Assessment. Draft. June 2013. Umgeni Water, Pietermaritzburg.

Umgeni Water, 2014. Infrastructure Master Plan 2014. 2014/2015 - 2044/2045. Volume 1. Umgeni Water, Pietermaritzburg.

uMgungundlovu District Municipality, 2010. Review of the Integrated Waste Management Plan of the uMgungundlovu District Municipality. Msunduzi Local Municipality IWMP. uMgungundlovu District Municipality, Pietermaritzburg.

uMgungundlovu District Municipality, 2012. Strategic Environmental Assessment and Strategic Environmental Management Plan. Status Quo Report. uMgungundlovu District Municipality, Pietermaritzburg, KZN

uMgungundlovu District Municipality, 2013. 2013/2014 Reviewed Integrated Development Plan. uMgungundlovu District Municipality, Pietermaritzburg.

Wildskies, 2015. uMkhomazi Water Project 1. Potable Water Component. Environmental Impact Assessment. Draft Avifaunal Specialist Study.

WRC, 2008. Improving Disinfection Efficiency in Small Drinking Water Treatment Plants. WRC Report No 1531/1/08. Water Research Commission (WRC), Pretoria.

<u>Websites:</u>

www.baynesfield.co.za/social-responsibility/conservancy.aspx

APPENDICES