March 2018

DRAFT SCOPING REPORT

ANGLO OPERATIONS PROPRIETARY LIMITED

Mafube Coal Mining (Pty) Ltd Proposed Road Realignment EIA/EMP - Draft Scoping Report

DMR Reference Number: MR 30/5/1/2/2/10026 MR

Due date for public comment: Wednesday 18 April 2018

Submitted to:
Department of Mineral Resources (DMR)
Interested and Affected Parties (I&APs)

Report Number: 1776031-318107-8

Distribution:

Department of Mineral Resources (DMR)
Interested and Affected Parties (I&APs)
Relevant Commenting Authorities
1 x copy to GAA Project File

PURPOSE OF THIS DOCUMENT

Mafube Coal Mining (Pty) Ltd (Mafube) is a Joint Venture between Anglo American Thermal Coal (AATC) and Exxaro Coal Mpumalanga (Pty) Ltd. The existing Mafube opencast operation currently mining the Springboklaagte reserve produces power station and A-grade thermal export coal. Mafube plan to expand their operations to the Nooitgedacht reserves and it is anticipated that the expanded operation will continue to produce power station and A-Grade thermal export coal. All coal mined at the Nooitgedacht reserve will be transferred to the existing beneficiation (washing) plant located at Springboklaagte for processing. The operations are currently in the construction phase and operational phase is scheduled to commence in May 2018.

Environmental authorisation (EA) conducted under the National Environmental Management Act (NEMA) for the Mafube LifeX operations was received from the Mpumalanga Department of Environmental Affairs and Tourism (MDEDET) on18 April 2013 (17/2/6/3 (101) N-1), and amendment to the EA received on 2 July 2014. An approval for the mining right's application was granted by the Mpumalanga Department of Minerals Resources (DMR) on 30 August 2013 (MR 30/5/1/2/2/10026 MR) and the EMP approved by them on 14 November 2013.

In terms of the National Water Act (Act No. 36 of 1998) (NWA), an Integrated Water Use Licence application (WULA) & Waste Water Management Plan (IWWMP) was also required for the LifeX project, and the applications for Nooitgedacht and Wildfontein was submitted in December 2013 and approved 1 December 2014. A WUL amendment application was submitted for the Nooitgedacht and Wildfontein operations and approved on 1 February 2016 and 21 December 2016 respectively. Mafube LifeX also holds a Nooitgedacht Wetland Interventions WUL, Licence No. 03/B12C/CI/5006, dated 13 April 2017.

During the project feasibility phase investigations, it was assessed that sections of D684 and D1048 district roads traverse the Nooitgedacht Coal Reserve and their closure and/or realignment are required before mining these sections can commence (Figure 4). These roads fall under the jurisdiction of the Mpumalanga Department of Public Works, Roads and Transport (DPWRT) their approval will ultimately be required to re-align these roads.

Golder Associates Africa (Pty) Ltd, an independent environmental and engineering company, is conducting the Scoping and Environmental Impact Assessment and licensing process for the proposed road realignment project.

As a minimum, the Scoping Report aims to satisfy the requirements stipulated in Appendix 2 of GN R. 326 (7 April 2017). Table 1 presents the document's composition in terms of the regulatory requirements.

Note that the following sections of Appendix 2 of GN No. 326 (7 April 2017) will be investigated further and reported on in the Environmental Impact Report (EIR), following the execution of the relevant specialist studies and targeted public participation:

- Section 2(1)(g)(v) - The impacts and risks identified for the preferred alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts:
  - can be reversed;
  - may cause irreplaceable loss of resources; and
  - can be avoided, managed or mitigated.
- Section 2(1)(g)(vii) - Positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community, that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;
- Section 2(1)(g)(viii) - The possible mitigation measures that could be applied and level of residual risk;
- Section 2(1)(g)(ix) - The outcome of the site selection matrix;

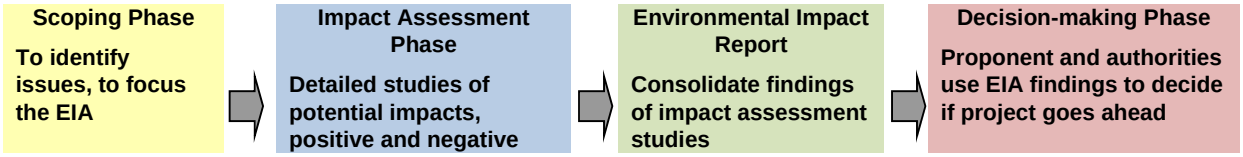
- Section 2(1)(g)(xi) - A concluding statement indicating the preferred alternatives, including preferred location of the activity.

The due date for comment on this Draft Scoping Report (DSR) is **18 April 2018**. Comments received during the public review period will be acknowledged and recorded in the draft EIA/EMPr, which will be presented for further public comment at a date to be advised.

Summary of what the Scoping Report contains

This report contains:

- A description of the proposed road realignment activities;
- An overview of the EIA process, including public participation;
- A description of the existing environment in the proposed project area;
- The anticipated environmental issues and impacts which have been identified; and
- The proposed scope of specialist studies planned for the Impact Assessment phase.



The figure above shows the various phases of an Environmental Impact Assessment. This EIA is in the Scoping Phase, during which interested and affected parties comment on the proposed project.

DOCUMENT ROADMAP

Table 1: Draft Scoping Report (DSR) Roadmap

Chapter	Title	Correlation with GN R. 326, Appendix 2	Overview
Executive Summary	Purpose of this Document	–	–
Executive Summary	Document Roadmap	–	–
1	Project Background and Motivation	2(1)(f)	A motivation for the need and desirability for the proposed road realignment.
2	Project Location	2(1)(b) & 2(1)(c)	A description of the location of the activity.
4	Legislation and Guidelines Considered	2(1)(e)	A description of the policy and legislative context within which the road realignment is proposed.
2	Scoping and EIA Process	2(1)(a)	Details of Environmental Assessment Practitioner (EAP) who prepared the report and the expertise of the EAP.
5	Need & Desirability	2(1)(f)	A motivation for the need and desirability for the proposed road realignment.
1, 3, 6, 9, 10	Project Description	2(1)(c) & 2(1)(d)	A description of the scope of the proposed activity.
		2(1)(g)(i)	Details of all the alternatives considered.
		2(1)(g)(vii)	Positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community, that may be affected.
8	Profile of the Receiving Environment	2(1)(g)(iv)	Environmental attributes associated with the alternatives.
		2(1)(g)(vii)	Positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community, that may be affected.
7	Public Participation	2(1)(g)(ii)	Details of the public participation process.
		2(1)(g)(iii)	A summary of the issues raised by IAPs.
9, 10, 11	Environmental Issues	2(1)(g)(v)	Impacts and risks identified for each alternative.
		2(1)(g)(vii)	Positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community, that may be affected.
		2(1)(g)(vi)	The methodology used in determining and ranking the potential environmental impacts and risks associated with the alternatives.
11	Plan of Study for EIA	2(1)(h)	A plan of study for undertaking the environmental impact assessment process.
114, 15	EAP Affirmation	2(1)(i) and 2(1)(j)	An undertaking under oath or affirmation by the EAP.
12		2(1)(k)	Where applicable, any specific information required by the competent authority.
13		2(1)(l)	Any other matter required in terms of section 24(4)(a) and (b) of the Act.

PUBLIC REVIEW OF THE SCOPING REPORT

This Scoping Report is available for comment for a period of 30 days from **16 March 2018 until 18 April 2018** at the public places in the project area listed in the table and upon request from the Public Participation Office of Golder Associates.

Public Place	Contact Person	Contact Number
Mafube LifeX Project Office	Mrs Chantelle Gerber	(011) 638 3479
eMalahleni Main Library	Ms Johanette Rozmiarek	(013) 690 6232
Golder Associates Africa, Midrand	Mrs Antoinette Pietersen	(011) 254 4800
The Golder Associates Africa website	www.golder.com/public	

OPPORTUNITIES FOR PUBLIC REVIEW

Stakeholders who wish to comment on the Scoping Report may do so in any of the following ways:

- Completing the comment sheet enclosed with this report or on-line via the Golder website (www.golder.com/public);
- Additional written submissions; and
- Comment by e-mail or telephone.

DUE DATE FOR COMMENT ON THIS SCOPING REPORT IS 18 April 2018

Please submit comments to the Public Participation Office:

Antoinette Pietersen

Golder Associates

P O Box 6001

HALFWAY HOUSE, 1685

Tel: (011) 254 4800 / 4805

Fax: 086 582 1561

Email: Apietersen@golder.co.za

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION AND BACKGROUND

1.1 Background

Mafube Coal, an existing operation outside of Middelburg in Mpumalanga, is a joint venture involving Anglo Operations Limited and Exxaro Coal Mpumalanga (Pty) Ltd. The expansion of the existing Mafube opencast operations onto the Nooitgedacht reserve (Mafube LifeX operations) extends the life of the existing Mafube operations by 20 years. Mafube LifeX operations will supply power station and A-grade thermal export coal.

Golder Associates Africa (Pty) Ltd (Golder) has been conducting environmental authorisation processes, studies and monitoring for the Mafube LifeX operations since 2008. The project plan has evolved during this time and several updates and amendments have taken place. The Mafube LifeX operations is currently in the construction phase and full operational phase is scheduled to commence in May 2018. Coal extracted from the life expansion pits on Nooitgedacht will be transported by conveyor approximately 7 km to the existing plant, at Springboklaagte, for processing.

In 2011 Golder was appointed by Mafube to conduct the Environmental Impact Assessment (EIA) process for the proposed Mafube LifeX operations, which included the mining operations at Nooitgedacht and Wildfontien. An Environmental Management Programme (EMP) was also submitted to the Department of Mineral Resources (DMR) for approval as part of their mining rights application, as required under the Mineral and Petroleum Resources Act (Act No. 28 of 2002) (MPRDA).

Environmental authorisation (EA) conducted under the National Environmental Management Act (NEMA) for the Mafube LifeX operations was received from the Mpumalanga Department of Environmental Affairs and Tourism (MDEDET) on18 April 2013 (17/2/6/3 (101) N-1), and amendment to the EA received on 2 July 2014. An approval for the mining right's application was granted by the Mpumalanga Department of Minerals Resources (DMR) on 30 August 2013 (MR 30/5/1/2/2/10026 MR) and the EMP approved by them on 14 November 2013.

In terms of the National Water Act (Act No. 36 of 1998) (NWA), an Integrated Water Use Licence application (WULA) & Waste Water Management Plan (IWWMP) was also required for the LifeX project, and the applications for Nooitgedacht and Wildfontein was submitted in December 2013 and approved 1 December 2014. A WUL amendment application was submitted for the Nooitgedacht and Wildfontein operations and approved on 1 February 2016 and 21 December 2016 respectively. Mafube LifeX also holds a Nooitgedacht Wetland Interventions WUL, Licence No. 03/B12C/CI/5006, dated 13 April 2017.

During the feasibility phase investigations, it was assessed that sections of district road D684 and district road D1048 traverse the Nooitgedacht Coal Reserve and their closure and/or re-alignment are required before this operation can commence (Figure 2). These roads fall under the jurisdiction of the Mpumalanga Department of Public Works, Roads and Transport (DPWRT) their approval will ultimately be required to re-align these roads.

Mafube has appointed Golder to conduct the EIA/EMP and public participation process (under NEMA) for the proposed realignment of sections of the D684 and D1048 district roads. Part of this process is to identify potential route realignment alternatives and follow an alternative analysis process to identify the most preferred alternative route.

An EIA application will be submitted to the Department of Mineral Resources (DMR) in terms of Regulations 326, 327, 325, and 324 published under NEMA on 7 April 2017. This proposed road realignment project triggers a full scoping and environmental assessment EIA process for certain listed activities under the NEMA, an Environmental Management Programme (EMP) based on the findings of the EIA and a Water Use Licence Application (IWULA). The public participation process will provide stakeholders with information about the proposed project, and several opportunities to comment throughout the EIA/EMP/IWULA process.

1.2 Contents of this Report

The purpose of a Scoping Report is to describe the project and the pre-project baseline environmental conditions within the project-affected area, and to present the proposed scope of work to develop an EIA for the project. This document has been structured as follows:

a) ***Introduction and overview*** – Introduces the Project and the Project proponent, gives an overview description of the Project and its scope, provides the details of the environmental practitioner, and explains the EIA process;

b) ***Policy, Legal and Administrative Framework*** – Describes the environmental policy, legal, and administrative framework applicable to the Project. This includes a summary of relevant South African regulations, the applicable administrative framework, and the environmental permitting process

c) ***Description of the Proposed Project*** - Provides a summary of the key Project components, the Project location, scale, nature and design, production process, main inputs and outputs, schedule and activities during different phases of the Project, inclusive of a description of the Project location and the properties on which the Project will take place;

d) ***Project Motivation*** – Discusses the need for and desirability of the Project and the project life;

e) ***Project Alternatives*** – summarises alternatives considered by the Project proponent and the process followed to select the preferred site;

f) ***Public Consultation*** – This section provides a summary of the public consultation activities proposed and carried out as part of the EIA process and keeps a record of issues raised by interested and affected parties (I&APs);

g) ***Description of the Environment that may be affected*** – Describes the current pre-project biophysical, socio-economic, and cultural status of the area, key characteristics (sensitive or vulnerable areas), important heritage resources, current land use and livelihoods;

h) ***Methodology used to determine the significance of environmental impacts*** – Describes the manner in which environmental impacts are assessed for significance before the implementation of mitigation measures;

i) ***Mitigation measures and risk levels*** – Discusses issues raised by I&APs and mitigation measures that can be implemented to address concerns. Provides an assessment of impacts and risks associated with such mitigation measures and the alternatives considered;

j) ***Final site layout plan*** and motivation for preferred site and layout;

k) ***Plan of study for EIA process*** – Identifies the environmental aspects to be assessed by specialists, provides the terms of reference for specialist studies, indicates the stages of consultation with the authorities and provides details of the public consultation process to be followed during the impact assessment process;

l) ***EIA Process*** – summarises the processes being undertaken with respect to Environmental and Social Impact Assessment for the Project;

m) ***Next Steps in the Process*** – Indicates what the next steps in the process are;

n) ***References*** – references to literature consulted; and

o) ***Appendices*** – technical material supporting the Scoping Report, including the Curricula Vitae (CV) of the environmental assessment practitioner, comments and response report, and document limitations.

2.0 PROPONENT AND PRACTITIONER DETAILS

2.1 Details of the Proponent

For the purposes of this EIA, the following person may be contacted at Mafube Coal Mining:

Table 2: Proponent's contact details

Contact Person:	Chantelle Gerber
Name of Proponent:	Mafube Coal (A joint venture between Anglo Operations Limited (AOL) and Exxaro)
Name of Mine:	Mafube Coal Mining (Pty) Ltd
Address:	Mafube LifeX project office, D684 Road, Farm Springboklaagte
Telephone No.:	011 638 3479
Email address:	chantelle.gerber@angloamerican.com

2.2 Details of the Environmental Impact Assessment Practitioner

Mafube has appointed Golder Associates Africa (Pty) Ltd (GAA) as an independent Environmental Assessment Practitioner (EAP) to undertake the scoping phase of the Environmental Impact Assessment (EIA) that is required for the proposed road realignment project.

Golder Associates Africa is a member of the world-wide Golder Associates group of companies, offering a variety of specialised engineering and environmental services. Employee owned since its formation in 1960, the Golder Associates group employs more than 8 000 people who operate from more than 180 offices located throughout Africa, Asia, Australasia, Europe, North America and South America. Golder Associates Africa (GAA) has offices in Midrand, Pretoria, Florida, Durban, Rustenburg, Cape Town, Maputo and Accra. GAA has more than 300 skilled employees and is able to source additional professional skills and inputs from other Golder offices around the world.

GAA has no vested interest in the proposed project and hereby declares its independence as required by the South African EIA Regulations.

For purposes of this EIA, the following persons may be contacted at GAA:

Table 3: Contact details of the environmental assessment practitioner

Contact Persons:	Mariëtte Weideman	Antoinette Pietersen
Purpose:	Technical	Public Participation
Address:	P.O. Box 6001 Halfway House 1685	P.O. Box 6001 Halfway House 1685
Telephone:	011 254 4883	011 254 4805
Fax:	086 582 1561	086 582 1561
Cell phone:	084 515 6965	083 280 5024
E-mail:	mweideman@golder.co.za	apietersen@golder.co.za

2.2.1 Expertise of environmental assessment practitioner

2.2.1.1 Qualifications of EAP

Education

- B.Sc. Biological Sciences in Botany and Biochemistry - North West University (Potchefstroom Campus)
- B.Sc. (Hons) Environmental Sciences and Development - North West University (Potchefstroom Campus)
- B.Sc. (Hons) Environmental Management - University of South Africa (UNISA)
- AVCASA Crop Protection Diploma - Tshwane University of Technology

Career Enhancing Courses

- Planning for Effective Public Participation - IAP2
- Communications for Effective Public Participation - IAP2
- Microsoft Project 2007 Essentials - BYTES Technology Group
- Project Management Fundamentals - Golder Associates (internal training)
- Environmental Law for Environmental Managers - Centre for Environmental Management (CEM), Potchefstroom.

Professional Affiliations

- Professional Natural Scientist (Pr.Sci.Nat) (Reg. No.400107/17) - South African Council for Natural Scientific Professions (SACNASP)

2.2.2 Summary of past experience

Mariëtte has 6 and a half years' work experience in Environmental Management, specialising in Environmental and Social Impact Assessments (ESIAs), Basic Assessments (BAs), Environmental Management Programme reports (EMPr's) for mining and industry, Emergency Response Plans, Section 24G applications, Legal Compliance Auditing, and the Public Participation Processes. Mariëtte has experience with Southern African legislation as well as IFC Performance Standards and Equator Principles. Mariëtte has been involved in international ESIA projects in the following countries; South Africa, DRC, Botswana and Mozambique, and as such she has a good track record of understanding the local regulatory and permitting processes in different countries. Mariëtte also has experience in conducting technical and quality reviews of specialist reports (copy of CV appended to this DSR).

2.3 Description of the Property

Table 4: Details of the property

Aspect		**Description**
Application area		Approximately 75 ha (for entire length of the proposed road)
Magisterial District		Steve Tshwete and Emakhazeni Local Municipalities
Distance and direction from nearest town		39 km east of the town of Middelburg via the R104 regional road, and 45 km west of Belfast
SG Codes		
FARM NAME	**PORTION NUMBER**	**21-Digit Key**
Properties affected by closure of existing district road (D1048 & D684)		

Aspect		Description
NOOITGEDACHT 417 JS	4	T0JS00000000041700004
NOOITGEDACHT 417 JS	8	T0JS00000000041700008
NOOITGEDACHT 417 JS	14	T0JS00000000041700014
NOOITGEDACHT 417 JS	15	T0JS00000000041700015
NOOITGEDACHT 417 JS	16	T0JS00000000041700016
NOOITGEDACHT 417 JS	RE	T0JS00000000041700000
PANPLAATS 395 JS	6	T0JS00000000039500006
PANPLAATS 395 JS	8	T0JS00000000039500008
SPRINGBOKLAAGTE 416 JS	1	T0JS00000000041600001
SPRINGBOKLAAGTE 416 JS	10	T0JS00000000041600010
ROODEPOORT 418 JS	9	T0JS00000000041800009
ROODEPOORT 418 JS	10	T0JS00000000041800010
ROODEPOORT 418 JS	11	T0JS00000000041800011
ROODEPOORT 418 JS	16	T0JS00000000041800016
Properties affected by Alternative A		
Roodepoort 418 JS	7	T0JS00000000041800007
Roodepoort 418 JS	9	T0JS00000000041800009
Roodepoort 418 JS	11	T0JS00000000041800011
Roodepoort 418 JS	13	T0JS00000000041800013
Roodepoort 418 JS	14	T0JS00000000041800014
Roodepoort 418 JS	16	T0JS00000000041800016
Properties affected by Alternative B		
Roodepoort 418 JS	14	T0JS00000000041800014
Roodepoort 418 JS	16	T0JS00000000041800016
Bayview 430 JS	RE	T0JS00000000043000000
Jubilatum 401 JS	RE (0)	T0JS00000000040100000
Witklip 391 JS	5	T0JS00000000039100005
Witklip 391 JS	14	T0JS00000000039100014
Properties affected by Alternative C		
Roodepoort 418 JS	4	T0JS00000000041800014
Roodepoort 418 JS	6	T0JS00000000041800006
Roodepoort 418 JS	12	T0JS00000000041800012
Roodepoort 418 JS	16	T0JS00000000041800016
Hartbeesthoek 393 JS	RE (0)	T0JS00000000039300000
Hartbeesthoek 393 JS	4	T0JS00000000039300004
Genadebult 121 JS	1	T0JS00000000041800014
Panplaats 395 JS	6	T0JS00000000041800014
Properties affected by Alternative D		
Not Applicable as this road is the existing district roads in the area.		
Properties affected by Alternative E		
Roodepoort 418 JS	1	T0JS00000000041800001
Roodepoort 418 JS	7	T0JS00000000041800007

Aspect		Description
Roodepoort 418 JS	8	T0JS00000000041800008
Roodepoort 418 JS	9	T0JS00000000041800009
Roodepoort 418 JS	10	T0JS00000000041800010
Roodepoort 418 JS	11	T0JS00000000041800011
Roodepoort 418 JS	13	T0JS00000000041800013
Roodepoort 418 JS	14	T0JS00000000041800014
Nooitgedacht 417 JS	4	T0JS00000000041700004
Properties affected by Preferred Route Alternative F		
Springboklaagte 416 JS	1	T0JS00000000041600001
Springboklaagte 416 JS	12	T0JS00000000041600012
Nooitgedacht 417 JS	4	T0JS00000000041700004
Nooitgedacht 417 JS	14	T0JS00000000041700014
Nooitgedacht 417 JS	15	T0JS00000000041700015
Roodepoort 418 JS	8	T0JS00000000041800008
Roodepoort 418 JS	9	T0JS00000000041800009
Roodepoort 418 JS	10	T0JS00000000041800010
Roodepoort 418 JS	11	T0JS00000000041800011
Roodepoort 418 JS	13	T0JS00000000041800013

2.4 Locality Map

Mafube Coal Mining (Pty) Ltd is situated approximately 39 km east of the town of Middelburg via the R104 regional road, and 45 km west of Belfast, in the Mpumalanga Province (Figure 1 and Figure 2). The mining operation is located within the jurisdiction of the Nkangala District Municipality and falls within the Steve Tshwete and Emakhazeni Local Municipalities.

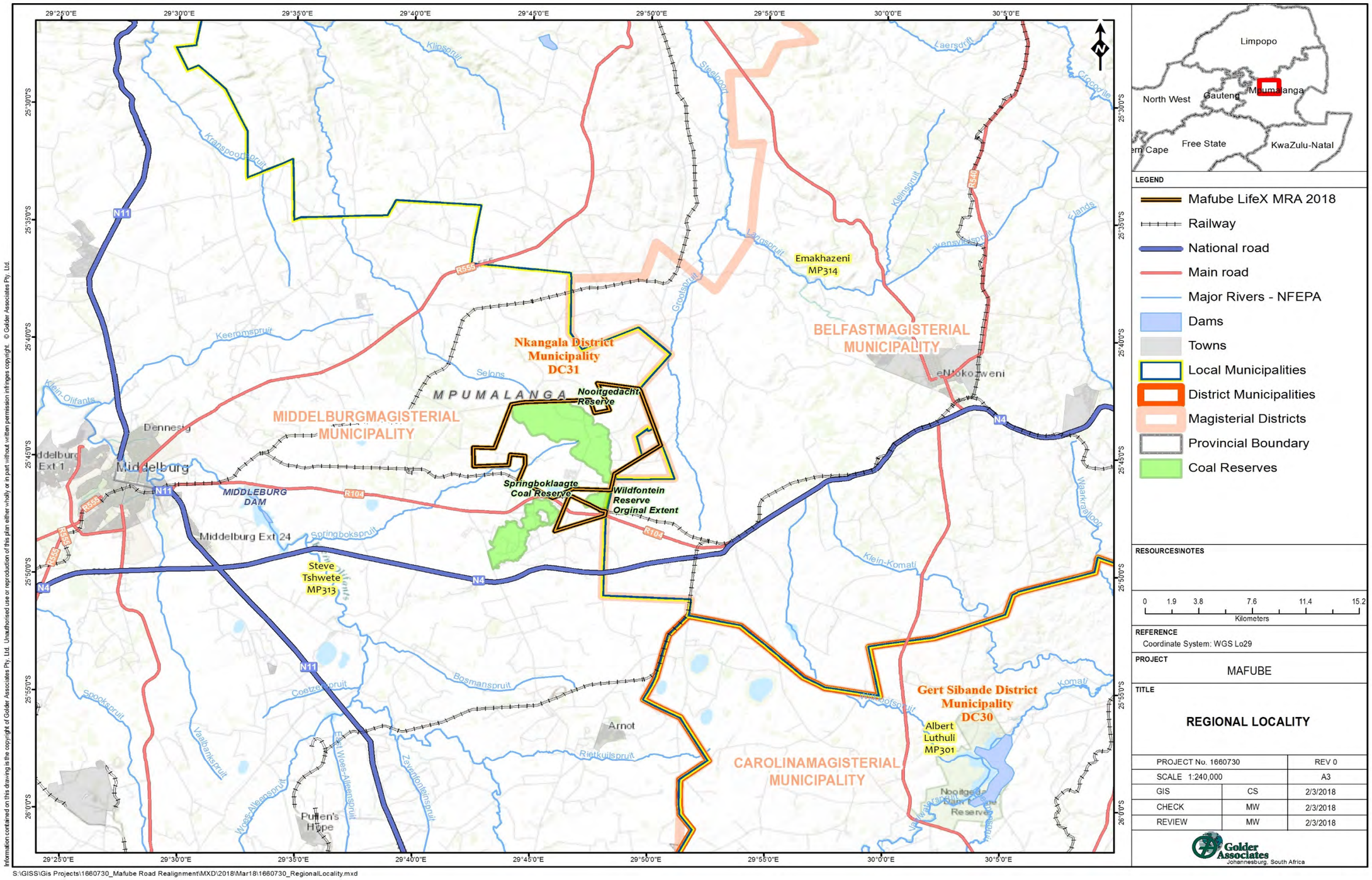


Figure 1: Regional locality map

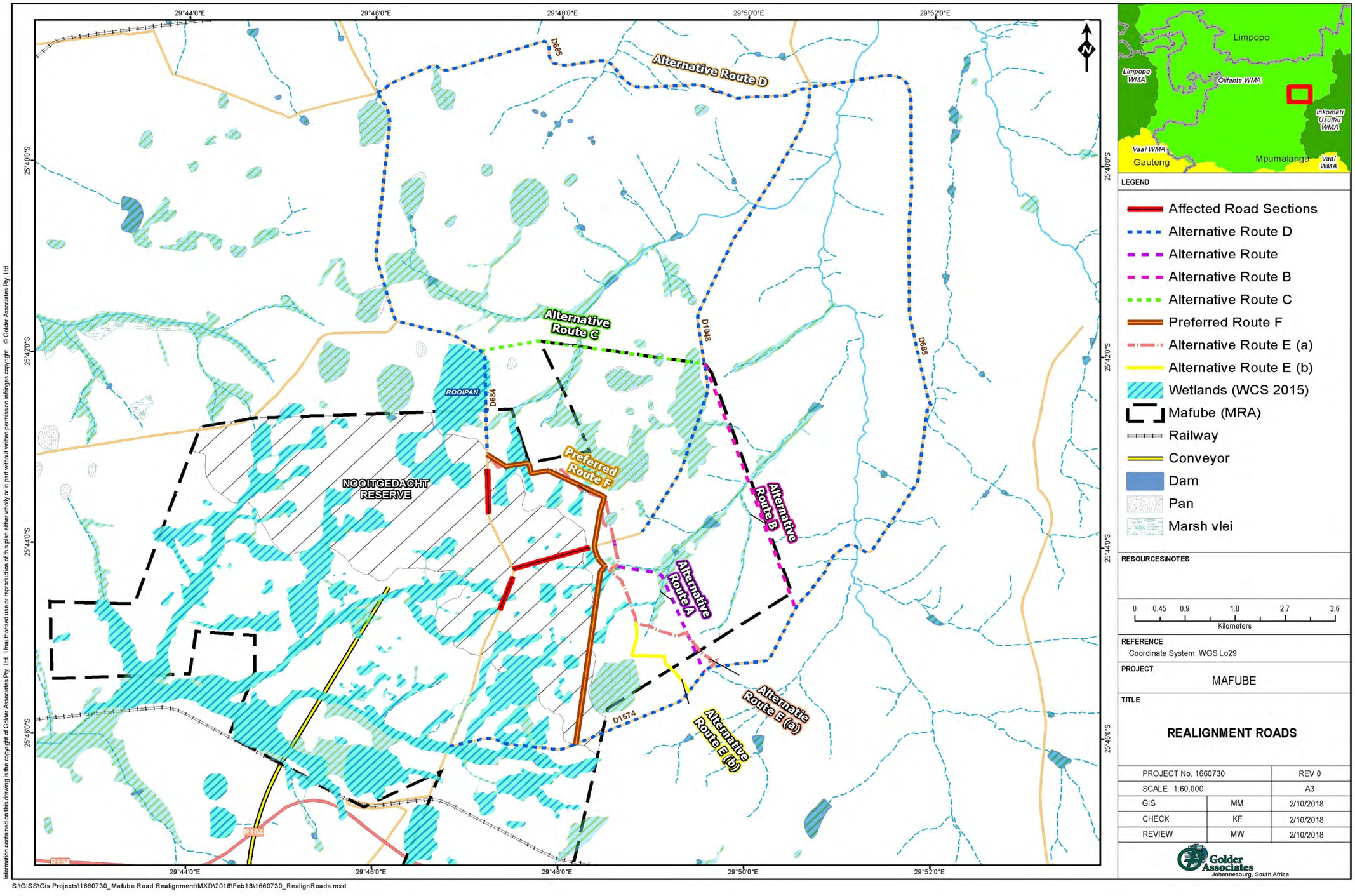


Figure 2: Locality Map for the Mafube Road Realignment Project

3.0 DESCRIPTION AND SCOPE OF THE PROPOSED OVERALL ACTIVITY

In 2011 Golder was appointed by Mafube to conduct the Environmental Impact Assessment (EIA) process for the proposed Mafube LifeX operations, which included the mining operations at Nooitgedacht and Wildfontien. An Environmental Management Programme (EMP) was also submitted to the Department of Mineral Resources (DMR) for approval as part of their mining rights application, as required under the Mineral and Petroleum Resources Act (Act No. 28 of 2002) (MPRDA).

Environmental authorisation (EA) under the National Environmental Management Act 107 of 1998 (NEMA) for the Mafube LifeX operations was received from the Mpumalanga Department of Environmental Affairs and Tourism (MDEDET) in April 2013 (17/2/6/3 (101) N-1). An approval for the mining right's application was granted by the Mpumalanga Department of Minerals Resources (DMR) on 30 August 2013 (MR 30/5/1/2/2/10026 MR) and the EMP approved on 14 November 2013.

In terms of the National Water Act (Act No. 36 of 1998) (NWA), an Integrated Water Use Licence application & Waste Water Management Plan was also required for the Mafube LifeX operations, and these applications were submitted in December 2013 and approved 1 December 2014. Subsequent amendments to these licences were issued on 1 February 2016. A WUL authorising a number of section 21 (c) & (i) water uses associated with wetland interventions as part of an extensive wetland rehabilitation programme were issued on 13 April 2017.

The Mafube LifeX operations is in the construction phase and operations are scheduled to commence in May 2018.

During the feasibility phase investigations, it was assessed that sections of district road D684 and district road D1048 traverse the Nooitgedacht Coal Reserve and their closure and/or realignment are required before this operation can commence (Figure 4). These roads fall under the jurisdiction of the Mpumalanga Department of Public Works, Roads and Transport (DPWRT) their approval will ultimately be required to re-align these roads.

3.1.1 Listed and Specific Activities

Golder identified the activities listed in Table 5 as activities that require environmental authorisation in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA) regulations, GN R.326, G NR. 327, G NR. 325, and G NR 324 gazetted 7 April 2017, for the proposed realignment of the district roads.

Table 5: Listed activities requiring environmental authorisation

Relevant Government Notice	Number of Listed Activity	Aerial extent of the Activity Ha or m²	Description of the Activity	Legislation Text
GN R. 327	12(ii)	Entire length of the proposed road covers an area of Approx. 75 ha. Listed Activity will cover sections within the 75 ha.	Proposed road construction /development physical footprint of 100 square metres or more within a watercourse	*"The development of—* *(i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or* *(ii) 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."
GN R. 327	19	Entire length of the proposed road covers an area of Approx. 75 ha. Listed Activity will cover sections within the 75 ha.	During road construction over watercourses there may be a requirement to dredge, excavate or remove more than 10 cubic metres of material from a watercourse.	*"The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse; but excluding where such infilling, depositing, dredging, excavation, removal or moving—* • *will occur behind a development setback;* • *is for maintenance purposes undertaken in accordance with a maintenance management plan;* • *falls within the ambit of activity 21 in this Notice, in which case that activity applies;* • *occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or* • *where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies."*
GN R. 327	24(ii)	Entire length of the proposed road covers an area of Approx. 75 ha. Listed Activity will cover sections within the 75 ha.	Road being constructed may be wider than 8 metres.	*"The development of a road—* *(i) 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) with a reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 metres; but excluding a road—* *(a) which is identified and included in activity 27 in Listing Notice 2 of 2014;* *(b) where the entire road falls within an urban area; or* *(c) which is 1 kilometre or shorter."*
GN R. 327	56(i)	Entire length of the proposed road covers an area of Approx. 75 ha. Listed Activity will cover sections within the 75 ha.	Road being constructed may be widened by more than 6 metres and lengthened by more than 1 kilometre.	*"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."*
GN R. 325	24	Entire length of the proposed	Road being constructed in	*"The extraction or removal of peat or peat soils, including the disturbance of*

		road covers an area of Approx. 75 ha. Listed Activity will cover sections within the 75 ha.	wetland areas that might contain peat soils.	*vegetation or soils in anticipation of the extraction or removal of peat or peat soils, but excluding where such extraction or removal is for the rehabilitation of wetlands in accordance with a maintenance management plan."*
GN R. 325	27(i)	Entire length of the proposed road covers an area of Approx. 75 ha. Listed Activity will cover sections within the 75 ha.	Road being constructed may have a reserve wider than 30 metres.	*"The development of a road-* *(i) with a reserve, wider than 30 metres; or* *(ii) catering for more than one lane of traffic in both directions;* *but excluding [the development and related operation of] a road—* *(a) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Government Notice 545 of 2010, in which case activity 24 in Listing Notice 1 of 2014 applies;* *(b) which is 1 kilometre or shorter; or* *(c) where the entire road falls within an urban area."*
GN R. 324	4	Entire length of the proposed road covers an area of Approx. 75 ha. Listed Activity will cover sections within the 75 ha.	The development of a road wider than 4 metres with a reserve less than 13,5 metres.	*f. Mpumalanga* *i. Outside urban areas:* *(aa) A protected area identified in terms of NEMPAA, excluding disturbed areas;* *(bb) National Protected Area Expansion Strategy Focus areas;* *(cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;* *(dd) Sites or areas identified in terms of an international convention;* *(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;* *(ff) Core areas in biosphere reserves; or* *(gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas, where such areas comprise indigenous vegetation; or* *ii. Inside urban areas:* *(aa) Areas zoned for use as public open space; or* *(bb) Areas designated for conservation use in Spatial Development Frameworks*

				adopted by the competent authority or zoned for a conservation purpose.
GN R. 324	12	Entire length of the proposed road covers an area of Approx. 75 ha. Listed Activity will cover sections within the 75 ha.	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.	*f. Mpumalanga* *i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004;* *ii. Within critical biodiversity areas identified in bioregional plans; or* *iii. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning or proclamation in terms of NEMPAA.*
GN R. 324	14	Entire length of the proposed road covers an area of Approx. 75 ha. Listed Activity will cover sections within the 75 ha.	The development of (i) dams or weirs, where the dam or weir, including infrastructure and water surface area exceeds 10 square metres; or (ii) infrastructure or structures with a physical footprint of 10 square metres or more;	*f. Mpumalanga* *i. Outside urban areas:* *(aa) A protected area identified in terms of NEMPAA, excluding conservancies;* *(bb) National Protected Area Expansion Strategy Focus areas;* *(cc) World Heritage Sites;* *(dd) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;* *(ee) Sites or areas identified in terms of an international convention;* *(ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;* *(gg) Core areas in biosphere reserves; or* *(hh) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve, where such areas comprise indigenous vegetation."*
GN R. 324	18	Entire length of the proposed road covers an area of Approx. 75 ha.	The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre.	*f. Mpumalanga* *i. Outside urban areas:* *(aa) A protected area identified in terms of NEMPAA, excluding conservancies;* *(bb) National Protected Area Expansion Strategy Focus areas;*

		Listed Activity will cover sections within the 75 ha.		*(cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;* *(dd) Sites or areas identified in terms of an international convention;* *(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;* *(ff) Core areas in biosphere reserves; or* *(gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve, where such areas comprise indigenous vegetation; or* *ii. Inside urban areas:* *(aa) Areas zoned for use as public open space; or* *(bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose.*

3.1.2 Activities to be undertaken

The project activities include those during the pre-construction (setting up servitudes and site camps before construction), construction, and operational phases of the proposed road realignments and closure development. Each activity has potential impacts on the environment and is summarised in Table 6 below.

Table 6: Summary of project activities

Activity	Description
Pre-construction phase	
Demarcation of servitudes	■ *Surveying*: all sections of the proposed route must be surveyed in detail. ■ *Fencing:* the surveyed sections will be temporarily fenced in order to constrain construction activities. ■ *Search-and-rescue:* any species of flora of high conservation status within these servitudes will be removed by the Environmental Compliance Officer (ECO) and stored for transplantation. ■ *Clearing:* the removal of all vegetation and topsoil in preparation of stable foundations for new construction works as well as along proposed access routes and in areas set aside for construction camps. ■ *Topsoil stripping:* topsoil within the servitudes will be stripped and stockpiled or removed as part of the Nooitgedacht mining operation schedule. ■ *Access road construction:* this will involve the construction of the various roads required to access the construction areas, construction camps and other surface infrastructure sites.
Transport of material to site	■ *Road transport:* materials sourced outside of the study area will be transported to the servitude by road. The existing district D1574 road and farm roads will be utilised as a means of delivering these materials to site, with potential temporary impacts on the transport infrastructure and local road users in the area.

Activity	Description
Establishment of construction camps	■ *Construction of temporary camps:* these will involve clearing of the vegetation, fencing of camps and the construction of houses, workshops, store-rooms and vehicle parking areas. The camps will be electrified and ablution and potable water provided. An Environmental Management Plan (EMP) will be compiled as part of this EIA, which will describe parameters such as the following: ▪ The contractor will provide a plan detailing the layout of camp site facilities, such as chemical toilets, areas for stockpiling of materials, storage of hazardous materials and provision of containers. ▪ Stockpiles for concrete materials will comprise side-restrained triangular bin-type structures. Bund walls will be constructed. High quality materials with low dust generating characteristics will be used. ▪ Hazardous waste will be disposed of at a Department of Water Affairs and Forestry approved landfill site. ▪ All hazardous materials will be stored in a secured, appointed area that is fenced and has restricted entry. ▪ Fuel and gas will be stored in a secure area in a steel tank supplied and maintained by the fuel suppliers. Fuel storage will generally occur in the workshop areas of site camps, which is generally fenced and paved. Bund walls will be built around an impermeable substratum. ▪ Workshops will be equipped with grease traps in the drainage collection system. Used oil will be collected in drums from these traps and disposed of off-site. ▪ Domestic waste will be collected in drums and removed to the nearest municipal waste site for disposal. ▪ Suitable washing facilities and sanitary arrangements at site offices, workshops and construction sites will be provided. Sanitary facilities for the site camps will comprise either prefabricated septic tanks or stand-alone bucket-systems. ▪ Water for human consumption will be available at the site offices and at other convenient locations on site.
Establishment of crusher plants	■ Possible need for a temporary crusher plant to crush rock obtained from road cuttings to be used for the construction.
Construction phase	
Structures	The proposed road will require the construction of some new drainage structures, such as pipe and box culverts.
Earthworks	■ *Clearing of vegetation:* Vegetation along the route will be cleared and uprooted. ■ *Cuttings:* Cuttings will be initiated using bulldozers and back actors to remove the softer material. ■ *Blasting:* Possible drilling and blasting will occur where rock is encountered that cannot be ripped. These activities will be strictly controlled.
Road construction	■ Road construction activities done in accordance with legislative district road specifications.
Site removal and rehabilitation	Site removal encompasses the removal of all building material, temporary structures and any other waste material generated during construction. All such material must be removed from site and disposed of appropriately once construction is complete. The following will be removed from site where: ■ Storage structures; ■ Wayleaves required for earth moving vehicles; ■ All construction material, including concrete slabs and braai areas;

Activity	Description
	■ Accommodation structures; ■ Workshop structures; ■ Waste material generated by the workforce and during construction; ■ Extra construction material not used or required on site; ■ Stripped vegetation; ■ Stockpiled topsoil; and ■ Rock and other material generated during construction (e.g. during blasting and excavations), which cannot be utilised on site.

4.0 POLICY AND LEGISLATIVE CONTEXT

This section summarises the legal, policy, and administrative framework within which the EIA is being undertaken and identifies the regulatory authorities involved in deciding on the application for authorisation.

4.1 Relevant South African Legislation

As shown in Table 5, Golder has identified activities that require environmental authorisation that were not included in the EIA and EMP process undertaken by Golder Associates in 2012 (Golder Associates, 2012) for the Mafube LifeX operations. The activities identified by Golder, as listed in Table 5, includes activities within Regulation GN R.324, which requires a full scoping and environmental impact assessment process to be undertaken. The activity also requires a Water Use Licence (WUL) application for the proposed realignment of sections of the D1048, D1574 and D684 district roads and will be applied for in terms of the National Water Act 1998 (Act 36 of 1998).

In summary, the following key legislation is relevant to the Mafube LifeX Road Realignment EIA/EMP Process:

- National Environmental Management Act (Act 107 of 1998) (NEMA) and applicable Regulations; and
- National Water Act (Act 36 of 1998) (NWA).

Other legislation applicable to the project includes, but is not limited to:

- National Heritage Resources Act (Act 25 of 1999);
- National Environmental Management: Biodiversity Act (Act 10 of 2004);
- National Environmental Management: Air Quality Act (Act 39 of 2004) and applicable Regulations, Standards and Notices published in terms of NEMAQA;
- Environment Conservation Act (Act 73 of 1989);
- Conservation of Agricultural Resources Act (Act 43 of 1983); and
- Municipal by-laws.

The following documents have been used for guidance:

- Institute of Environmental Assessment (IEMA), 1993. Guidelines for the Environmental Assessment of Road Traffic;
- International Finance Corporation (IFC), 2007. Traffic Safety Guidelines in the General EHS Guidelines: Community Health and Safety;
- International Finance Corporation (IFC), 2007. Performance Standard 2: Assessment and Management of Environmental and Social Risks and Impacts;
- South African National Ambient Air Quality Standards (NAAQS) for common pollutants;

- National Dust Control Regulations were promulgated under NEMAQA and published in the Government Gazette No. 36974; and
- Sections 18 to 20 of NEMAQA deals with the establishment of Priority Areas in so-called “hot-spot” areas of South Africa where ambient air quality standards are often exceeded or may often be exceeded.

4.1.1 National Environmental Management Act

In terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), as amended and the EIA Regulations, an application for environmental authorisation for certain listed activities must be submitted to the provincial environmental authority, the national authority (Department of Environmental Affairs, DEA), depending on the types of activities being applied for or, when mining and mineral processing activities are involved, the Department of Mineral Resources (DMR).

The current EIA regulations, GN R.326, GN R.327, GN R.325 and GN R.324, promulgated in terms of Sections 24(5), 24M and 44 of the NEMA and subsequent amendments, commenced on 7 April 2017. GN R.327 lists those activities for which a Basic Assessment is required, GN R.325 lists the activities requiring a full EIA (Scoping and Impact Assessment phases) and GN R.324 lists certain activities and competent authorities in specific identified geographical areas. GN R.326 defines the EIA processes that must be undertaken to apply for Environmental Authorisation.

The activities requiring environmental authorisation in terms of the NEMA are included in Table 5.

4.1.2 National Water Act

The National Water Act, 1998 (Act No. 36 of 1998) (NWA) is the primary legislation regulating both the use of water and the pollution of water resources. It is applied and enforced by the Department of Water and Sanitation (DWS).

Section 19 of the National Water Act regulates pollution, which is defined as “the direct or indirect alteration of the physical, chemical or biological properties of a water resource to make it:

- less fit for any beneficial purpose for which it may reasonably be expected to be used; or
- harmful or potentially harmful to -
  - the welfare, health or safety of human beings;
  - any aquatic or non-aquatic organisms;
  - the resource quality; or
  - property.”

The persons held responsible for taking measures to prevent pollution from occurring, recurring or continuing include persons who own, control, occupy or use the land. This obligation or duty of care is initiated where there is any activity or process performed on the land (either presently or in the past) or any other situation which could lead or has led to the pollution of water.

The following measures are prescribed in the section 19(2) of the NWA to prevent pollution:

- cease, modify or control any act or process causing the pollution;
- comply with any prescribed standard or management practice;
- contain or prevent the movement of pollutants;
- eliminate any source of the pollution;
- remedy the effects of pollution; and
- remedy the effects of any disturbance to the bed or banks of a watercourse.

The NWA states in Section 22 (1) that a person may only use water:

- without a licence –

  (i) if that water use is permissible under Schedule 1;

(ii) if that water use is permissible as a continuation of an existing lawful use; or
(iii) if that water use is permissible in terms of a general authorisation issued under section 39;

- if the water use is authorised by a licence under this Act; or
- if the responsible authority has dispensed with a licence requirement under subsection (3).

Water use is defined in Section 21 of the NWA. Mafube's proposed road realignment activities may involve the following water uses:

a) impeding or diverting the flow of water in a watercourse; and
b) altering the bed, banks, course or characteristics of a watercourse.

4.1.3 National Environmental Management: Air Quality Act (Act no. 39 of 2004) (NEM: AQA)

The NEM: AQA has shifted the approach of air quality management from source-based control to the control of the receiving environment. The Act also devolved the responsibility of air quality management from the national sphere of government to the local municipal sphere of government (district and local municipal authorities). Local municipalities are thus tasked with baseline characterisation, management and operation of ambient monitoring networks, licensing of listed activities, and emission reduction strategies. The main objectives of the Act are to protect the environment by providing reasonable legislative and other measures that (i) prevent air pollution and ecological degradation, (ii) promote conservation and (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development in alignment with Sections 24a and 24b of the Constitution of the Republic of South Africa.

4.1.3.1 Ambient air quality standards

The South African National Ambient Air Quality Standards (NAAQS) for common pollutants prescribe the allowable ambient concentrations of pollutants which are not to be exceeded during a specified time period in a defined area (Table 7). If the standards are exceeded, the ambient air quality is defined as poor and potential adverse health impacts are likely to occur.

Table 7: South African National Ambient Air Quality Standards

Pollutant	Averaging Period	Limit Value (µg/m^3)	Limit Value (ppb)	Frequency of Exceedance	Compliance Date
Nitrogen dioxide -NO_2 (a)	1 hour	200	106	88	Immediate
	1 year	40	21	0	
Particulate matter - PM_{10} (b)	24 hours	75	-	4	Immediate
	1 year	40	-	0	
Ozone - O_3 (c)	8 hours (running)	120	61	11	Immediate
Lead - Pb (d)	1 year	0.5	-	0	Immediate
Carbon monoxide - CO (e)	1 hour	30 000	26 000	88	Immediate
	8 hours (calculated on 1 hourly averages)	10 000	8 700	11	
Benzene (C_6H_6) (f)	1 year	5	1.6	0	Immediate
Sulphur dioxide - SO_2 (g)	10 minutes	500	191	526	Immediate

Pollutant	Averaging Period	Limit Value (µg/m^3)	Limit Value (ppb)	Frequency of Exceedance	Compliance Date
	1 hour	350	134	88	
	24 hours	125	48	4	
	1 year	50	19	0	
Particulate matter $PM_{2.5}$ (h)	24 hours	40		4	Immediate
	24 hours	25		4	1 January 2030
	1 year	20		0	Immediate
	1 year	15		0	1 January 2030

Notes:

a. *The reference method for the analysis of NO2 shall be ISO 7996*
b. *The reference method for the determination of the particulate matter fraction of suspended particulate matter shall be EN 12341*
c. *The reference method for the analysis of ozone shall be the UV photometric method as described in ISO 13964*
d. *The reference method for the analysis of lead shall be ISO 9855*
e. *The reference method for analysis of CO shall be ISO 4224*
f. *The reference methods for benzene sampling and analysis shall be either EPA compendium method TO-14 A or method TO-17*
g. *The reference method for the analysis of SO2 shall be ISO 6767*
h. *The reference method for the analysis of PM2.5 shall be EN14907*

4.1.3.2 National Dust Control Regulations

On 1 November 2013, the National Dust Control Regulations were promulgated under NEM: AQA, and published in the Government Gazette No. 36974. The dust fall standard defines acceptable dust fall rates in terms of the presence of residential areas (Table 8).

Table 8: Acceptable dust fall rates

Restriction areas	Dust fall rate (mg/m^2/day over a 30-day average)	Permitted frequency of exceedance
Residential areas	Dust fall < 600	Two per annum (not in sequential months)
Non-residential areas	600 < Dust fall < 1200	Two per annum (not in sequential months)

4.1.3.3 Priority area

Sections 18 to 20 of NEM: AQA deal with the establishment of Priority Areas in so-called “hot-spot” areas of South Africa where ambient air quality standards are often exceeded or may often be exceeded. The establishment of a Priority Area is intended to achieve the following:

- It effectively allows for the concentration of limited air quality management capacity (human, technical and financial) for dealing with acknowledged problem areas to obtain measurable air quality improvements in the short, medium and long term;
- It prescribes a cooperative governance regime by effectively handing-up air quality management authority to the tier of government that can provide leadership and coordination; and
- It allows for “cutting edge” air quality management methodologies that consider all contributors to the air pollution problem, i.e. air-shed air quality management.

The Mafube LifeX operations are located within the Highveld Priority Area (HPA) (Figure 3). The Highveld area in South Africa is widely accepted as having a poor air quality with elevated concentrations of criteria pollutants. The elevated concentrations are attributed to the dense concentration of industrial and non-industrial sources within the Highveld area. The Minister of Environmental Affairs and Tourism therefore

declared the Highveld Priority Area (HPA) on 23 November 2007. Since the declared area overlaps provincial boundaries, the Department of Environmental Affairs (DEA) functions as the lead agent in the management of the priority area (DEA, 2011).

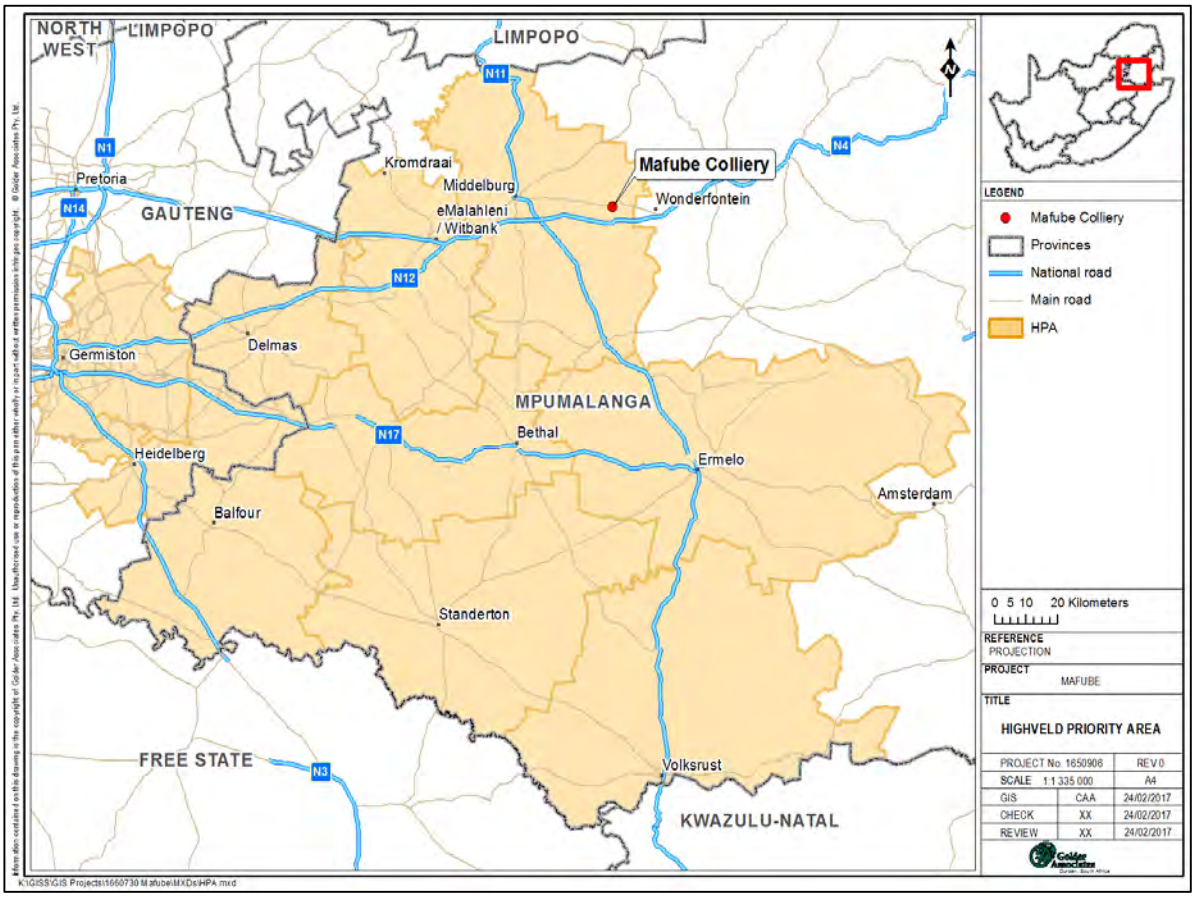


Figure 3: Location of Mafube within the HPA

4.2 Mpumalanga Roads Act (Act no. 1 of 2008)

The legal framework for the declaration and de-declaration of Provincial roads is provided for in Section 7 of the Act. The Member of the Executive Council must make regulations prescribing the requirements for Provincial roads declaration and de-declaration, provide details relating to any changes to routes, and consult with the Municipality affected by any changes.

The legal framework for construction and maintenance of Provincial roads is provided for in Section 9 of the Act. The Member of the Executive Council is responsible for the construction and maintenance of Provincial roads. If a Municipality, entity or person wishes to undertake construction and/or maintenance of Provincial roads, written approval must be obtained from the Member of the Executive Council, the construction and maintenance should adhere to Provincial standards and requirements, and if the Member of the Executive Council has given written approval to any Municipality, entity or person for any works on a Provincial road, he/she must specify the terms or reference and any payment for works performed.

The legal framework for access to main roads and district roads and closure of Provincial roads is provided for in Section 10 of the Act. A person may only gain access to a main road or district road at an entrance or exit authorised by the Member of the Executive Council. The Member of the Executive Council may, as may be necessary, designate, authorise or otherwise provide for access to and from a main road or district road.

The legal framework for fencing on Provincial roads is provided for in Section 14 of the Act. The Member of the Executive Council may authorise the erection of fencing adjacent to a Provincial road. An owner of land adjacent to a Provincial road is responsible for all maintenance of any fence adjacent to his/her property.

The legal framework for public right-of-way is provided for in Section 31 of the Act. A public right-of-way must be registered by the Member of the Executive Council as well as constitute a reasonable means of access to a public road or public amenity. A Municipality, entity or person applying for the registration or de-registration of a public right-of-way will bear the costs thereof.

The legal frameworks for environmental policy, environmental obligations, and environmental impact assessment are provided for in Sections 34, 35 and 36, respectively, of the Act. The Member of the Executive Council must regulate the operations of the Department to minimise the impact of transport infrastructure and operations on the environment. Environmental management must constitute an integral part of the planning, construction, operation and maintenance of the Provincial road network. The Member of the Executive Council must comply with any National or Provincial requirement for an environmental impact assessment in the construction of Provincial transport infrastructure and operations.

4.3 South African National Standard (SANS)

The SANS Method for environmental noise impact assessment (SANS 10328:2008) provides a method for evaluating the noise impact of a proposed development. It is an umbrella document and makes many references to SANS 10103:2008 The measurement and rating of environmental noise with respect to annoyance and to speech communication (SANS 10103:2008).

The SANS 10103 Code of Practice provides typical ambient noise rating levels ($L_{Req,T}$) in various districts. The outdoor ambient noise levels recommended for the districts are shown in Table 9 below. It is probable that the noise is annoying or otherwise intrusive to the community or to a group of persons if the rating level of the ambient noise under investigation exceeds the applicable rating level of the residual noise (determined in the absence of the specific noise under investigation), or the typical rating level for the ambient noise for the applicable environment given in Table 9 (Table 2 of SANS 10103).

Table 9: Typical Rating Levels for Ambient Noise

Type of district	Equivalent continuous rating level ($L_{Req.T}$) for noise (dB(A))					
	Outdoors			Indoors, with open windows		
	Day-night $L_{R,dn}$	Day-time $L_{Req,d}$	Night-time $L_{Req,n}$	Day-night $L_{R,dn}$	Day-time $L_{Req,d}$	Night-time $L_{Req,n}$
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with one or more of the following: workshops; business premises; and main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

Notes:

1) If the measurement or calculation time interval is considerably shorter than the reference time intervals, significant deviations from the values given in the table might result.

2) If the spectrum of the sound contains significant low frequency components, or when an unbalanced spectrum towards the low frequencies is suspected, special precautions should be taken, and specialist advice should be obtained. In this case the indoor sound levels might significantly differ from the values given in Column 5 to 7.

3) *In districts where outdoor $L_{R,dn}$ exceeds 55 dB, residential buildings (e.g. dormitories, hotel accommodation and residences) should preferably be treated acoustically to obtain indoor $L_{Req,T}$ values.*

4) *For industrial districts, the $L_{R,dn}$ concept does not necessarily hold. For industries legitimately operating in an industrial district during the entire 24 h day/night cycle, $L_{Req,d}$ =, $L_{Req,n}$ = 70 dB can be considered as typical and normal.*

5) *The values given in columns 2 and 5 in this table are equivalent continuous rating levels and include corrections for tonal character, impulsiveness of the noise and the time of day.*

6) *The values given in columns 3, 4, 6 and 7 in this table are equivalent continuous rating levels and include corrections for tonal character and impulsiveness of the noise.*

7) *The noise from individual noise sources produced, or caused to be produced, by humans within natural quiet spaces such as national parks, wilderness areas and bird sanctuaries should not exceed a maximum A-weighted sound pressure level of 50 dBA at a distance of 15 m from each individual source.*

SANS 10103 provides criteria, for evaluating the community or group response to a noise source, these are presented in Table 10.

Table 10: SANS 10103 Categories of community or group response

Excess, $\Delta L_{Req,T}$ dB(A)	Category	Description
0 to 10	Little	Sporadic complaints
5 to 15	Medium	Widespread complaints
10 to 20	Strong	Threats of community or group action
>15	Very Strong	Vigorous community or group action

SANS 10103 provides three methods for determining the excess level ($\Delta L_{Req,T}$) of a proposed development:

- $\Delta L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS $L_{Req,T}$ of the Residual noise (determined in the absence of the Rated noise, i.e. the specific noise under investigation);

$\Delta L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS the typical Rating level for the applicable district as determined from

- of SANS 10103:2008; or
- $\Delta L_{Req,T}$ = Expected increase in $L_{Req,T}$ of ambient noise in an area because of a proposed development under investigation

4.4 Administrative Framework

This section summarises the key administrative bodies relevant to the project.

4.4.1 Mpumalanga Department of Mineral Resources (DMR)

Mafube's mining operations are covered by an existing approved Environmental Management Programme (EMP) and associated Addenda lodged with the Department of Mineral Resources (DMR). This application for environmental authorisation will be submitted to DMR as the competent authority during this EIA/EMP process.

4.4.2 Department of Water and Sanitation (DWS)

The Department of Water and Sanitation (DWS) is the custodian of South Africa's water resources. It is primarily responsible for the formulation and implementation of policy governing the water sector. It also has overall responsibility for water services provided by local government.

The National Water Act 1998 (Act 36 of 1998) provides the DWA with the authority and the tools for the optimal management of South Africa's water resources. The registration of water use is one of these tools and is required for the proposed project.

4.4.3 Mpumalanga Department Agriculture, Rural Development, Land and Environmental Affairs (M-DARDLEA)

Mpumalanga Department Agriculture, Rural Development, Land and Environmental Affairs (M-DARDLEA), will be consulted to comment on this application for Environmental Authorisation.

5.0 NEED AND DESIRABILITY OF PROPOSED ACTIVITIES

Environmental Authorisation was granted for the Mafube LifeX Nooitgedacht opencast operations in April 2013. Sections of the D684, D1574 and D1048 district roads traverse the Nooitgedacht coal reserve (Figure 4) and their closure and/or realignment are required before the mining operations at those locations can commence, which will be by 2022 as per the current scheduled mine plan.

Mafube LifeX operations will produce power station and A-Grade thermal export coal. The Nooitgedacht operations will exploit a mineable coal reserve comprising about 120 million mineable in-situ tons of thermal coal located within an area of approximately 2957.12 ha. Mining will be by opencast methods. Mining of these opencast reserves will take place over a period of approximately 20 years, an average of 540,000 tons of ROM per month will be mined (6.484 mtpa).

Thus, due to its economic and local importance and to make the project feasible in its entirety, the total coal reserve would need to be exploited, and so these sections of the district roads mentioned above would need to be realigned and/or closed.

5.1 Period for which Environmental Authorisation is required

The realignment of sections of the three (3) district roads will be on a permanent basis. These sections will be closed and the new proposed alternative route will replace the existing affected district road.

6.0 PROCESS FOLLOWED TO REACH PREFERRED ROUTE ALTERNATIVE

6.1 Closure of Sections of the D684 and D1048

During the 2012 Mafube LifeX EIA/EMP authorisation process, a traffic impact assessment was conducted by Techworld Consulting Engineers (TW553 - Traffic Report_Mafube Opencast Coal Expansion_25Jun12) to assess the likely impact of the closure and/or re-alignment of the abovementioned roads. From this study, it is evident that the roads that traverse the coal reserves does not serve a mobility function but rather provides access to the farms in the area. The re-alignment of these roads will therefore not have a significant impact on traffic flows and transportation in the area (Techworld Consulting Engineers, June 2012).

A further study was conducted in 2016 (Golder, 1650906 – 304345 – 3) to assess the impacts of using the D684 as access to the Nooitgedacht operations area during construction. The methodology for the study was a combination of qualitative and quantitative data gathering approach to generate a baseline and assess impacts. Data was gathered through secondary sources in the desktop review, verified by a site visit and sample traffic survey undertaken on 18 May 2016. The results were analysed through content analysis techniques (Golder Associates Africa (Pty) Ltd, 2016).

All the route realignment alternatives identified in Section 6.3 to 6.8 would also need to include the closure of D684 over a distance of approximately 2.8km from the start of East Pit 1 in the South to the Northern boundary of East Pit 3 in the North, and the closure of D1048 over a distance of approximately 1.6km from the T-junction with D684 in an eastern direction to the Eskom Powerline intersection to the east of East Pit 2. These road closures are required because of the location of the Nooitgedacht East Pits 1, 2 and 3 (Figure 4).

Two (2) route realignment alternatives (Alternative A and B) discussed in this report were identified by Kruger in 2012 as part of the traffic impact assessment study and an additional four (4) route realignment alternatives (Alternative C, D, E and F) were identified by the Golder project team. Route alternative F has been selected as the preferred route realignment option (selection process described in Section 10.4 of this report).

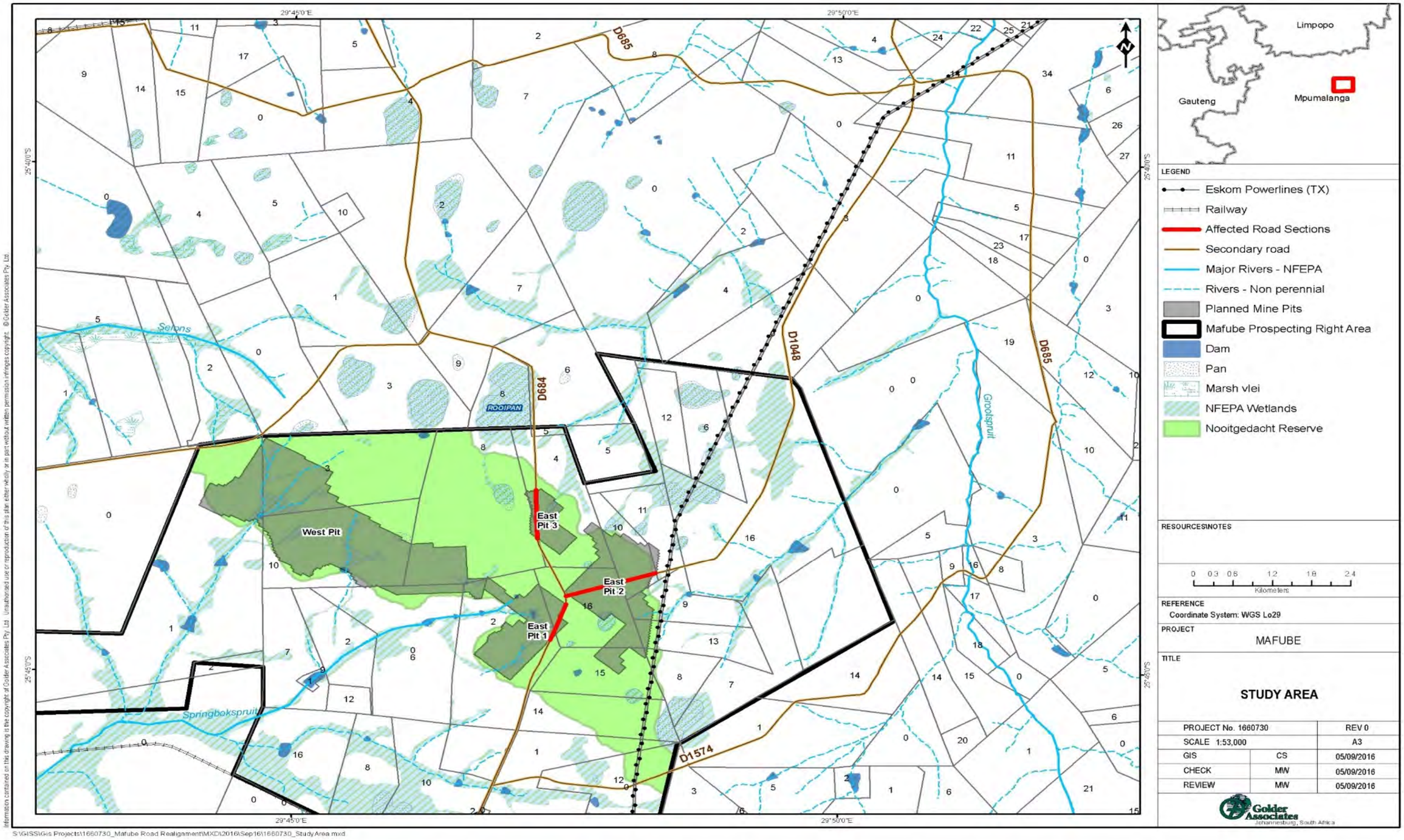


Figure 4: Mafube LifeX Road Realignment Study area

6.2 Identified Route Realignment Alternatives

6.3 Alternative A – Construction of new D683/D1048 link Road

Alternative A entails the proposed closure of the affected road as described in Section 6.1 above, and the construction of a new gravel road as indicated in Figure 7 below. This alternative route is approximately 3.51 km long and will run along existing property boundaries. The last 600 m of this proposed alternative route, follows an existing farm road that may need upgrading should this route be selected as the preferred route alternative. Approximately 1.54 km of the proposed alternative route will traverse existing agricultural fields, and will also require the construction of at least two (2) watercourse crossings.

The properties and landowner's details in Table 11 below, will be the properties directly affected by the construction of this Alternative route option.

Table 11: Alternative A - Properties and Landowner Details

Property Details	Landowner Details
Roodepoort 418 JS Portion 7	ATSEUN (Pty) Ltd
Roodepoort 418 JS Portion 9	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 11	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 13	Anglo Operations Limited
Roodepoort 418 JS Portion 14	ATSEUN (Pty) Ltd
Roodepoort 418 JS Portion 16	Toys Boerdery Pty Ltd

ATSEUN and Toys Boerdery will be the landowners mostly affected by this proposed route alternative and Golder still needs to understand what process Mafube will follow regarding landowner negotiations and compensations. Landowner consultation will need to take place to assess the by-in from the landowners regarding this proposed alternative route option.

Figure 5: View of the Alternative A route option taken from its proposed beginning just off the D1574 road

Figure 6: View of the Alternative A route option taken from its proposed end where it will link into the D1048 road

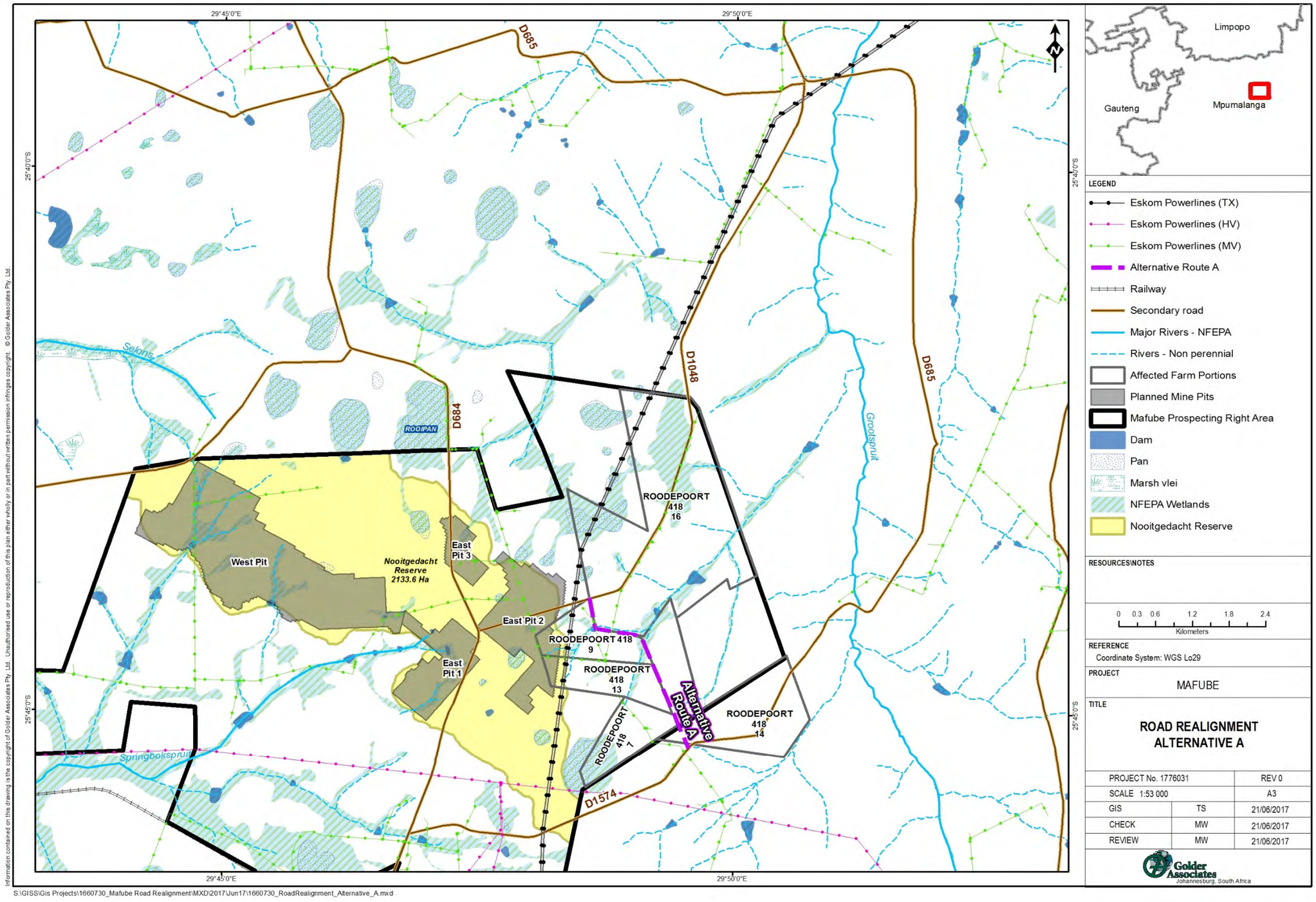


Figure 7: Mafube LifeX - Road Realignment Route Alternative A

6.4 Alternative B – Construction of new D683/D1048 link Road

Alternative B entails the proposed closure of the affected road as described in Section 6.1 above, and the construction of a new gravel road as indicated in Figure 10 below. This alternative route has an approximate length of 5.0 km and will run along existing property boundaries although currently there is no boundary fences. The entire length of the proposed alternative route run along existing agricultural field boundaries or have agricultural fields on one side and grazing veld on the other side. The alternative route will also require the construction of at least two (2) watercourse crossings.

The properties and landowner's details in Table 12 below, will be the properties directly affected by the construction of this Alternative route option.

Table 12: Alternative B - Properties and Landowner Details

Property Details	Landowner Details
Roodepoort 418 JS Portion 14	ATSEUN (Pty) Ltd
Roodepoort 418 JS Portion 16	Toys Boerdery Pty Ltd
Bayview 430 JS Portion RE	Bayview MARI-LO CC
Jubilatum 401 Portion RE (0)	Toys Boerdery (Pty) Ltd
Witklip 391 JS Portion 5	Kusic Prop CC – (Not confirmed)
Witklip 391 JS Portion 14	ATSEUN (Pty) Ltd

Figure 8: View of the Alternative B route option taken from its proposed beginning just off the D684 road

Figure 9: View of the Alternative B route option – photo taken from the D1048 road

Toys Boerdery will be the landowner mostly affected by this proposed route alternative. It should be noted, that even though the proposed route will follow the property bound lines as indicated on Figure 10, the top section of Alternative D will affect the flowing properties: Roodepoort 818 JS Portion 16 and Jubilatum 401 JS Portion RE (0) – these properties are both owned by Toys Boerdery, and so there are currently no boundary fences (see Figure 9 above). Should this alternative be selected as the most preferred alternative, traversing these properties with the proposed dirt road may have an impact on the current and future land use of these properties.

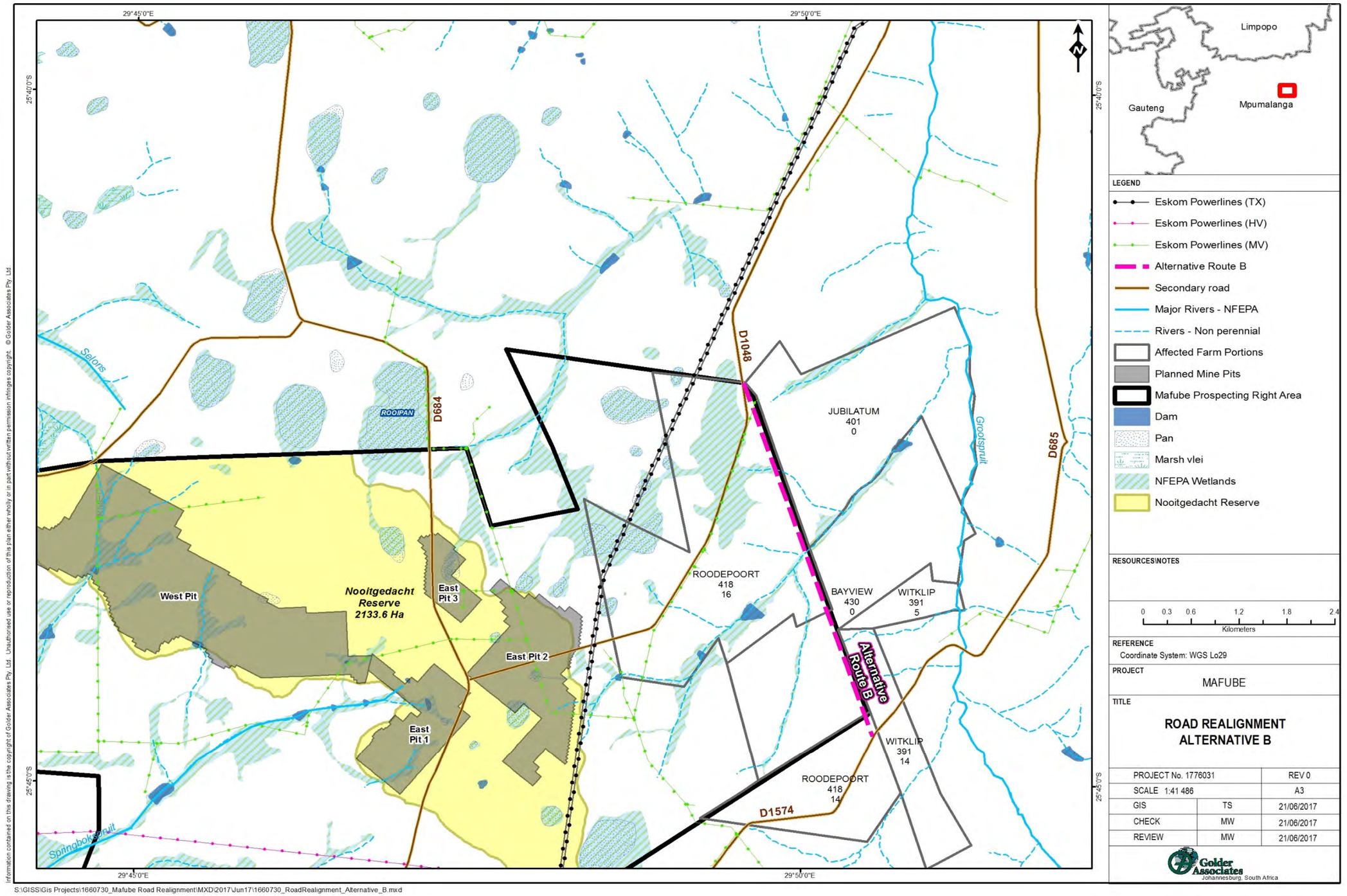


Figure 10: Mafube LifeX - Road Realignment Route Alternative B

6.5 Alternative C – Construction of new D683/D1048 link Road

Alternative C entails the proposed closure of the affected road as described in Section 6.1 above, and the construction of a new gravel road linking the existing D684 and the existing D1048 roads as indicated in Figure 12 below. This alternative route is approximately 4.06 km long. The first 2.47 km will cut through natural vegetation and grazing land, and the last section (approximately 1.59 km) will run through existing agricultural fields. The proposed alternative route will require the construction of at least one (1) watercourse crossing, and there are two (2) small pans that will be affected by this alternative route option as it is currently illustrated on Figure 12.

The properties and landowner's details in Table 13 below, will be the properties directly affected by the construction of this Alternative route option.

Table 13: Alternative C - Properties and Landowner Details

Property Details	Landowner Details
Roodepoort 418 JS Portion 4	Loop & Staan Beleggings CC
Roodepoort 418 JS Portion 6	Loop & Staan Beleggings CC
Roodepoort 418 JS Portion 12	Loop & Staan Beleggings CC
Roodepoort 418 JS Portion 16	Toys Boerdery (Pty) Ltd
Hartbeesthoek 393 JS Portion RE (0)	Toys Boerdery (Pty) Ltd
Hartbeesthoek 393 JS Portion 4	ATSEUN (Pty) Ltd
Genadebult 121 JS Portion 1	PT Bothma Boerdery CC
Panplaats 395 JS Portion 6	Hooggenoeg Boerdery CC

Figure 13 illustrates the latest available Life of Mine plans for the Mafube LifeX and Zonnebloem operations, which falls into this study area. According to this mine plan, Zonnebloem will mine through a section of the D684 road in the year 2023. Currently, Golder is unaware of any alternative process underway by Zonnebloem to realign this section of the D684 road which will be affected by their mining operations. Thus, Alternative C may be classed as a 'fatal flaw' alternative because to northern section of the D684 will not be accessible from 2023 until the decommissioning and closure of the Zonnebloem operations.

Figure 11: View of the Alternative C route option taken from its proposed link at D684 just above Rooipan

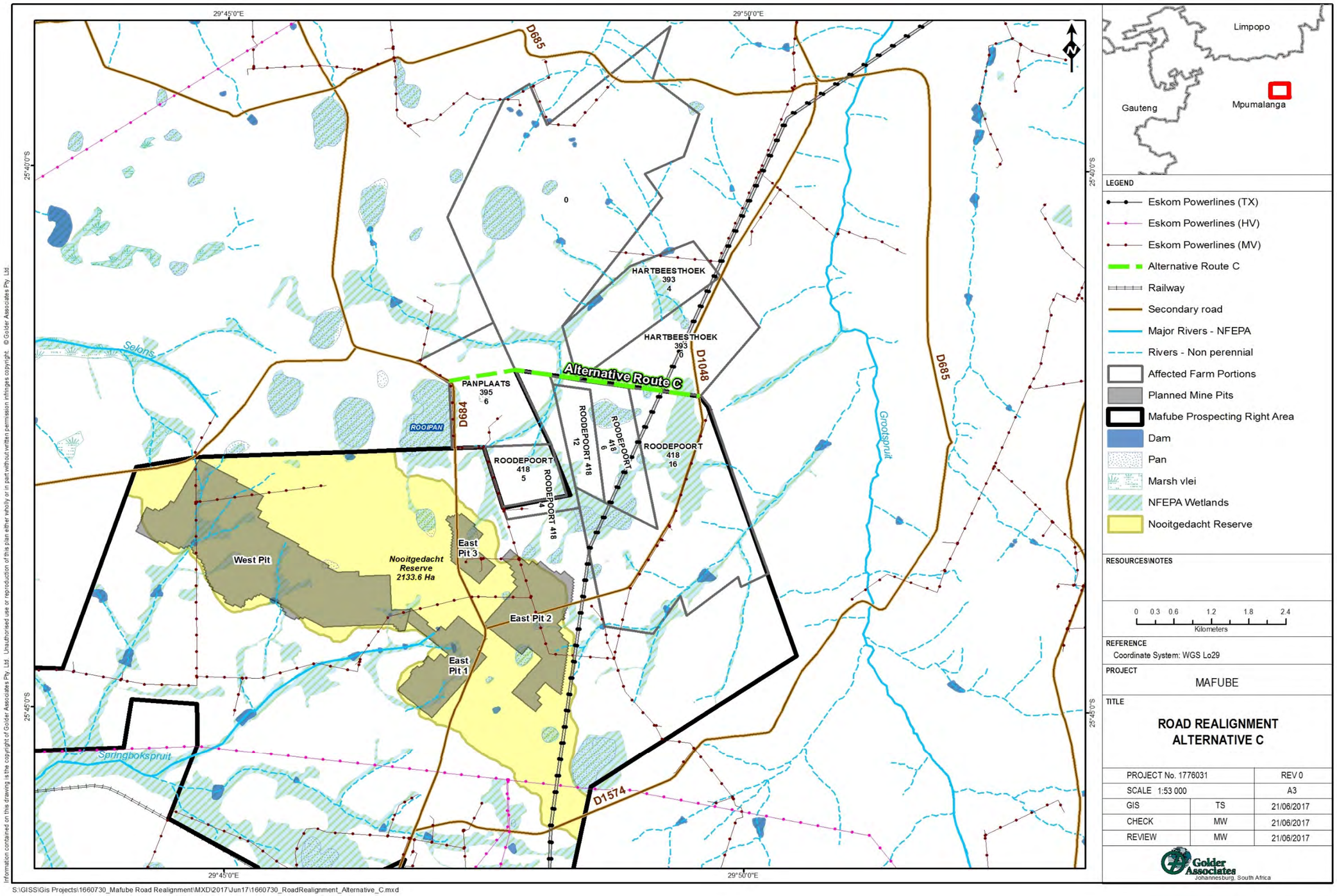


Figure 12: Mafube LifeX - Road Realignment Route Alternative C

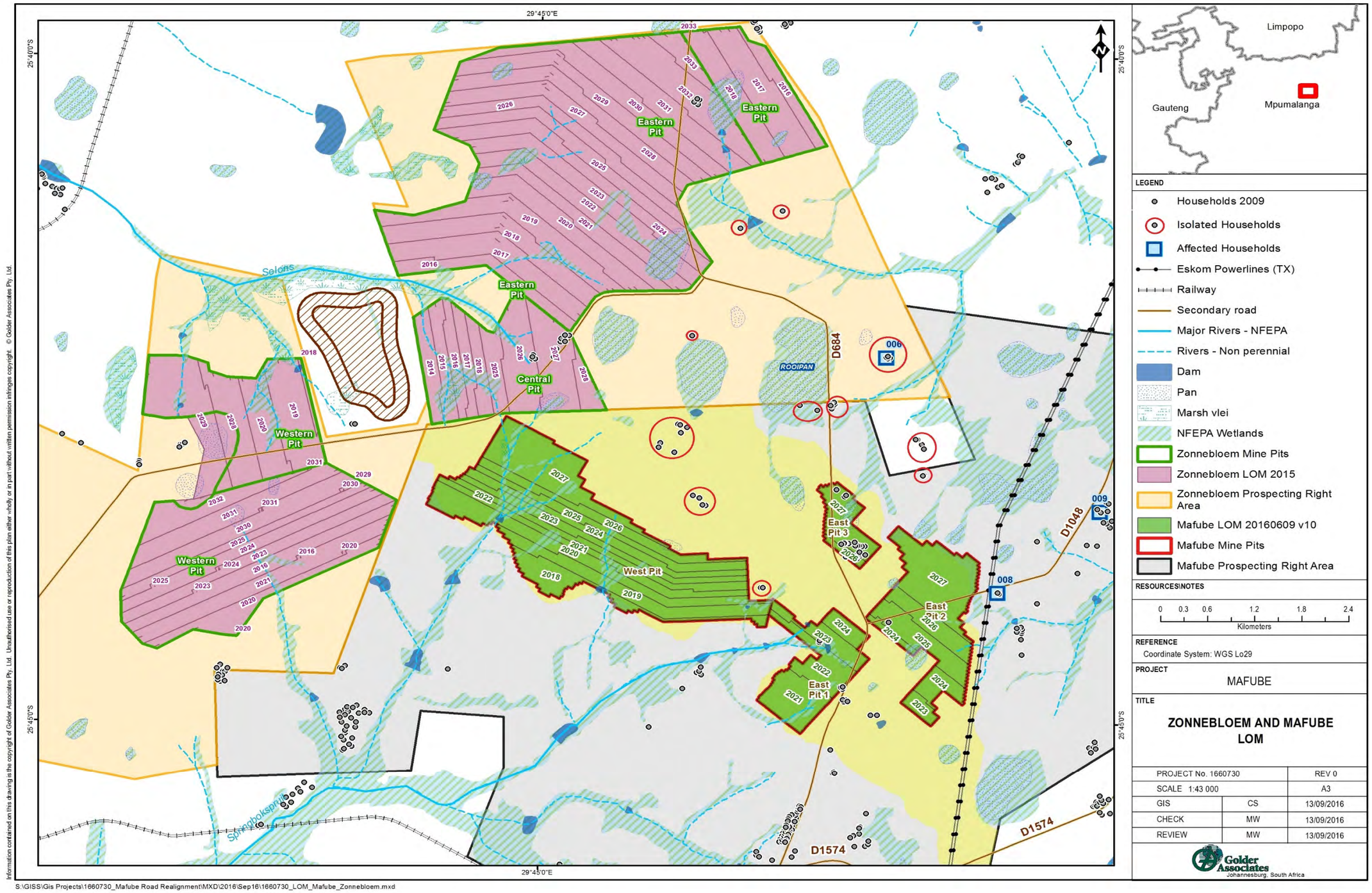


Figure 13: Mafube LifeX - Road Realignment Route Alternative C - Zonnebloem and Mafube LifeX Mine Plans and Affected Households

6.6 Alternative D – Upgrade and Maintenance of Existing D1574, D685, and Sections of D684 and D1048

The last option identified, would entail not constructing any additional 'link' road connecting the D1574 and the D1048 district roads, which will affectively by-pass the effected D684 section of road. This option will only include some upgrades to be done at the existing river/watercourse crossings on the D1574, D685 and D1048 roads, as well as maintenance of these roads during the operational phase of the Mafube LifeX operations (Figure 16).

The combined distance from the intersection of the D1574 and D684 roads to the point where the D684 road will be closed below Rooipan is 37.45 km (traveling via the loop road formed by the D1574, D685, and D684 roads). In this section of road, there are two existing river/watercourse crossings that would require upgrading and an overall distance of approximately 10.4 km of existing road surface currently in a poor state that would also need attention if this alternative route option be selected as the most preferred option.

Figure 14: Current state and quality of river crossings

Figure 15: Current state and quality of the existing road

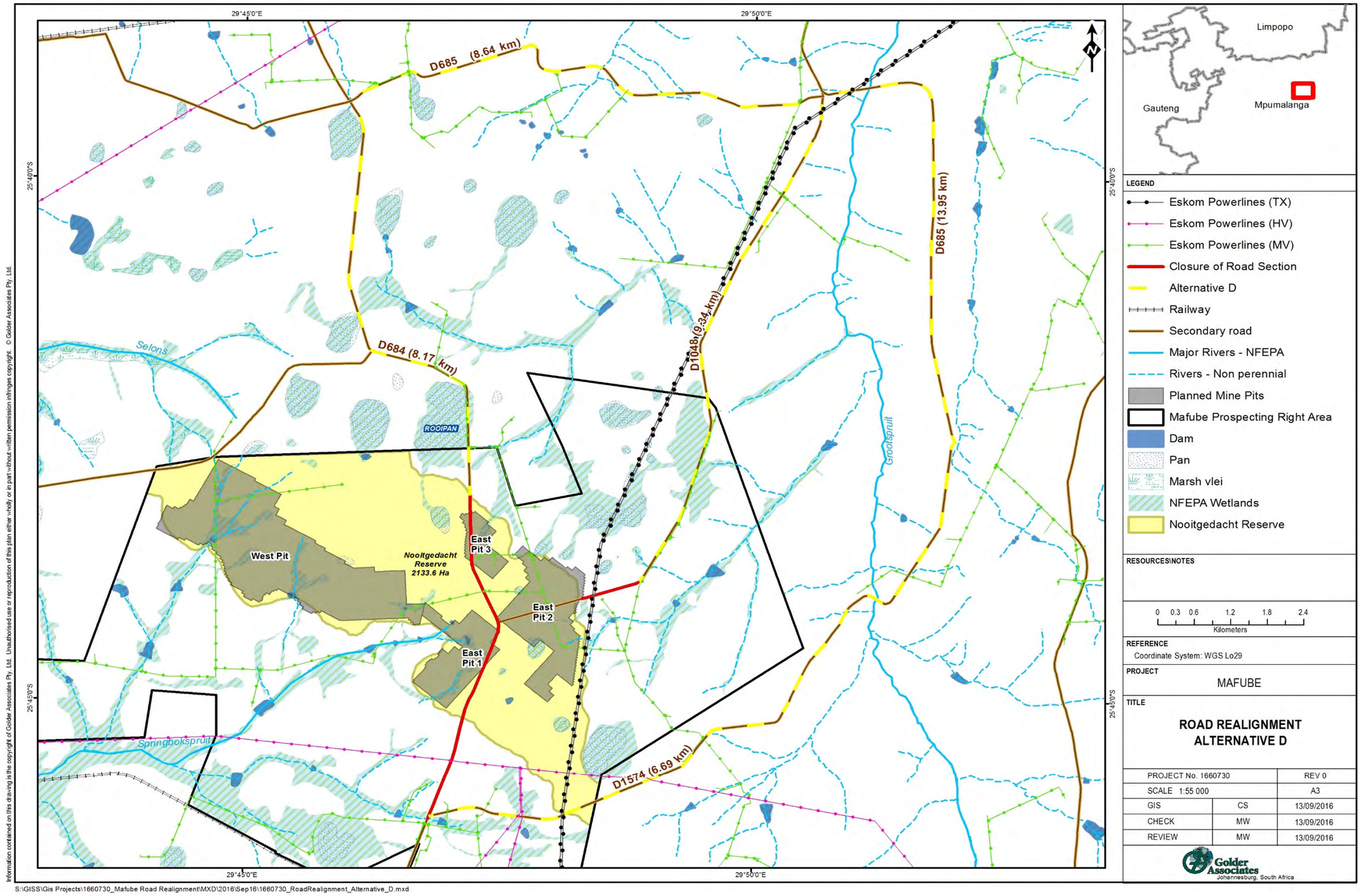


Figure 16: Mafube LifeX - Road Realignment Route Alternative D (use of existing roads to bypass the mining operations)

6.7 Alternative E – Construction of new D683/D1048 link Road

Alternative E entails the proposed closure of the affected road as described in Section 6.1 above, and the construction of a new gravel road as indicated in Figure 19 below. This alternative route has an approximate length of 7.52 km and will run along existing property boundaries although currently there is no boundary fences. The entire length of the proposed alternative route run along existing agricultural field boundaries or have agricultural fields on one side and grazing veld/natural vegetation on the other side. The alternative route will also require the construction of at least two (2) watercourse crossings.

The properties and landowner's details in Table 14 below, will be the properties directly affected by the construction of this Alternative route option.

Table 14: Alternative E - Properties and Landowner Details

Property Details	Landowner Details
Roodepoort 418 JS Portion 1	ATSEUN Pty Ltd
Roodepoort 418 JS Portion 7	ATSEUN Pty Ltd
Roodepoort 418 JS Portion 8	Anglo Operations Limited
Roodepoort 418 JS Portion 9	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 10	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 11	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 13	Anglo Operations Limited
Roodepoort 418 JS Portion 14	ATSEUN Pty Ltd
Nooitgedacht 417 JS Portion 4	Hooggenoeg Boerdery CC

Preliminary consultation with ATSEUN (Pty) Ltd, one of the property owners has highlighted this alternative route option as a less preferred route alternative. The property owner has voiced his concerns regarding safety as the proposed route will pass close to the existing farm house. It should be noted, that even though the proposed route will follow the property boundary lines as indicated on Figure 19, the bottom section of Alternative E will affect the flowing properties: Roodepoort 418 JS Portion 1 and 7, these properties are both owned by ATSEUN (Pty) Ltd, and there are currently no boundary fences. Should this alternative be selected as the most preferred alternative, traversing these properties with the proposed district access road may have an impact on the current and future land use of these properties, and some possible negative acceptance by the current landowner.

Figure 17: View of the Alternative E route option taken from its proposed beginning just off the D684 road

Figure 18: View of the Alternative E route option – photo taken from the D1048 road

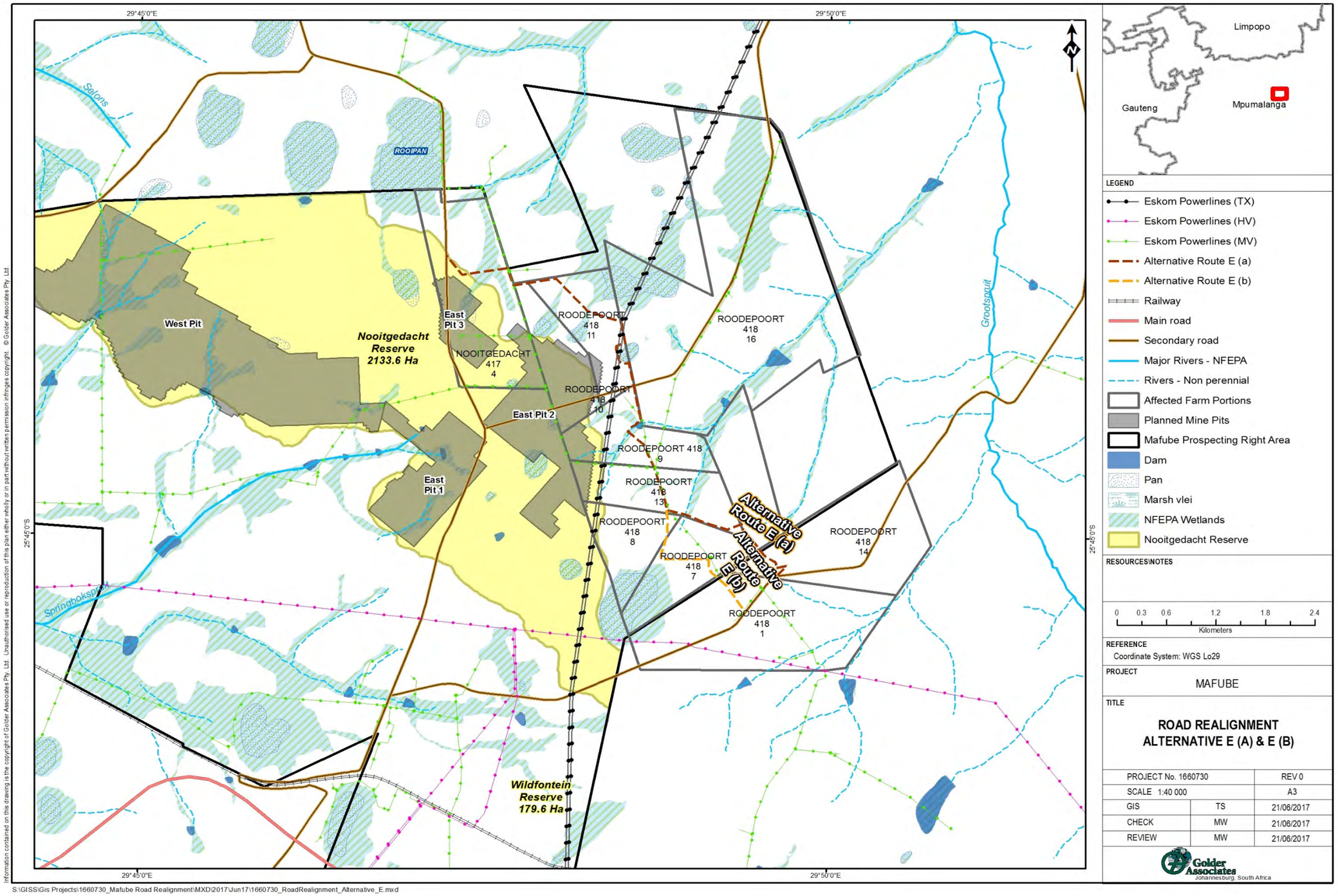


Figure 19: Mafube LifeX - Road Realignment Route Alternative E

6.8 Alternative F – Construction of new D683/D1048 link Road

Alternative F entails the proposed closure of the affected road as described in Section 6.1 above, and the construction of a new gravel road as indicated in Figure 22 below. This alternative route has an approximate length of 5.0 km and will run along existing property boundaries although currently there is no boundary fences. The entire length of the proposed alternative route run along existing agricultural field boundaries or have agricultural fields on one side and grazing veld on the other side. The alternative route will also require the construction of at least two (2) watercourse crossings.

The properties and landowner's details in Table 15 below, will be the properties directly affected by the construction of this Alternative route option.

Table 15: Alternative F - Properties and Landowner Details

Property Details	Landowner Details
Springboklaagte 416 JS Portion 1	Anglo Operations Limited
Springboklaagte 416 JS Portion 12	Anglo Operations Limited
Nooitgedacht 417 JS Portion 4	Hooggenoeg Boerdery CC
Nooitgedacht 417 JS Portion 14	Wessels Anneke
Nooitgedacht 417 JS Portion 15	Anglo Operations Limited
Roodepoort 418 JS Portion 8	Anglo Operations Limited
Roodepoort 418 JS Portion 9	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 10	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 11	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 13	Anglo Operations Limited

Figure 20: View of the Alternative F route option taken from its proposed beginning just off the D684 road

Figure 21: View of the Alternative F route option – photo taken from the D1048 road

All farm portions affected by Alternative F, are/will be owned by Anglo Operation Limited / Mafube Coal Mining (Pty) Ltd. It should be noted, that a big percentage of the affected portions are currently agricultural maize fields that will be traversed by the proposed road. Should this alternative be selected as the most preferred alternative, traversing these properties with the proposed dirt road may have an impact on the current and future land use of these properties.

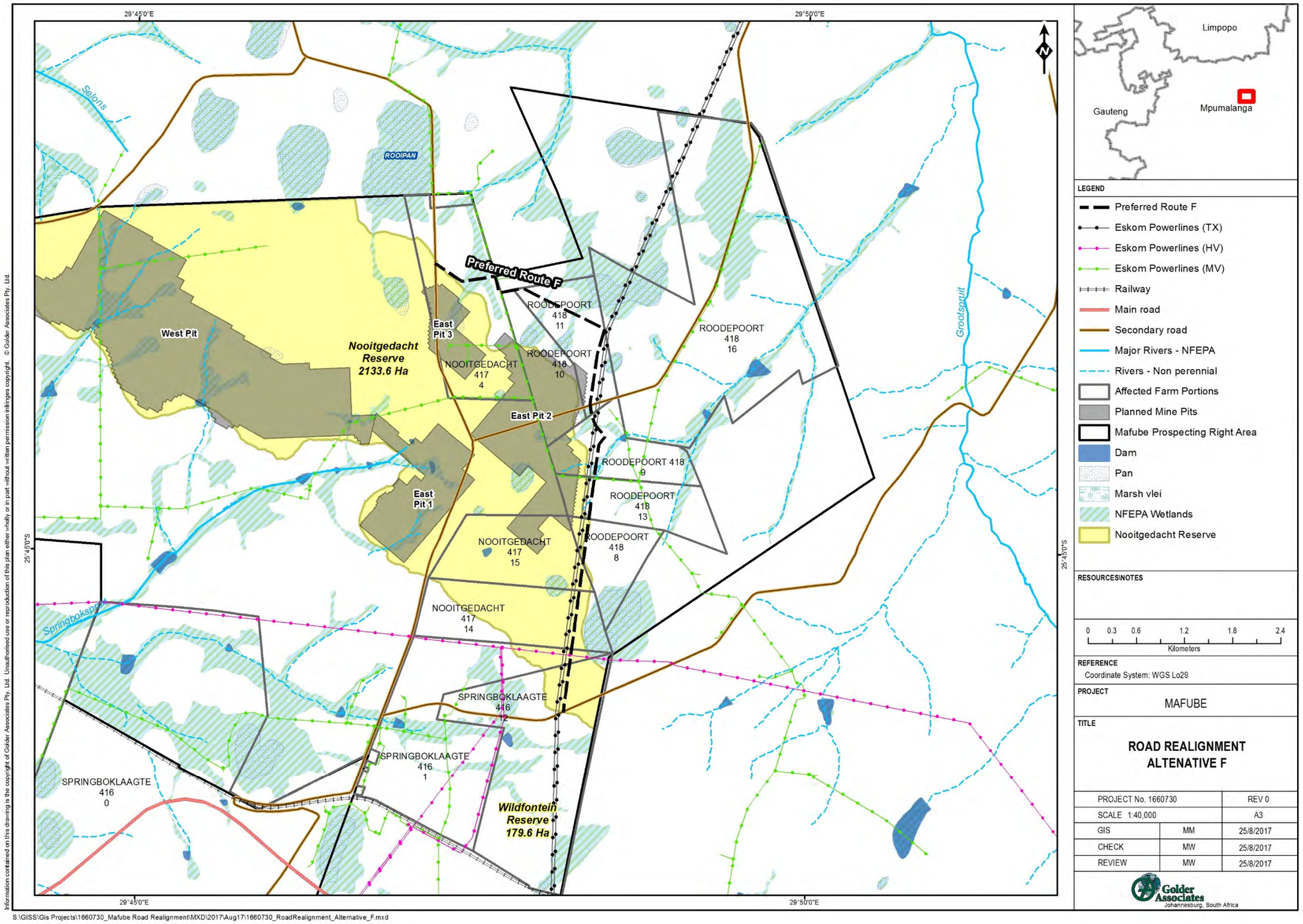


Figure 22: Mafube LifeX - Road Realignment Route Alternative F

6.9 The no-action alternative

As shown earlier in Figure 4, the D684 road traverses the middle of the Eastern pit of the Mafube LifeX Nooitgedacht mining operations. Should the road not be realigned, the operations will not commence and thus the coal reserves not be mined. The complete Mafube Nooitgedacht LifeX expansion project will then not be feasible.

By not mining the coal reserve available in the Nooitgedacht reserve, will prevent the use of a valuable coal reserve for the generation of electricity at a time when there is a growing shortage of electricity limiting economic growth in the country. A-grade coal export volumes will also be negatively impacted, which will affect the revenue flow and financial performance of Mafube Coal Mining (Pty) Ltd.

7.0 PUBLIC PARTICIPATION PROCESS

This section provides an overview of the public participation process undertaken to date in this EIA/EMPr process to support the application to the DMR for environmental authorisation. All comments received during this current EIA/EMPr process will be added into a Comment and Response Report, which will be appended to the EIA/EMPr report.

7.1 Objectives of public participation process

The principles that determine communication with society at large are included in the principles of the National Environmental Management Act (NEMA) (Act 107of 1998, as amended) and are elaborated upon in General Notice 657, titled *"Guideline 4: Public Participation" (Department of Environmental Affairs and Tourism, 19 May, 2006), which states that: "Public participation process means a process in which potential interested and affected parties (I&APs) are given an opportunity to comment on, or raise issues relevant to, specific matters."*

Public participation is an essential and regulatory requirement for an environmental authorisation process, and must be undertaken in terms of Regulations 39 to 44 of the Environmental Impact Assessment (EIA) Regulations GN R.982 (December 2014). Public participation is a process that is intended to lead to a joint effort by stakeholders, technical specialists, the authorities and the proponent/developer who work together to produce better decisions than if they had acted independently.

The public participation process is designed to provide sufficient and accessible information to Interested and Affected Parties (I&APs) in an objective manner and:

During the Scoping Phase to enable them to:

- raise issues of concern and suggestions for enhanced benefits;
- verify that their issues have been recorded;
- assist in identifying reasonable alternatives;
- comment on the plan of study of specialist studies to be undertaken during the impact assessment phase; and
- contribute relevant local information and traditional knowledge to the environmental assessment.

During the Impact Assessment Phase to assist them to:

- contribute relevant information and local and traditional knowledge to the environmental assessment;
- verify that their issues have been considered in the environmental investigations; and
- comment on the findings of the environmental assessments.

During the decision-making phase:

- to advise I&APs of the outcome, i.e. the authority decision, and how the decision can be appealed.

7.2 Stakeholder composition

Stakeholders will be given the opportunity to register and contribute. Stakeholders will include the following sectors of society:

- Government (National, provincial and local);
- Environmental NGOs;
- Agriculture, including local landowners;
- Industry and mining in the area;
- Commerce;
- Labour unions and the unemployed;
- Community representatives, CBOs, development bodies in the immediate vicinity; and
- Local groupings in the vicinity, including church groups, women's groups, youth groups, schools, voluntary associations, and others.

7.3 Public participation during Scoping

This section provides a summary of the public participation process followed during the Scoping Phase of the EIA.

7.3.1 Announcing the opportunity to participate

Draft Scoping Report

This Draft Scoping Report will be available for public review for 30 days from ***16 March 2018 until 18 April 2018***. The availability of the report was announced on 9 March 2018 and stakeholders were invited to participate in the EIA and public participation process and to pass on the information to friends /colleagues /neighbours who may be interested and to register as I&APs.

The proposed project was announced as follows:

- Distribution of the Draft Scoping Report (DSR) and a letter of invitation to participate to all I&APs on the database, accompanied by a registration, comment and reply sheet that was mailed/emailed to the entire stakeholder database. Copies of the announcement documents are attached as APPENDIX B.
- The abovementioned documents were made available at the public places listed on page ii of this report, posted to the Golder website www.golder.com/public, and uploaded to the South African Heritage Resources Agency (SAHRA) website;
- An advertisement was published in the Middelburg Observer on Friday 9 March 2018, (APPENDIX C); and
- Site notices were placed at the entrance of the Mafube LifeX project offices and at visible places at the boundary of the property.

Final Scoping Report

- The DSR will be updated after the expiry of the public review period and submitted to the Department of Mineral Resources (DMR);
- The final Scoping Report will include comments received from the local community and I&APs received at the public meeting to be held on ***Wednesday 4 April 2018*** at 11:00am, at the Arnot Vroue Landbou-unie Hall, Farm Springboklaagte, Middelburg District.

7.4 Public participation during the Impact Assessment Phase

Public participation during the impact assessment phase of the EIA will entail a review of the findings of the EIA, presented in the Draft EIA Report and Environmental Management Programme (EMPr), and the volume of specialist studies. These reports will be made available for public comment at a date to be announced. I&APs will be advised timeously of the availability of these reports and how to obtain them. They will be encouraged to comment either in writing (mail or email), or by telephone. Ample notification of due dates will be provided.

All the issues, comments and suggestions raised during the comment period on the Draft EIA Report/EMPr will be added to the Comment and Response Report that will accompany the Final EIA Report/EMPr. The Final EIA Report/EMPr will be submitted to the Department of Mineral Resources (DMR) for a decision about the proposed road realignment project.

On submission of the Final EIA Report/EMPr to the DMR, a personalised letter will be sent to every registered I&AP to inform them of the submission and the opportunity to request copies of the final reports.

7.5 Announcement of Lead Authority's decision

Once the DMR has taken a decision about the proposed project, the Public Participation Office will immediately notify I&APs of this decision and of the opportunity to appeal. This notification will be provided as follows:

- A letter will be sent, personally addressed to all registered I&APs, summarising the authority's decision and explaining how to lodge an appeal should they wish to; and
- An advertisement to announce the Lead Authority's decision will be published in the Middelburg Observer newspaper, if so required by the authorities.

8.0 ENVIRONMENTAL ATTRIBUTES AND DESCRIPTION OF THE BASELINE RECEIVING ENVIRONMENT

This section of the report provides a description of the receiving environment and existing conditions on and in the vicinity of the proposed road realignment project components.

Please note: The scoping and EIA reports produced by Golder Associates Africa (GAA. 2012) provided a comprehensive, in-depth description of the receiving environment. Only the salient points applicable to the affected land portions of Springboklaagte 416 JS, Roodepoort 418 JS, Nooitgedacht 417 JS, and Panplaats 395 JS are summarised in this draft scoping report, with extensive references to the previous report, but inclusive of the latest available monitoring data.

8.1 Topography

The proposed road realignment project area lacks any pronounced geomorphological features, but lies on undulating topography between 1480 to 1900meters above mean sea level (mamsl). Pans are a distinctive feature of the landscape particularly to the north of the site. Local watercourses drain into the Klein-Olifants River, which in turn drain into the Middelburg Dam.

8.2 Land use and sensitive receptors

The air quality study area extends approximately 10 km from the proposed road sections (including alternatives) and Mafube operations (Figure 25). This area is predominantly farm land with numerous homesteads distributed throughout. Fifteen (15) schools were identified within the study area, most notable are the following located along the proposed Alternative D route:

- Sulimyembezi Primary; Olifantslaagte Primary; and Nodaga Primary.

No healthcare facilities were identified within this area.

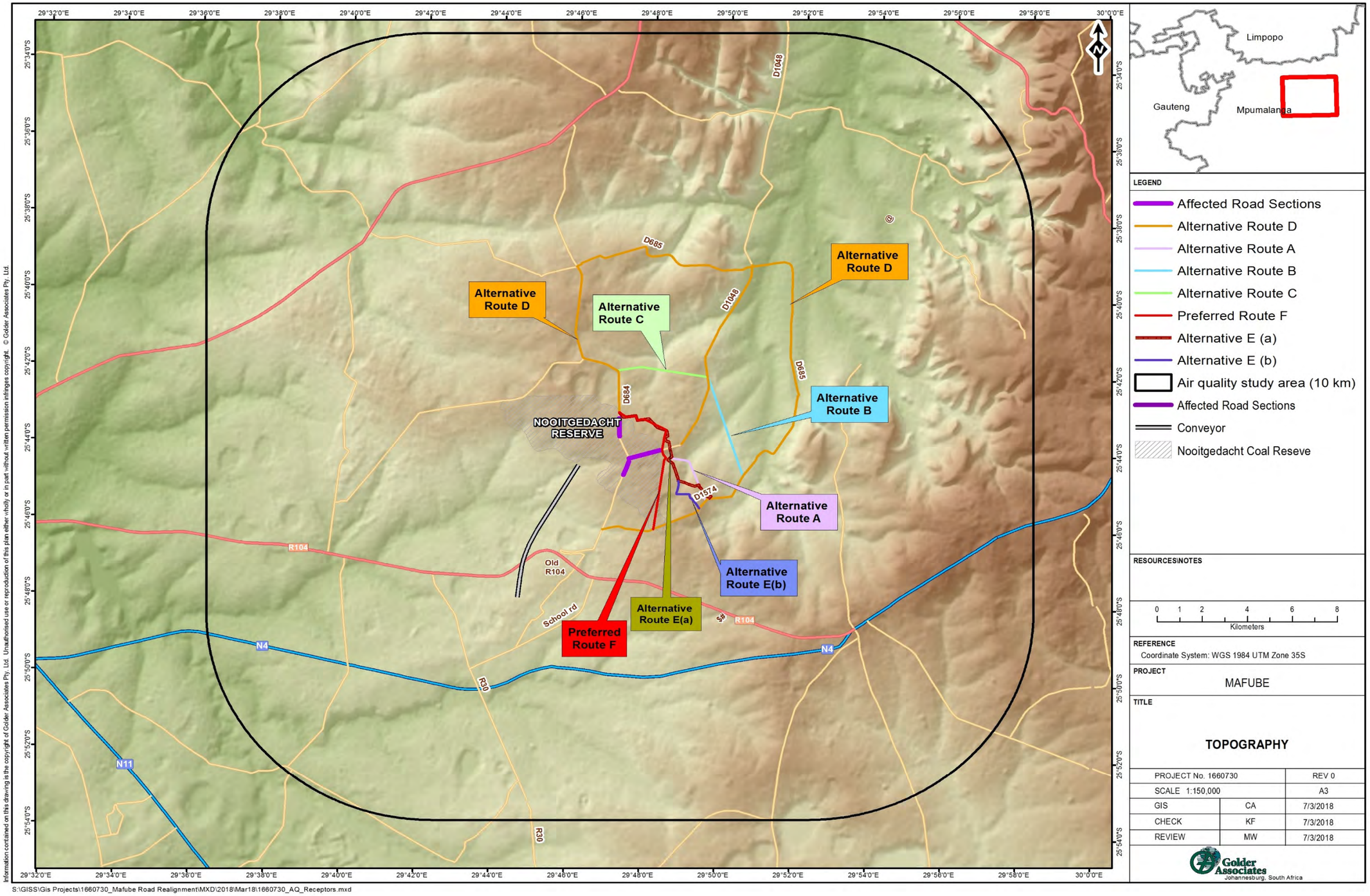


Figure 23: Topography in the vicinity (within 10 km) of the proposed routes

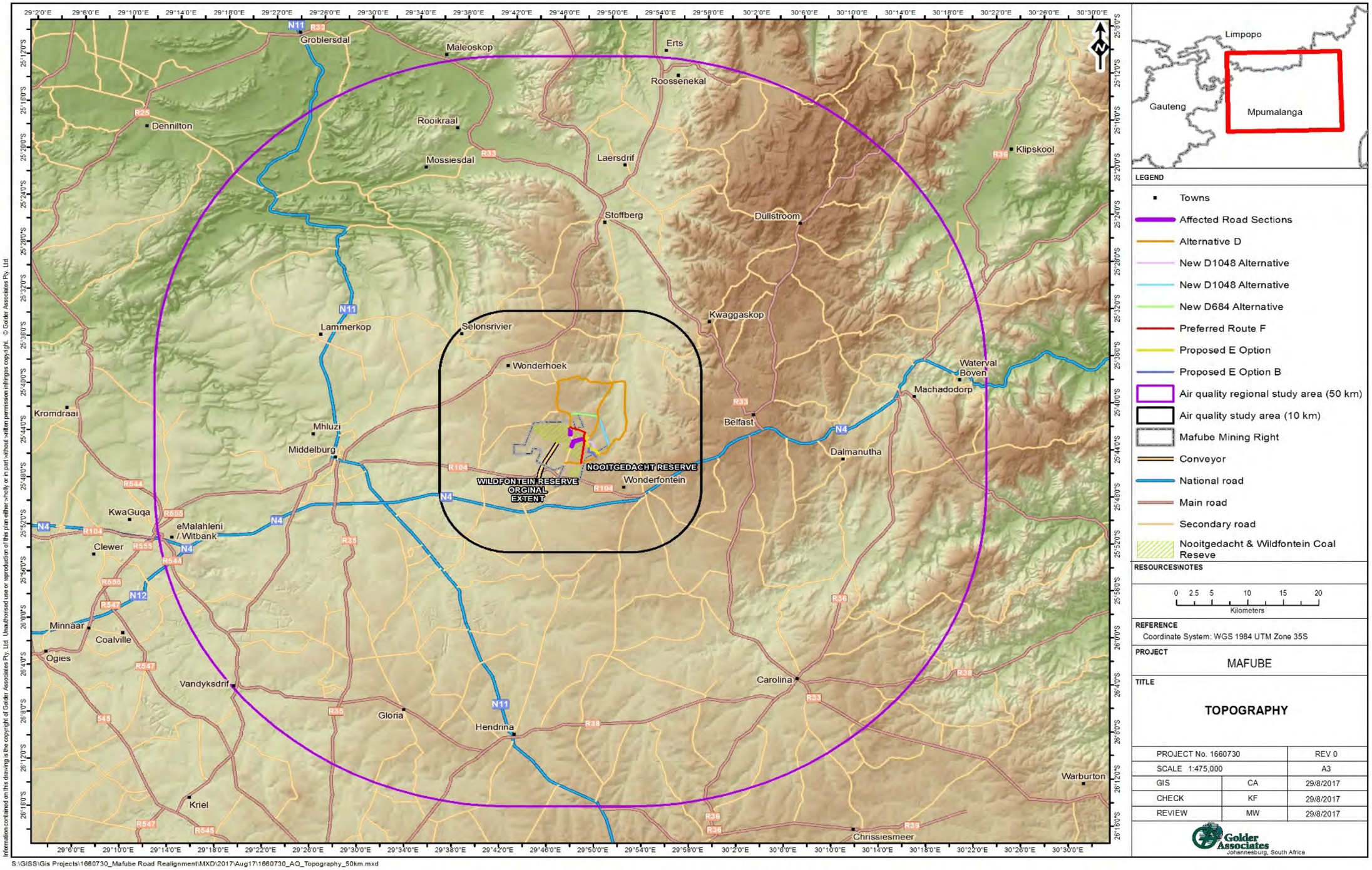


Figure 24: Topography within 50 km of the proposed routes

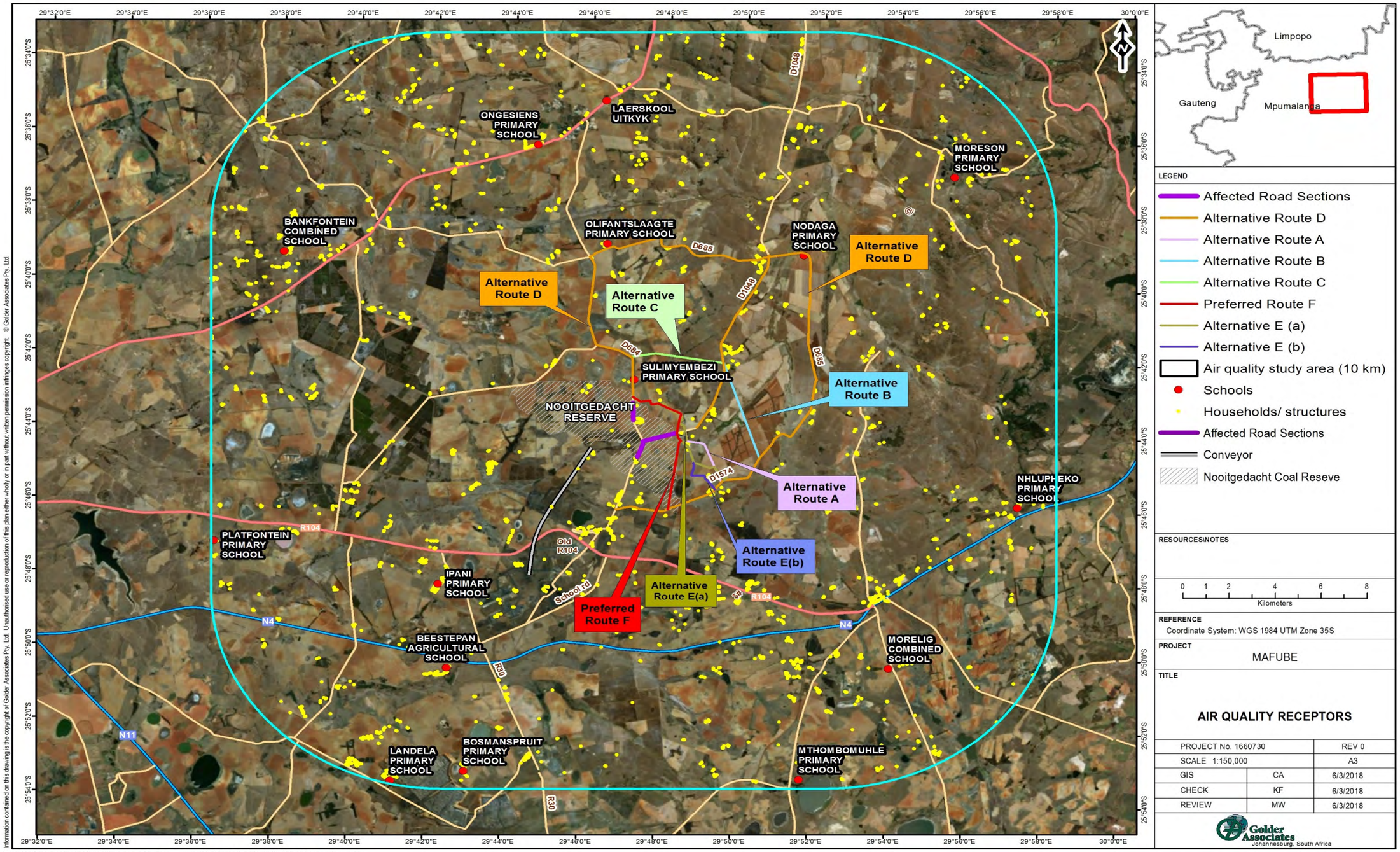


Figure 25: Air Quality receptors in the vicinity of the proposed routes

8.3 Regional climate

The Mafube LifeX operations are situated in the subtropical high-pressure belt. The mean circulation of the atmosphere over the subcontinent is anticyclonic throughout the year (except for near the surface). The synoptic patterns affecting the typical weather experienced in the region owe their origins to the subtropical, tropical and temperate features of the general atmospheric circulation over Southern Africa.

The subtropical control is brought via the semi-permanent presence of the South Indian Anticyclone (HP cell), Continental High (HP cell) and the South Atlantic Anticyclone (LP cell) in the high pressure belt located approximately 30°S of the equator. The tropical controls are brought via tropical easterly flows (LP cells) (from the equator to the southern mid-latitudes) and the occurrence of the easterly wave and lows (Preston-Whyte and Tyson, 1997). The temperature control is brought about by perturbations in the westerly wave, leading the development of westerly waves and lows (LP cells) (i.e. cold front from the polar region, moving into the mid-latitudes) (Preston-Whyte and Tyson, 1997).

Seasonal variations in the positioning and intensity of the HP cells determine the extent to which the westerly waves and lows impact the atmosphere over the region. In winter, the high pressure belt intensifies and moves northwards while the westerly waves in the form of a succession of cyclones or ridging anticyclones move eastwards around the South African coast or across the country. The positioning and intensity of these systems are thus able to significantly impact the region. In summer, the anticyclonic HP belt weakens and shifts southwards and the influence of the westerly wave and lows weakens.

Anticyclones (HP cells) are associated with convergence in the upper levels of the troposphere, strong subsidence throughout the troposphere, and divergence near the surface of the earth. Air parcel subsidence, inversions, fine conditions and little to no rainfall occur as a result of such airflow circulation patterns (i.e. relatively stable atmospheric conditions). These conditions are not favourable for air pollutant dispersion, especially with regard to emissions emitted close to the ground.

Westerly waves and lows (LP cells) are characterised by surface convergence and upper-level divergence that produce sustained uplift, cloud formation and the potential for precipitation. Cold fronts, which are associated with the westerly waves, occur predominantly during winter. The passage of a cold front is characterised by pronounced variations in wind direction and speed, temperature, humidity, pressure and distinctive cloud bands (i.e. unstable atmospheric conditions). These unstable atmospheric conditions bring about atmospheric turbulence which creates favourable conditions for air pollutant dispersion.

The tropical easterlies and the occurrence of easterly waves and lows affect Southern Africa mainly during the summer months. These systems are largely responsible for the summer rainfall pattern and the north easterly wind component that occurs over the region (Schulze, 1986; Preston-Whyte and Tyson, 1988).

In summary, the convective activity associated with the easterly and westerly waves disturbs and hinders the persistent inversion which sits over Southern Africa. This allows for the upward movement of air pollutants through the atmosphere leading to improved dispersion and dilution of accumulated atmospheric pollution.

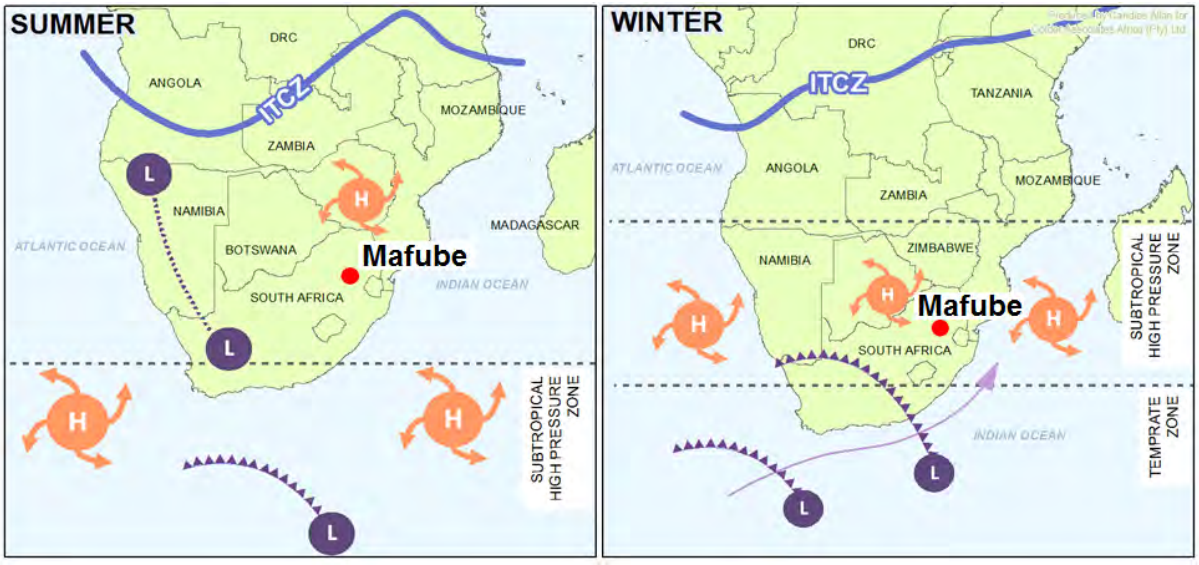


Figure 26: Seasonal circulation patterns affecting the regional climate

8.3.1 Boundary layer conditions

The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere and is directly affected by the earth's surface. The earth's surface affects the boundary layer through the retardation of air flow created by frictional drag, created by the topography, or as result of the heat and moisture exchanges that take place at the surface.

During the day, the atmospheric boundary layer is characterised by thermal heating of the earth's surface, converging heated air parcels and the generation of thermal turbulence, leading to the extension of the mixing layer to the lowest elevated inversion. These conditions are normally associated with elevated wind speeds, hence a greater dilution potential for the atmospheric pollutants.

During the night, radiative flux divergence is dominant due to the loss of heat from the earth's surface. This usually results in the establishment of ground based temperature inversions and the erosion of the mixing layer. As a result, night times are characterised by weak vertical mixing and the predominance of a stable layer. These conditions are normally associated with low wind speeds, hence less dilution potential.

The mixed layer ranges in depth from a few metres during night time to the base of the lowest elevated inversion during unstable, daytime conditions. Elevated inversions occur for a variety of reasons, however typically the lowest elevated inversion on the Highveld is located at a mean height above ground of 1550 m during winter months with a 78 % frequency of occurrence. During summer, the mean subsidence inversion occurs at about 2600 m with a 40 % frequency. Atmospheric stability is frequently categorised into one of six stability classes. These are briefly described in Table 16.

Table 16: Atmospheric stability classes

Designation	Stability Class	Atmospheric Condition
A	Very unstable	Calm wind, clear skies, hot daytime conditions
B	Moderately unstable	Clear skies, daytime conditions
C	Unstable	Moderate wind, slightly overcast daytime conditions
D	Neutral	High winds or cloudy days and nights
E	Stable	Moderate wind, slightly overcast night-time conditions
F	Very stable	Low winds, clear skies, cold night-time conditions

The atmospheric boundary layer is normally unstable during the day as a result of the turbulence due to the sun's heating effect on the earth's surface. The thickness of this mixing layer depends predominantly on the intensity of solar radiation, growing gradually from sunrise to reach a maximum at about 5 to 6 hours after sunrise. This situation is more pronounced during the winter months due to strong night-time inversions and a slower developing mixing layer. During the night a stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral.

For elevated releases, the highest ground level concentrations would occur during unstable, daytime conditions. The wind speed resulting in the highest ground level concentration depends on the plume buoyancy. If the plume is considerably buoyant (high exit gas velocity and temperature) together with a low wind, the plume will reach the ground relatively far downwind. With stronger wind speeds, on the other hand, the plume may reach the ground closer, but due to the increased ventilation, it would be more diluted. A wind speed between these extremes would therefore be responsible for the highest ground level concentrations. In contrast, the highest concentrations for ground level, or near-ground level releases would occur during weak wind speeds and stable (night-time) atmospheric conditions

8.3.2 Temperature

The area may be described as temperate, experiencing warm summers and cold winters. The highest recorded temperatures in the region are typically experienced during the summer months of December, January, February and the lowest during the winter months of June, July and August. The mean daily maximum and minimum temperatures in summer are 27.2ºC and 13.2ºC respectively. The mean daily maximum and minimum temperatures in winter are 18.4ºC and -1.8ºC respectively. The temperature data for the Witbank Weather Station was obtained from the South African Weather Service. The minimum, maximum and mean average daily temperatures measured at the Witbank Station for each month are given in Table 17.

Table 17: Minimum, Maximum and Average temperature

Month	Daily Mean ºC	Daily Max ºC	Daily Min ºC
October	18.3	24.8	11.7
November	18.9	24.6	13.2
December	19.8	25.1	14.5
January	20.6	26.2	14.9
February	20.5	26.0	15.0
March	20.2	26.1	14.2
April	17.5	23.9	11.2
May	14.5	21.3	7.7
June	12.2	19.1	5.2
July	11.4	18.4	4.3
August	14.1	21.5	6.7
September	16.4	23.5	9.2
Average	**17.0**	**23.4**	**10.7**

8.3.3 Wind speed and direction

8.3.3.1 Meteorological overview

The meteorological overview was based on the analysis of South African Weather Service (SAWS) meteorological data from the DEA Highveld station in Middelburg (25°47'45.87"S 29°27'46.08"E) from 2013 -

2015[1]. The station is located approximately 30 km from the Mafube. Typically, data is considered representative within 20 km, however due to the relatively simple terrain between the Mafube LifeX operations and Middleburg and the lack of an alternative data source; it is assumed the Middelburg data is representative of the local conditions at Mafube.

8.3.3.2 Wind roses for 2013 - 2015

Wind roses summarize the characteristics of the wind field at a specified location by representing their strength, direction and frequency. Calm conditions are defined as wind speeds of less than 1 m/s which are represented as a percentage of the total winds in the centre circle. Each directional branch on a wind rose represents wind originating from that specific cardinal direction (16 cardinal directions). Each cardinal branch is divided into segments of different colours which represent different wind speed classes. For the current wind roses, wind speed is represented on a scale from blue to red, with dark blue indicating low wind speeds (1 – 2 m/s) and red representing high wind speeds (in excess of 10 m/s)[2]. Each circle in the wind rose represents a percentage frequency of occurrence.

Winds predominantly originate along the north-westerly and south-easterly sectors in the region. Wind speeds are low, averaging 1.6 m/s with calm conditions (<1 m/s) 32 % of the time.

8.3.3.3 Diurnal wind roses

Diurnal variations in wind speed and direction are shown in Figure 28.

8.3.3.4 Seasonal wind roses

Seasonal variations in wind speed and direction are shown in Figure 29.

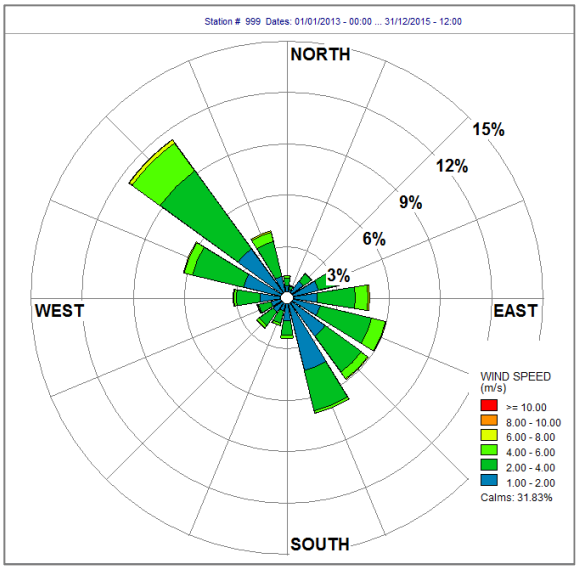
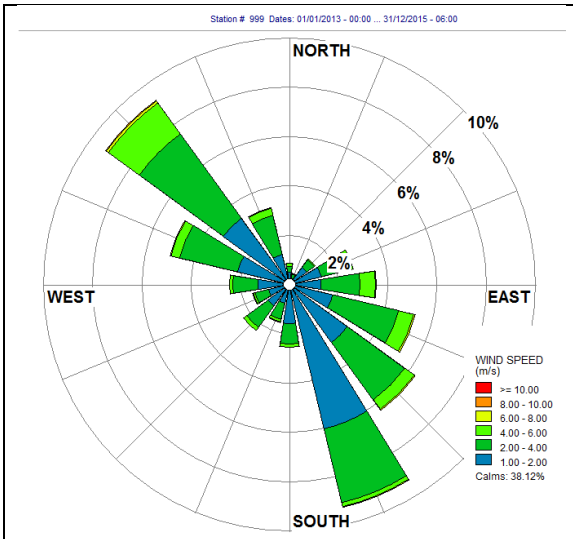


Figure 27: Average wind rose for Middelburg for 01 January 2013 to 31 December 2015

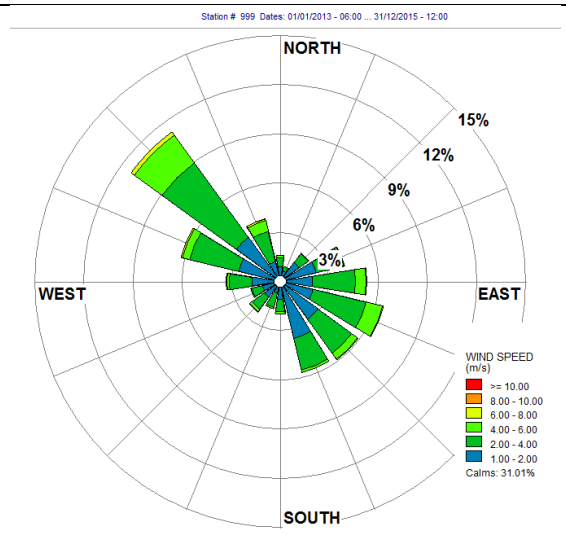
[1] 96% data availability for the period 01/01/2013 to 31/12/2015

[2] These wind speed classes and associated colours are specific to the MM5 modelled data wind roses only



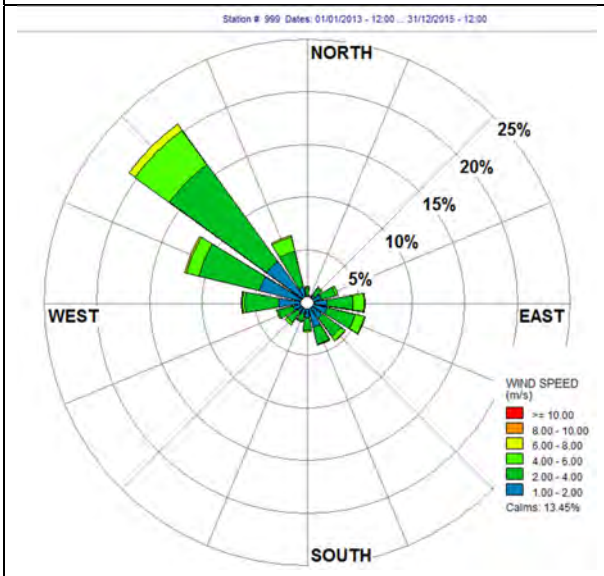
00:00 to 05:59

Wind dominant NW and SE sectors



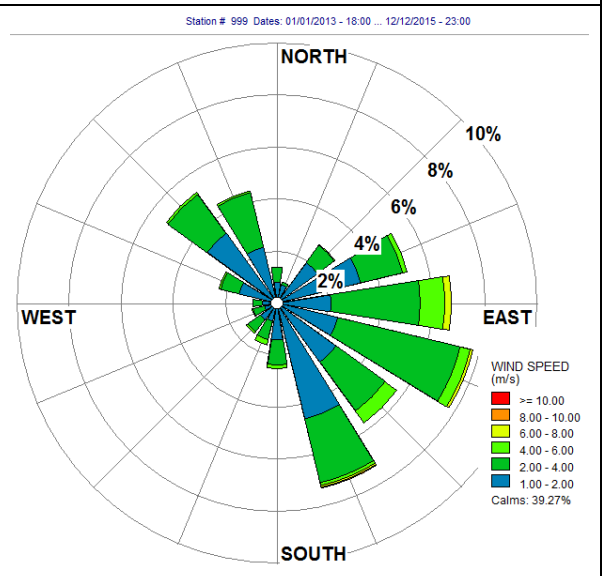
06:00 to 11:59

Wind dominant NW SE sectors



12:00 to 17:59

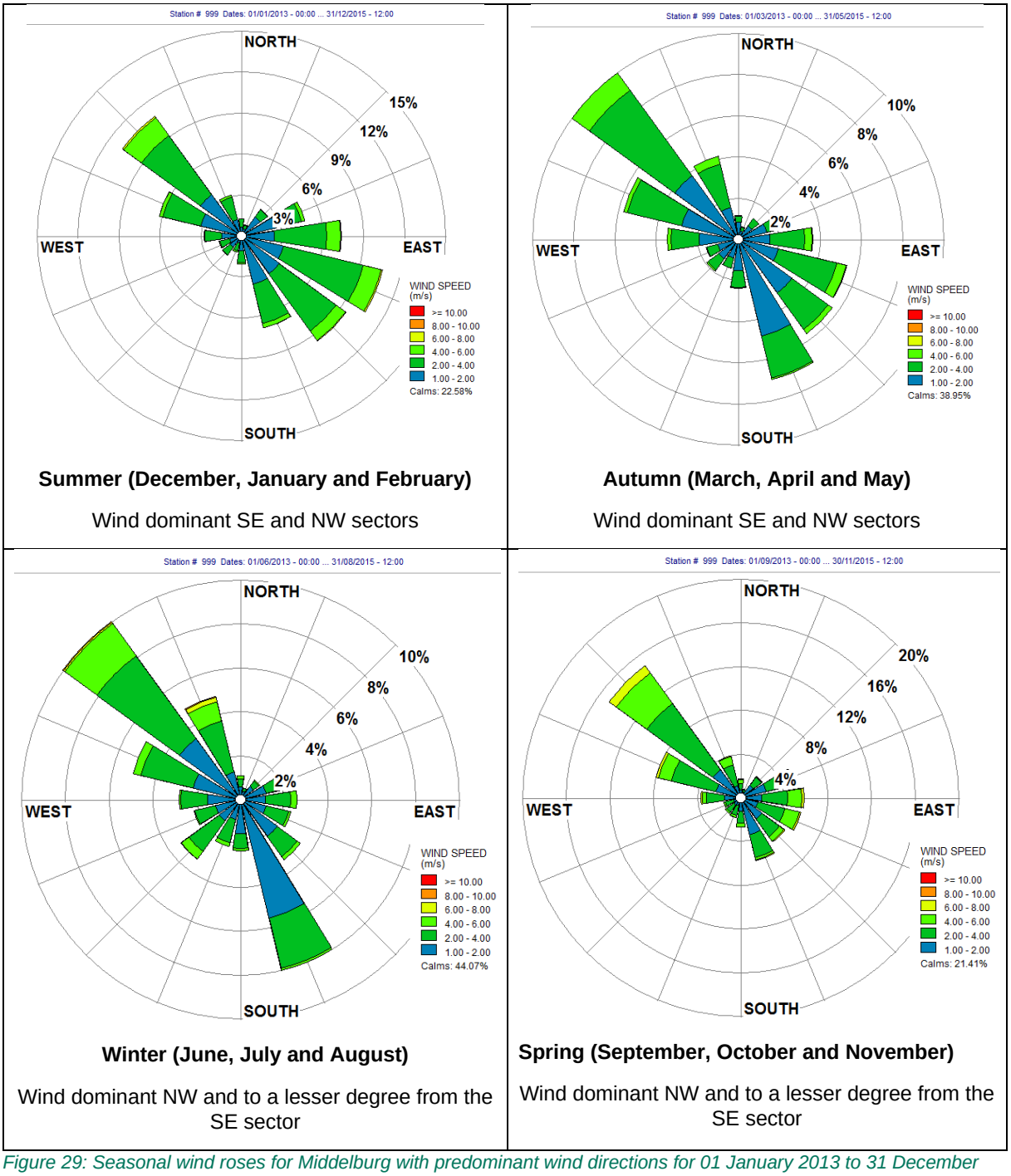
Wind dominant NW sector and to a lesser degree and SE sector



18:00 to 23:59

Wind dominant SE to E sectors and to a lesser degree and NW sector

Figure 28: Diurnal wind roses for Middelburg with predominant wind directions for 01 January 2013 to 31 December 2015



Summer (December, January and February)

Wind dominant SE and NW sectors

Autumn (March, April and May)

Wind dominant SE and NW sectors

Winter (June, July and August)

Wind dominant NW and to a lesser degree from the SE sector

Spring (September, October and November)

Wind dominant NW and to a lesser degree from the SE sector

Figure 29: Seasonal wind roses for Middelburg with predominant wind directions for 01 January 2013 to 31 December 2015

8.3.4 Evaporation

The study area has a Mean Annual Symons (S) Pan evaporation of 1550 mm/year (Midgley *et al*. (1990)). The average monthly S-Pan evaporation rates for the 4A evaporation zone presented in Table 18 and plotted in Figure 30 were used in the model.

Table 18: Average monthly S-pan evaporation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Evaporation (mm/month)	167	158	174	171	142	140	108	91	74	81	107	139

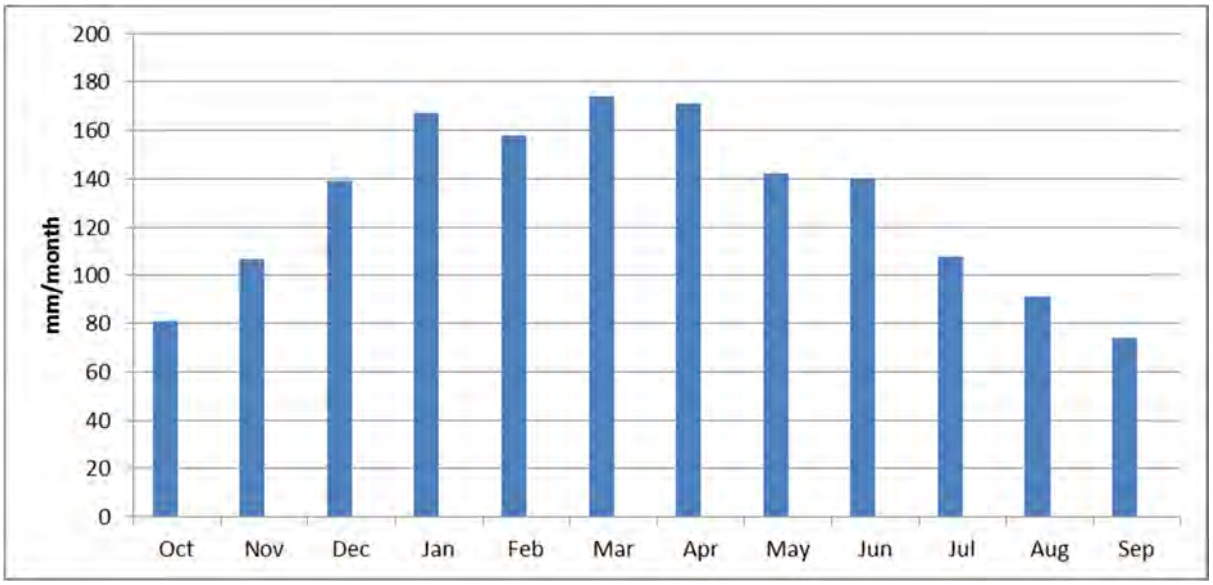


Figure 30: Average monthly evaporation for the 4A evaporation zone

8.3.5 Rainfall

The Rainfall data for the study area was sourced through the Design Rainfall Estimation Program (Smithers and Schulze, 2002) and the Daily Rainfall Data Extraction Utility (Kunz, 2004). Station 0516554 W (Roodepoort) was selected for use in the study. The rainfall gauge metadata is presented in Table 19. The selection is based on the station being the closest station to the site with a reasonably long and reliable record. The station is located about 11 km from the site.

Table 19: Metadata for Roodepoort rain gauge

Station Name	Station No	Distance	Latitude	Longitude	Record	Reliable	MAP	Altitude
		(km)	(°)(')	(°)(')	(Years)	(%)	(mm)	(mamsl)
Roodepoort	0516554 W	11	25°49'	29°49'	97	79.4	688	1711

The cumulative distribution function of annual rainfall is presented in Figure 31. The analysis of annual rainfall shows that:

- The Mean Annual Precipitation (MAP) is 680 mm/annum. 50% of the years receive between 580 mm/annum and 780 mm/annum.
- The annual rainfall depth varies considerably year to year, between 250 mm/annum and 1250 mm/annum. A dry year (defined as the 5th percentile) will receive 450 mm/annum. A wet year (defined as the 95th percentile) can receive 950 mm/annum.

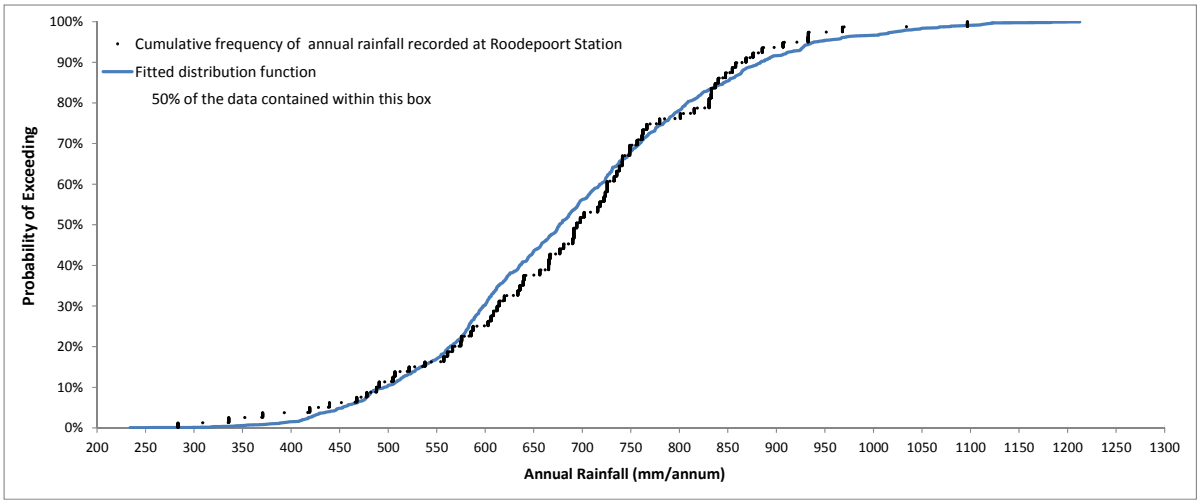


Figure 31: Cumulative distribution function of annual rainfall at the Roodepoort rain gauge

The boxplot of monthly rainfalls is presented in Figure 32. It provides a visual summary of:

- The centre of the data (the median - the centre line of the box);
- The variation (interquartile range - the box height);
- The skewness (the relative size of box halves); and
- The presence or absence of outliers ("far outside" values represented by the 1st and 99th Percentile).

The analysis of monthly rainfall shows that:

- The dry season occurs between May and September and receives less than 3% of the annual rainfall.
- The wet season occurs between October and April and receives more than 97% of the annual rainfall. On average, 85% of the annual rain falls within a period of 5 months (November to March)

The wettest months are December and January with median values around 120 mm/month. These months can experience more than 250 mm/month.

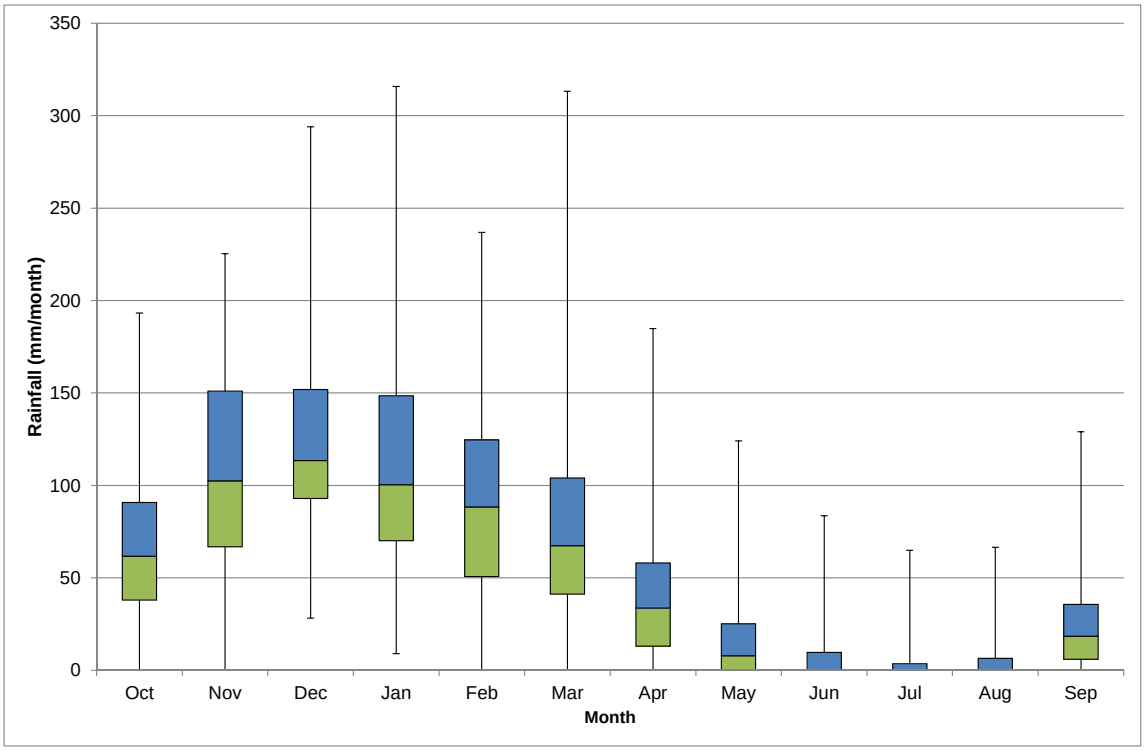


Figure 32: Box plot of monthly rainfall from Roodepoort Station record (0516554 W) from 1920 to 2000

The 24-hour rainfall depths for the different recurrence intervals calculated for the Roodepoort rain gauge are presented in Table 20.

Table 20: 24 hour Storm Rainfall for various annual recurrence intervals

	2	5	10	20	50	100	200
24 h rainfall (mm/d)	58	77	90	103	122	137	152

8.4 Geology

The area is underlain by thin sequences of sedimentary rocks of the Dwyka Group and the Vryheid Formation of the Ecca Group of the Karoo Supergroup, which rest uncomfortably on an uneven floor of older rocks composed of rhyolite and granophyre of the Upper Transvaal Supergroup. Intrusive dolerite dykes and sills are common.

The Nooitgedacht coal reserves fall within the Witbank coalfield, comprising sediments of the coal-bearing Ecca Group of the Karoo Supergroup that were deposited on a volcanic pre-Karoo floor. Five coal seams are present in the Witbank coalfield.

The Karoo sediments in the study area are predominantly preserved on the higher elevations and have been eroded in the valley floors to expose the older basement rocks comprising of older diorite and/or gabbro of the Mokolian erathem, more specifically rocks of the Lebowa Granite Suite and gabbro of the Timbavati Formation. The Mokolian rocks in turn overlie older Transvaal Supergroup Rocks of the Vaalian erathem (Figure 33).

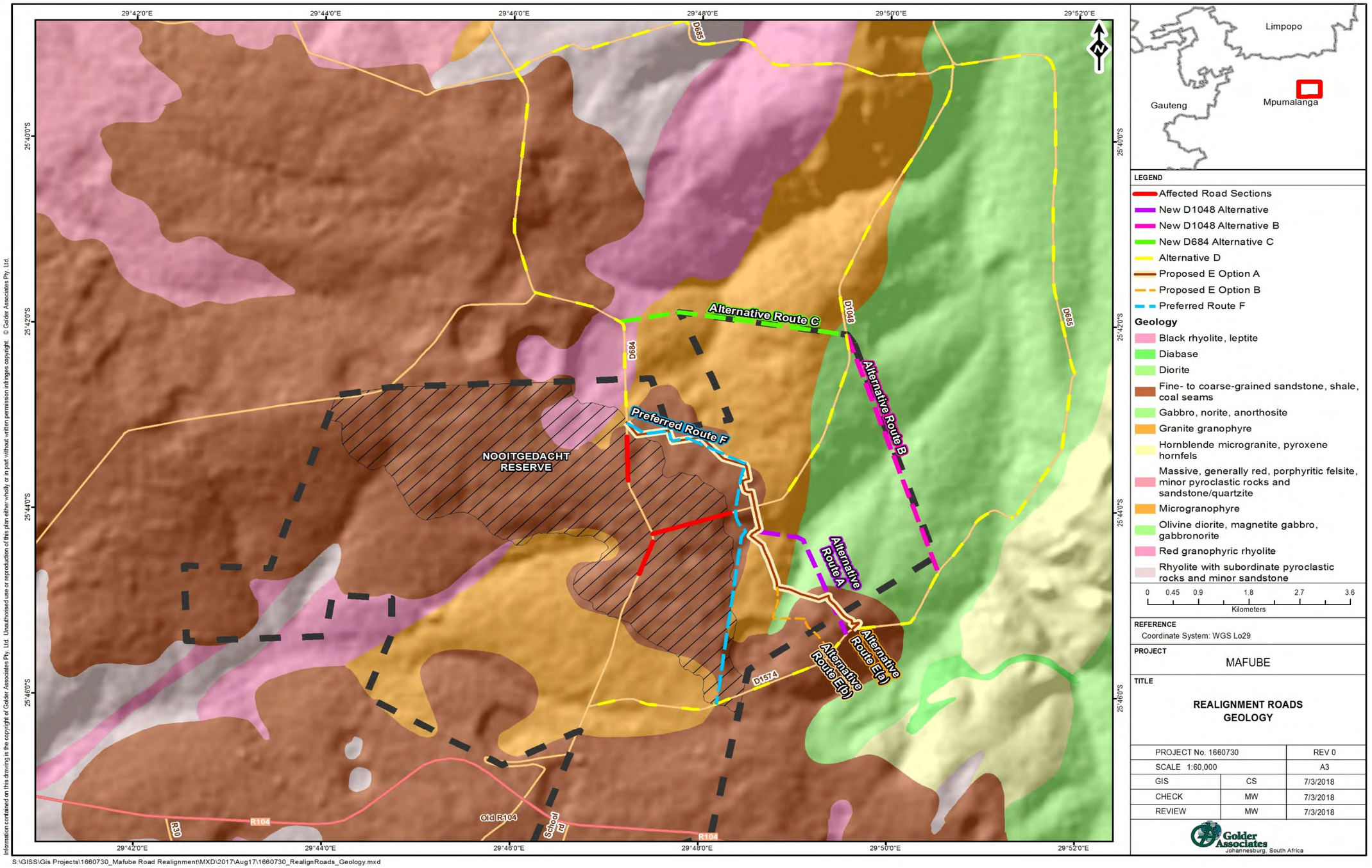


Figure 33: Local Geology of the project area

8.5 Soils

Soils in the proposed road realignment area are typical of the Highveld catena with deeper soils of moderate to high agricultural potential on the upper slope and heavy soils with higher clay content on the lower slope.

The distribution of soils is closely linked to topography and parent materials from which they are derived. Free-draining soils (Clovelly, Hutton, and Griffin) are generally derived from the sediments (sandstone and shales) of the Ecca group, while the more structured and clayey soils are associated with the intrusive dolerite dykes and sills. The heavier, dark grey and mottled clay rich colluvium and hydromorphic soils dominate the low-lying, gently sloping, stream and pan environments.

The following documents were reviewed at a desk-top level in order to obtain an understanding of the soil and land capability along the Route Alternatives. Since Route Alternative D is along an existing dirt road, it was not included in the baseline soil assessment.

The desk-top assessment also served to collect relevant data on the soil. The following documents and information sources were used:

- Soil, land capability and land use assessment of the proposed Nooitgedacht and Wildfontein opencast areas of Mafube Coal Mining (Pty) Ltd Report compiled by Steenkamp (2012);
- Land type map for South Africa;
- Erosion susceptibility maps for Mpumalanga; and
- National Land Capability map.

The soils and land capability assessment was focused on the proposed Route Alternatives.

8.5.1 Land type description

The land type survey was conducted in the early 1970's in order to compile inventories of the natural resources of South Africa in terms of soil, climate and terrain and was conducted as a reconnaissance survey at scale of 1:250 000. The survey reflects the dominant soils in each land type by percentage. The land type information is not a substitute for a detailed soil map, but gives a very good indication of where certain soil patterns are located.

The land type memoirs and associated maps of 2528 Pretoria, (Land type Survey Staff, 1976-2006) indicates that the site lies within the Ea8, Ea5, Ba20, Ba17 and Ib24 land types. The estimated percentage each land type occupies for the Route Alternatives are provided in Table 21.

The main land types are shown in Figure 34.

Land type unit Ea indicates "land with high base status, dark coloured and/or red soils, usually clayey, associated with basic parent materials. A land type, more than half of which is covered by soil forms with vertic, melanic and red structured diagnostic horizons. Land types in which these soils cover less than half of the area may also qualify for inclusion (i) where duplex soils occur in the non-rock land but where unit Ea soils cover a larger area than the duplex soils, or (ii) where exposed rock covers more than half the land type." (AGIS, 2016).

The Ea 8 land type unit comprises 28.5% of the Hutton soil form, 26.5% of the Shortlands soil form, 17.0 % of the Mayo soil form, 15% Glenrosa soil form, 8% of the Arcadia soil form, 3.5 % of the Bonheim soil form and 1.5% of the Rensburg soil form. The Hutton soil form is medium sandy loam to sandy clay loam, with a clay content of 10 -20% in the topsoil, 15 – 35 % clay in the B horizon and has an effective depth of 500-1200 mm. Depth limiting material associated with the Hutton soil form in the Ea 8 land type unit includes saprolite. The majority (75%) of soils of this land type unit is found in midslope terrain position with 20% occurring in footslope position and 5% occurring in the valley position. The dominant geology represented

by land type Ea8 is Ferrogabbro, ferrodiorite and diorite of the Upper zone; gabbro, norite and anorthosite of the Main zone, Bushveld Complex; hornblende microgranite and piroxeenhornfels (AGIS, 2016).

The Ea 5 land type unit comprises 52% of the Shortlands soil form, 34% of the Hutton soil form, 7 % of the Bonheim soil form, 4% of the Arcadia soil form, 2% of the Rensburg soil form and 1% are stream beds. The Shortlands soil form is fine sandy clay to clayey soils with clay content of 30 -40% in the topsoil, 35 – 60 % clay in the B horizon and has an effective depth of 500 – 800 mm. Depth limiting material associated with the Shortlands soil form in the Ea 5 land type unit includes saprolite. The majority (50%) of soils of this land type unit is found in midslope terrain position, 25% occurring in the crest position, 20% occurring in footslope position and 5% occurring in the valley position. The dominant geology represented by land type Ea5 is Mainly ferrogabbro and ferrodiorite of the Upper zone, Rustenburg Layered Suite; some gabbro, norite, anorthosite and magnetite gabbro of the Main zone, Rustenburg Layered Suite, Bushveld Complex; hornblende microgranite and pyroxene hornfels of Vaalian age in places (AGIS, 2016).

Land type unit Ba represents “a catena that in its perfect form is represented by (in order from highest to lowest in the upland landscape) Hutton, Bainsvlei, Avalon and Longlands forms. The valley bottom is occupied by one or other gley soil (e.g. Rensburg, Willowbrook, Katspruit, Champagne forms).”

The Ba 20 land type unit comprises 32.3% of the Hutton soil form, 16% of the Glencoe soil form, 15 % of the Avalon soil form, 9.5% Wasbank soil form, 7% of the Longlands soil form, 5.5 % of the Clovelly soil form, 4.3% of the Katspruit soil form, 5.5% of the Mispah soil form and 5% consisting of pans. The Hutton soil form is medium sandy loam to sandy clay loam, with a clay content of 15-25% in the topsoil, 20-35 % clay in the B horizon and has an effective depth of 600-1200 mm. Depth limiting material associated with the Hutton soil form in the Ba 20 land type unit includes saprolite and hardpan ferricrete. The majority (50%) of soils of this land type unit is found in crest position, 30% in the midslope terrain position with 15% occurring in footslope position and 5% occurring in the valley position. The dominant geology represented by land type Ba20 is mainly sandstone, shale, shaly sandstone and grit of the Ecca Group, Karoo Sequence; some gabbro, norite and granophyre of the Bushveld Igneous Complex, as well as rhyolite of the Damwal Formation, Rooiberg Group, Transvaal Sequence (AGIS, 2016).

The Ba 17 land type unit comprises 44.3% of the Hutton soil form, 29.3% of the Shortlands soil form, 15 % of the Glencoe/Avalon soil forms, 5.5% Swartland soil form, 5% Mispah soil form and 1% of the Oakleaf soil form. The Hutton soil form is fine sandy clay loam with a clay content of 20 – 35% in the topsoil, 30 - 45 % in the subsoil and has an effective depth of 450-1200 mm. Depth limiting material associated with the Hutton soil form in the Ba 17 land type unit includes saprolite and hardpan ferricrete. The majority (95%) of soils of this land type unit is found in midslope position and 5% occurring in the valley position. The dominant geology represented by land type Ba17 is mainly ferrogabbro and ferrodiorite of the Upper zone, Rustenburg Layered Suite, Bushveld Complex (AGIS, 2016).

Land type unit Ib indicates “land types with exposed rock (exposed country rock, stones or boulders) covering 60 – 80% of the area.” (AGIS, 2016)

The Ib24 land type unit comprises 60% Rock, 16.2% of the Hutton soil form, 15 % of the Clovelly soil form, 7% of the Mispah soil form and 1.2% stream beds. The Hutton soil form is medium/coarse sand clay loam, with a clay content of 20 – 30 % in the topsoil, 20 – 40 % clay in the subsoil and has an effective depth of 600 – 1200 mm. Depth limiting material associated with the Hutton soil form in the Ib24 land type unit includes hard rock and saprolite. The majority (50%) of soils of this land type unit is found in midslope terrain position with 45% occurring in crest position, 3% in the footslope position and 2% occurring in the valley bottom position. The dominant geology represented by land type Ib24 is mainly granophyre of the Rashoop Suite; leptite of the Bushveld Complex; granophyric rhyolite of the Damwal Formation, Rooiberg Group (AGIS, 2016).

Table 21: Land types of Route Alternatives

Routes	Land type occupied by route
Alternative A:	**Ba20 (±14%)**- Plinthic catena: upland duplex and margalitic soils rare; Dystrophic and/or mesotrophic; red soils widespread **Ea8 (±86%)**- one or more of: vertic, melanic, red structured diagnostic horizons; Undifferentiated
Alternative B:	**Ea8 (± 57.5%)**- one or more of: vertic, melanic, red structured diagnostic horizons; Undifferentiated **Ea5 (± 16.9%)** – one or more of: vertic, melanic, red structured diagnostic horizons; Undifferentiated **Ib24 (±13.5%)** – miscellaneous land classes; Rock areas with miscellaneous soils **Ba17 (±11.5%)** – plinthic catena: upland duplex and margalitic soils rare; Dystrophic and/or mesotrophic; red soils widespread
Alternative C:	**Ba20 (±72%)** – Plinthic catena: upland duplex and margalitic soils rare; Dystrophic and/or mesotrophic; red soils widespread **Ib24 (±28%)** – miscellaneous land classes; Rock areas with miscellaneous soils
Alternative D:	No new roads constructed - Existing district roads will be used by locals
Alternative E:	**Ba20 (±100%)**- Plinthic catena: upland duplex and margalitic soils rare; Dystrophic and/or mesotrophic; red soils widespread
Preferred Alternative F:	**Ba20 (±100%)**- Plinthic catena: upland duplex and margalitic soils rare; Dystrophic and/or mesotrophic; red soils widespread

Table 22: Land types for Route Alternatives and dominant soil form (Land type Survey Staff, 1976-2006)

Route Alternative	Land type	Dominant Soil form/ feature
A	Ea8	Hutton
	Ba20	Hutton
B	Ea8	Hutton
	Ea5	Shortlands
	Ib24	Rocks
	Ba17	Hutton
C	Ba20	Hutton
	Ib24	Rocks
E	Ba20	Hutton
F	Ba20	Hutton

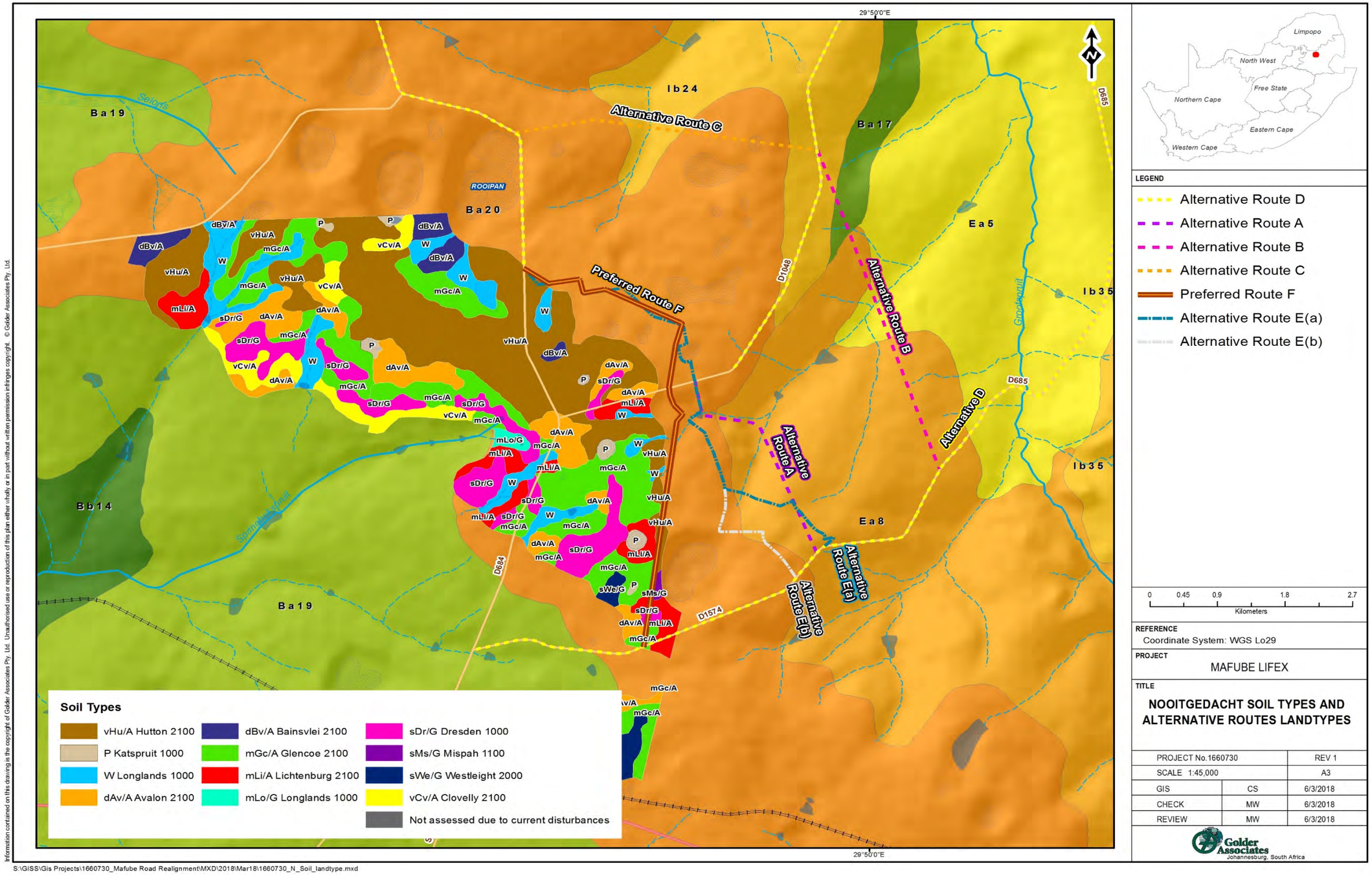


Figure 34: Nooitgedacht soil types and Land types intersected by Alternatives Routes

8.5.2 Dominant soils characteristics

The soils occurring along each of the Route Alternatives is the Hutton soil form (as defined in the land type survey). A soil survey conducted on the farms Nooitgedacht and Wildfontein (located east to south east of the Route Alternatives) at a scale of 1:40 000, indicate that the following soil forms occur in the area: Hutton (31.11%), Bainsvlei (3.01%), Lichtenburg (5.80%), Clovelly (4.64%), Avalon (9.80%), Glencoe (21.14%), Westleigh (4.15%), Dresden (9.47%), Mispah (0.21%), Longlands (0.81%) and Katspruit (1.53%). The soil forms identified in the soil survey conducted by Steenkamp (2012), are similar to what is recorded in the Land type memoirs for the areas of Route Alternatives. Both the soil survey by Steenkamp (2012) and the Land type data indicate that the Hutton soil form is the dominant soil form in the study area.

Hutton soils are characterised by relatively uniform red, apedal (structureless) subsoil. The red soil colour is attributed to hematite. Hutton soils very seldom become saturated with water, thus reducing conditions that may change the soil colour never occurs. These soils occur is better drained positions in the landscape and on better drained underlying material. Fine sand variants of this form are sensitive to wind erosion and are easily compacted by cultivation. The wind erosion hazard of the topsoil is low to moderate, based on the clay content.

8.5.3 Soil erodibility

The soil erodibility, the tendency of the soil to be detached and transported by wind or water, becomes increasing important as the slope increasing. Silt and fine sandy soils are usually more easily erodible than more clayey soils. The soils susceptibility to wind and water erosion based on textural class and slope in the study area is listed below (Table 23 and Table 24) and shown in Figure 35 and Figure 36. The erosion susceptibility maps were generated using the Land type survey data (Schoeman & van der Walt, 2006).

Table 23: Water erosion susceptibility classes per Route Alternative

Route Alternative	Water erosion class	Description	Area (ha)*
Alternative A	4a	Sandy loams strongly dominant. Somewhat susceptible	1.2
Alternative A	5	Sandy clay loams. Non-susceptible	7.6
Alternative B	5	Sandy clay loams. Non-susceptible	15.0
Alternative C	4a	Sandy loams strongly dominant. Somewhat susceptible	8.6
Alternative C	5	Sandy clay loams. Non-susceptible	3.4
Alternative D	5	Sandy clay loams. Non-susceptible	86.7
Alternative D	3c	Loamy sands sub-dominant. Moderately susceptible	4.7
Alternative D	4a	Sandy loams strongly dominant. Somewhat susceptible	45.3
Alternative D	4a	Sandy loams strongly dominant. Somewhat susceptible	0.2
Alternative D	4b	Sandy loams dominant. Somewhat susceptible	3.7
Alternative E (A)	5	Sandy clay loams. Non-susceptible	5.6
Alternative E (A)	4a	Sandy loams strongly dominant. Somewhat susceptible	16.8
Alternative E (B)	5	Sandy clay loams. Non-susceptible	1.4
Alternative E (B)	4a	Sandy loams strongly dominant. Somewhat susceptible	21.2
Alternative F	4a	Sandy loams strongly dominant. Somewhat susceptible	22.2

Notes: * Area occupies 15m buffer along route

Table 24: Wind erosion susceptibility of land for Route Alternatives

Route Alternative	Wind erosion class	Description	Area (ha)
Alternative A	1	Land with low susceptibility to water erosion. Generally, level to gently sloping. Soils have favourable erodibility index.	1.2

Route Alternative	Wind erosion class	Description	Area (ha)
Alternative A	3	Land with moderate susceptibility to water erosion. Generally moderately sloping land. Soils have low to moderate erodibility.	7.6
Alternative B	2	Land with low to moderate susceptibility to water erosion. Generally, gently to moderately sloping. Soils have low to moderate erodibility.	4.6
Alternative B	3	Land with moderate susceptibility to water erosion. Generally moderately sloping land. Soils have low to moderate erodibility.	10.4
Alternative C	1	Land with low susceptibility to water erosion. Generally, level to gently sloping. Soils have favourable erodibility index.	8.6
Alternative C	2	Land with low to moderate susceptibility to water erosion. Generally, gently to moderately sloping. Soils have low to moderate erodibility.	3.4
Alternative D	1	Land with low susceptibility to water erosion. Generally, level to gently sloping. Soils have favourable erodibility index.	45.5
Alternative D	2	Land with low to moderate susceptibility to water erosion. Generally, gently to moderately sloping. Soils have low to moderate erodibility.	27.5
Alternative D	3	Land with moderate susceptibility to water erosion. Generally moderately sloping land. Soils have low to moderate erodibility.	25.0
Alternative D	5	Land with low to moderate water or wind erosion hazard. Generally, level to gently sloping land; soils may have low to very high erodibility.	4.7
Alternative E (a)	1	Land with low susceptibility to water erosion. Generally, level to gently sloping. Soils have favourable erodibility index.	16.8
Alternative E (a)	3	Land with moderate susceptibility to water erosion. Generally moderately sloping land. Soils have low to moderate erodibility.	5.6
Alternative E (b)	1	Land with low susceptibility to water erosion. Generally, level to gently sloping. Soils have favourable erodibility index.	21.2
Alternative E (b)	3	Land with moderate susceptibility to water erosion. Generally moderately sloping land. Soils have low to moderate erodibility.	1.4
Alternative F	1	Land with low susceptibility to water erosion. Generally, level to gently sloping. Soils have favourable erodibility index.	22.2

Notes: * Area occupies 15m buffer along route

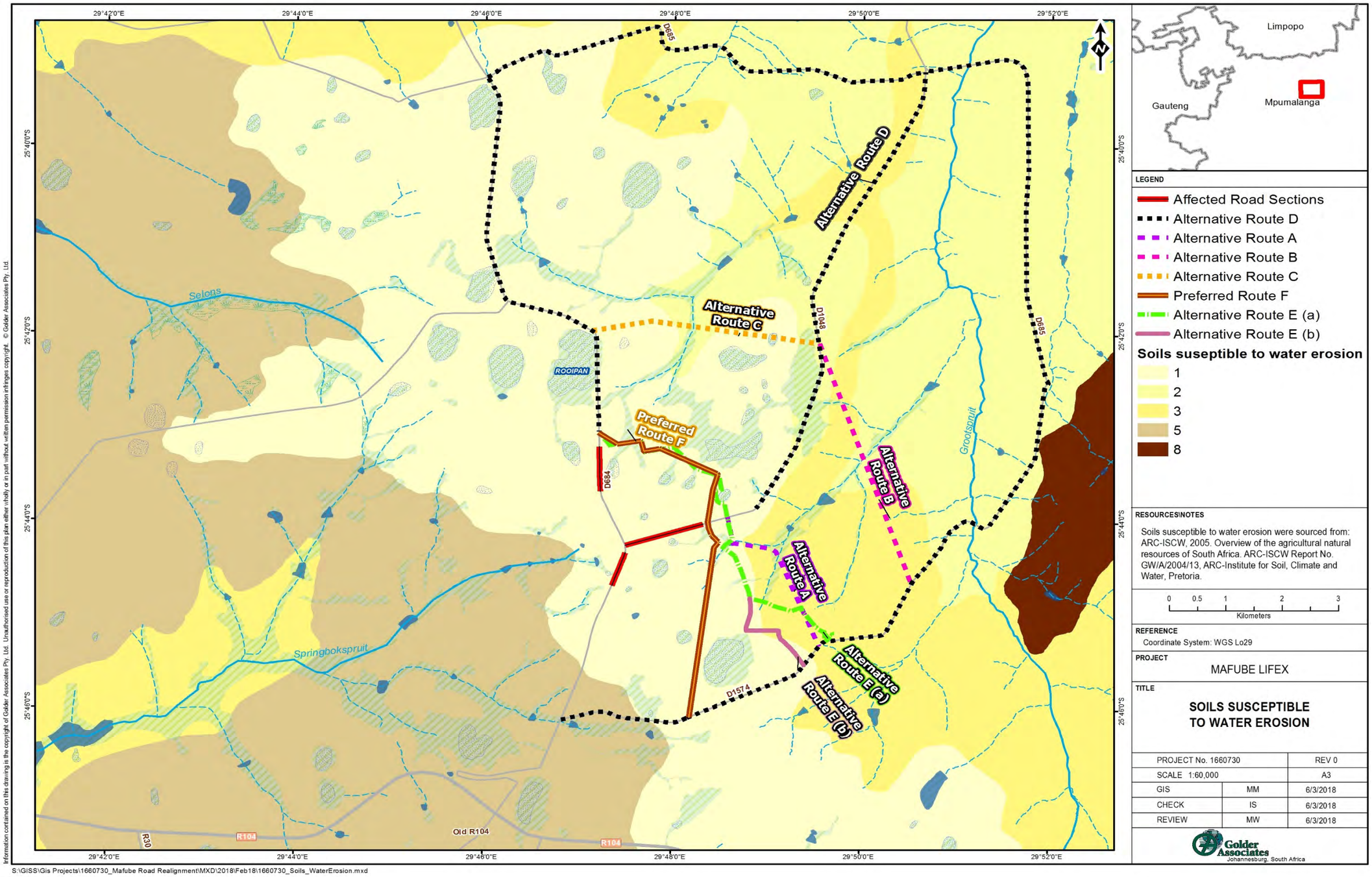


Figure 35: Soils susceptibility to water erosion

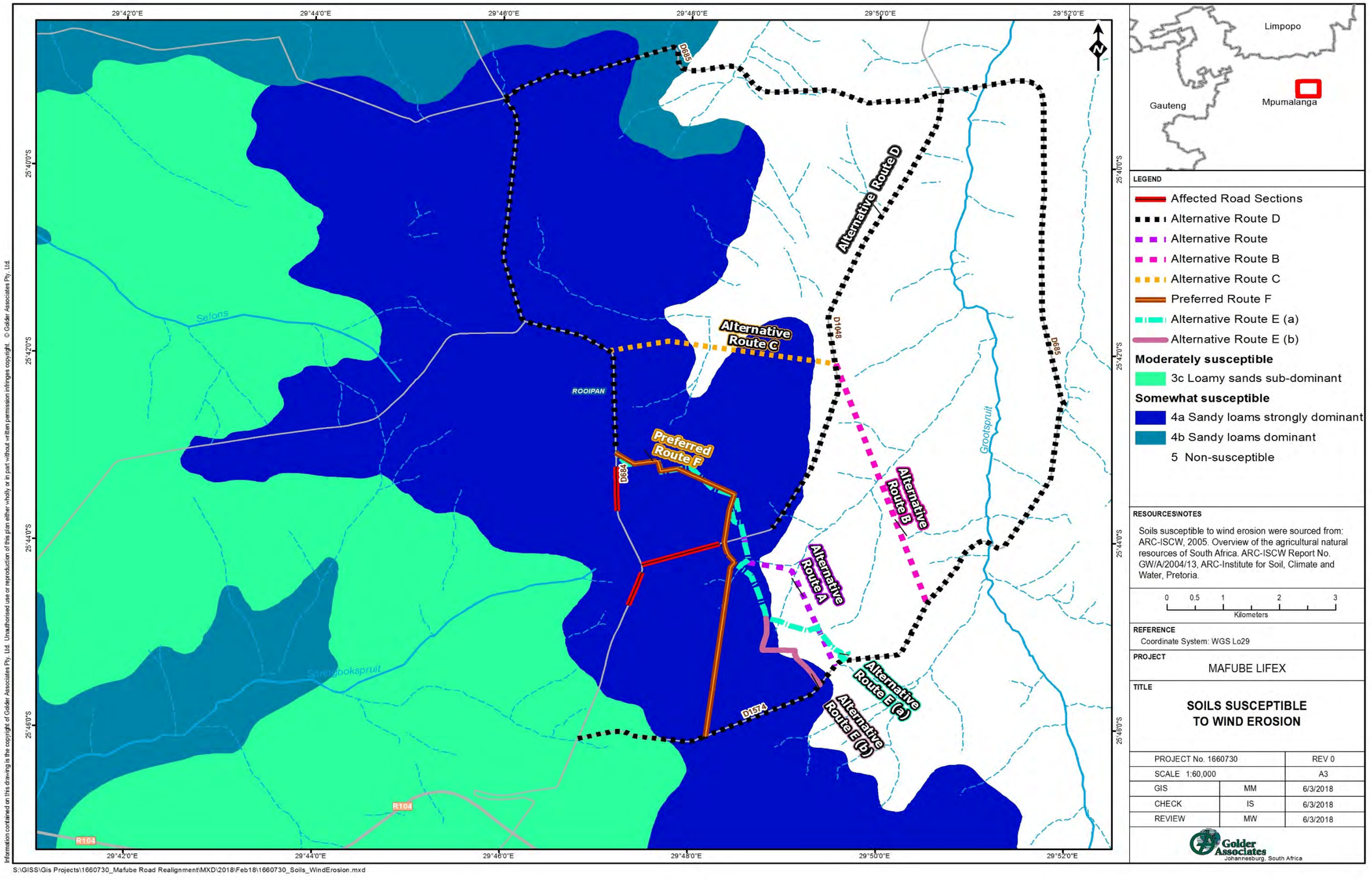


Figure 36: Soils susceptibility to wind erosion

8.5.4 Baseline Land Capability

Land capability classification (LCC) is a system of grouping soils into map units based on the ability of the land to sustain rain-fed arable crops (Klingebiel & Montgomery, 1961). The map units are classed as *arable* (classes I – IV) or *non- arable* (class VI- VIII) depending on the degree of physical limitations and therefore also indicates the potential of the soil for agricultural use. The LCC does not indicate soil fertility status, a chemical feature of the soil which can be ameliorated. The parameters evaluated during land capability assessment may include combinations of the following:

- Soil textural and structural properties (sand, silt and clay content), as these are known to be co-variants with a number of other more complex soil properties (hydraulic conductivity, CEC, moisture retention; plasticity; susceptibility to compaction).
- Susceptibility to erosion as determined by the type of soil and *slope* (to be considered if changes in land cover and changes in slope may result from a developmental initiative);
- Continuous or periodic waterlogging, caused by low permeability of underlying material, the presence and duration of water tables, or flooding (to be considered in infrastructure placement);
- Depth of soils relative to limiting materials/layers, specifically inhibiting root penetration
- Soil Salinity, specifically regarding plant sensitivity to saline conditions;
- Mechanical (Physical) limitations such as rocky outcrops or deep gullies, which prevent access to areas
- Climatic conditions, temperature and rainfall are the key determinant in land arability.

The national land capability classification for the project area was evaluated. The land capability classification was undertaken at a national scale, using the land type data on a scale of 1:250 000. The classification is as follows: "*The land capability is assigned to each land type by applying the table for soil and climate classes constituting land capability classes, to each soil entry. Land types in which a particular class occupies more than 50%, are assigned to that class, starting with Class I. If the land type does not comply with this requirement, components belonging to the next class in the sequence are added to the components from higher classes. If the sum occupies more than 50%, the land type is assigned to that class*."

The land capability classes (ha) for each Route Alternative are indicated in Table 25 below.

The classes have the following capabilities as defined in the land capability system for South Africa (Schoeman et al., 2000):

- **Class II**: "Land in Class II have some limitations that reduce the choice of plants or require moderate conservation practices. It may be used for cultivated crops, but with less latitude in the choice of crops or management practices than Class I. The limitations are few and the practices are easy to apply. Limitations may include singly or in combination the effects of:
  - *Gentle slopes.*
  - *Moderate susceptibility to wind and water erosion.*
  - *Less than ideal soil depth.*
  - *Somewhat unfavourable soil structure and workability.*
  - *Slight to moderate salinity or sodicity easily corrected but likely to recur.*
  - *Occasional damaging flooding.*
  - *Wetness correctable by drainage but existing permanently as a moderate limitation.*

- Slight climatic limitations on soil use and management

Limitations may cause special soil-conserving cropping systems, soil conservation practices, water-control devices or tillage methods to be required when used for cultivated crops".

- **Class III** – *"Land in this class has severe limitations that reduce the choice of plants or require special conservation practices, or both. It may be used for cultivated crops, but has more restrictions than Class II. When used for cultivated crops, the conservation practices are usually more difficult to apply and to maintain. The number of practical alternatives for average farmers is less than that for soils in Class II. Limitations restrict, singly or in combination, the amount of clean cultivation, time of planting, tillage, harvesting, and choice of crops. Limitations may result from the effects of one or more of the following:*
  - *Moderately steep slopes.*
  - *High susceptibility to water or wind erosion or severe adverse effects of past erosion.*
  - *Frequent flooding accompanied by some crop damage.*
  - *Very slow permeability of the subsoil.*
  - *Wetness or some continuing waterlogging after drainage.*
  - *Shallow soil depth to bedrock, hardpan, fragipan or claypan that limit the rooting zone and the water storage.*
  - *Low water-holding capacity.*
  - *Low fertility not easily corrected.*
  - *Moderate salinity or sodicity.*
  - *Moderate climatic limitations."*
- **Class VIII:** *"Land in this class have limitations that preclude its use for commercial plant production and restrict its use to recreation, wildlife, water supply or aesthetic purposes. Land in Class VIII cannot be expected to return significant on-site benefits from management for crops, grasses or trees, although benefits from wildlife use, watershed protection or recreation may be possible. Badlands, rock outcrop, sandy beaches, river wash, mine tailings and other nearly barren lands are included in Class VIII. Limitations that cannot be corrected may result from the effects of one or more of:*
  - *Erosion or erosion hazard.*
  - *Severe climate.*
  - *Wet soil.*
  - *Stones.*
  - *Low water-holding capacity.*
  - *Salinity or sodicity."*

The land capability for the different Route Alternatives is shown in Table 25 and Figure 37. The approximate area and land capability each Route occupies is listed below.

Table 25: Land capability classes (ha) each Route Alternatives occupies

Route Alternative	Class II	Class III	Class VIII
Alternative A	21.7	3.4	
Alternative B	2.2	7.9	
Alternative C		12.8	2.2
Alternative D	45.5	67.6	27.2
Alternative E (A)	16.8	5.7	
Alternative E (B)	21.2	1.3	
Alternative F	19.2		

Notes: * Area occupies 15m buffer along route

8.5.5 Soil agricultural potential

The agricultural potential is dependant of the characteristics of the land and management input and reflects of the production capacity of a land under a specific management. The various land capability classes also have different agricultural potentials. At the desktop level of the assessment, the land capability classes were assigned soil agricultural potentials. For the different Route Alternatives, these are –Soils in Land Capability (LC) Class II as high potential, soils in Class III having a moderate potential and soils in Class VIII having a low potential. These ratings however need to be confirmed during the soil survey of the Route Alternative selected

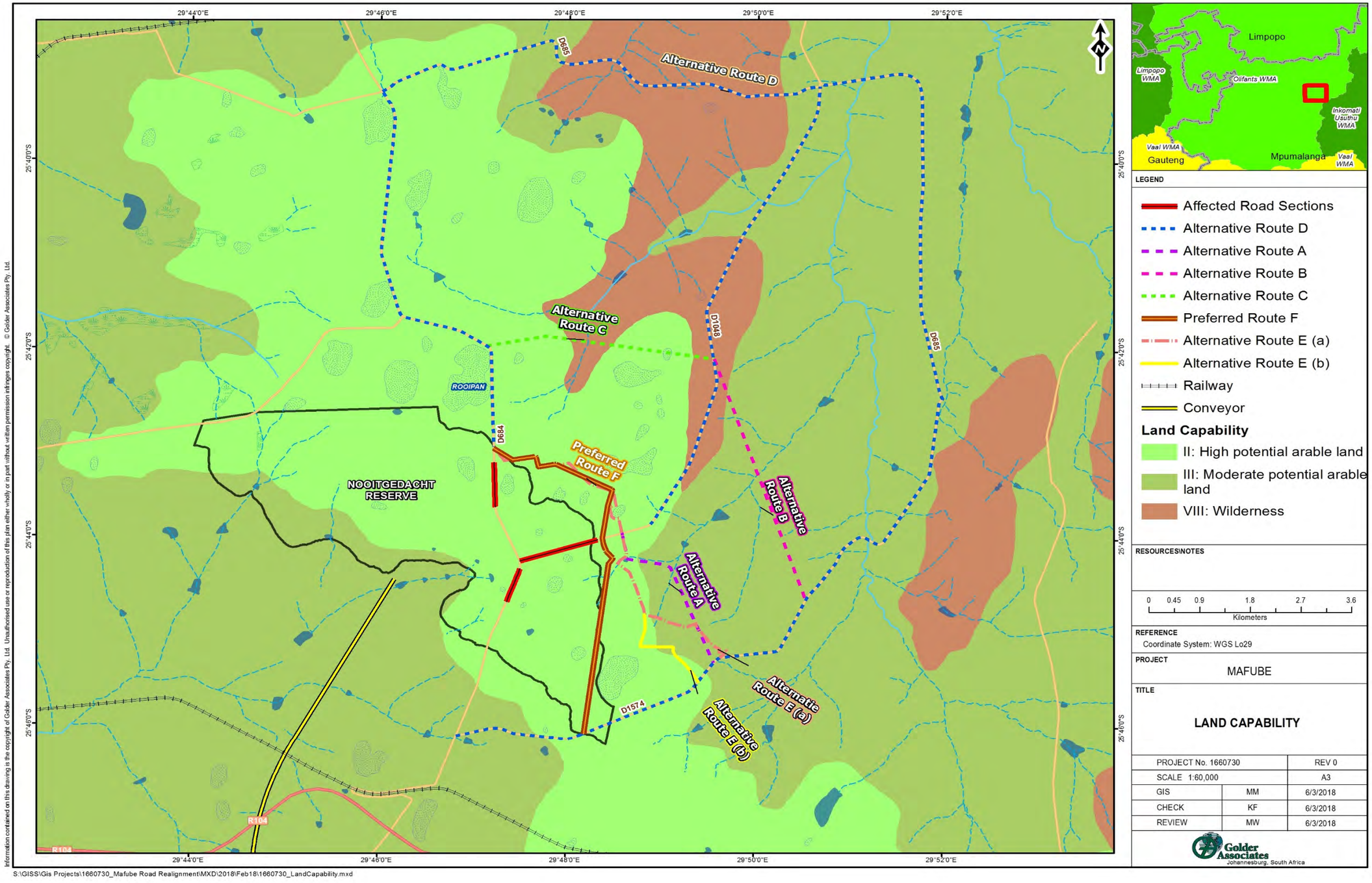


Figure 37: Land capability of Route Alternatives

8.6 Surface Water

The proposed road realignment area is situated within the upper reaches of the Olifants Catchment Water Management Area (WMA), and is located in the Middelburg Dam sub-catchment, forming part of the Loskop Dam catchment, and within quaternary sub-catchment B12C of the Limpopo-Olifants primary drainage region (Figure 38). Local watercourses drain into the Klein-Olifants River, which in turn drains into Middelburg Dam. Thereafter the Klein-Olifants flows into the Olifants River, which drains into the Loskop Dam.

The water users in the catchment are varied and include agriculture (irrigation), municipal including commercial and domestic and natural aquatic ecosystems. The water quality in the Middelburg Dam has deteriorated steadily since the 1970's when mining started in the catchment.

8.6.1 Catchment Description

Regionally the Nooitgedacht and Wildfontein opencast coal mine expansion project as well as the associated road realignment alternatives are situated in the upper reaches of the Olifants Water Management Area (WMA) and span over two quaternary catchments, namely:

- The Klein-Olifants quaternary catchment B12C which is drained by the Mooifontein Spruit, the Springbok Spruit, and ultimately the Klein Olifants River; and
- The Steelpoort River quaternary catchment B41A which is drained mainly by the Grootspruit, Hartebeeshoek Spruit, Lang Spruit, and ultimately the Steelpoort River.

The location of road realignment alternatives is shown in (Figure 4). The project could potentially impact on the Middelburg Dam located on the Klein Olifants River. The predominant land use in the study area is commercial agriculture. Grassland is the dominant vegetation type in the region with patches of forest occurring as an interrupted, thin band towards the eastern boundary.

8.6.2 Regional Drainage Network

As shown in (Figure 4), the study area is located in the B14A and B12C quaternary catchments. There are a number of perennial and non-perennial streams flow within and through the area, ultimately draining into major rivers Olifants River and Steelpoort River.

The Nooitgedacht and Wildfontein open cast mining coal expansion area as well as the associated road realignment alternatives are made up of predominantly flat to gently sloping catchments within the Olifants Limpopo Water Management Area (WMA). The study area is approximately 45 km south-west of Belfast and approximately 39 km north-east of the Middelburg. The catchment is still largely undeveloped with limited water resources and water uses.

The greater Mafube catchment is a relatively wet catchment with various perennial and non-perennial flow and therefore produces a sustainable yield of surface water.

8.6.2.1 Local Drainage Network

The Road Realignment Alternatives for the proposed Nooitgedacht and Wildfontein operations cross several streams. These alternatives include both existing roads as well as proposed roads. The streams include both perennial and non-perennial streams. As per the requirements of the Section 21 (c) and (i) of the NWA, a surface water impact assessment for all road-river crossings needs to be carried out. A total of three (3) road-river/wetland/water course crossings have been identified along the proposed road realignment routes.

8.6.3 Baseline Water Quality Monitoring Programme

Mafube LifeX operations maintains forty-one (41) surface water monitoring sites (Figure 39) which have been aligned with aquatic monitoring sites and their locations (Table 26) not situated on wetlands, but in flowing streams. A monthly monitoring programme is conducted and there are nearly 15 constituents that are currently monitored.

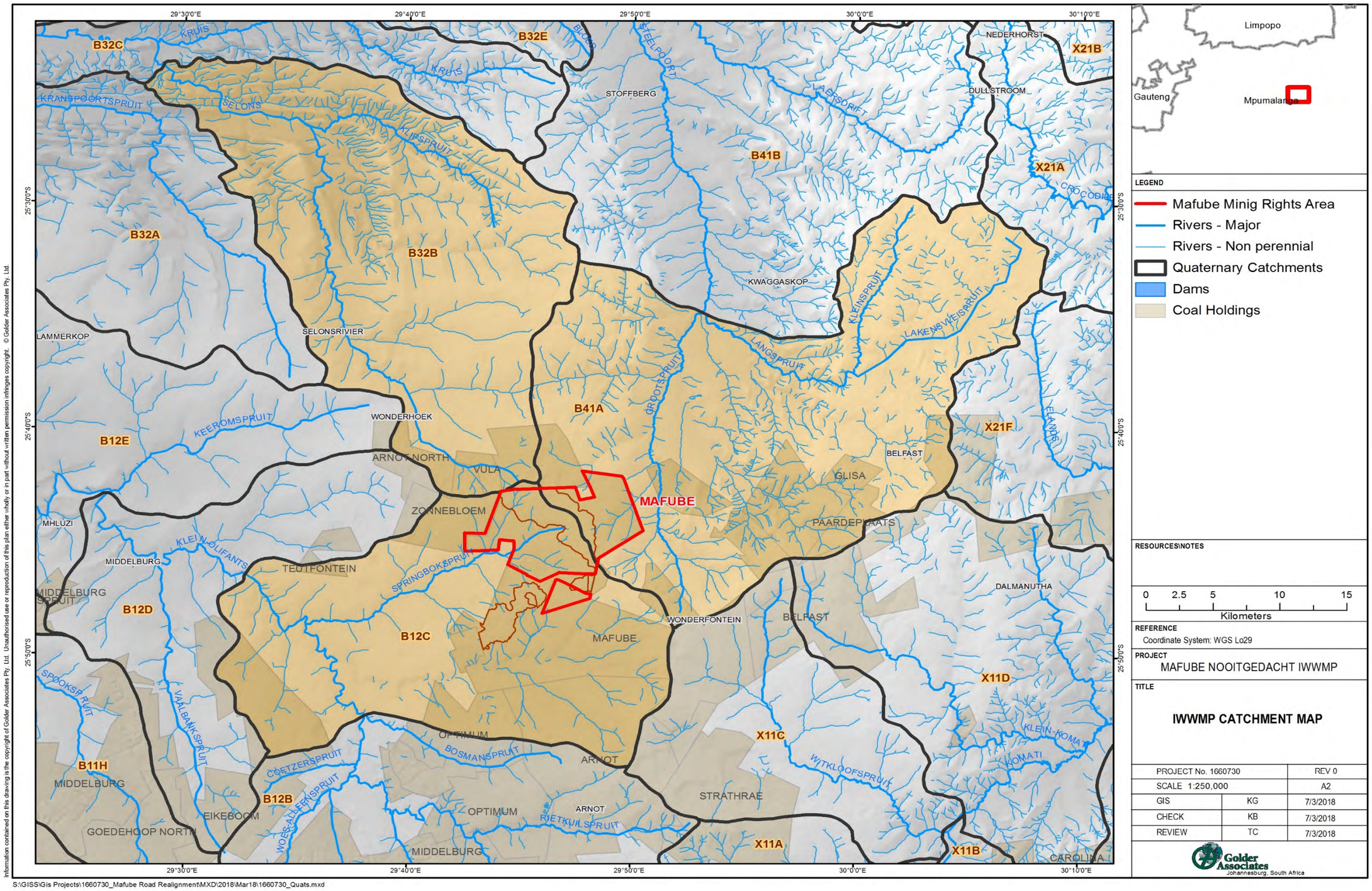


Figure 38: Quaternary catchments of the study area

The importance of a monitoring programme is to provide a baseline data set to detect any changes in the water quality profile potentially due to impacts from mine activity. If there is a large increase or decrease in certain constituent values in a short period it is important to assess the reason for the change and implement the necessary mitigation measures. A monitoring programme is also important when the monitoring site is a point of discharge to the environment from the mine. This allows the mine to determine the impacts that the discharge could have on the downstream users and to implement mitigation measures.

Table 26: Water quality monitoring points

Description	Monitoring Point	Co ordinates	
		Latitude	Longitude
Klein Olifants System	KO1	S25°46'7.98"	E29°46'49.20"
Klein Olifants System	KO3	S25°44'20.81"	E29°44'09.45"
Klein Olifants System	KO4	S25°44'39.534"	E29°43'07.518"
Klein Olifants System	KO5	S25°45'31.47"	E29°43'44.22"
Klein Olifants System	KO6	S25°45'41.103"	E29°43'9.737"
Klein Olifants System	KO7	S25°47'06.79"	E29°40'52.00"
Steelpoort System	Stream S2	S25°44'21.30"	E29°44'10.20"
Klein Olifants System	Stream S3	S25°44'50.10"	E29°45'36.10"
Klein Olifants System	Stream S4	S25°46'7.90"	E29°46'32.50"
Steelpoort System	Stream S6	S25°42'19.80"	E29°48'3.90"
Steelpoort System	Stream S7	S25°42'43.90"	E29°48'10.30"
Steelpoort System	Stream S8	S25°43'58.70"	E29°49'20.40"
Klein Olifants System	C1 Upstream	S25°44'33.90"	E29°46'12.30"
Klein Olifants System	C1 downstream	S25°44'36.50"	E29°45'57.40"
Klein Olifants System	C2 Upstream	S25°45'1.10"	E29°45'57.40"
Klein Olifants System	C2 downstream	S25°44'53.30"	E29°45'51.70"
Klein Olifants System	C3 Upstream	S25°45'43.60"	E29°45'48.80"
Klein Olifants System	C3 downstream	S25°45'35.80"	E29°45'17.40"
Klein Olifants System	C4 Upstream	S25°46'11.80"	E29°45'17.40"
Klein Olifants System	C4 downstream	S25°46'3.60"	E29°45'0.10"
Klein Olifants System	C5 Upstream	S25°46'56.60"	E29°44'53.60"
Klein Olifants System	C5 downstream	S25°46'55.50"	E29°44'43.70"
Klein Olifants System	Upstream of Wildfontein Mine	S25°46'15.90"	E29°48'24.30"
Klein Olifants System	Downstream of Wildfontein Mine	S25°46'7.98"	E29°46'49.20"
Klein Olifants System	Impacted Wetland Upstream	S25°46'37.50"	E29°48'19.80"
Steelpoort System	SP1	S25°44'5.700"	E29°51'12.266"
Steelpoort System	SP2	S25°43'22.080"	E29°49'58.738"
Steelpoort System	SP4	S25°40'51.150"	E29°49'2.803"
Steelpoort System	SP5	S25°39'8.776"	E29°51'7.297"
Pan System	Pan 26 (now Pan11)	S25°42'19.143"	E29°46'56.091"
Pan System	Pan 4	S25°43'13.99"	E29°48'36.56"
Pan System	Pan 5	S25°45'30.70"	E29°48'31.84"
Pan System	Pan 10	S25°43'37.58"	E29°48'10.24"
Pan System	Pan 10W	S25°42'7.42"	E29°45'32.53"
Pan System	Pan 11	S25°43'44.73"	E25°43'44.73"

Description	Monitoring Point	Co ordinates	
		Latitude	Longitude
Pan System	Pan 12	S25°46'35.85"	E29°44'19.24"
Pan System	Pan 13	S25°46'56.71"	E29°44'22.27"
Pan System	Pan 20	S25°42'34.91"	E29°45'7.50"
Pan System	Pan 23	S25°46'57.95"	E29°46'29.96"
Pan System	Pan 25	S25°42'24.03"	E29°46'13.40"
Pan System	Pan 29	S25°46'24.34"	E29°45'54.71"

Table 27 shows the results of the February, April and June 2017 water quality analyses as compared against the IWUL limits. The values that are highlighted in red are values that are above (or below in the case of pH and dissolved oxygen) the recommended IWUL limit guidelines.

The following were noted through the water quality analysis:

- EPHs were recorded at low concentrations (0.01 mg/L) in June 2017 for sites K6 and K07;
- The pH in June varied within a rather narrow range of pH units close to neutral (7.22) to alkaline pH (8.65);
- Fluctuations in concentrations were recorded for sodium, chloride, aluminium and manganese, with a general increase in June 2017;
- Pan 26 shows non-compliance with the IWUL limits in both April and June 2017 for most constituents. This is to be expected, since pan water chemistry is typically quite different from flowing/fresh surface water;
- All the samples collected exceeded IWUL limits for ammoniacal nitrogen (as NH_3) and orthophosphate (as $P0_4$);
- Monitoring point K03 showed low levels of dissolved oxygen than stipulated as IWUL requirement;
- Exceedance of S4, suspended solids and turbidity were recorded in at site K01 in June 2017;
- A decrease on levels of alkalinity and Iron at sites SP2 and K03 were noted in June 2017; and
- The results appear to indicate that the impacts are from agricultural activities in the area.

Table 27: Water quality results

Water quality constituent	Units	IWUL Limit	KO3	KO3	KO3	KO4	KO4	KO4	KO6	KO6	KO6	KO7	KO7	KO7	SP1	SP1	SP1
			09/02/2017	04/05/2017	22/06/2017	09/02/2017	04/05/2017	22/06/2017	09/02/2017	04/05/2017	03/07/2017	09/02/2017	04/05/2017	23/062017	09/02/2017	04/05/2017	22/06/2017
pH	pH units	6.5 – 8.4	7.76	7.08	7.65	7.32	6.83	7.22	7.71	7.48	7.71	7.83	7.38	7.81	8.29	8.22	8.35
Electrical conductivity (EC)	mS/m	40	10.3	8.8	10.7	5.1	4.6	4.37	10.5	10.1	9.84	29.8	20.83	18.75	34.7	36.7	39.1
Suspended Solids	mg/l	25	<10	14.4	16	<10	16	10	22	24	<10	19	14	64	<10	10	10
Dissolved oxygen	mg/l	>6	8	7	8	7	7	5	7	7	9	6	6	8	7	8	8
Sulphate as SO_4^{2-}	mg/l	30	2.5	3.3	4.3	1.9	2.3	3.2	2.3	3.6	3.7	6.3	25.9	32.9	9.3	12.1	18.9
Sodium as Na	mg/l	20	12.9	8.9	10.3	5.6	5.1	4.9	9.5	9	10.6	19.2	13.1	13.4	17.2	15.5	17.3
Chloride as Cl^-	mg/l	30	4.2	7.4	8	3.9	4.1	4.7	3.9	5.9	7.2	11.3	7.6	7.3	17.8	17.8	21.5
Turbidity	NTU	5	831	14.4	15.4	15.1	10.3	13.5	44.4	16.5	12.6	9	18	49.5	2	4.4	3.9
Alkalinity as $CaCO_3$	mg/l	120	40	22	22	16	12	7	42	30	27	132	52	37	148	140	148
Iron as Fe	mg/l	1	1.16	0.28	0.414	4.052	1.197	0.745	0.829	0.692	0.551	0.322	0.313	0.456	0.078	0.098	0.1
Aluminium as Al	mg/l	1	0.026	0.46	0.526	0.05	0.059	0.59	0.129	0.062	0.231	<0.02	0.091	.0.257	<0.02	<0.02	<0.020
Manganese as Mn	mg/l	1	0.133	0.028	0.016	0.217	0.042	0.014	0.069	0.028	0.021	2.779	0.472	0.094	0.77	0.047	0.039
Ammoniacal Nitrogen as NH_3	mg/l	0.007	1.2	0.15	0.15	1.43	0.06	0.12	1.20	0.24	<0.03	0.16	0.56	0.37	1.57	0.14	0.14
Ammoniacal Nitrogen as NH_4	mg/l	1	1.27	0.16	0.16	1.51	0.06	0.13	1.27	0.25	<0.03	0.17	0.59	0.39	1.66	0.015	0.15
Nitrite as N*	mg/l	6	0.055	<0.02	<0.006	<0.006	<0.02	<0.006	0.055	3.6	<0.006	<0.006	1.7	<0.006	<0.006	2	<0.006
Nitrate as N*	mg/l	6	0.81	1.8	0.45	0.23	0.7	0.23	0.77	<0.02	0.81	0.23	<0.02	0.32	0.25	<0.02	0.66
Orthophosphate as PO_4	mg/l	0.05	0.08	0.14	-	0.09	0.13	-	0.10	0.17	-	<0.06	<0.06	-	0.08	<0.06	<0.06
Benzene	mg/l	0.1	-	-	-	-	-	-	<0.0005	-	<0.00005	0.0005	-	<0.00005	-	-	-
Toluene	mg/l	0.1	-	-	-	-	-	-	<0.005	-	<0.005	<0.005	-	<0.005	-	-	-
Ethylbenzene	mg/l	0.1	-	-	-	-	-	-	<0.001	-	<0.001	<0.001	-	<0.001	-	-	-
p/m-Xylene	mg/l	0.1	-	-	-	-	-	-	<0.002	-	<0.002	<0.002	-	<0.002	-	-	-
o-Xylene	mg/l	0.1	-	-	-	-	-	-	<0.001	-	<0.001	<0.001	-	<0.001	-	-	-
Naphthalene	mg/l	0.1	-	-	-	-	-	-	<0.002	-	<0.002	<0.002	-	<0.002	-	-	-
EPH (C8-C40)	mg/l	0.1	-	-	-	-	-	-	<0.01	-	<0.010	<0.01	-	<0.010	-	-	-

*Notes: * In April, N03 and N02 was measured as, N03 and N02 respectively and not as N*

Table 46: Continued

Water quality constituent	Units	IWUL Limit	SP2	SP2	SP2	SP4	SP4	SP4	SP5	SP5	SP5	Pan 11	Pan 26	Pan 26
			09/02/2017	04/05/2017	23/06/2017	09/02/2017	04/05/2017	22/06/2017	09/02/2017	04/05/2017	22/06/2017	09/02/2017	04/05/2017	23/06/2017
pH	pH units	6.5 – 8.4	8.24	8.14	8.18	7.78	7.43	7.63	8.03	7.84	8.21	8.70	7.36	8.65
Electrical conductivity (EC)	mS/m	40	23	27.4	25.2	8.9	7.67	8.18	29.9	26.7	29.4	375	71.9	283
Suspended Solids	mg/l	25	<10	14	16	<10	14	10	11	12	24	14	28.6	42
Dissolved oxygen	mg/l	>6	7	7	9	7	8	9	5	7	7	5	1	8
Sulphate as SO_4^{2-}	mg/l	30	2	3.6	8.3	2.1	3.1	3.2	11.6	10.3	14	110.1	39.7	105.6
Sodium as Na	mg/l	20	14.1	16.1	17.2	9.2	8.6	9.6	15.4	13.9	16	931.8	126.5	561.2
Chloride as Cl^-	mg/l	30	4.6	5.6	10	5.1	6.7	7	11.7	11.9	13.8	796.8	96.4	598.4
Turbidity	NTU	5	5	6.5	10.4	9	12.8	9.7	2.9	5.8	18.8	592	28.6	317
Alkalinity as $CaCO_3$	mg/l	120	114	140	108	34	18	17	126	96	108	592	159	356
Iron as Fe	mg/l	1	0.402	0.172	0.131	1.142	0.627	0.414	0.069	0.245	0.102	0.079	0.807	0.666
Aluminium as Al	mg/l	1	<0.02	<0.02	<0.020	0.069	0.029	0.172	<0.02	0.023	<0.02	0.047	0.543	0.899
Manganese as Mn	mg/l	1	0.039	0.057	0.08	0.128	0.022	0.021	0.076	0.018	0.019	0.003	0.031	0.004
Ammoniacal Nitrogen as NH_3	mg/l	0.007	1.28	0.05	<0.03	1.28	0.28	0.12	0.19	0.17	0.12	-	0.66	-
Ammoniacal Nitrogen as NH_4	mg/l	1	1.36	0.05	<0.03	1.36	0.3	0.13	0.2	0.18	0.13	-	0.7	-
Nitrite as N*	mg/l	6	<0.006	0.7	<0.006	<0.006	3.3	<0.006	<0.006	3.5	<0.006	<0.006	<0.2	<0.006
Nitrate as N*	mg/l	6	<0.05	<0.02	0.23	0.36	<0.02	1.13	0.29	<0.02	1.13	0.36	<0.02	0.54
Orthophosphate as PO_4	mg/l	0.05	0.11	0.17	<0.06	0.11	<0.06	<0.06	0.16	0.15	<0.06	1.79	0.25	2.97
Benzene	mg/l	0.1	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	mg/l	0.1	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	mg/l	0.1	-	-	-	-	-	-	-	-	-	-	-	-
p/m-Xylene	mg/l	0.1	-	-	-	-	-	-	-	-	-	-	-	-
o-Xylene	mg/l	0.1	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/l	0.1	-	-	-	-	-	-	-	-	-	-	-	-
EPH (C8-C40)	mg/l	0.1	-	-	-	-	-	-	-	-	-	-	-	-

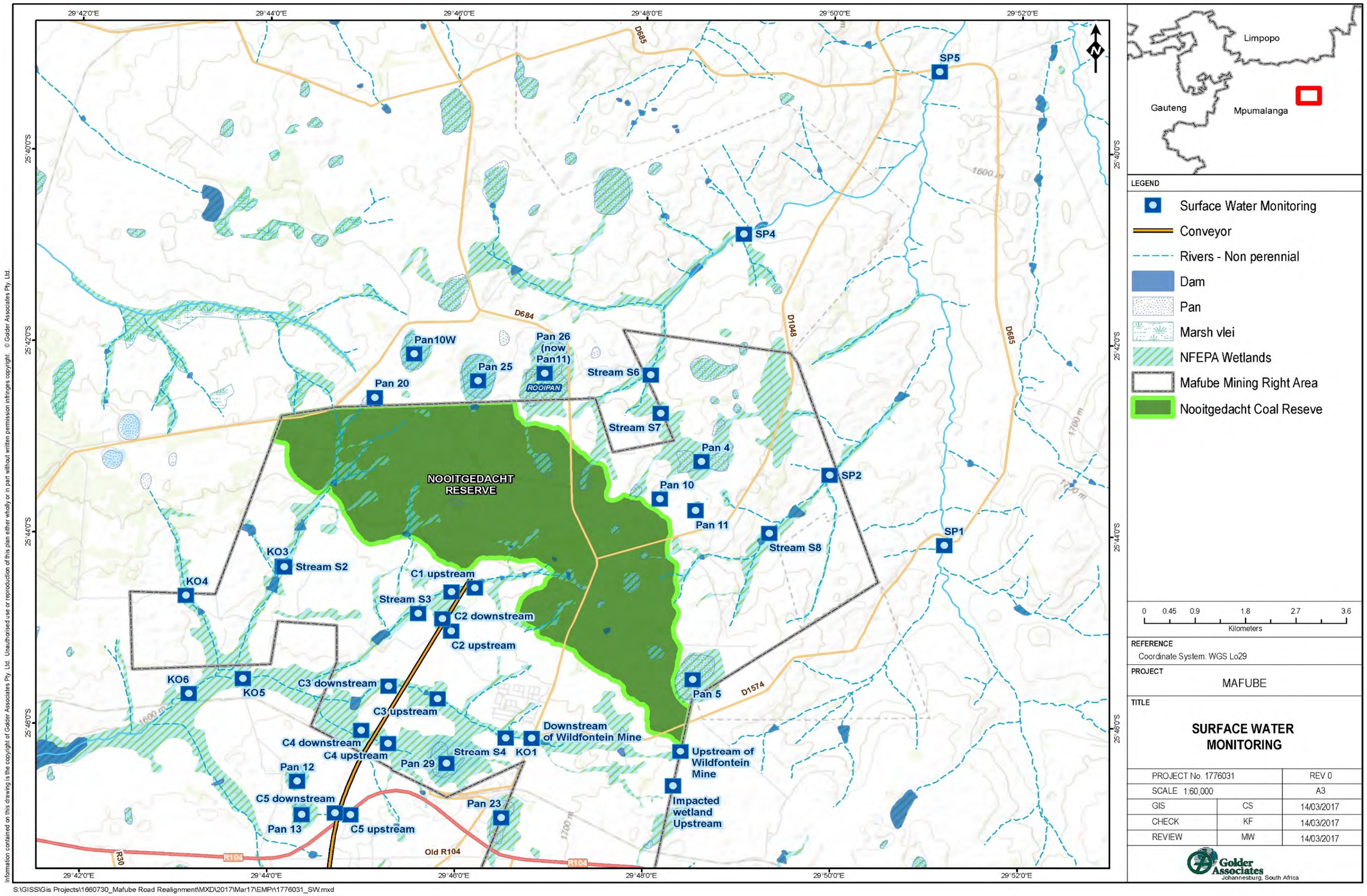


Figure 39: Surface water Monitoring sites

8.7 Groundwater

Groundwater is the main source of water for domestic use and, to a lesser extent, for stock watering. The groundwater resource is accessed through boreholes and occasional springs. Borehole yields may average between 1 to 2 litres per second. The depth of the groundwater table varies with the season and may be anywhere between surface and a depth of about 16 metres. The quality of the groundwater is generally very good.

8.8 Regional Ambient air quality

According to the HPA Baseline Assessment (2010), Steve Tshwete Local Municipality is considered a hotspot area where ambient air quality is poor and ambient PM_{10} and SO_2 concentrations regularly exceed the national ambient air quality standards (NAAQS). These exceedances are the cumulative result of emissions from industries, domestic fuel burning, motor vehicle emissions, mining and cross-boundary transport of pollutants (into the HPA). According to the Baseline document (2010), the Mafube LifeX operations falls in an area where on average fewer than 3 exceedances of the daily PM_{10} air quality standard are predicted, (less than the allowable 4 exceedances per year) (Figure 40).

A cumulative study conducted for Eskom in 2006 predicted elevated PM_{10} concentrations to occur in the region, with background maximum daily concentrations between 25 µg/m³ and 75 µg/m³ and an annual average concentration of about 10 µg/m³.

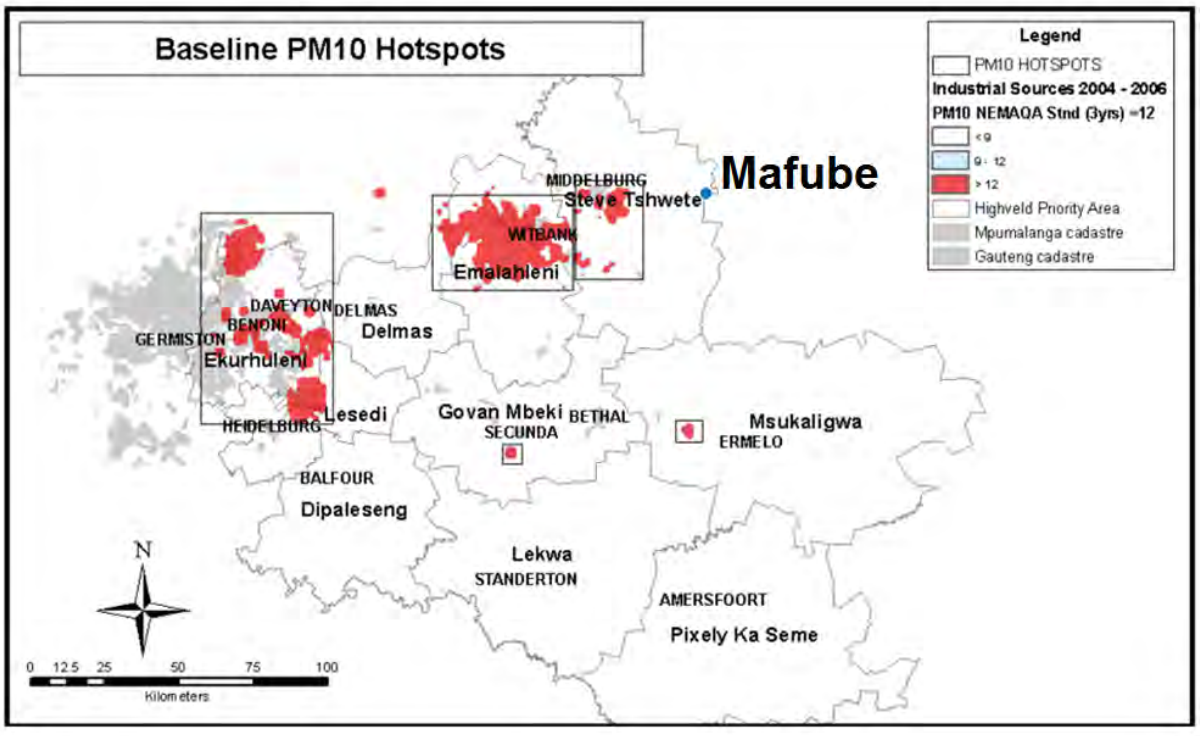


Figure 40: Baseline PM_{10} hotspots within the HPA (adapted from the HPA Baseline Assessment, 2010)

8.8.1 Sources of emissions

The current air pollution sources of concern in the vicinity of the Mafube LifeX operations include:

- Other mines and quarries;
- Heavy vehicles using dirt roads;
- Vehicles' exhaust emissions;

- Coal fired power stations;
- Domestic fuel burning; and
- Agriculture.

These sources and associated emissions are further discussed in the sections that follow.

8.8.1.1 Mining activities

Coal mining operations are prominent emission sources in the HPA. Mining operations include activities that result in the entrainment/suspension of particulate matter, including but not limited to:

- The use of vehicles on unpaved and paved roads for transporting coal, personnel, waste rock etc.;
- Blasting;
- Overburden stripping;
- Coal and overburden materials handling;
- Crushing and screening of coal; and
- Wind entrainment from stockpiles, waste rock dumps and tailings storage facilities.

Dust emissions occur at several points in the storage cycle, such as coal loading onto haul trucks in the mine, discharge onto the Run of Mine (RoM) stockpile, and disturbances by strong wind currents, and load-out from the stockpile (Cowherd et al., 1988). Factors which influence the rate of wind erosion include surface compaction, moisture content, vegetation, and shape of storage pile, particle size distribution, wind speed and rain.

When fresh coal is loaded onto a stockpile, the potential for particulate emissions is at a maximum. Fine coal particles are easily disaggregated and released to the atmosphere upon exposure to air currents, either from the coal transfer itself or from wind erosion (USEPA, 2006).

Gases emitted from coal stockpiles include Volatile organic compounds (VOC's); carbon oxides, hydrocarbons, sulphuric gases and hydrogen. The potential sources of these gases include degassing, low temperature oxidation and, in extreme cases, spontaneous combustion.

Coal beds contain reservoirs of gases, mainly carbon dioxide (CO_2) and methane (CH_4). These gases are stored on the internal surfaces of organic matter or within the molecular structure of the coal. From the moment that coal is exposed to air, it is subject to low temperature oxidation (weathering) by atmospheric oxygen. This process can be sustained if the heat produced by the exothermic oxidation cannot be sufficiently dissipated by heat transfer within the stockpile. Temperatures are therefore generally higher and atmospheric pressures lower than those occurring in the coal beds. These conditions are ideal for degassing. In addition to the CO_2 and CH_4 emitted in the degassing process, dimethylsulphide (DMS) is emitted from lignite (IEA Clean Coal Centre, 2013).

Spontaneous combustion is caused when coal oxidizes and airflow is insufficient to dissipate the heat. During combustion, the reaction between the coal and the air produces oxides of carbon, including CO_2, oxides of sulphur (SO_x), and various oxides of nitrogen (NOx). Because of the hydrogenous and nitrogenous components of coal, hydrides and nitrides of carbon and sulphur are also produced during the combustion process. These include hydrogen cyanide (HCN), sulphur nitrate (SNO_3) and other toxic substances including: arsenic, lead, mercury, nickel, vanadium, beryllium, cadmium, barium, chromium, copper, molybdenum, zinc, selenium and radium (World Coal Institute, 2008).

8.8.1.2 Vehicle emissions

Air pollution generated from vehicle emissions may be grouped into primary and secondary pollutants. Primary pollutants are those emitted directly to the atmosphere as exhaust emissions, whereas secondary pollutants are formed in the atmosphere as a result of atmospheric chemical reactions, such as hydrolysis,

oxidation, or photochemical reactions. The primary pollutants emitted typically include CO_2, CO, hydrocarbons (including benzene, 1.2-butadiene, aldehydes and polycyclic aromatic hydrocarbons (PAHs)), SO_2, NO_x and particulates. Secondary pollutants formed in the atmosphere typically include NO_2, photochemical oxidants such as O_3, hydrocarbons, sulphuric acid, sulphates, nitric acid, and nitrate aerosols (USEPA, 1995).

The quantity of pollutants emitted by a vehicle depends on specific vehicle related factors such as vehicle weight, speed and age; fuel-related factors such as fuel type (petroleum or diesel), fuel formulation (oxygen, sulphur, benzene and lead replacement agents) and environmental factors such as altitude, humidity and temperature (Samaras and Sorensen, 1999).

Pollutants emitted from heavy off-highway vehicles include: particulate matter (PM), NO_X, CO and SO_2. CO is produced as a result of incomplete combustion, while NO_x results from the oxidation of nitrogen at high temperature and pressure in the combustion chamber. SO_2 is derived from the combustion of sulphur in diesel. PM is produced from the incomplete combustion of the diesel, additives in fuels and lubricants, and oil breakdown products that accumulate in the engine lubricant.

8.8.1.3 Vehicle entrainment of dust on unpaved roads

Dust entrainment on unpaved roads is a significant source of local dust emissions in the region Figure 41. Particulate emissions from paved roads occur when loose, spilt material on the road surface becomes suspended as vehicles travel across the road surface and/or when fine particulates are blown from the transported load. At industrial and construction sites, the surface loading is continually replenished by carry-over of material from unpaved roads and spillage from vehicles. Various field studies have shown that even paved roadways can be major sources of atmospheric particulate matter (USEPA, 1995).

Figure 41: Dust generated on D648 by an heavy (left) and light (right) motor vehicles (Golder, 2016)

8.8.1.4 Power generation

As a result of the high temperature combustion process, air pollutants released by coal-fired power stations primarily include fine particulates (PM_{10} and $PM_{2.5}$), SO_2, NO_x, nitric oxide (NO), NO_2, CO, CO_2, nitrous oxide (N_2O), and trace amounts of mercury.

The non-combustible portion of the fuel remains as solid waste. The coarser, heavier waste is called bottom ash and is extracted from the burner, and the lighter, finer portion is fly ash, usually emitted as particulates through the stack and resulting in the formation of particulate matter which is liberated to the atmosphere via a stack (post scrubbing at most power stations).

8.8.1.5 Domestic fuel burning

Both formal and informal housing are noted throughout the region. It is therefore highly likely that households within these communities will use coal, wood and paraffin for space heating and/or cooking purposes. Emissions from these communities are therefore anticipated to impact the region, especially during the winter period due to the increased demand for space heating and occasional temperature inversion conditions.

Domestic fuel burning of coal emits a large amount of gaseous and particulate pollutants, including sulphur dioxide, heavy metals, total and respirable particulates, inorganic ash, carbon monoxide, polycyclic aromatic hydrocarbons (PAHs), and benzo(a)pyrene. Pollutants arising due to the combustion of wood include respirable particulates, NO_2, CO, PAHs, particulate benzo(a)pyrene and formaldehyde. The main pollutants emitted from the combustion of paraffin are NO_2, particulates, CO and PAHs.

8.8.1.6 Agriculture

The area largely comprises large-scale, commercial crop farming. Crop farming may result in increased particulate emissions during the dry winter period due to seasonal wild fires, fallow farmlands, and large-scale field ploughing.

8.8.2 Local ambient air quality monitoring

The Mafube LifeX dust fallout monitoring results for the period from 24 January 2017 to 22 June 2017 are presented in Table 28 and illustrated graphically in Figure 42. Results show exceedances of the dust fallout limit for residential areas (600 mg/m^2/day) were recorded at no less than one monitoring location during each monitoring period. The highest concentrations were typically recorded at D7 and D9, both of which are located along roadways. The highest concentrations were recorded for the 24 February 2017 to 23 March 2017 period. These elevated concentrations were attributed to dust generated by unpaved roads and fallow farm fields.

Table 28: Results from the dust fallout monitoring network (24 January 2017 – 22 June 2017)

Dust-fallout (mg/m^2/day)	2017/01/24 to 2017/02/24	2017/02/24 to 2017/03/23	2017/03/23 to 2017/05/03	2017/05/03 to 2017/06/22
D6	394	283	130	211
D7	No Data	No Data	**777**	288
D8	357	**655**	144	101
D9	No Data	No Data	No Data	No Data
D11	No Data	No Data	No Data	154
D12	No Data	No Data	332	127
D13	**1341**	**2045**	**939**	494
D14	494	341	312	229
D8-E	363	71	306	167
D8-W	401	296	85	195
D8-N	56	486	95	120
D8-S	120	333	166	118
D6-E	83	186	187	157
D6-W	155	160	248	196
D6-N	99	182	173	133
D6-S	74	104	141	146
D14-E	222	341	92	174
D14-W	255	207	136	157
D14-N	175	256	97	164

Dust-fallout (mg/m^2/day)	2017/01/24 to 2017/02/24	2017/02/24 to 2017/03/23	2017/03/23 to 2017/05/03	2017/05/03 to 2017/06/22
D14-S	143	280	130	134
Network Average	296	389	249	182
Network Recovery	80%	80%	90%	95%

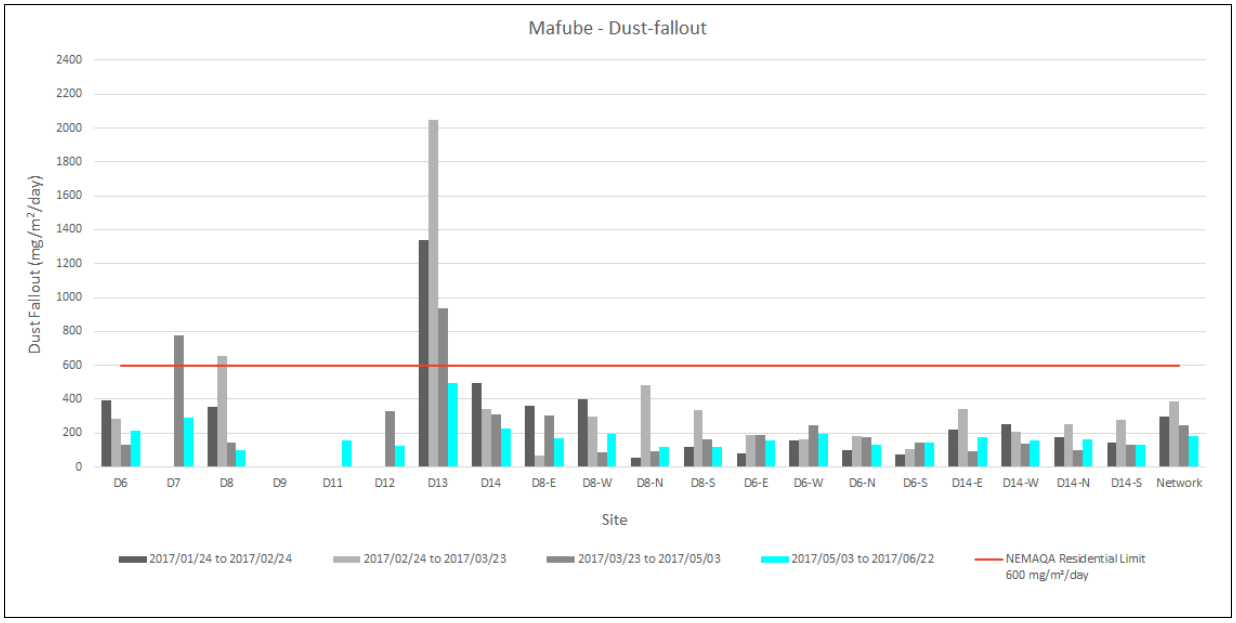


Figure 42: Dust fallout monitoring results from 24 January 2017 to 22 June 2017

The dust fallout monitoring network consists of a number stations, as seen in Figure 44.

Figure 43 reflects a comparison between the results of the dust fallout monitoring conducted by Mafube between 2014 and 2017. Annual average dust fallout results for Mafube are provide in (Table 29). Dust fallout rates in 2016 were approximately 65% to 108% higher in comparison to other years, this difference is most likely as a result of construction activities in the area during 2016.

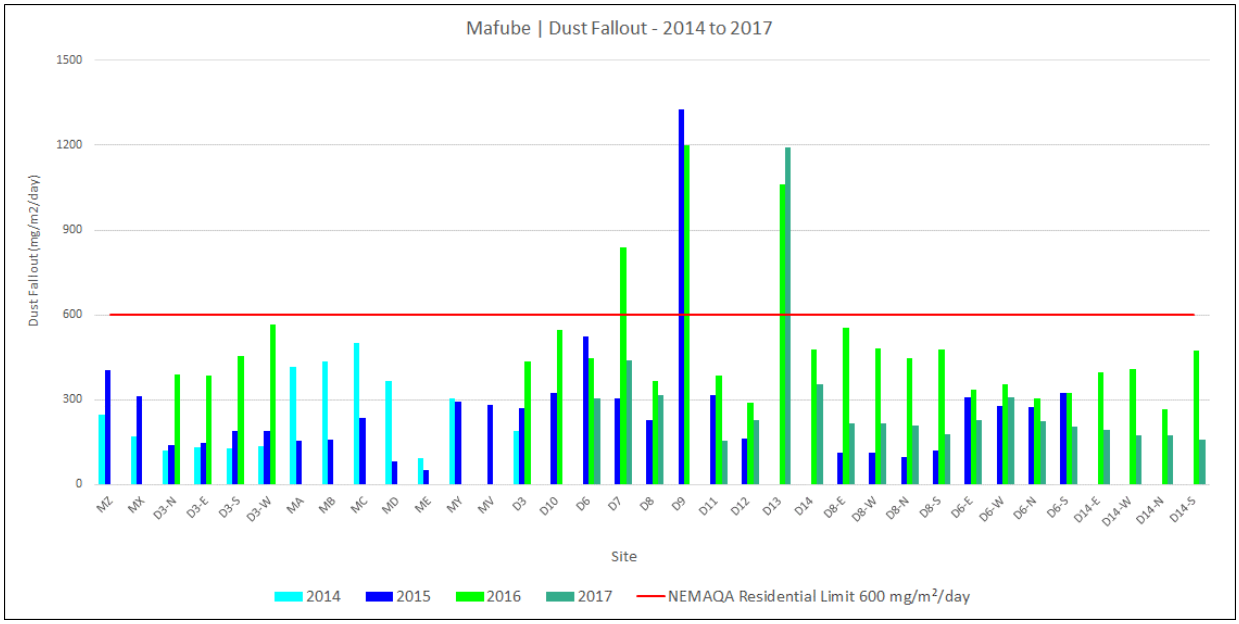


Figure 43: Annual average dust fallout results 2014 – 2017

Table 29: Annual average dust fallout results 2014 – 2017

Site	2014	2015	2016	2017
Network Average	233	235	484	293

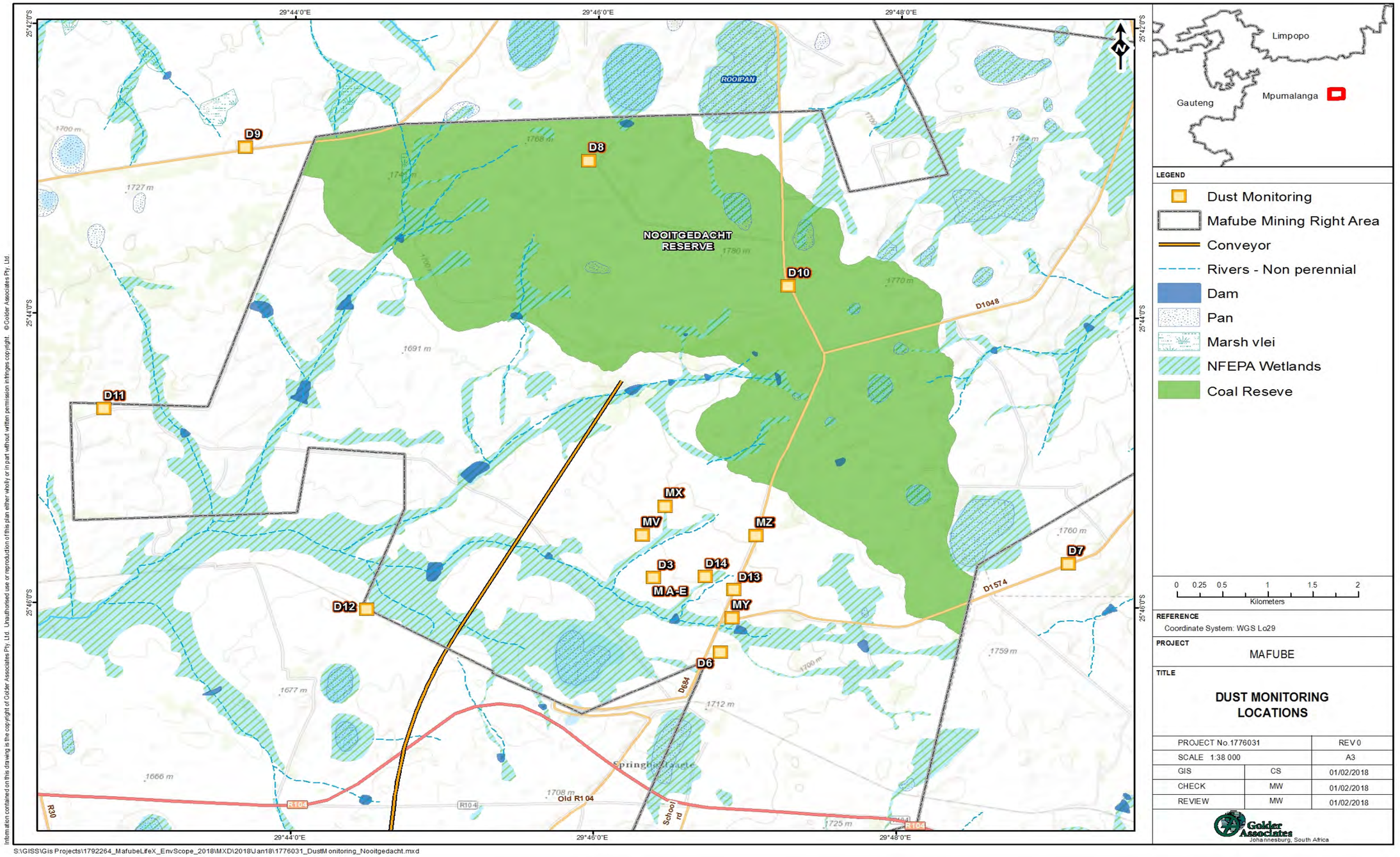


Figure 44: Location of the dust fallout monitoring network

8.9 Ecology

Aquatic Ecology Methodology

This Baseline Assessment Report from an aquatic ecology perspective was based on the following two components:

- Literature Review – The literature review was based on a desktop study of existing ecological specialist reports, GIS maps and expected fish lists (Kleynhans *et al.,* 1999, IUCN, 2016.3). The aim of the literature review was to develop a broad historical characterisation of the study area, including the presence and potential presence of species of conservation importance, (i.e. Red Data and protected species) were also highlighted; and
- Existing data – as a number of aquatic assessments and biomonitoring surveys have been, and continue to be, conducted in the study area by Golder for Mafube (Golder Report No's.: 11616366-11381-8, 1412454-13511-4, 1660730-312402-3), data were retrieved from these studies. Data from the most recent survey conducted during December 2016, formed part of the wet season aquatic biomonitoring programme for the Mafube LifeX operations was used, coupled with historical data taken from surveys conducted in September 2011, March 2012, November 2014 and May 2015, also for the Mafube LifeX operations and Mafube Nooitgedacht Environmental Impact Assessment Project was assessed.

Wetland Study Methodology

Information presented on wetlands and pans in the study area is based on the 2011/2012 study (see Golder Report No. 11616366-11460-13) and a 2014 report by Wetland Consulting Services (Pty) Ltd. Both studies included a field programme and associated sampling.

Terrestrial Ecology Methodology

Terrestrial ecology data presented is based on the 2011/2012 study (see Golder Report No. 11616366-11332-6), but has been updated to reflect current conservation statuses.

The terrestrial ecology study for the original Mafube LifeX operations was conducted during 2011 and 2012. The study comprised two components; a literature review and a field programme. The tasks associated with these components are briefly summarised below:

- Literature Review – The literature review was based on a desktop study of existing ecological specialist reports, biodiversity and conservation databases and guidelines, as well as legislation relevant to the area. The aim of the literature review was to develop a broad historical characterisation of the study area, with an emphasis on identifying and delineating preliminary vegetation communities / land units and compiling lists of flora and fauna potentially occurring on site. The presence and potential presence of species of conservation importance, (i.e. Red Data and protected species) were also highlighted; and
- Field Programme – the field programme consisted of two field surveys; a dry season field survey was conducted in September 2011 and a wet season survey in February 2012. Field surveys comprised both flora and fauna sampling. Vegetation was sampled using line-transects selected in the various vegetation communities / land units. Fauna were sampled using a combination of traps, spot counts and direct (opportunistic encounters) and indirect observations (identification of burrows, tracks, faeces).

8.9.1 Aquatic Ecology

8.9.1.1 Aquatic Study Area – Regional Context

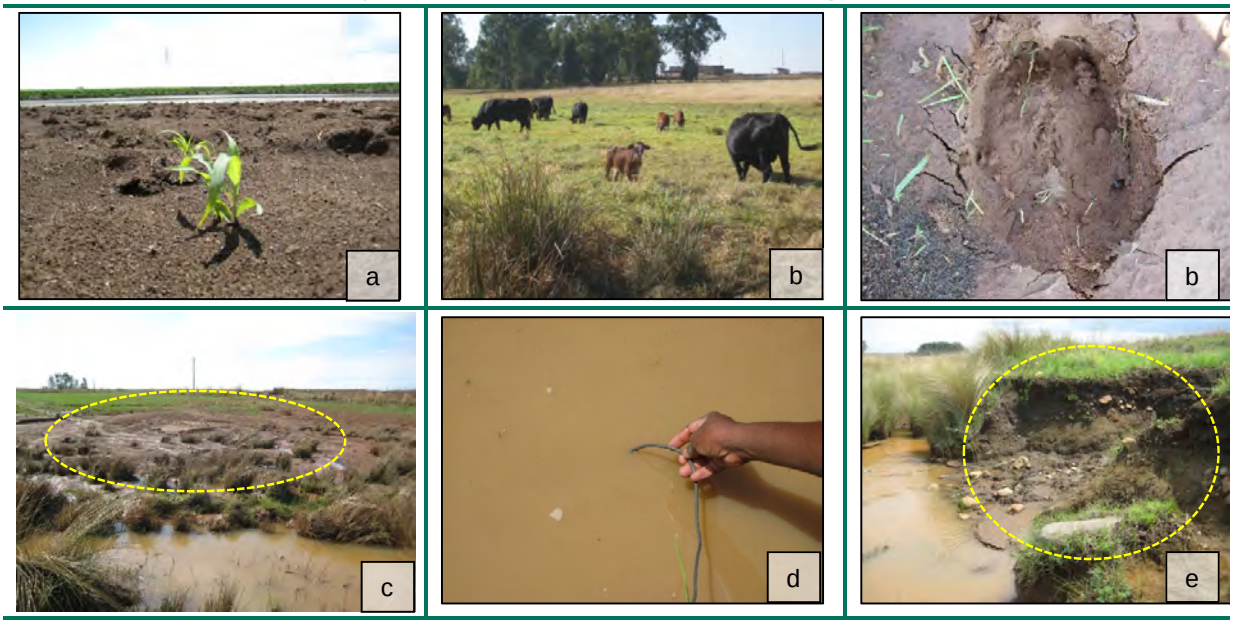
The study area falls within the Olifants Water Management Area (WMA4), Quaternary Drainage Region B12C (Klein-Olifants River) and B41A (Steelpoort River) within the Highveld (11) – Lower Level 1 Ecoregion and the Grassland Biome (Mucina and Rutherford, 2006 and Dallas, 2007). The rivers which have been assessed previously, and which may be affected by the proposed road re-alignment project, include the Steelpoort system and pan systems (Figure 45). In accordance with the Department of Water and Sanitation (DWS, 2013) the Present Ecological Status (PES) of the Steelpoort River is in a Class C (moderately modified) (Figure 45). It is important to note that the Steelpoort River falls within a fish sanctuary for *Enteromius anoplus* (Figure 45). Furthermore, the river falls under the Mpumalanga Biodiversity Conservation Pan (MBCP) for rivers, as it is a highly significant strategic water source area (Figure 45).

There are a number of surrounding impacts in the study area namely, natural and man-made barriers, land use and utilisation of resources (Table 30). It is important to take note of these as any modification or disturbances to the sites or surrounding catchment may have an effect on the biological results previously collected in the aquatic system. As the study area falls within an economic hub for agricultural and mining activities, there are a range of anthropogenic impacts on the Steelpoort River, adjoining tributaries and pan systems.

Table 30: Resource utilization and surrounding impacts in the project area

Illustration and Discussion

Agricultural Activities and Associated Impacts



Agricultural activities (a) within the direct project area are substantial with free roaming cattle (b) have been observed through-out. Overgrazing results in exposed ground cover and promoting increased runoff velocities (c) that transportation of particulates (d) into the receiving rivers, and further resulting in erosion (e).

Large commercial maize fields (a) are located within and surrounding the project area. The pesticides and herbacides used for the management of these crops, further have direct impacts on the rivers in the project area.

Nutrients Inputs

Visible nutrient inputs have been noted. However, high nutrient input has been noted during previous surveys, particularly in November 2014. This may have been attributed to the high level of agricultural activities within the project area. High nutrient input (in the form of nitrates and phosphates) contributed to large volumes of algae blooms at various sites, a sign of eutrophic conditions. The sources of such nutrients may be from the surrounding land-use in the area potentially from mining and agricultural activities.

Illustration and Discussion

Water Abstraction Practices

Water abstraction practices are taking place primarily at Pan 29, adjacent to the railway. Although, this pan is not included within this baseline report, it is important to note that these activities are taking place in the project area

The rivers drain the project area in a north-easterly direction and thus may potentially be directly or indirectly impacted upon.

The sites assessed included 4 sites in the Steelpoort system and 9 pans (Figure 46). Co-ordinates of these sampling sites coupled with site descriptions are listed in Table 31. A map of the project area showing the location of the selected aquatic sampling sites is presented in Figure 46.

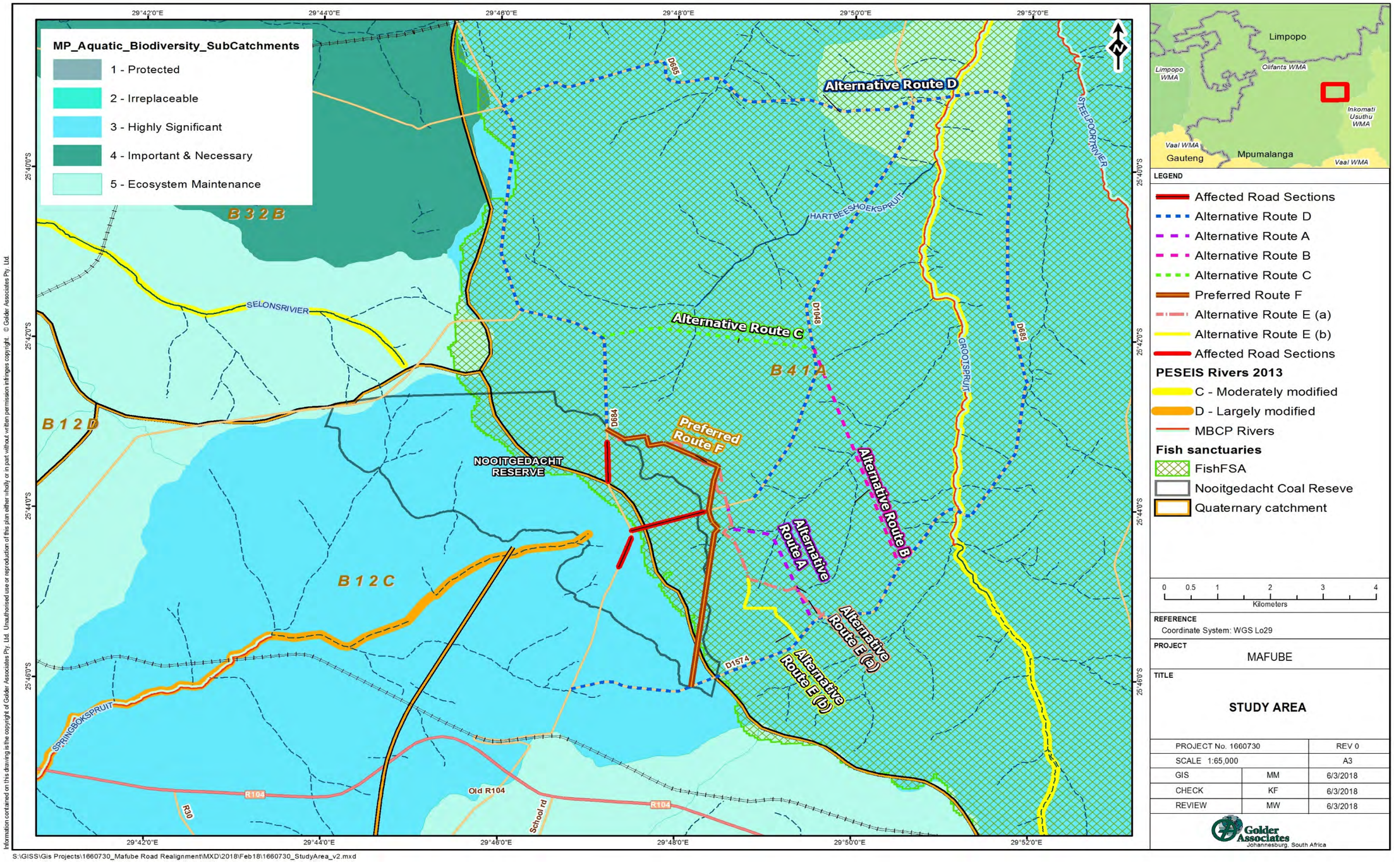


Figure 45: Aquatic study location

Table 31: Selected aquatic sampling sites previously monitored for the Mafube LifeX operations, with three additional pan sites potentially affected by the proposed road realignment project (*WGS_84 Datum co-ordinate system represented in decimal degrees)*

River / pan name	Site Name	Longitude	Latitude	Aquatic System	Description	Flow Conditions at the time of the December 2016 survey
Rivers						
Steelpoort	SP1	29.853407	-25.734917	River	This site is located upstream on the Steelpoort River, west of the proposed new D1048 alternative B road realignment.	Slow Shallow Limited flow conditions
	SP2	29.832983	-25.7228	River	Located within a very deep channel in the Steelpoort River on a farm on the proposed new D1048 alternative B road realignment.	Slow Deep Limited flow conditions
	SP4	29.817445	-25.680875	River	The site is located downstream, north of the proposed new D684 alternative C road realignment	Slow Shallow Moderate flow conditions
	SP5	29.852027	-25.652438	River	This site is the only downstream site located north-east of the proposed new D684 alternative C road realignment situated on the Steelpoort River. The site is further located beyond the Mafube LifeX mining lease area, north-east of the mining infrastructure.	Slow Deep Limited flow conditions
Pans						
Pans	Pan 5	29.808845	-25.758527	Pans	Located upstream from the proposed new D1048 alternative A road realignment.	Shallow water level following rainfall event Sampled Pan (Aquatics)
	Pan 4	29.810156	-25.720554		Located downstream from the proposed new D1048 alternative A road realignment.	Dry (Grass Pan / Seep)
	Pan 10	29.802845	-25.727105			Dry (Grass Pan / Seep)
	Pan 11	29.809186	-25.72909			Dry (Grass Pan / Seep)
	Pan 26 (now Pan 11)	29.782248	-25.705318		Located upstream from the proposed new D684 alternative C road realignment.	Shallow water level following rainfall event Sampled Pan (Aquatics)
	Pan C1	29.817431°	-25.701212°		Located adjacent to the proposed new D1048 alternative A road realignment.	Dry (Grass Pan / Seep).
	Pan C2	29.810748°	-25.705177°			
	Pan C3	29.813902°	-25.698461°			

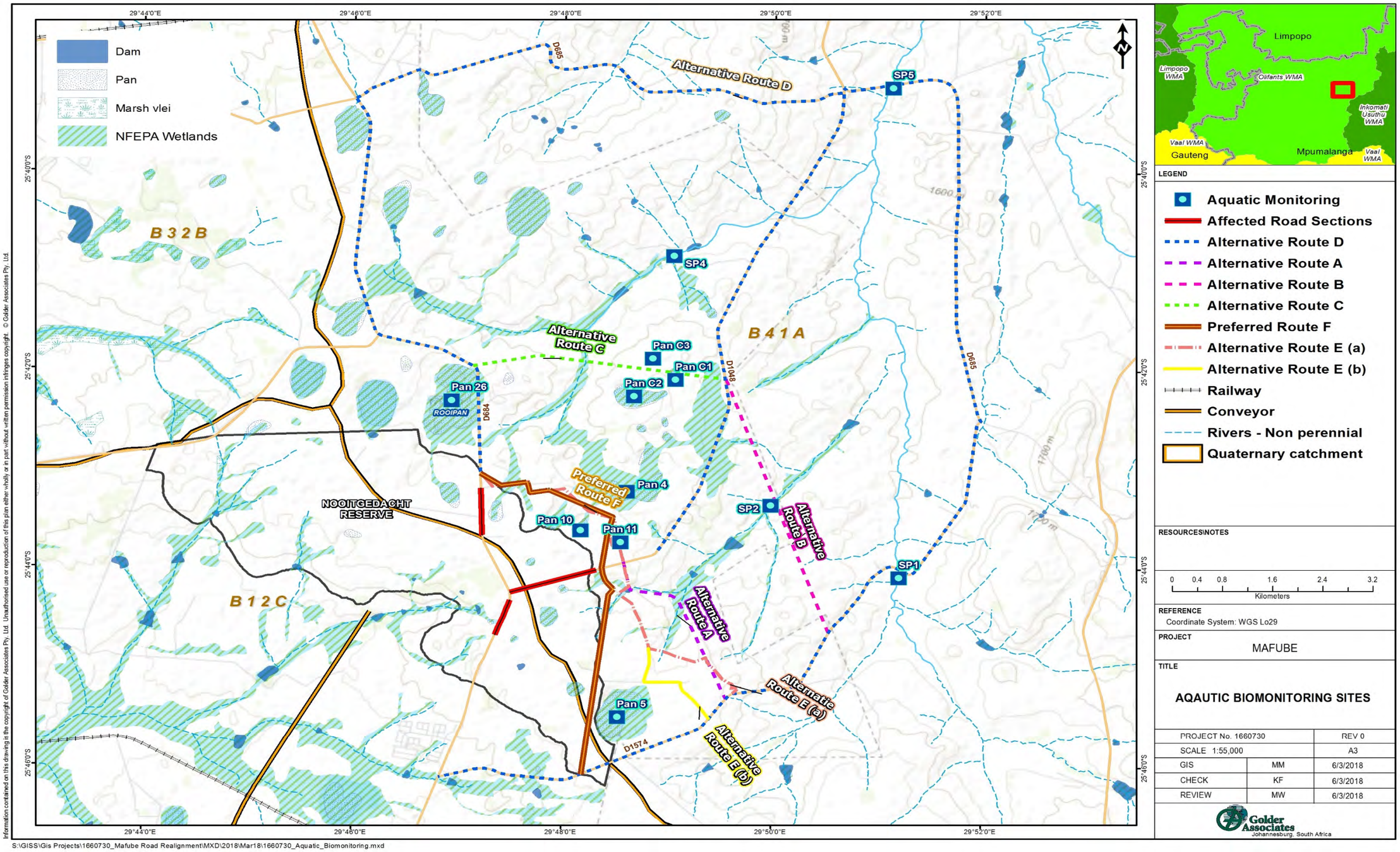


Figure 46: Aquatic biomonitoring sampling sites

8.9.1.2 In situ Water Quality

The *in situ* water quality results within the study area have indicated both spatial and temporal fluctuations. The Steelpoort River's water quality has mostly been acceptable to aquatic ecosystem standards. The percentage saturation levels of dissolved oxygen have however fluctuated within the Steelpoort River system, of which during some surveys were below the guideline value of 80% (Golder report No. 1660730-312402-3). The low saturation levels recorded at the time of all the previous surveys, including the most recent survey, were probably linked to limited flow conditions at the sites, coupled with decaying organic matter on the stream bed. During the decay of the organic material, the microbes involved consumes oxygen in the water column and this will result in hypoxic conditions that can increase respiratory stress, changes in behaviour and consequently elevated mortality rates amongst aquatic biota (Davies and Day, 1998). According to Davies and Day (1998) DO fluctuations can occur in polluted water where salinity can cause an increase in the concertation, while salinity, decomposition of organic pollutants and chemical pollutants can lower the available oxygen in the water. In terms of the pans, pH, TDS concentrations and oxygen saturation at some sites either exceeded or fell below the guideline values. However, as pans are closed systems, with no 'flushing' of water taking place, these results were expected.

In general, the current state of the *in situ* water quality within the study area may be a consequence of the surrounding agricultural and mining practices taking place within the surrounding area. Furthermore, the physical stream characteristics such as limited flow, channelization, instream and bank erosion further contribute to the results observed in the past.

8.9.1.3 Habitat Availability

Overall, the aquatic systems within the study area are homogenous with limited habitat availably. Historically, habitat availability particularly within the Steelpoort River (site SP5) has been recorded as *good* to *poor* (Table 32). This site is characterised by stones-in-current, likely contributing to the *good* and *adequate* habitat availability recorded during the September 2011 and March 2012 surveys respectively (Table 32). The *poor* habitat availability recorded since November 2014, was likely attributed primarily to its deep and wide channel and limited flow conditions. Habitat availability within the adjoining tributaries of the Steelpoort River (visually assessed during previous surveys) would more than likely reflect poor habitat diversity. This may further be as a result of the study area being located high up in the catchment, whereby valley bottom systems have become eroded and thus resulting in naturally poor habitat conditions.

Overall it can be said that the limited habitat availability within this system, including surrounding aquatic systems, is not a consequence of the mining activities, but rather attributed to agricultural activities in the project area. Cattle activity, such as trampling and overgrazing, is resulting in bank and head cut erosion (Table 30 b, c and e) and thus having an effect on the aquatic habitat.

Table 32: Historical Integrated Habitat Assessment System scores for site SP5 on the Steelpoort River (Golder Report No. 1660730-312402-3)

River	Site	IHAS Score (%)				
		Sep'11	Mar'12	Nov'14	May'15	Dec'16
Steelpoort	SP5	64	75	47	32	48

8.9.1.4 Aquatic Macroinvertebrates

Historically, the aquatic macroinvertebrate assemblages within the Steelpoort system have been relatively low. This is primarily attributed to the *poor* habitat availability (limited biotopes) and homogenous nature of the river systems which supports far less biota in the study area. Similar taxa, namely tolerant air breathing taxa and taxa not highly sensitive to pollution impacts, are consistently being recorded within the Steelpoort system and surrounding tributaries. The biotic integrity of the aquatic macroinvertebrate communities in the study area range from slightly impaired (PES Class B – site SP1 and SP2) to severely impaired (PES Class E – site SP4) within the Steelpoort River (Golder Report No. 1660730-312402-3). In general, the relatively low biotic integrity in the study area is not a direct influence of the mining activity in the study area, but more from agricultural practices as mentioned in Section 8.9.1.2. Furthermore, the fact that these river systems

have poor habitat availability and no riparian canopy, further contribute to poor biotic integrity. Cattle trampling and grazing adjacent to the aquatic systems is resulting in exposed soils, increasing the run-off into the rivers, coupled with bank erosion. This has resulted in instream modification temporally, having a direct impact on the aquatic macroinvertebrate assemblages in the study area. Furthermore, high nutrient load into the aquatic systems is resulting in high algae growth. This reduces habitat availably, smothers habits and results in a more homogenous layer over what would have been a more complex substrate. This therefore negatively impacted the taxa which are regarded as mostly intolerant.

During the recent December 2016 survey, aquatic macroinvertebrates were sampled within the pans in the study area. However, owing to the recent drought conditions experienced in the country (end-2015), the biota within the pans were exposed to a suite of adverse environmental conditions/stressors during that period (Hussain and Pandit, 2012). Pans 4, 5, 10, 11, C1, C2 and C3 were dry at the time of that survey, with the exception of Pan 26 (now pan 11) which was inundated by the recent rainfall events. As the survey took place relatively soon after the rains, the aquatic macroinvertebrate communities did not have sufficient time in which to re-colonise owing to this natural disturbance, resulting in low species richness within the pans. In particularly Pan 26 (now Pan 11), no aquatic macroinvertebrates were recorded.

8.9.1.5 Ichthyofauna

A total of 10 indigenous fish species are expected to occur within the study area. One is currently unlisted on the IUCN Red List and nine are least concern. Species in this category are considered to be widespread and abundant (IUCN, 2016.3). Refer to Table 33 below for the expected fish list for the study area.

The most recent fish surveys conducted in the study area were in September 2011, March 2012 and May 2015. Overall, due to the study area being located within the upper reaches of the Steelpoort River catchment area, low fish diversity is expected. *Enteromius anoplus* (Chubbyhead Barb),*E. paludinosus* (Straightfin Barb), *Clarias gariepinus* (Sharptooth Catfish) and *Pseudocrenilabrus philander* (Southern Mouthbrooder) are the only fish species which have been recorded in the study area during the surveys conducted in September 2011, March 2012, November 2014 and May 2015 (Golder Report No. 11616366-11381-8). As displayed in Figure 45, the Steelpoort River falls within a fish sanctuary for *E. anoplus*. This fish species was the most abundant species recorded in the study area during the aquatic surveys (Golder Report No. 11616366-11381-8).

Generally, there is no significant trajectory of change within the fish communities in the study area, due to the mining or anthropogenic activities within the upper catchment. The low fish diversity within the study area is further compromised by the presence of *Micropterus salmoides* (Largemouth bass) (Figure 47) occurring within the dams that have been constructed within the study area. Bass are a species often stocked for recreational fishing purposes. This may be cause for concern as this invasive species threatens the native fishes and aquatic macroinvertebrates and consequently may have a negative impact on the community structure and potentially fragment the indigenous fish populations in the study area. No IUCN red data fish species were sampled in the study area during those sampling events (IUCN, 2016.3, Golder Report number 11616366-11381-8, 1412454-13511-4).

Figure 47: Micropterus salmoides (Largemouth Bass)

Table 33: Fish species expected to occur within the study area (Kleynhans, 1999, IUCN, 2016.3)

Species	Fish Code	Common Name	Likely abundance within project sites	Habitat Preference and Biology	IUCN Status	Species Intolerance Rating	Intolerance Decryption
Amphilius uranoscopus	AURA	Stargazer (Mountain catfish)	Rare	Clear, flowing water in rocky habitats. Feeds on macroinvertebrates and other small organisms of rock surfaces. Breeds in summer.	Least Concern	4.8	Intolerant
Enteromius anoplus	BANO	Chubbyhead Barb	Abundant	Cool waters in a variety of habitats, with good cover. Omnivorous, feeding on insects, seeds, algae and diatoms. Breeds in summer after rain.	Least Concern	2.6	Moderately tolerant
Enteromius neefi	BNEE	Sidespot Barb	Moderate	Cool waters in a variety of habitats, with good cover. Omnivorous, feeding on insects, seeds, algae and diatoms. Breeds in summer after rain.	Least Concern	3.4	Moderately intolerant
Enteromius paludinosus	BPAU	Straightfin Barb	Moderate	A hardy species with a preference for slow-flowing, well-vegetated waters or margins. Omnivore.	Least Concern	1.8	Tolerant
Enteromius trimaculatus	BTRI	Threespot Barb	Moderate	A hardy and common species. A wide variety of well-vegetated habitats. Omnivore. Breeds in summer.	Least Concern	3.0	Moderately intolerant
Labeo umbratus	LUMB	Moggel	Rare	Favours slow-flowing rivers, impoundments and dams. Feeds on soft sediments and detritus. Breeds in summer after rains.	Least Concern	2.3	Moderately tolerant
Labeobarbus polylepis	BPOL	Bushveld Smallscale Yellowfish	Rare	A cool water species. Favours deep pools dams, and flowing waters. Omnivore with distinct seasonal diets. Breeds in spring and summer.	Least Concern	3.1	Moderately intolerant

Species	Fish Code	Common Name	Likely abundance within project sites	Habitat Preference and Biology	IUCN Status	Species Intolerance Rating	Intolerance Decryption
Clarias gariepinus	CGAR	Sharptooth Catfish	Moderate	Occurs in any habitat but favours large floodplains, sluggish rivers, lakes and dams. Completely omnivorous and eats available organic food source. Breeds in summer after rains.	Least Concern	1.2	Tolerant
*Cyprinus carpio**	CCAR	Carp	Moderate	Wide variety of habitats, but favours large, slow-flowing waters with soft substrates or sediments. Omnivorous. Breeds in spring and summer. Introduced species.	Exotic	1.4	Tolerant
*Gambusia affinis**	GAFF	Mosquitofish	Abundant	Requires slow-slowing waters with plant cover. Carnivorous. Tolerant species. Introduced species.	Exotic	2.0	Moderately tolerant
*Micropterus salmoides**	MSAL	Largemouth Bass	Moderate	Favours clear, slow-flowing waters with emergent vegetation. Thrives in dams. Primarily piscivorous, but also carnivorous and cannibalistic. Breeds in spring. Introduced species.	Exotic	2.2	Moderately tolerant
Pseudocrenilabrus philander	PPHI	Southern Mouthbrooder	Abundant	Wide variety of habitats, but favours vegetated zones. Breeds from early spring to late summer.	Unlisted	1.3	Tolerant
Tilapia sparrmanii	TSPA	Banded Tilapia	Moderate	Quiet, slow-flowing waters with emergent vegetation. Omnivore.	Least Concern	1.3	Tolerant

8.9.2 Wetland Ecology

A wetland study and impact assessment of the proposed Mafube LifeX operations was undertaken in 2011/2012 as part of the Environmental Impact Assessment (EIA) process. Several subsequent studies on wetland and pans associated with the project area have also been conducted. These studies focused primarily on the Mafube Mining Rights Area.

8.9.2.1 Regional Context

Mafube is situated within the Highveld DWA Level 1Ecoregion. This Ecoregion boundary is determined by plains with a moderate to low relief. This region is the source of several large rivers. Moist grassland vegetation types are situated towards the east with dryer areas towards the west and south. The wetlands of the study area are further situated within quaternary catchment B12C. The region in which the study area occurs experiences strong seasonal summer rainfall, with very dry winters. Mean annual precipitation is between 650 – 900 mm (average: 726 mm) (Golder Report No. 11616366-11460-13).

8.9.2.2 Wetland Systems at Mafube

The wetland systems associated with the study include various open water pans, shallow grass dominated depressions, valley head and hill-slope seeps, as well as valley bottom wetlands with well-defined stream channel and unchanneled valley bottom wetlands. These have generally already been negatively impacted on by various historic and current activities such as *inter alia*, cultivation, overgrazing, artificial dams and the encroachment of exotic invasive plant species.

The original 2011/2012 wetland study and impact assessment identified about 21 pans in the Mafube Mining Rights Area. The characteristics of the various pans varies; a number are small grass dominated depressions, many of which have been disturbed by cultivation, while others such as Rooipan are fairly large. Pans are generally surrounded by modified land and / or other forms of disturbance and these can have associated negative impacts on pan seepage zones and broader catchments.

Several wetland systems are also present in the area. These are generally closely flanked by cultivation and often negatively impacted by *inter alia*; roads (gravel and tarred), soil borrowing, erosion, farm fences, ploughing, alien invasive species encroachment and the construction of artificial dams /weirs. Refer to Figure 48 and Figure 51 for photograph examples of wetland habitats taken in the study area.

The most recent field-based delineations for the area were conducted in 2015 by Wetland Consulting Services Pty (Ltd) (WCS). Figure 52 shows a delineation of wetlands in the study area based on an overlay of NFEPA database and the WCS 2015 delineations.

Figure 48: Large water-filled pan.

Figure 49: Small grass and sedge pan.

Figure 50: Channelled valley-bottom wetland.

Figure 51: Wetland encroached by the exotic Salix babylonica (willow trees) and flanked by exotic Acacias.

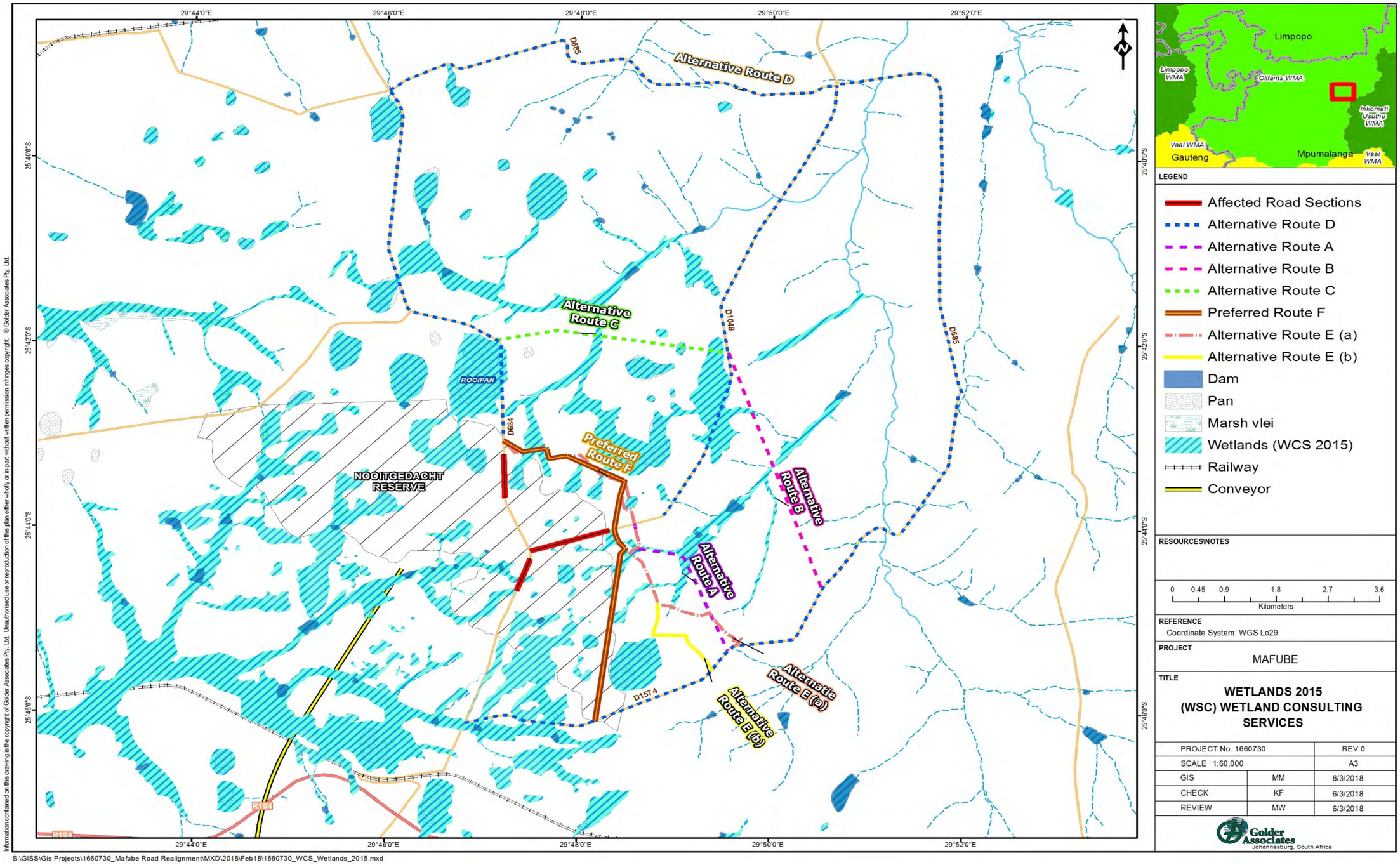


Figure 52: Overlay of the WCS wetland delineations and the NFEPA wetlands showing the various road realignment options.

8.9.3 Terrestrial Ecology

8.9.3.1 Biophysical Environment – Regional Context

The study area is located in the grassland biome, which covers approximately 28% of South Africa and is the dominant biome of the central plateau and inland areas of the eastern subcontinent (Manning, 2009; SANBI, 2013). Grasslands are typically situated in moist, summer rainfall regions that experience between 400 mm and 2000 mm of rainfall per year. Vegetation consists of a dominant field-layer comprising grasses and herbaceous perennials, with little- to no woody plants.

South Africa's grassland ecosystems are aggregated into five groups, with the study area forming part of the 'Mesic Highveld Grasslands' grouping (*sensu* SANBI 2013). These grasslands occur at mid-altitudes and experience warm, wet summers (MAP 700-1200 mm) and cold winters. They are typically highly productive sourveld[3] grasslands that are dominated by long-lived perennial grasses (SANBI, 2013). Fire is common in Mesic Highveld Grasslands and, coupled with frequent winter frost, maintains these ecosystems in a relatively treeless form (SANBI, 2013; Tainton, 1999). Apart from their importance as rich stores of biodiversity, grasslands are critically important water production landscapes, constituting about half of South Africa's Strategic Water Source Areas (SANBI, 2013).

Based on Mucina and Rutherford (2006) delineation of South Africa's vegetation, the study area is characterised by five vegetation types, namely:

- Rand Highveld Grassland;
- Eastern Highveld Grassland;
- Eastern Temperate Freshwater Wetlands;
- Lydenburg Montane Grassland; and
- Sekhukhune Montane Grassland.

8.9.3.2 National and Provincial Conservation Considerations

- In line with the Mpumalanga Biodiversity Sector Plan (2013) and the identification of Critical Biodiversity Areas (CBA), much of the study area comprises 'Modified Land' (both old and current agricultural fields) and 'Other Natural Areas'. Small patches of CBA Optimal and CBA Irreplaceable are present though – Figure 54.
- At a national level, the NEMBA Threatened Ecosystems, (2011) recognises both Rand Highveld Grassland and Eastern Temperate Freshwater Wetlands as Vulnerable ecosystems - Figure 55; and
- The Steenkampsberg Important Bird Area (IBA) is located to the east of the study area – see Figure 56.

[3] Grasslands where vegetation becomes unacceptable to grazers during the dry season and thus do not provide year-round grazing, unless supplemented by salt licks (Tainton, 1999).

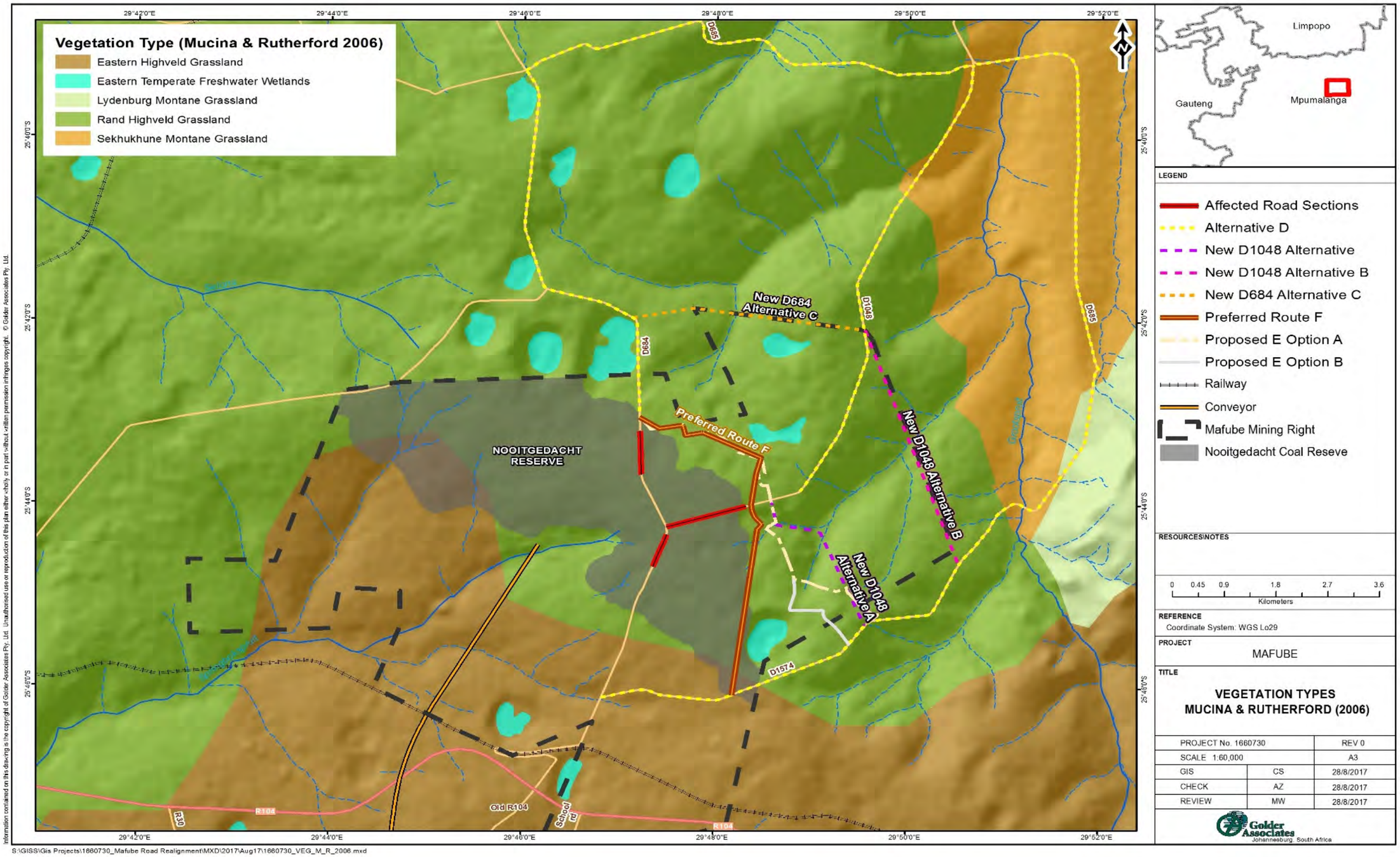


Figure 53: Study area in relation to the regional vegetation types (Mucina & Rutherford, 2006).

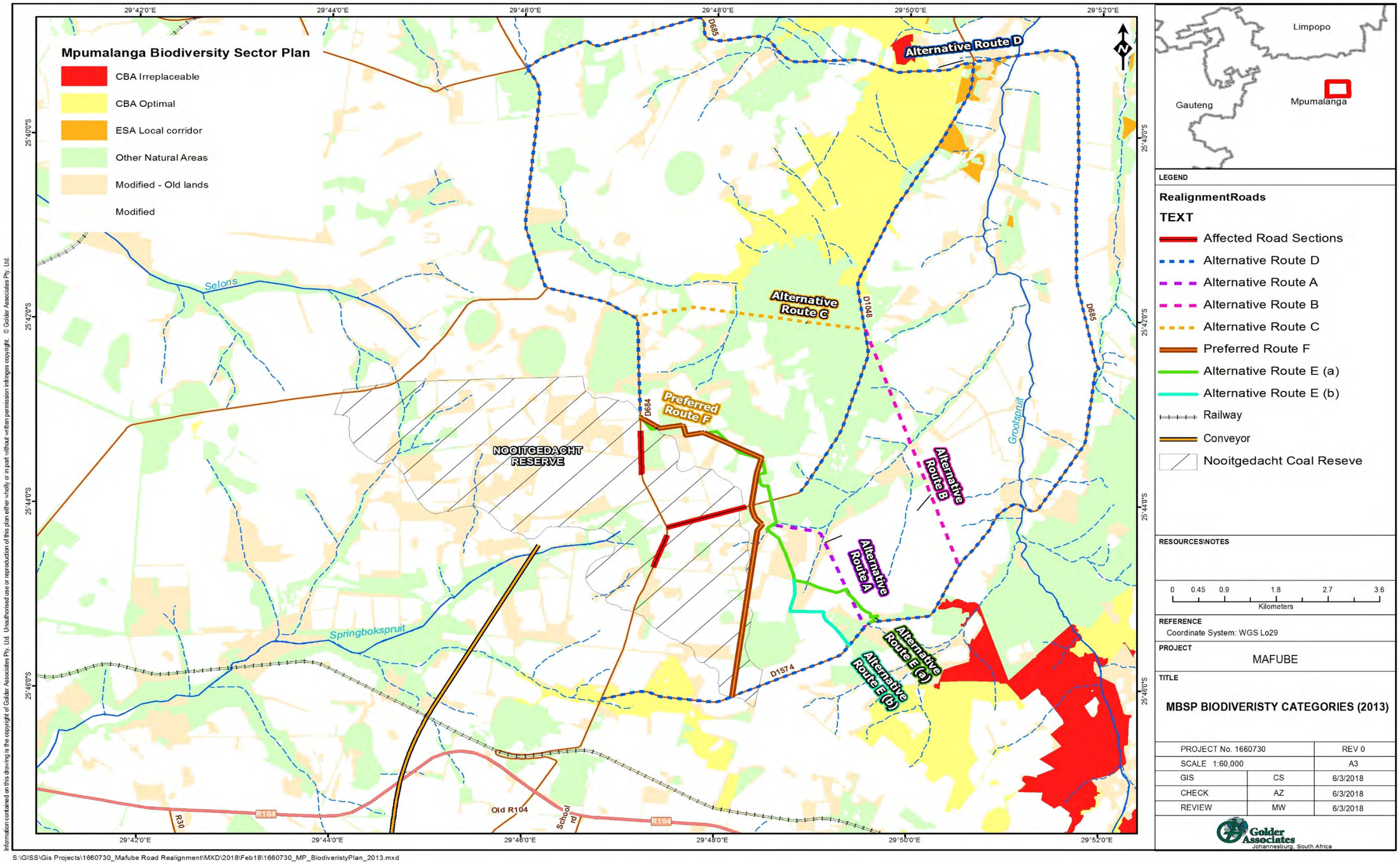


Figure 54: Characterisation of the study area and surrounds in terms of the Mpumalanga Biodiversity Sector Plan (2013).

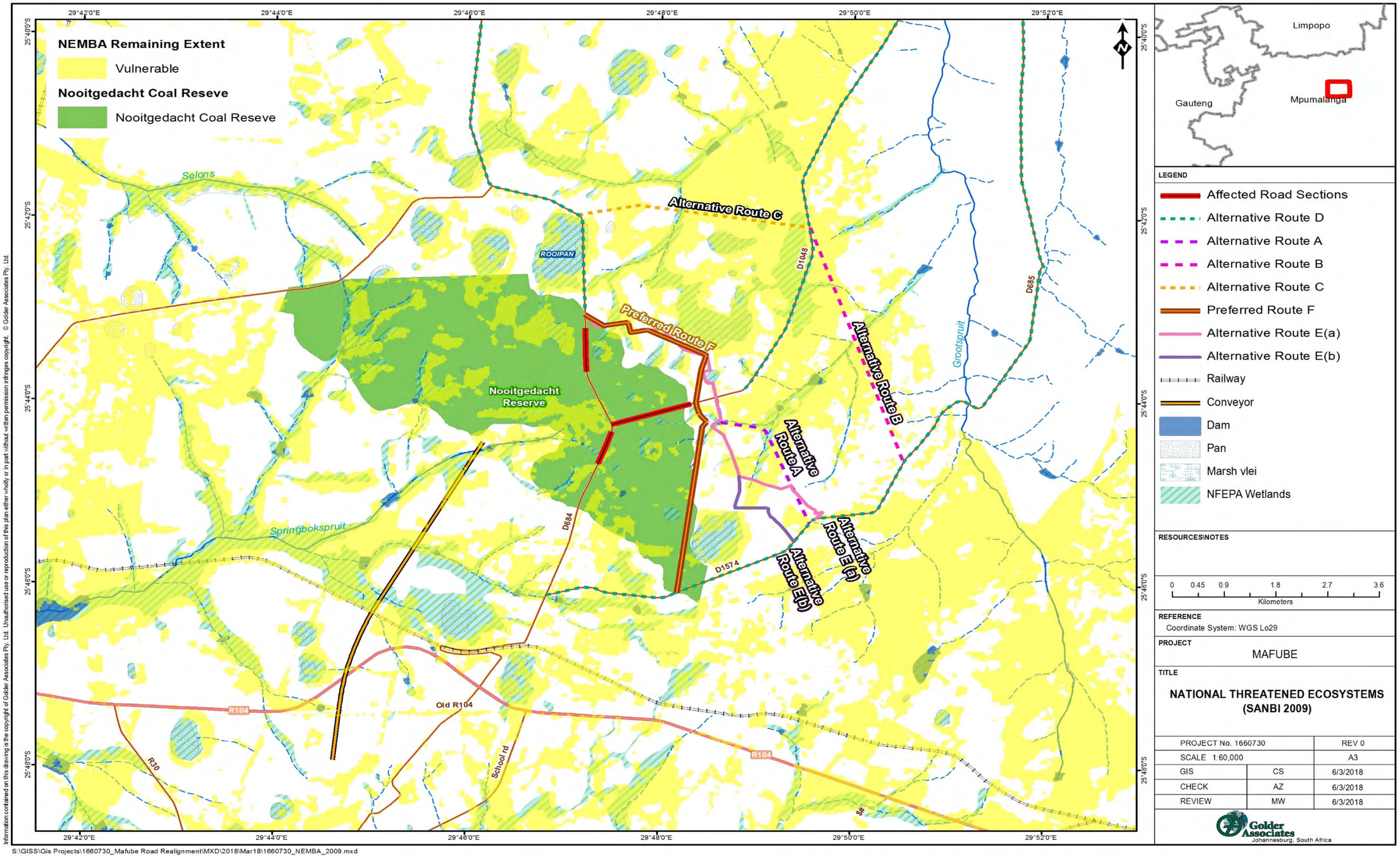


Figure 55: Study area in relation to the NEMBA South African threatened ecosystems.

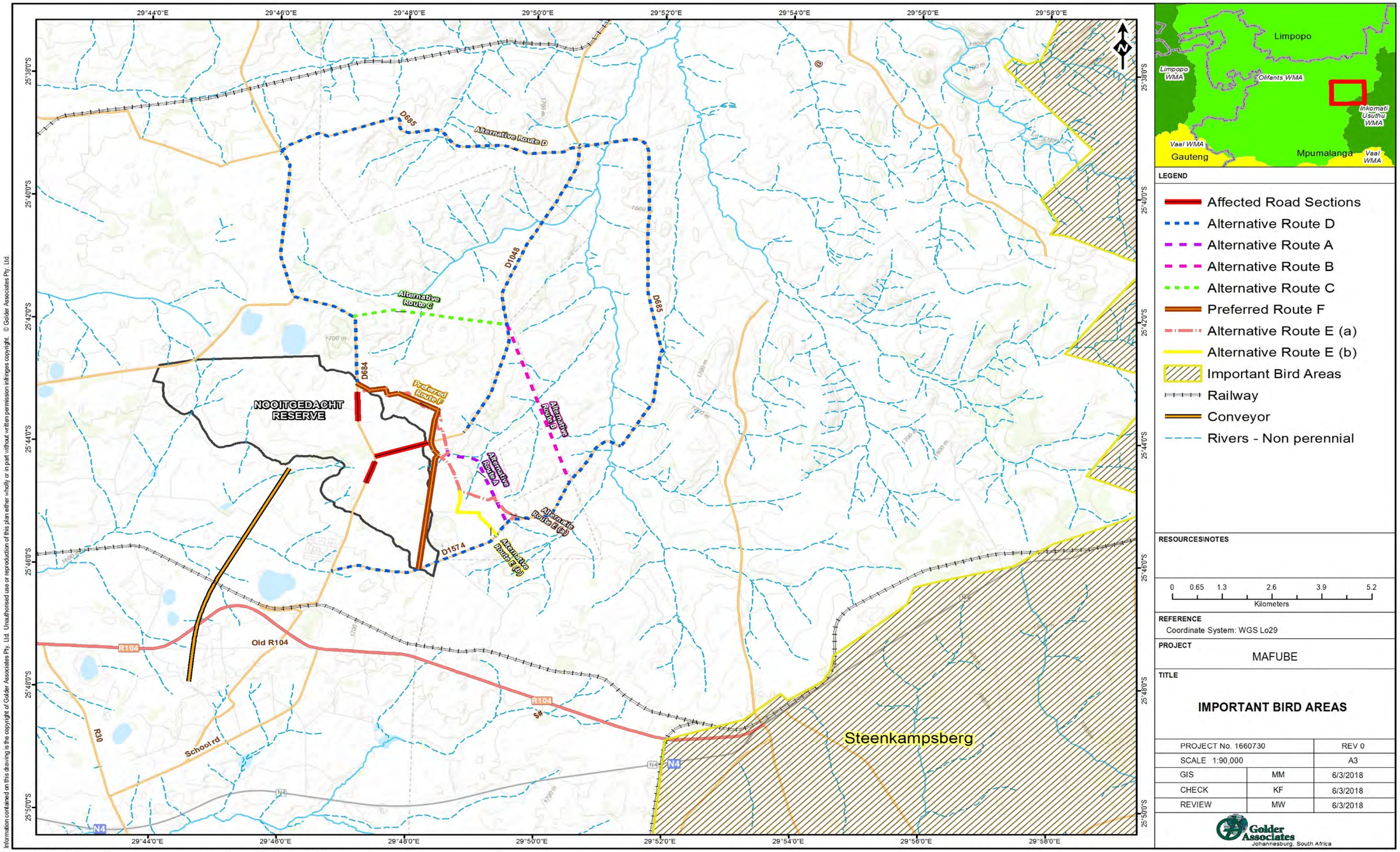


Figure 56: Important Bird Areas in the Mafube LifeX Region.

8.9.3.3 Flora Assessment

Five broad vegetation communities / land units were identified in the study area during the 2011/2012 field programme:

- *Eucalyptus-Acacia* woodlots;
- Disturbed grassland;
- Dry mixed grassland;
- Moist mixed grassland community; and
- Cultivated land

The characteristics of the vegetation communities / land units are detailed below:

8.9.3.3.1 Eucalyptus-Acacia Woodlots

Eucalyptus-Acacia woodlots are found in isolated patches throughout the study area. These areas are depauperate of indigenous vegetation and are dominated by the exotic trees *Eucalyptus* (gums) and *Acacia* (Wattle) and in some areas *Populus* x *canescens* (poplar). Species present in the herbaceous layer include grasses such as *Hyparrhenia hirta*, *Sporobolus africana* and the exotic forbs *Bidens pilosa, Verbena bonariensis, Conyza bonariensis* and *Taraxacum officinale*.

8.9.3.3.2 Disturbed Grassland

Large areas of the study area consist of open grasslands dominated by tall grass species, most notably by *Eragrostis* species and *Hyparrhenia hirta*. The shift in grass composition from a diverse species assemblage to that dominated by *Eragrostis* and *Hyparrhenia* species is typical of Highveld grasslands that have been subjected to some form of disturbances, most often cultivation and/or overgrazing.

Figure 57: Disturbed Grassland

8.9.3.3.3 Dry Mixed Grassland

The Dry Mixed Grassland vegetation community typically occurs in regions of the study area where shallow, rocky soils preclude ploughing and cultivation. These areas are less disturbed and have a higher biodiversity than the Disturbed Grassland vegetation community. In the context of the surrounding landscape matrix, areas of Dry Mixed Grassland act as important refuge and corridor habitats for fauna

Figure 58: Dry Mixed Grassland

8.9.3.3.4 Moist Mixed Grassland

Moist Mixed Grasslands occur along streams and wetlands, and around pans, artificial dams and seeps in the study area. This vegetation community is characterised by grasses including wetland-type species such *as Agrostis spp., Andropogon eucomus, Arundinella nepalensis, Imperata cylindrica, Eragrostis gummiflua, Eragrostis plana.* Forbs, reeds and rushes are also common including various *Cyperus* spp*., Juncus* spp*., Typha capensis.* Woody species recorded include the exotic the common exotics *Acacia and Eucalyptus* species, as well as *Populus* x *canescens* and *Salix babylonica.*

Figure 59: Moist Mixed Grassland

8.9.3.3.5 Cultivated Land

The majority of the study area has been cleared for cultivation, most notably maize (*Zea mays*) production. Cultivated lands that are in current use have no natural vegetation, while lands that have been left fallow are often invaded by pioneer weeds and invasive species such as *inter alia*, *Argemone ochroleuca, Bidens pilosa, Conyza bonariense, Conyza canadensis*, *Datura ferox, Taraxacum officinale* and *Verbena bonariensis,* as well as grasses including *Cynodon dactylon, Eleusine coracana,* various *Hyparrhenia* species and *Melinis repens.*

8.9.3.3.6 Listed Alien Invasive Species

Listed alien invasive species recorded in the study area (Table 34). These are listed under the Conservation of Agricultural Resources Act (CARA) (Act No. 43 of 1983) and the National Environmental Management: Biodiversity Act (2004) (Act No. 10 of 2004) and require control.

Table 34: Declared weeds and invasive plants recorded in the study area in 2011/2012

Scientific Name	Common Name	Afrikaans Name	CARA Category	NEMBA Category
Argemone ochroleuca	White flowered Mexican poppy	Witblom-bloudissel	1	1b
Acacia spp.	Wattle	Wattel	2	1b
Cirsium vulgare	Scottish thistle	Skotse dissel	1	1b
Datura ferox	Large thorn apple	Grootstinkblaar	1	1b
Eucalyptus spp.	Blue gum	Bloekom	2	1b or 2
Opuntia ficus-indica	Sweet prickly pear	Boere-turksvy	1	1b
Populus x canescens	Grey polar	Vaalpopulier	2	2
Salix babylonica	Weeping willow	Treurwilger	2	-
Solanum sisymbriifolium	Dense-thorned bitter apple	Doringtamatie	1	1b
Verbena bonariensis	Wild Verbena	-	-	1b

8.9.3.3.7 Plants of Conservation Importance

Plant species of conservation importance that occur or potentially occur in the study area as per available literature and the field programme are listed in Table 35.

Table 35: Plant species of conservation importance that occur or potentially occur in the study area

Family	Scientific name	Conservation Status		
		Regional IUCN Red List (2015)	NEMBA ToPS List (2013)	Mpumalanga Protected Species (1998)
AGAPANTHACEAE	*Agapanthus campanulatus* subsp. *patens*	Least Concern	-	Protected
AMARYLLIDACEAE	*Brunsvigia radulosa*	Least Concern		Protected
AMARYLLIDACEAE	*Boophone disticha*	Declining	-	Protected
AMARYLLIDACEAE	*Crinum bulbispermum*	Declining		Protected
AMARYLLIDACEAE	*Crinum graminicola*	Least Concern	-	Protected
AMARYLLIDACEAE	*Nerine gracilis*	Near Threatened	-	Near Threatened
APOCYNACEAE	*Brachystelma chloranthum*	Least Concern	-	Protected
APOCYNACEAE	*Ceropegia rendallii*	Least Concern	-	Protected
APOCYNACEAE	*Miraglossum davyi*	Vulnerable	-	Protected
ASPHODELACEAE	*Aloe ecklonis*	-	-	Protected
ASPHODELACEAE	*Aloe greatheadii* var. *davyana*	Least Concern	-	Protected
ASPHODELACEAE	*Aloe lineata*	-	-	Protected
ASPHODELACEAE	*Aloe longibracteata*	-	-	Protected
ASPHODELACEAE	*Aloe masculata*	-	-	Protected
ASPHODELACEAE	*Aloe mutabilis*	-	-	Protected
ASPHODELACEAE	*Aloe reitzii* var. *reitzii*	Near Threatened	-	Near Threatened
ASPHODELACEAE	*Kniphofia typhoides*	Near Threatened	-	Protected

Family	Scientific name	Conservation Status		
		Regional IUCN Red List (2015)	NEMBA ToPS List (2013)	Mpumalanga Protected Species (1998)
AQUIFOLIACEAE	*Ilex mitis* var. *mitis*	Declining	-	Protected
ARACEAE	*Zantedeschia albomaculata* subsp. *albomaculata*	Least Concern	-	Protected
ASTERACEAE	*Callilepis leptophylla*	Declining	-	-
GESNERIACEAE	*Streptocarpus latens*	Rare	-	Rare
GESNERIACEAE	*Streptocarpus denticulatus*	Vulnerable	-	Vulnerable
HYACINTHACEAE	*Drimia altissima*	Declining	-	Declining
HYACINTHACEAE	*Eucomis autumnalis*	Declining	-	Protected
HYACINTHACEAE	*Eucomis montana*	Declining	-	Protected
HYACINTHACEAE	*Eucomis pallidiflora* subsp. *pallidiflora*	Least Concern	-	Protected
HYACINTHACEAE	*Merwilla plumbea*	Near Threatened	-	Near Threatened
IRIDACEAE	*Gladiolus longicollis* subsp. *longicollis*	Least Concern	-	Protected
IRIDACEAE	*Gladiolus paludosus*	Least Concern	-	Protected
IRIDACEAE	*Gladiolus papilio*	Least Concern	-	Protected
IRIDACEAE	*Gladiolus elliotii*	Least Concern		Protected
IRIDACEAE	*Gladiolus crassifolius*	Least Concern		Protected
IRIDACEAE	*Gladiolus pole-evansii*	Rare	-	Protected
IRIDACEAE	*Gladiolus vernus*	Least Concern	-	Protected
IRIDACEAE	*Gladiolus woodii*	Least Concern	-	Protected
IRIDACEAE	*Hesperantha coccinea*	Least Concern	-	Protected
MESEMBRYANTHEMACEAE	*Delosperma lydenburgense*	Least Concern	-	Protected
MESEMBRYANTHEMACEAE	*Delosperma obtusum*	Least Concern	-	Protected
MESEMBRYANTHEMACEAE	*Khadia carolinensis*	Vulnerable	-	Protected
OLEACEAE	*Olea capensis* subsp. *enervis*	Least Concern	-	Protected
ORCHIDACEAE	*Disa cooperi*	Least Concern	-	Protected
ORCHIDACEAE	*Disa versicolor*	Least Concern	-	Protected
ORCHIDACEAE	*Eulophia ovalis var. bainesii*	Least Concern	-	Protected
ORCHIDACEAE	*Eulophia ovalis var. ovalis*	Least Concern	-	Protected
ORCHIDACEAE	*Eulophia zeyheri*	Least Concern	-	Protected
ORCHIDACEAE	*Habenaria dregeana*	Least Concern	-	Protected
ORCHIDACEAE	*Habenaria bicolor*	Near Threatened	-	Protected
ORCHIDACEAE	*Habenaria kraenzliniana*	Near Threatened	-	Protected
ORCHIDACEAE	*Satyrium hallackii* subsp. *ocellatum*	Least Concern	-	Protected
ORCHIDACEAE	*Satyrium parviflorum*	-	-	Protected
ORCHIDACEAE	*Eulophia cooperi*	Least Concern	-	Protected

Family	Scientific name	Conservation Status		
		Regional IUCN Red List (2015)	NEMBA ToPS List (2013)	Mpumalanga Protected Species (1998)
SCROPHULARIACEAE	*Jamesbrittenia macrantha*	Near Threatened	-	Near Threatened
ZAMIACEAE	*Encephalartos lanatus*	Vulnerable	Protected	Specially protected

Conservation statuses: SANBI (2015), NEMBA ToPS List (2013) and Mpumalanga Nature Conservation Act (1998).

8.9.3.4 Fauna Assessment

8.9.3.4.1 Mammals

Based on available literature, 63 mammal species potentially occur in the central grasslands of Mpumalanga Province. Eleven species were recorded in the study area during the 2011/2012 field programme, including Scrub Hare (*Lepus saxatilis*), Porcupine *(Hystrix africaeaustralis*), Black-backed Jackal *(Canis mesomelas*), Slender Mongoose (*Atiliax paludinosus*), Yellow Mongoose (*Cynictis penicillata*), African Wild Cat (*Felis lybica*), Aardvark (*Orycteropus afer*), Common Duiker (*Sylvicapra grimmia*), Steenbok (*Raphicerus campestris*), Red Veld Rat (*Aethomys chrysophilus*) and Four-striped Mouse (*Rhabdomys pumilio*). The low diversity, particularly of small mammals is attributed to the disturbed nature of much of the study area.

Table 36: Red Data and protected mammal species that may occur in the study area

Scientific name	Common name	Conservation Status		
		Red List (2016)	NEMBA TOPS List (20137)	Mpumalanga Protected Species (1998)
Chrysospalax villosus	Rough-haired Golden Mole	Vulnerable	Critically Endangered	-
Amblysomus robustus	Robust Golden Mole	Vulnerable	Endangered	-
Amblysomus septentrionalis	Highveld Golden Mole	Near Threatened	-	-
Dasymys incomtus	Water Rat	Near Threatened	-	-
Vulpes chama	Cape Fox	-	Protected	-
Aonyx capensis	Cape-clawless Otter	Near Threatened	Protected	Protected
Leptailurus serval	Serval	Near Threatened	Protected	
Proteles cristatus	Aardwolf	-	-	Protected
Parahyaena brunnea	Brown Hyaena	Near Threatened	Protected	-
Mellivora capensis	Honey Badger	-	Protected	Protected
Ourebia ourebi	Oribi	Endangered	Endangered	Protected
Raphicerus campestris	Steenbok	-	-	Protected
Pelea capreolus	Grey Rhebok	Near Threatened	Protected	Protected
Lutra maculicollis	Spotted-necked Otter	Vulnerable	Protected	Protected
Felis nigripes	Black-footed Cat	Vulnerable	Protected	Protected
Atelerix frontalis	South African Hedgehog	Near Threatened	Protected	Protected
Orycteropus afer	Aardvark	-	Protected	Protected

Scientific name	Common name	Conservation Status		
		Red List (2016)	NEMBA TOPS List (20137)	Mpumalanga Protected Species (1998)
Redunca fulvorufula	Mountain Reedbuck	-	-	Protected

8.9.3.4.1.1 Birds

Approximately 305 bird species have been recorded in the relevant quarter degree squares in which the study area is located according to SIBIS:SABIF (2009) database. Common birds recorded in the grassland and woodlot communities in the study area include Longtailed Widow (*Euplectes progne*), Hadeda Ibis (*Bostrychia hagedash*), Familiar Chat (*Cercomela familiaris*), Pied crow (*Corvus albus*), Black-shouldered kite (*Elanus caeruleus*), Red-billed Quelea (*Quelea quelea*), Fiscal Shrike (*Lanius collaris*), Laughing Dove (*Streptopelia senegalensis*) and the Cape Turtle Dove *(Streptopelia capicola*). In the pan and wetland environments water birds such as the Red-knobbed Coot (*Fulica cristata*), White-breasted Cormorant (*Phalacrocorax carbo*), Yellow-billed Duck (*Anas undulata*), Willow Warbler (*Phylloscopus trochilus*), Spurwinged Goose (*Plectropterus gambensis*) and the Knob-billed Duck (*Sarkidiornis melanotos*) were common. Greater flamingo (*Phoenicopterus ruber*) were also recorded in the study area. This species is listed as Near Threatened. Some additional birds of conservation importance that may occur in the study area are listed in Table 37.

Table 37: Red data and protected bird species that may occur in the study area

Scientific name	Common name	Conservation Status		
		Red List (2016)	NEMBA TOPS List (2013)	Mpumalanga Protected Species (1998)
Alcedo semitorquata	Half-collared Kingfisher	Near Threatened	-	Protected
Anthropoides paradiseus	Blue Crane	Near Threatened	Vulnerable	Protected
Balearica regulorum	Grey Crowned Crane	Endangered	Vulnerable	Protected
Bugeranus carunculatus	Wattled Crane	Critically Endangered	Critically Endangered	Protected
Ciconia nigra	Black Stork	Vulnerable	-	Protected
Circus ranivorus	African Marsh Harrier	Endangered	-	Protected
Eupodotis caerulescens	Blue Korhaan	-	-	Protected
Geronticus calvus	Southern Bald Ibis	Vulnerable	Vulnerable	Protected
Glareola nordmanni	Black-winged Pratincole	Near Threatened	-	Protected
Lissotis melanogaster	Black-bellied Korhaan	-	-	Protected
Neotis denhami	Denham's Bustard	Vulnerable	Vulnerable	Protected
Phoenicopterus minor	Lesser Flamingo	Near Threatened	Protected	Protected
Phoenicopterus ruber	Greater Flamingo	Near Threatened	Protected	Protected
Sagittarius serpentarius	Secretarybird	Vulnerable	-	Protected
Spizocorys fringillaris	Botha's Lark	Endangered	-	Endangered
Tyto capensis	Grass Owl	Vulnerable	-	Protected

8.9.3.4.1.2 Herpetofauna

Based on available literature 48 reptile and 18 amphibian species potentially occur in the study area. Two species potentially occurring in the study area; namely Breyer's Long-tailed Seps (*Tetradactylus breyeri*) and the Striped Harlequin Snake (*Homoroselaps dorsalis*), are listed as Vulnerable and Near Threatened, respectively (Bates *et al.*, 2014), while 13 species are considered endemic (Bates *et al.*, 2014) - listed in Table 38.

The Giant Bullfrog (*Pyxicephalus adspersus*) is listed as Near Threatened on the regional IUCN Red List (Minter *et al.*, 2004) and as protected in Mpumalanga Province. Although not recorded during this study, Giant Bullfrog have been recorded at sites designated as highly significant by the MBSP, which occur in the south-west of the study area (Pers. comm. M. Lotter 2012).

Table 38: Reptiles of conservation importance potentially occurring in the study area

Family	Scientific name	Common name	Status	Red List (2014)
Agamidae	*Agama aculeata distanti*	Eastern Ground Agama	Endemic	-
Colubridae	*Philothamnus natalensis*	Natal Green Snake	Endemic	-
Cordylidae	*Pseudocordylus melanotus melanotus*	Common Crag Lizard	Endemic	-
	Smaug vandami	Van Dam's Dragon Lizard	Endemic	-
	Platysaurus orientalis orientalis	Sekhukhune Flat Lizard	Endemic	-
	Chamaesaura aenea	Coppery Grass Lizard	Endemic	Near threatened
Gekkonidae	*Lygodactylus nigropunctatus*	Black-spotted Dwarf Gecko	Endemic	-
	Lygodactylus ocellatus ocellatus	Spotted Dwarf Gecko	Endemic	-
	Pachydactylus affinis	Transvaal Gecko	Endemic	-
Gerrhosauridae	*Tetradactylus breyeri*	Breyer's Long-tailed Seps	Endemic	Vulnerable
Lamprophiidae	*Homoroselaps lacteus*	Spotted Harlequin Snake	Endemic	-
	Lamprophis aurora	Aurora House Snake	Endemic	-
	Lycodonomorphus inornatus	Olive Ground Snake	Endemic	-
	Duberria lutrix lutrix	South African Slug-eater	Endemic	-
	Homoroselaps dorsalis	Striped Harlequin Snake	Endemic	Near Threatened
Scincidae	*Acontias gracilicauda*	Thin-tailed Legless Skink	Endemic	-

Source: Bates *et al.*(2014)

8.10 Visual

8.10.1 Landscape Character

The proposed mining area lacks any prominent topographical features and is characterised by gently undulating plains. Seasonally, pans and inundated wetlands are a distinctive feature in the landscape, particularly in the northern section of the site. Local watercourses drain into the Klein-Olifants River, which in turn drains into the Middelburg Dam. The site itself is representative of the local topography and does not include any distinctive topographical features. The vegetation in the area is dominated by Highveld grasses with an abundance of cosmos within the surrounding areas. The vegetation in the area has been severely impacted by agricultural activities, resulting in natural vegetation being limited to areas unsuitable for ploughing. These areas are however then heavily utilized for livestock grazing, predominately by cattle for the beef market.

Land use in the study area includes Eskom power stations, coal and platinum mining activities, and a strong agricultural sector comprising cultivation and livestock grazing, with supporting infrastructure such as grain silos and the Arnot railway siding located in the south-eastern section of the study area. Subsistence farming is limited to small areas surrounding commercial agricultural operations. Other land uses include isolated nodes of forestry. Middelburg is now the largest commercial and residential centre in the Steve Tshwete Local Municipality. Businesses include a general dealer, farming cooperative and silos located next to the Arnot siding. The residential component includes farmsteads and workers' housing, scattered through the study area, as well as the Sikhululiwe village, located in the south-eastern section of the study area and built to accommodate relocated families within the area. The main road and rail infrastructure in the area includes the N4, which runs east-west approximately 1km south of the project, the R104, running more or less parallel to the N4 just to the north of it as well as other local tarred and dirt roads, and the Mozambique railway line. Other support infrastructure includes Eskom power lines and telecommunication lines.

8.10.2 Sense of Place and Aesthetic Value

The road realignment project area is located within an area dominated by gently undulating plains. The sense of place is established by the 'openness' of the topography, enhancing the rural character of the agricultural activities. The farmsteads and associated structures also add to the rural character of the study area. Another element contributing to the sense of place is the existing mining activities. These are mostly open cast activities with supporting structures and infrastructure. Landscapes with greater diversity or containing "distinctive" features are classified as having a higher scenic value than landscapes with low diversity, few distinctive features, or more "common" elements. Generally, the greater the diversity of form, line, texture, and colour in a landscape unit or area, the greater the potential for high scenic value. Scenic quality classifications are:

- High - distinctive landscape, often with a strong sense of place;
- Moderate - common landscape; and
- Low - minimal landscape, often with a weak sense of place.

'Land types', each with its dominant landscape characteristic, sense of place and aesthetic value within the study area, have been identified as follows: Land types with a low scenic quality classification include roads, the railway, power and telecommunication infrastructure as well as the infrastructure and structures associated with the mining activities. A moderate rating was assigned to farmsteads and agricultural support facilities such as grain silos. Agricultural activities, crop production and grazing as well as the natural grassland vegetation were assigned a high scenic quality.

The scenic quality of the landscape within the study area is rated as moderate to high within the context of the sub-region. A summary of the scenic quality of the various landscape types is contained in Table 39below.

Table 39: Value of the Visual Resource - Scenic Quality

High (*agricultural activities and natural grassland vegetation)*	**Moderate** *farmsteads and agricultural support facilities*	**Low** *(roads, railway, power and telecommunication infrastructure as well as mining infrastructure***)**
These landscape types are considered to have a high value because they are: Distinct landscapes that exhibit a very positive character with valued features that combine to give the experience of unity, richness and harmony. They are landscapes that may be considered to be of particular importance to conserve and which have a strong sense of	These landscape types are considered to have a *moderate* value because they are: Common landscapes that exhibit some positive character, but which have evidence of alteration / degradation / erosion of features, resulting in areas of more mixed character. They are potentially sensitive to change in general and change may be detrimental if	These landscape types are considered to have a *low* value because they are: Minimal landscapes generally negative in character with few, if any, valued features due to their inherent characteristics or due to major negative man-made impacts. Scope for positive enhancement could occur.

High (*agricultural activities and natural grassland vegetation)*	**Moderate** *farmsteads and agricultural support facilities*	**Low** *(roads, railway, power and telecommunication infrastructure as well as mining infrastructure***)**
place. They may be sensitive to change in general and may be detrimentally affected if change is inappropriately dealt with.	inappropriately dealt with but change may not require special or particular attention to detail.	

The combination of the above described features results in a mixed agricultural / industrial landscape character. The positive agricultural character is affected negatively by the mining component. Although the landscape has been impacted by the existing mining operation, the sense of place of the study area is established with the combination of natural grassland plains with extensive agriculture. The study area has a distinct pastoral sense of place derived from the expansive agricultural fields, scattered farmsteads and rural character. This rural character is still very much intact, supporting its spacious sense of place despite the existence of the mining activities.

A stated above, the visual context is characterised by the openness of the gently undulating topography which allows for expansive views towards the proposed development. Travellers along public roads in the vicinity of the Project, the R104 and other local tarred and dirt roads mostly include farmers, labourers and people visiting or working at the mine. The R104 is however considered to be a ‘quiet’ road. The proposed study site can only be partially viewed from the public roads in the area as the topography screens it in most places. The most sensitive viewing areas, as far as the Project is concerned, are from high points on nearby farms located within the study area.

8.10.3 Aesthetics

The intended mining area on Nooitgedacht and Wildfontein reserves may be visible from the district road, from several farmhouses and from topographical high points in the surrounding area. It is not located along any recognised tourist route and the visual quality of the wider area has already been affected adversely by the current mining activities, the power station and local infrastructure such as power lines, railways and roads.

The pre-mining visual appearance of Nooitgedacht and Wildfontein reserves and the adjacent areas are determined by the current vegetation cover (including maize fields and clumps of exotic trees), surface water features and power lines.

8.11 Noise

Measurements and auditory observations were taken in May 2007 and December 2011 by Jongens Keet Associates at 13 in order to establish the ambient noise conditions of the study area (. The following results were presented in the Final Report (JKA602r005 dated 28 June 2012):

- Residual noise levels at the various farmhouses and farm labourers’ dwellings are relatively low (quiet). Daytime ambient conditions across the area range from about 38 dBA to 48 dBA near the main road. Evening conditions range from about 30 dBA to 39 dBA, while the night-time ambient levels fall even lower to about 25 dBA in places. These are acceptable rural residential conditions (SANS 10103).
- Residual noise levels at the schools meet the noise standards required for educational purposes, namely does not exceed 50 dBA during school hours.

The average L_{Aeq} at points 4 and 6 was 42.1 dBA, approximately 3 dB lower than the typical rural residential noise level rating of 45 dBA.

Noise levels at point 5 were comparatively higher, averaging 43.8 dBA.

Table 40: Noise measurements made by Jongens Keet Associates in 2007 and 2011

Site	Location	Dates	Daytime			Night time		
			L_{Aeq}	L_{max}	L_{min}	L_{Aeq}	L_{max}	L_{min}
4	At Sikhululiwe Village, just west of Road D684	May 2007	38.8	47.6	29.6	35.5	41.2	29.9
		December 2011	43.8	58.4	28.5	-	-	-
5	At a farm house on farm Roodepoort 418-JS, approximately 600 m east of Road D684	May 2007	40.8	58.0	31.1	34.8	44.7	31.7
		December 2011	46.8	64.9	31.4	-	-	-
6	At school and houses just east of Road D684	May 2007	40.2	53.7	29.7	-	-	-
		December 2011	45.6	57.5	29.3	-	-	-

In addition to the baseline monitoring, Jongens Keet Associates the prevailing 24-hour residual noise level related to the average daily traffic (ADT) flows on the main roads through the area were also calculated. The noise levels generated from the traffic on these roads were calculated using the *South African National Standard SANS 10210 Calculating and Predicting Road Traffic Noise* and 2011 traffic data. The results for the D684 are shown in Table 41.

According to these calculations, the road traffic along the D684 results in the degradation of the noise climate by up to 100 m from the road centreline.

Table 41: Calculated noise climate alongside the D684 (Jongens Keet Associates, 2012)

Road	Offset from D684 centreline														
	25 m			50 m			100 m			250 m			500 m		
	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
D684N	46	37	47	43	34	44	40	31	40	36	27	36	32	23	32
D684S	51	42	51	48	39	48	45	36	45	40	31	41	36	27	37

Note: Red text indicates exceedance of the typical noise level rating for a rural residential district during the day (Ld = 45 dB) or night (Ln = 35 dB) period.

8.12 Traffic

Two sections of provincial district roads, namely a section of Road D684 and a section of Road D1048 traverse through the Nooitgedacht Coal Reserve. Mining of this area by the owners Anglo Operations Limited / Mafube Coal Mining (Pty) Ltd requires the closure and relocation of these sections of roads.

Road D684 is an unpaved road, approximately 8 m in width (Figure 60 and Figure 61). It is located in a rural area that consists predominantly of farming and some coal mining operations. It provides access to the Sikhululiwe Village that is located adjacent to the road reserve.

Figure 60: Northerly view of D648 from survey point

Figure 61: Southerly view of D648 from survey point

8.12.1 Traffic Flow

The intersection of road D684 and D1048 was surveyed by Techworld in 2012 (Techworld Consulting Engineers, June 2012). This intersection is located 3 km north of the follow-up sample count site (conducted by Golder in May 2016). The 2012 data indicated that 22 light vehicles, 2 buses and 5 HGVs travelled south past Sikhululiwe Village on the D648 over a 12 hour period. In addition, 29 light vehicles, 5 buses and 3 HGVs travelled North on the D648 past Sikhululiwe Village over the same 12 hour period. This equates to a vehicle passing Sikhululiwe Village every ~11 minutes.

The sample count carried out in May 2016 was done over a four hour period (9:45 to 13:45). Over this period 19 light vehicles and one HGV moved North on the D684 past Sikhululiwe Village and 23 light vehicles and 2 HGVs moved south. This compares with the 2012 dataset as follows:

Table 42: Comparison of 2012 and 2016 traffic count datasets for four hour period (9:45 to 13:45)

Flow direction	North (2012)		North (2016		South (2012)		South (2016)	
Vehicle Type	Light	HGV	Light	HGV	Light	HGV	Light	HGV
Number of Vehicles	7	3	19	1	10	1	23	2

There were no buses or taxis counted during this period for both the 2012 and 2016 datasets. The figures indicated that HGV traffic is largely the same as it was in 2012, over this time period, but light vehicle traffic has increased by 63% northbound and 56% southbound. From the 2016 sample dataset it was calculated that a vehicle moves past Sikhululiwe Village every ~5 minutes. The meeting with the Sikhululiwe residents and the Ward 7 Councillor indicated that HGV traffic is highest in the mornings and evenings when children and workers are transported to school and work respectively.

Figure 62: School buses in Sikhululiwe Village

According to the Sikhululiwe residents, a total of seven school buses utilise the D648 for transporting children and adolescents to and from schools. Three school buses transport children to and from Arnot Primary School in Sikhululiwe Village (Figure 62). Two buses use the road to transport children to Morelig Combined School. One bus transports children to the Ipan Primary School and one bus to the Beestepan Agricultural High School. In addition, a further three buses use D648 to transport farm workers- two trucks drive to and from Beestepan Farm and one to and from Van Wyk Farm. It was stated that HGV traffic worsens during the harvesting season (April to August) due to trucks transporting agricultural produce. Road D684 is also used by pedestrians to access the Arnot Station Shopping Centre.

8.12.2 Traffic Safety

The Sikhululiwe residents and the Ward 7 Councillor mentioned that road safety awareness among the villagers is good, however drivers can be negligent. They estimated that approximately ten accidents have been reported in the area over the past 15 months. There have been no fatalities

8.12.3 Infrastructure

The signage on the road appears to be adequate. As it is an unpaved road there are no formal pedestrian crossings however there is signage indicating that children cross the road (Figure 63 and Figure 64).

Figure 63: Signage for vehicles turning on to D648 from Sikhululiwe Village

Figure 64: Sign warning of children crossing

There are culverts installed at road junctions on the D684 (Figure 65). There are existing drainage lines running the length of the road which appear to be sufficient, however, for certainty the road would need to be revisited in the wet season.

Figure 65: Culvert installed at Sikhululiwe Village entrance

8.12.4 Environmental Disturbance

Dust has been identified as being a nuisance to Sikhululiwe Village residents as well as being dangerous to road users in terms of visibility. It is particularly problematic in the dry season. Dust generated by vehicles passing on the D684 can be seen in Figure 66 and Figure 67. Noise and vibration emanating from vehicles on route D648 was not identified by the Sikhululiwe Village representatives as being problematic.

Figure 66: Dust generated on D648 by an HGV

Figure 67: Dust generated on D648 by a light vehicle

8.13 Sites of Cultural Importance

Archaeological and cultural resources refer to resources having prehistoric, palaeontological, historical, cultural, artistic or religious values, as well as unique natural environmental features that embody cultural values, such as sacred groves and forests (International Finance Corporation (IFC), 2006). The National Heritage Resources Act (no 25 of 1999) (NHRA) stipulates that all cultural heritage resources are the property of the State and may not be disturbed without authorization from the relevant heritage authority. Section 34 (1) of the NHRA states that "no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…" Mpumalanga encompasses some of the richest geological, archaeological and cultural heritage in the world.

The Phase I HIA study for the Mafube LifeX operations, completed in 2012 by Dr Julius Pistorius revealed the following types and ranges of heritage resources in and near the Mafube LifeX operations Area (Pistorius, 2012) (Figure 68):

- Farmstead complexes with farm houses and outbuildings which are older than sixty years and which therefore qualify as historical structures;
- A number of formal and informal graveyards. Several of the graveyards are older than sixty or hundred years and therefore qualify as historical graveyards;
- Rural dwelling complexes, some of which may be older than sixty years and which therefore may qualify as historical remains;
- Remains from the recent past which are younger than sixty years and which therefore have no outstanding cultural or historical significance; and
- Modern farm-houses and farm homestead complexes which have no historical significance.

The historical farmstead complexes and graveyards qualify as significant heritage resources. Some of the rural dwelling complexes may have historical affinities as some of these complexes or individual dwellings in these family homesteads may be older than sixty years.

The remains from the recent past as well as the modern farm-houses or farm homestead complexes have no historical significance. The significance of the heritage resources was determined by means of stipulations from the National Heritage Resources Act (No 25 of 1999) and by means of various other criteria. Mitigation measures are proposed for those heritage resources that may be affected by the proposed Mafube LifeX road realignment operations. It must be noted that some of the farmstead complexes, graveyards and rural village complexes fall outside the Mafube Project Area where they need not be affected by the Mafube LifeX road realignment project.

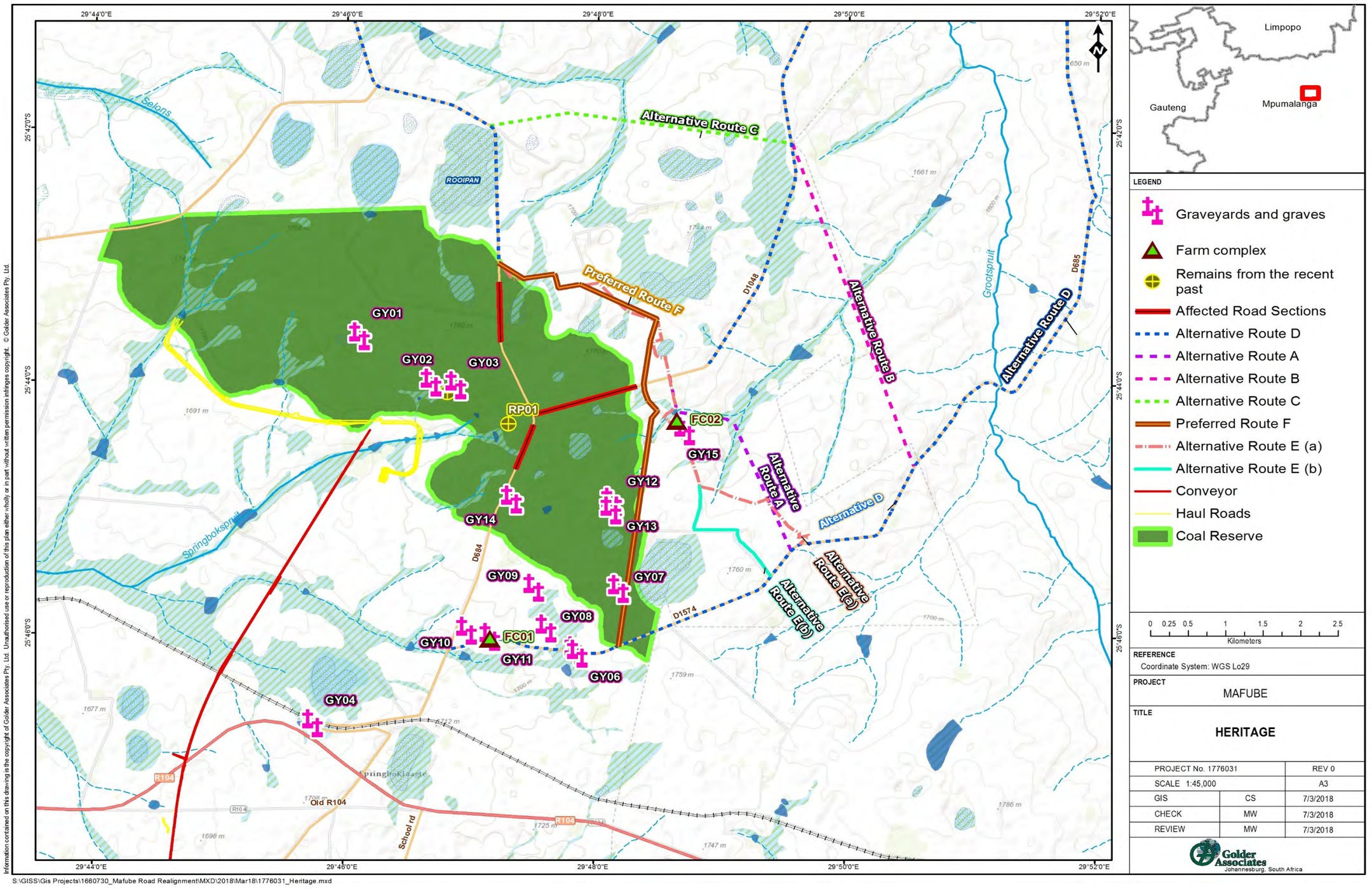


Figure 68: Sites of Cultural and Heritage importance

8.14 Paleontological

A Palaeontological study is generally warranted where rock units of LOW to VERY HIGH palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large scale projects with high potential heritage impact are planned; and where the distribution and nature of fossil remains in the proposed area is unknown. The specialist will inform whether further monitoring and mitigation are necessary.

8.14.1 Background to Palaeontology of the area

When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a desktop and or field scoping (survey) study by a professional palaeontologist is usually warranted. The main purpose of a field scoping (survey) study would be to identify any areas within the development footprint where specialist palaeontological mitigation during the construction phase may be required (SG 2.2 SAHRA AMPHOB, 2012).

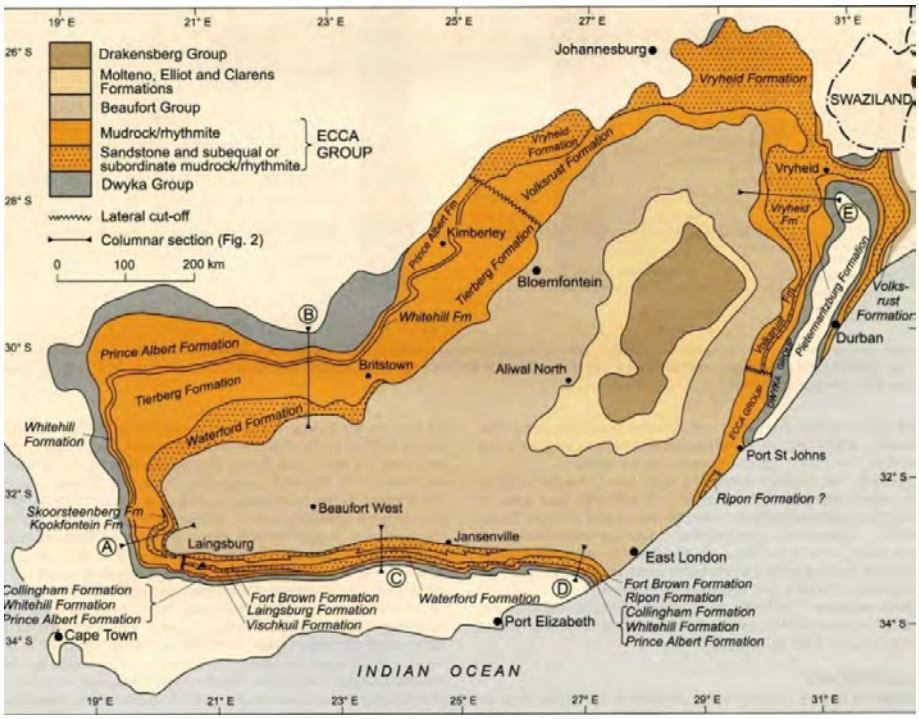


Figure 69: Extent of the Ecca Group (Johnson 2009).

The Ecca Group may contain fossils of diverse non-marine trace, *Glossopteris* flora, mesosaurid reptiles, palaeoniscid fish, marine invertebrates, insects, and crustaceans (Johnson 2009). *Glossopteris* trees rapidly colonised the large deltas along the northern margin of the Karoo Sea. Dead vegetation accumulated faster than it could decay, and thick accumulations of peat formed, which were ultimately converted to coal. It is only in the northern part of the Karoo Basin that the glossopterids and cordaitales, ferns, clubmosses and horsetails thrived (McCarthy and Rubidge 2005).

The *Glossopteris* flora is thought to have been the major contributor to the coal beds of the Ecca. These are found in Karoo-age rocks across Africa, South America, Antarctica, Australia and India. This was one of the early clues to the theory of a former unified Gondwana landmass (Norman and Whitfield 2006).

Table 43: Criteria used (Fossil Heritage Layer Browser/SAHRA)

Rock unit	Significance/vulnerability	Recommended action
Vryheid Formation	Very High	Field assessment and protocol for finds is required
Bushveld Complex	Insignificant or zero	No palaeontological studies are required.
Rooiberg Group	Low	No palaeontological studies are required however a protocol for finds is required

Table 44: Taken form palaeontological technical report (Groenewald and Groenewald 2014).

Subgroup / Supergroup	Group	Formation	Fossil Heritage	Comment
Karoo Supergroup	Ecca	Vryheid	Rich fossil plant assemblages of the Permian Glossopteris flora, rare fossil wood, diverse palynomorphs. Abundant low diversity trace fossils, rare insects, possible conchostracans, non-marine bivalves, fish scales	Globally important and under collected

A desktop palaeontological assessment was undertaken during February 2017 (summer season) and the following was reported:

The formations present are mainly the Rustenburg Layered Suite (Mr, Vu) of the Bushveld Complex, Transvaal Supergroup (Vdr) and the Vryheid Formation, Karoo Supergroup (Pe).

The proposed road realignment project is situated on the Bushveld Complex. It is Vaalian in age (2,100 – 1,920 Ma) and consists of an igneous intrusion with anorthosite, hybrid gabbro, gabbro, diabase, epidiorite, pyroxenite, and norite rocks. A small section is Mokolian in age (1920 ±40 Ma). The Bushveld Complex is a great body of igneous origin and it is intrusive in the Transvaal Supergroup. Both mafic and ultramafic rocks are present in the Rustenburg Layered Suite. The site is covered in 'Bushveld' vegetation. The weathering product is known as 'black turf' (Kent, 1980; Visser, 1989). There is also a presence of mining operations past and present.

The Transvaal Supergroup fills an east-west elongated basin in the south-central part of the old Transvaal (now North – West, Gauteng and Mpumalanga Provinces) as far south as Potchefstroom. It is Vaalian in age, approximately 2600 Ma to 2100 Ma. A maximum thickness of the Transvaal Supergroup reaches 2000 m in the north-eastern section. An east-west elongated basin is filled with clastic, volcanic and chemical sedimentary rocks. Three groups based on lithological differences have been established: they are the Rooiberg, Chuniespoort, and Pretoria Groups as well as other smaller groups (Kent 1980). It is the Bushveld Complex that is responsible for the tilting of the Transvaal sediments and the heat of its intrusion having created andalusite crystals (Norman and Whitfield 2006). This Supergroup is underlain by the Ventersdorp, Witwatersrand and Pongola Supergroups, and the Dominion Group. The Rooiberg Group is divided into the Formations Damwal and Selonsrivier in the Loskop dam area (Visser 1989).

The Vryheid Formation (Pe,Pv), Ecca Group is rich in plant fossils such as the *Glossopteris flora* represented by stumps, leaves, pollen and fructifications. This formation is early to mid-Permian (Palaeozoic) in age and consists of sandstone, shaly sandstone, grit, conglomerate, coal and shale. Coal seams are present in the Vryheid Formation within the sandstone and shale layers. Fossils are mainly present in the grey shale which is interlayered between the coal seams (Kent 1980, Visser 1989). Borehole logs in the coalfields show the following layers; soil, shale and sandstone, shale and sandstone interbedded, sandstone, coal, conglomerate reworked diamictite, Dwyka Tillite, and the Pre-Karoo Basement.

Fossils in South Africa mainly occur in rocks of sedimentary nature and not in rocks from igneous or metamorphic nature. Therefore, if there is the presence of Karoo Supergroup strata the palaeontological sensitivity is generally LOW to VERY HIGH, but here locally VERY HIGH for the Vryheid Formation,

INSIGNIFICANT or ZERO for the Bushveld Complex, and LOW for the Rooiberg Group (SG 2.2 SAHRA APMHOB, 2012).

8.15 Socio Economics

The Steve Tshwete Local Municipality area covers 3,993 km², it has an estimated population of 173,800 residents which is largely based in Middelburg, Mhluzi, smaller mining towns and rural areas. Land-use within this municipality is characterized by a high intensity crop production, cultivated grazing and open cast coal mining. In the northwest of the municipality it is game farms supported by the eco-tourism industry. The high natural resource potential creates employment opportunities within the primary sector which is comprised of agriculture and mining. It is almost twice as high in Steve Tshwete Local Municipality as at the national level. However, Steve Tshwete's Local Municipality Spatial Development Framework (SDF) notes the existence of competing interests between the two sectors. Despite this, the economic value of mining cannot be ignored. Mining is well-established as the largest economic contributor in the municipality. It also impacts on the economic status of Mpumalanga province. The employment opportunities associated with the primary sector have resulted in an influx of people which resulted into an above average population growth in the last 10 years. This has increased the levels of informal housing in the local municipality area.

The Mafube LifeX operations and the associated road re-alignment route options are located within the Nkangala District Municipality. The Nooitgedacht coal reserve is situated in Steve Tshwete Local Municipality and the road network options span into the neighbouring eMakhazeni Local Municipality. This section describes the social baseline of the project area at a provincial, district and local municipal level and further in terms of the Ward area and local community or settlement level.

8.15.1.1 Overview of the Regional Area

8.15.1.1.1 Mpumalanga Province

The Mpumalanga Province is entirely landlocked and shares a border with Swaziland and Mozambique. The geographical area of the province is 79 511 km². The province consists of four district municipalities and 20 local municipalities.

Mbombela Local Municipality (previously Nelspruit Local Municipality) is the administrative and business hub of the Lowveld. Mpumalanga is highly accessible, with a network of excellent roads and railway connections, as well as some small airports, including the Kruger Mpumalanga International Airport.

About a third of the people speak siSwati, the language of neighbouring Swaziland, with isiZulu, Xistonga and isiNdebele commonly heard.

Mpumalanga is rich in coal reserves, and home to South Africa's major coal-fired power stations, three of which are the biggest in the southern hemisphere. Mpumalanga produces about 80% of the country's coal and remains the largest production region for forestry and agriculture.

8.15.1.1.2 Nkangala District Municipality

The Nkangala District Municipality (Nkangala DM) is one of the three districts of the Mpumalanga Province. The Mafube Mining Right Area is situated within the Nkangala DM which consists of 160 towns and villages and covers an area of 16 758 km².

The Nkangala DM is the economic hub of Mpumalanga and is rich in minerals and natural resources. The district economy is dominated by the power, manufacturing and mining sectors. These sectors are followed by community services, trade, finance, transport, agriculture and construction.

A strong point of the district is the Maputo Corridor, which brings increased potential for economic growth and tourism development. The proximity to Gauteng opens opportunities to a larger market, which is of benefit to the district's agricultural and manufacturing sectors. The potential inherent in exporting goods has been identified as an area that warrants further investigated (Nkangala DM IDP, 2015 - 2016).

8.15.1.1.3 Steve Tshwete Local Municipality

Steve Tshwete Local Municipality (Steve Tshwete LM) is a category B[4] municipality situated in Nkangala district in Mpumalanga Province. Steve Tshwete LM can be regarded as one of the commercial hubs in Mpumalanga with a higher household income compared to other municipalities. Its local economy is one of the largest in the district, dominated by the mining and manufacturing sectors. It is positioned approximately 150 km east of Pretoria on the way to Mbombela and covers a geographic area of 3 993 km².

The municipality is well located as it is traversed by the Maputo Development Corridor, the Middelburg/ Steelpoort mining resource link, as well as the Middelburg/Bethal/Ermelo/Richards Bay Corridor.

Provincial roads traverse the area of jurisdiction of Steve Tshwete LM. The most prominent of these are the N4 National route crossing the area from east to west and the N11, traversing the area from north to south (Steve Tshwete LM IDP, 2016-17).

8.15.1.1.4 eMakhazeni Local Municipality

eMakhazeni Local Municipality (eMakhazeni LM) is also a category B[5] municipality situated in Nkangala district in Mpumalanga Province. Although its contribution to the overall Mpumalanga economy is relatively small, with mining and transport being the main contributors, it is regarded as an important gateway to major tourist attractions in both Mpumalanga and Limpopo Provinces. It has a geographic area of 4 736 km² and is strategically located between the Pretoria/Johannesburg complex in Gauteng and Nelspruit in Mpumalanga. It is an important gateway along the N4 Maputo Corridor which is the main link between Gauteng Province, Mpumalanga Province and Mozambique. The R540, which runs in a northern direction from the N4 Freeway through eMakhazeni and Dullstroom, provides an important link to Lydenburg and other centres in the Lowveld, particularly Hoedspruit, Pilgrim's Rest and Graskop. Railway lines from Gauteng stretch through this area and provide linkages with the Maputo and Richards Bay harbours respectively. The main contributors to the eMakhazeni LM economy are mining, transport and community services (eMakhazeni LM IDP, 2016-17).

8.15.1.2 Population Demographics

A comparison of population and gender distribution within the regional area is presented in Table 45. Mpumalanga Province has a total population of 4 949 885 of which 52% is female and 48% male. This trend is carried through in the Steve Tshwete LM and also to Ward level where the same gender distribution is evident in the study area. Within the Nkangala DM, the gender distribution evens out with 50% being female and 50% being male (Stats SA, 2011).

The Mpumalanga Province has an average population density of 64.7 people per km². Within the Nkangala DM, the average population density increased compared to the provincial average of 78.1 people per km². Within the Steve Tshwete LM there is an average population density of 57.6 people per km². However, at Ward level, the population density decreases to 17.0, 9.6 and 4.1 people per km² within Wards 7, 9 and 2 respectively.

The Nkangala DM has approximately 356 911 households and a population growth rate of 2.5% per annum. Nkangala DM has a total population of 1 308 150 (Nkangala DM Final Draft IDP 2016/17-2020/21)

Table 45: Population and Gender Distribution

Region	Total	Total Female	%	Total Male	%	Area in km²	Population Density
Mpumalanga Province	4 949 885	2 558 980	52	2 390 905	48	76 495	64.7
Nkangala DM	1 308 150	651 897	50	656 253	50	16 758	78.1
Steve Tshwete LM	229 839	110 425	48	119 414	52	3 993	57.6

[4] **Category B municipality** is a type of **municipality** that serves as the third, and most local, tier of local government (Nkangala DM IDP, 2015-2016)

[5] **Category B municipality** is a type of **municipality** that serves as the third, and most local, tier of local government (eMakhazeni DM IDP, 2016-2017)

Region	Total	Total Female	%	Total Male	%	Area in km²	Population Density
Steve Tshwete LM Ward 7	5 821	2 647	45	3 174	55	342	17.0
Steve Tshwete LM Ward 9	6 629	3 133	47	3 496	53	690	9.6
eMakhazeni LM Ward 2	5 117	2 460	48	2 657	52	1 255	4.1

Source: Stats SA, 2011

Over the ten year period from 2001 to 2011, Steve Tshwete LM population increased by 4.76%. This could be attributed to the number of industries that were opened within the 10 years (2001 - 2011) that attracted workers into Middelburg (Stats SA, 2011).

Steve Tshwete LM exhibits the second highest urbanisation rate in the Nkangala DM at 72.1% (Steve Tshwete ITP, Draft 2013). This high urbanisation rate is coupled with the depopulation of rural areas. The northern boundary of the Steve Tshwete LM bisects Loskop Dam, with the Loskop Dam Nature Reserve surrounding the dam. To the east of Middelburg Town is the Middelburg Dam, and to the north-west thereof is the Botshabelo Nature Reserve (Steve Tshwete LM IDP, 2016 - 17).

eMakhazeni LM, by contrast, has the smallest population within the district. It has however seen a population increase of 9.78% between 2001 and 2011 (eMakhazeni LM IDP, 2016-17). This could be attributed to an increase in industries in the Belfast and Machadodorp areas.

8.15.1.2.1 Ethnicity

African/black population continues to constitute the highest group followed by the white population since 1996 to date. Asian and coloured population constitute the minor population group (Steve Tshwete LM IDP, 2016-17). A similar trend is evident in the eMakhazeni LM (eMakhazeni LM IDP, 2016-17).

8.15.1.2.2 Education

Educational attainment is a key indicator of capacity development in a population. Basic education is the foundation to securing employment and furthering one's skills levels. Table 46 depicts the educational levels attained in the region.

Within the Steve Tshwete LM a third of the regional and local populations have completed some secondary education. Steve Tshwete LM has the highest percentage (11%) of tertiary education successfully completed.

In Mpumalanga, 15% of the population received no formal schooling. In Nkangala DM, 12% of the population received no formal schooling. The figure for Steve Tshwete LM improves slightly at 7% but at a Ward level in the study area, the percentage of residents with no formal schooling is 14%, 23% and 28% for Wards 7, 8 and 2 respectively.

The literacy rate in Mpumalanga Province is approximately 68% and 74% in the Nkangala DM (Stats SA, 2011).

Table 46: Education Distribution of the Population

Region	No Schooling	Completed Some Primary	Completed Primary	Completed Some Secondary	Completed Secondary	Higher (Tertiary)
Mpumalanga Province	15%	12%	4%	33%	28%	8%
Nkangala DM	12%	11%	4%	35%	30%	8%
Steve Tshwete LM	7%	9%	3%	33%	36%	11%

Region	No Schooling	Completed Some Primary	Completed Primary	Completed Some Secondary	Completed Secondary	Higher (Tertiary)
Steve Tshwete Ward 7	14%	10%	3%	30%	33%	10%
Steve Tshwete Ward 9	23%	17%	4%	29%	24%	3%
eMakhazeni Ward 2	28%	15%	5%	29%	18%	3%

Source: Stats SA, 2011

Human Development Index (HDI) is defined as a standard measure of determining whether an area is developed or developing. According to the United Nations, the HDI is considered high when it is 0.8 and higher, medium when it ranges between 0.5 to 0.8 and an index value of 0.5 and lower, will be considered as a low rating. In 2013, Nkangala DM had a HDI of 0.609 compared to Mpumalanga with a HDI of 0.59 and 0.632 of the National Total. The Steve Tshwete LM has one of the highest municipal HDIs, with an index value of 0.659. eMakhazeni LM, scored in the lower range which indicates that improvements are required in the areas of literacy, life expectancy and per capita income if the HDI levels are to reach an acceptable range comparable with that of the rest of the rest of South Africa. (Nkangala DM IDP, 2015 - 2016).

8.15.1.2.3 Employment

Employment rates within an area are linked to the size of the economy as well as the personal income, education level and skills. This section provides a brief overview of employment rates and income levels within the region. An employment breakdown across the region is presented in Table 47. Mpumalanga has the majority of its workforce (41%) falling into the other or inactive category, while 35% are recorded as being employed, and 18% are unemployed. In Nkangala DM, 41% of the workforce is employed, 37% fall in the other or inactive category and 18% are unemployed. The other or inactive category describes individuals such as children or pensioners who are outside of the employable group.

In the Steve Tshwete LM, 53% of the workforce is recorded as being employed, 33% are in the other or inactive category and 13% are unemployed. Wards 7 and 9 have relatively high employment rates of 56% and 54% respectively and corresponding lower unemployment rates of 7% and 13% respectively. The high employment rate, particularly in Ward 7, can be linked to the relatively high tertiary education level (10%) and indicates that higher education levels provide the foundation to attaining employment. eMakhazeni Ward 2 displays similar employment trends as Mpumalanga Province and Nkangala DM.

Table 47: Employment

Region	Employed	Unemployed	Work Seeking	Other Or Inactive
Mpumalanga Province	35%	18%	6%	41%
Nkangala DM	41%	18%	5%	37%
Steve Tshwete LM	53%	13%	3%	31%
Steve Tshwete Ward 7	56%	7%	4%	33%
Steve Tshwete Ward 9	54%	13%	4%	30%
eMakhazeni Ward 2	39%	15%	4%	42%

Source: Stats SA, 2011

Table 48 below sets out a comparison of employment status over the 10 years period from 2001 until 2011 in the Steve Tshwete LM. Out of the 107 069 economically active population in the Steve Tshwete LM, 21 101 are unemployed while 85 968 are employed. The unemployment rate has dropped from 35.4% in 2001 to 19.7% in 2011. Youth unemployment remains a major challenge regionally. It is predicted that current

economic trends and cumulative mining industry retrenchments have led to an increase in the number of unemployed individuals (Steve Tshwete LM IDP, 2016 - 17).

Table 48: Employment Status

Labour Indicators	Steve Tshwete LM (2001)	Steve Tshwete LM (2011)
Employment		
Economically Active Population/Labour Force	64 474	107 069
Number of Employed	41 679	85 968
Unemployment		
Number of Unemployed	22 795	21 101
Official Unemployment	35.4%	19.7%
Unemployment amongst people with disabilities	38%	-
Youth Unemployment	46.1%	26.5%
Women Unemployment	49.2%	27.8%

Source: Stats SA, 2001-2011

The above trends are also evident within the eMakhazeni LM where an overall decline in unemployment from 30% in 2001 to 25.92% in 2011 is recorded. However, as mining remains a large contributor to GDP in the region, the recent retrenchments and mine closures (e.g. Assmang Chrome Machado Works in 2015) are of concern to the local authorities as current levels of unemployment will no doubt rise (eMakhazeni LM IDP, 2016-17). Mpumalanga is rich in various mineral resources including coal, gold, platinum group metals, silica, chromite, vanadiferous magnetite, argentiferous zinc, antimony, cobalt, copper, iron, manganese, tin, andalusite, chrysotile asbestos, kieselguhr, limestone, magnesite, talc and shale. It is therefore not surprising that mining and manufacturing are the largest employment sectors within the region as reflected in Table 49 below. Within the Nkangala DM and Steve Tshwete LM, mining and quarrying contribute 28% and 26% respectively. Within the eMakhazeni LM the largest employment sector is manufacturing at 21%. As the region serves as an important transport hub linking provinces and neighbouring states, transport, storage and communication also contribute to employment creation in a meaningful way as evidenced by a 15% employment rate in eMakhazeni and 11% in Steve Tshwete LM for this sector. Further important contributors are wholesale and retail trade, catering and accommodation and finance, insurance, real estate and business services.

Table 49: Employment Sectors (2010)

Sector	Mpumalanga	Nkangala DM	Steve Tshwete LM	eMakhazeni LM
Agriculture, forestry and fishing	3%	2%	2%	5%
Mining and quarrying	19%	28%	26%	15%
Manufacturing	21%	19%	22%	21%
Electricity, gas and water	5%	7%	10%	1%
Construction	2%	3%	3%	2%
Wholesale and retail trade, catering and accommodation	11%	8%	7%	11%
Transport, storage and communication	10%	10%	11%	15%
Finance, insurance, real estate and business	13%	11%	9%	15%
Community, social and personal services	6%	5%	3%	7%

Sector	Mpumalanga	Nkangala DM	Steve Tshwete LM	eMakhazeni LM
General government	10%	8%	6%	9%

Source: Quantec data, 2010

8.15.1.3 Social Infrastructure and Services

Provision of basic municipal infrastructure and community services within the Nkangala is a challenge due to its predominantly rural character and scattered settlements. The Nkangala DM has a dispersed spatial structure with population densities varying from very high (urban areas) to very low (small settlements and the rural areas). Most people are located in settlements adjacent to urban towns and there is a high demand for basic services such as adequate housing and sanitation. Within the less densely populated rural settlements, the need for adequate housing, sanitation and water supply is equally prevalent. Backlogs are the highest in the areas of sanitation, followed by electricity and water. Electricity backlogs are most severe in rural areas and amongst households on farms (Nkangala DM IDP, 2015 - 2016).

8.15.1.3.1 Municipal services

Municipal services provided to residents in the region include water (access to piped water), waste removal and sanitation. Figure 70 presents the level of access to piped water in the regional and local area. The majority of the residents of the Steve Tshwete LM have access to piped water either inside their dwellings, yards or within 200m from dwellings. In eMakhazeni LM Ward 2, 75% of residents have access to piped water either inside their dwellings, yards or within 200m from dwellings. Of concern, however is the fact that 20% of residents in this Ward have no access to piped water.

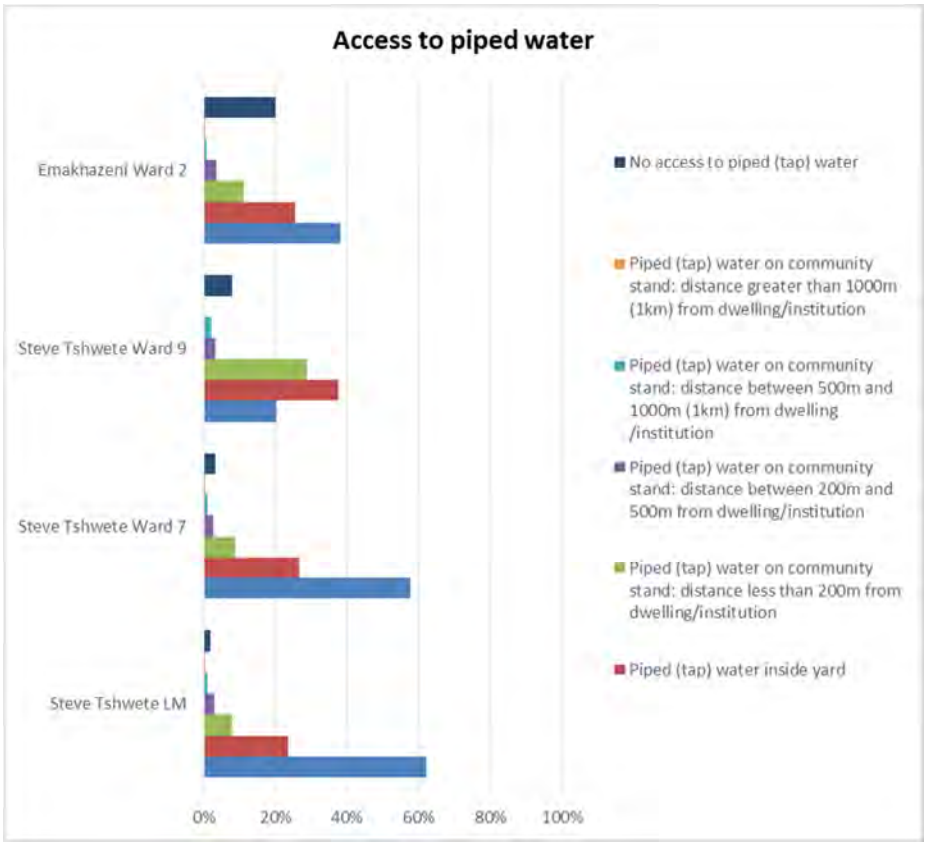


Figure 70: Provision of piped water (Stats SA, 2011)

Waste removal in the non-urban areas is problematic, and the findings of the Census 2011 indicated that many people made use of their own disposal sites (illegal dumps) or did not have access to a permitted landfill site (see Figure 71), resulting in littering and pollution. The majority of Steve Tshwete LM have their refuse removed by a local authority/private company at least once a week. However, in Ward 9, 83% of residents make use of their own refuse dumps with only 3% having access to waste removal by local authorities/private companies. In eMakhazeni Ward 2, only 25% of residents have access to municipal waste removal facilities with 55% of residents relying on their own refuse disposal methods.

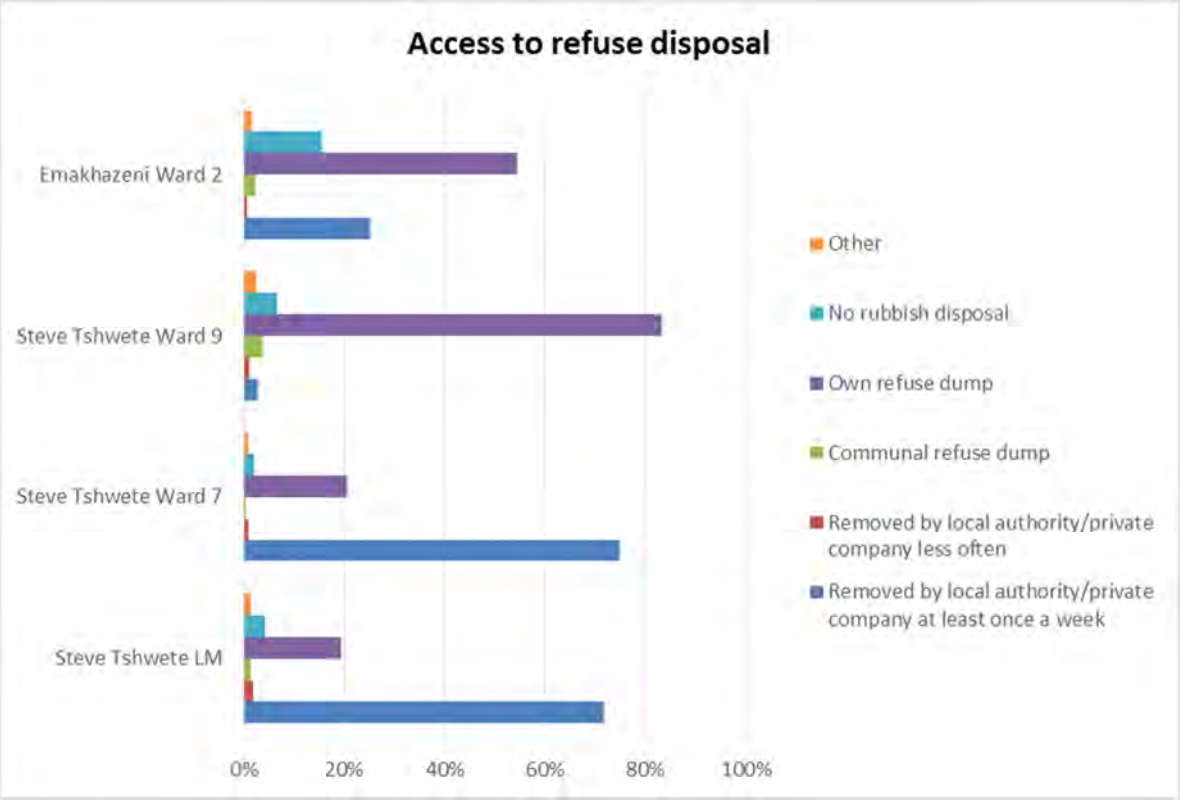


Figure 71: Refuse disposal (Stats SA, 2011)

The availability of sanitation facilities not only improves the dignity of people but also promotes their health. Areas without proper sanitation systems give rise to water-borne diseases like cholera, diarrhoea, and typhoid. It is therefore important that as a municipality, prioritisation should be given to this service.

The provision of adequate sanitation follows the same trend as afore listed municipal services. Figure 72 presents the various sanitation methods used within the region.

The majority of the inhabitants within Steve Tshwete LM Ward 7 have access to a flush toilet (connected to sewerage system). In Steve Tshwete Ward 9 and eMakhazeni Ward 2, access to adequate sanitation is an area that requires attention as in both regions almost half of the population rely on facilities ranging from a pit toilet without ventilation, bucket toiles, other or no facilities at all.

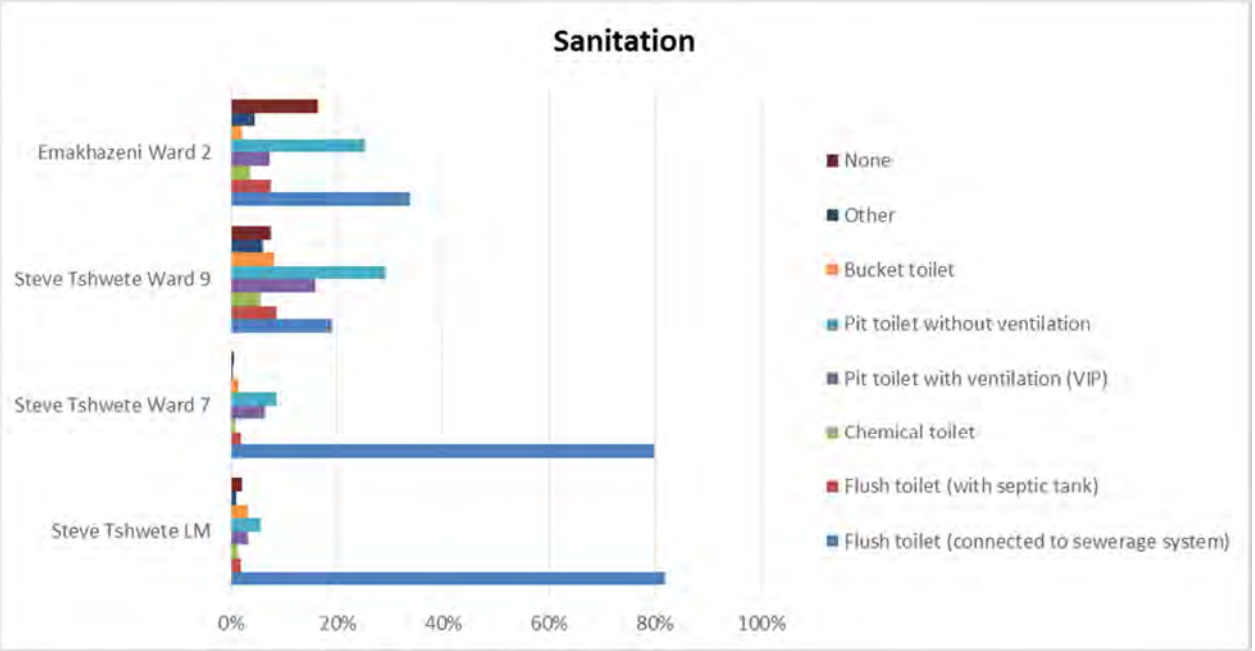


Figure 72: Sanitation (Stats SA 2011)

8.15.1.3.2 Public infrastructure

The local social public infrastructure consists of clinics, schools, community halls and libraries. Table 50 depicts a list of social infrastructure within the Steve Tshwete LM. There are 14 clinics in the local area. The co-ordination of health facilities is planned at a district level and is therefore not directly the responsibility of the local municipalities. There are 32 hospitals in the Nkangala DM (Steve Tshwete LM IDP, 2015 - 16/17).

Table 50: List of all community facilities Steve Tshwete LM

Facilities	Total Number of Facilities	Middelburg	Hendrina	Rietkuil	Pullenshope	Komati	Doornkop	Eastden	Nasaret	Mhluzi
Library	11	1	2	1	1	-	1	1	1	3
Community Hall	7	3	1	1	1	1	1	1		
Sport Stadium	5	3	1	0	0	-				
Police Station	6	2	2	0	1	1				
Clinic	14	8	2	0	1	1	1			
Post Office	5	1	1	1	1	1				
Crèche	20	3	3	1	2	1				
Primary School	25	17	3	1	1	1				
Secondary School	19	7	4	-	-	-				
Technical college	1	1	0	0	-	-				
Cemetery	11	8	3	0	-	-				

Steve Tshwete LM IDP, 2015-16/17

The local community has 20 crèches, 25 primary schools, 19 Secondary Schools and one Technical College. The Mpumalanga Department of Education has stated that there are 32 637 teaching posts for the 2014

academic year to service a total public school learner enrolment of 975 580 in grades 1 to 12, resulting in an overall educator - learner ratio for public schools in Mpumalanga at 1:29 (Nkangala DM IDP, 2015 - 2016).

Residents of eMakhazeni LM have access to 23 educational institutions ranging from a boarding school, a TVET college, 4 private schools, 1 school for learners with special educational needs, 7 primary schools and 9 secondary schools. Within Ward 2, the only educational institution is a primary school in Siyathuthuka Village on the outskirts of Belfast Town. Ward 2 residents also have access to medical facilities at the HG Grove Hospital Public Hospital located in Belfast, Belfast Gate Clinic and a mobile clinic. The closest library is located within Belfast Town (eMakhazeni LM IDP, 2016-17).

8.15.1.3.2.1 Roads

The Steve Tshwete LM is well located as it is traversed by the Maputo Development Corridor, the Middelburg/ Steelpoort mining resource link, as well as the Middelburg/Bethal/Ermelo/Richards Bay Corridor. Furthermore, some National and Provincial roads traverse the area of jurisdiction of the Steve Tshwete Local Municipality (Steve Tshwete LM IDP, 2016-17).

The most prominent of these are the N4 National route crossing the area from east to west and the N11, traversing the area from north to south. Other roads that traverse the area include the following:

- P154 Middelburg to eMalahleni and Wonderfontein;
- P127 Middelburg to Van Dyksdrift;
- P180 eMalahleni to Van Dyksdrift;
- P182 Hendrina to Van Dyksdrift;
- P30 Middelburg to Bethal;
- P51 Groblersdal to Stoffberg and Middelburg;
- P62 Stoffberg to Belfast; and
- P169 Stoffberg to Roossenekal.

These Provincial roads are important communication routes along which the majority of activities at a local scale and movement are concentrated.

The municipality is comprised of two primary nodal points: Middelburg/Mhluzi that is the main commercial and administrative centre, and the much smaller Hendrina/Kwazamokuhle near the south/east boundary (Steve Tshwete LM IDP, 2016-17).

The eMakhazeni LM is strategically located along the following main connecting roads (eMakhazeni LM IDP, 2016-17):

- N4 Pretoria/Johannesburg complex in Gauteng and Nelspruit in Mpumalanga;
- N4 Maputo Corridor which traverses the region from West to East;
- R555 from Middelburg;
- R33 from eMakhazeni which converge at Stoffberg Road in the northwest;
- P81-1 (R540) which connects eMakhazeni and Dullstroom with Lydenburg north of the eMakhazeni area;
- Road R216 which connects Dullstroom and Entokozweni;
- Road R36 linking Entokozweni with Carolina to the southwest;
- R541 linking Entokozweni with Badplaas to the southeast;

- R36 linking Entokozweni and Waterval-Boven with Lydenburg;
- R33 linking eMakhazeni with Ermelo;

8.15.1.3.2.2 Rail

Running parallel to the N4 is a rail line that connects Gauteng through the Steve Tshwete and eMakhazeni Local Municipalities to Maputo harbour in Mozambique. This significant rail infrastructure has been identified as part of the Southern African initiative to connect Walvis Bay (on the west coast) to Maputo (on the east coast). Once established the rail infrastructure will be called the Maputo Corridor (Steve Tshwete LM IDP, 2016-17).

Rail transport is restricted to carrying long distance goods, with very few passenger services and no daily commuting service. The importance of the railway line in terms of export potential via Maputo-Richard Bay harbours should be promoted (Steve Tshwete LM IDP, 2016-17).

8.15.1.3.2.3 Housing

Housing in the study area is comprised primarily of farm houses and traditional dwellings located in a rural setting (refer to Figure 73). Steve Tshwete Ward 7 has the highest concentration of farm houses at 89% followed by Ward 9 at 66% and eMakhazeni Ward 2 at 60%. Traditional dwellings feature prominently in Steve Tshwete Ward 9 at 26% and eMakhazeni Ward 2 at 31% with the remainder of residents in the study area being housed in semi-detached dwellings, informal dwellings and squatter settlements.

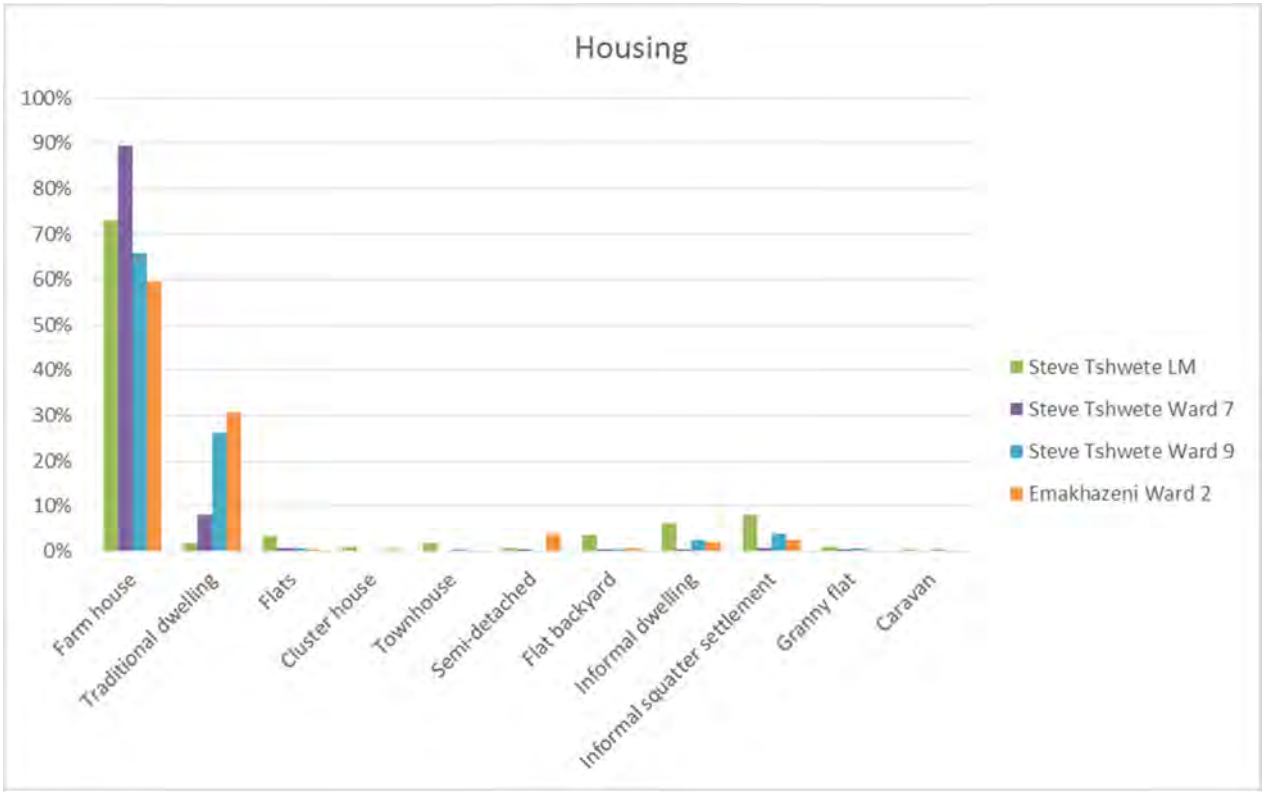


Figure 73: Housing, Stats SA 2011

Towns associated with the mines and power stations in the Steve Tshwete LM area of jurisdiction have been developed by Eskom namely Rietkuil, Pullenshope and Komati. Mining villages namely Blinkpan/ Koornfontein, Naledi and Lesedi were developed to accommodate mine employees. Kanhym, a farming company, developed Thokoza and Eikeboom villages. Social services and amenities are usually better

developed in the settlements mentioned. The Steve Tshwete LM exhibits the second highest urbanisation rate in the Nkangala DM at 72.1% (Steve Tshwete LM IDP, 2016 - 17).

8.15.1.4 Major Economic Activities

8.15.1.4.1 Income

In order to understand people's living standards as well as their ability to pay for essential services such as water, sanitation and health care, the income levels of the population are analysed and compared to the provincial and national averages. The average annual national household income according to the Income and Expenditure Survey (IES) 2010/2011 statistics was R 119 542. As presented in Figure 74 the majority of households at Ward level earn between R 38 201 - R 76 400 per annum, i.e. below the average national annual household income. In 2011 about 9% of households in Steve Tshwete Ward 7, 7% in Steve Tshwete Ward 9 and 7% in Emakhazeni Ward 2 reported no income.

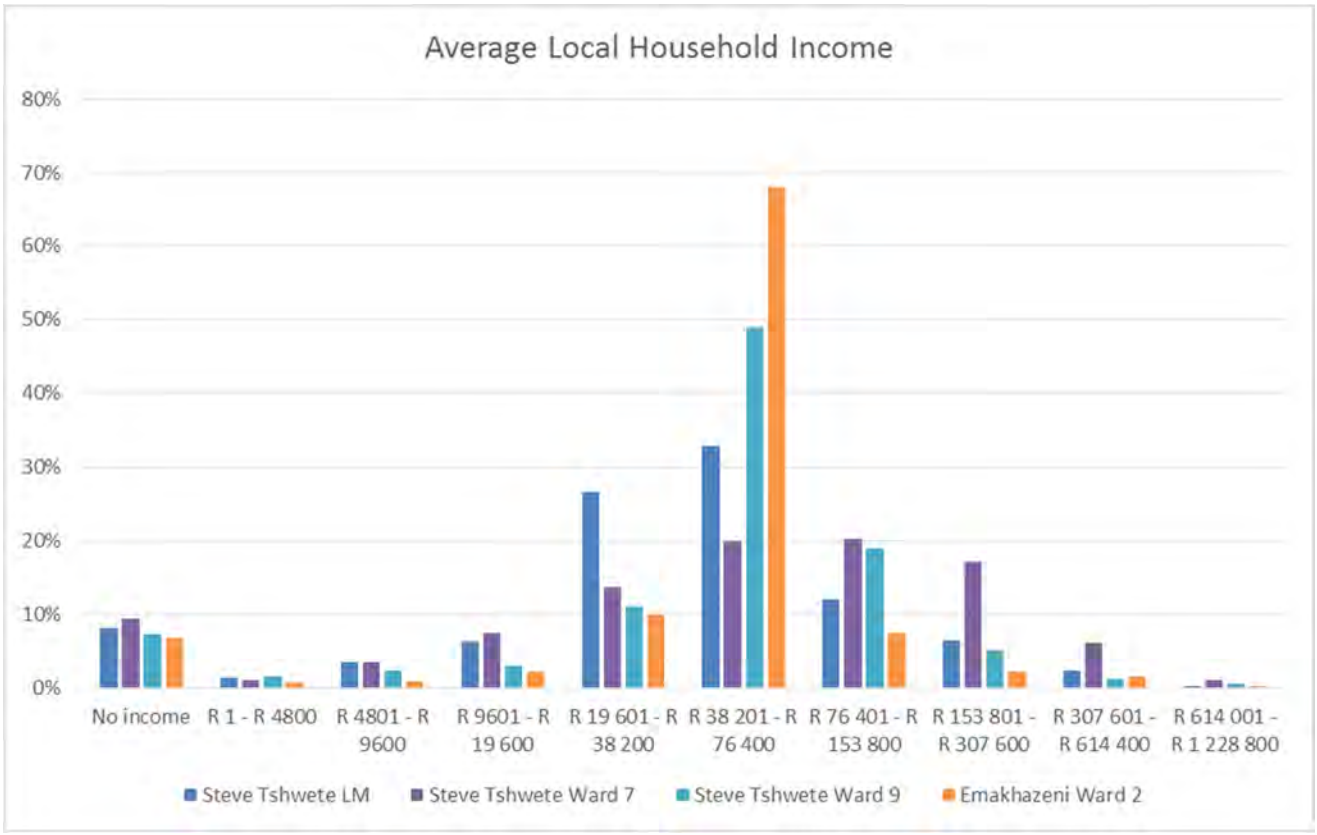


Figure 74: Income (Stats SA 2011)

The Gini coefficient is a summary statistic of income inequality. It varies in range from 0 to 1. If the Gini coefficient is equal to zero, income is distributed in a perfectly equal manner, in other words, there is not much variance between the high and low-income earners within the population. In contrast, if the Gini coefficient equals 1, income is entirely inequitable (i.e. one individual in the population is earning all the income, and the rest have no income). Generally, this coefficient lies in the range between 0.25 and 0.70. In 2013 income inequality as measured by the Gini coefficient in the Nkangala DM was at 0.59. The Steve Tshwete LM has the highest Gini coefficient in the district, with an index value of 0.60 (Nkangala DM IDP, 2015 - 2016).

8.15.1.4.2 Poverty

In the last ten years, the Steve Tshwete LM has made huge investments in infrastructure and housing development as a result of which, poverty and inequality have been decreasing steadily. However, the current rate of unemployment and poverty remain key factors contributing to high inequality levels.

Table 51: Poverty in Steve Tshwete 2001 to 2011

Indicators	2001	2011
Poverty rate	31.6%	25.9%
Number of people in poverty	48 865	59 929
Poverty gap (R million)	R 54	R 110

Source: Statistics South Africa Census 2001 and 2011

The poverty rate was at 25.9% in 2011 showing a decreasing trend from 31.6% in 2001. The Steve Tshwete LM had approximately 59 929 people living below the poverty line in 2011 and had the lowest number of people living in poverty. With the current decline in mining in Mpumalanga, this rate is expected to increase drastically due to the number of people who will no longer have jobs in the mining industry. The increase in unemployment will trigger an increase in social grant applications (Steve Tshwete LM IDP, 2016 - 17).

To alleviate the problem of poverty in the Emakhazeni LM, social grants have been made available by the Department of Social Development. The distribution of grants in this municipality for the 2011 period is reflected below:

Table 52: Number of recipients of social grants in 2011

Grant type	Number receiving grant
Old age pension	2 183
Disability grant	1 410
Child support grant	8 274
Care dependency grant	139
Foster care grant	502
Grant in aid	6

Source: Stats SA 2011

8.15.1.4.3 Economic activities

Mpumalanga's highest contributors are manufacturing (21%) and mining and quarrying (19%). The Nkangala DM has a 28% contribution from mining and quarrying and a 19% contribution from the manufacturing sector (Nkangala IDP, 2011/2012).

According to Stats SA 2011, leading sectors in terms of percentage (%) contribution to the Steve Tshwete local economy are mining (31.3%), manufacturing (26.3%) and finance (13.4%). These sectors' contributions resulted in the Steve Tshwete LM being the second largest contributor to the Nkangala economy at 38.7%. These industries generate mass employment opportunities mainly draw workers from the rural parts of this local municipality. Regarding the strongest main economic generator, the stainless steel manufacturing industry dominates in the Steve Tshwete LM. On the other hand, mining continues to grow despite key economic sectors being on the decline (Steve Tshwete IDP, 2016 - 2017).

Middelburg also forms the main commercial centre of the Steve Tshwete LM where the majority of people conduct their shopping activities. This includes the eMhluzi Mall and new Middelburg Mall, with approximately 20 000 m^2 of retail space, which has expanded commercial and shopping activities to the outskirts of the local municipality. Moreover, the recent opening of the carbonated soft drink factory (Twizza) has contributed to a large number of job opportunities (Steve Tshwete IDP, 2016 - 2017).

The Steve Tshwete LM economy and contribution towards the provincial Growth Domestic Product (GDP) continues to grow significantly. According to the 2011 census, the Steve Tshwete LM contributes 14.7% towards the Mpumalanga Economy with an estimated growth of about 4% from 2011 until 2016 (Steve Tshwete IDP, 2016 - 2017).

Leading sectors in terms of % contribution to Emakhazeni economy is mining (27.1%), transport (26%) trade (8.4%) and community services (14.7%). Mining has remained the biggest contributor in GDP in the municipality in the 2001 to 2012 period. Emakhazeni LM is expected to record a GDP growth of 2.8% per annum over the period 2013-2018 which is down from the 4.7% growth rate over the 1996-2013 period. Its contribution to the Mpumalanga overall economy in 2013 was 1.4% making it one of the smallest economies in the region. In order to prevent a further decline in growth and job losses in the region, support for the efforts of social partners in the area such as Nkomati Mine, Assmang Chrome and Exxaro Belfast operations is expressly encouraged by the local municipality (Emakhazeni LM IDP, 2016-17).

The Maputo Corridor runs through the Nkangala DM, bringing with it increased potential for economic and tourism development. The corridor connects the primary economic nodes of the Nkangala DM, the Mpumalanga Kruger International Airport and Maputo to Gauteng (Nkangala IDP, 2011/2012).

The south-western regions of the district are referred to as the “Energy Mecca” of South Africa, due to the large deposits of coal reserves and associated power stations, such as Kendal, Matla, Duvha and Ga-Nala (Kriel). The southward road and rail network connect the Steve Tshwete area to the Richards Bay and Maputo harbours, offering export opportunities for coal reserves. The refurbishment of some of the mothballed power stations poses opportunities for the mining and energy sectors, as well as the revitalisation of some of the smaller towns in the district such as Delmas, Hendrina and Arnot (Nkangala IDP, 2011/2012; Stats SA 2011).

9.0 POTENTIAL IMPACTS IDENTIFIED

The following potential impacts were identified during the scoping phase:

1) **Socio-economic:** At this stage, the impact listed below are for all the alternative options of the road realignment. The impact assessment phase will consider only the preferred option. Potential impacts for the road realignment options could include:

   - Loss of access to the D684 and part of the D1048 roads in and out of the area.

   There is potential for a loss of access into and out of the area due to the closure of the D684 and the D1048 roads. Two homesteads situated north of the D684 and D1048 split will be affected as their only access south bound is on the D684. They travel on foot at least once a week to the centre, south past the railway line. There is available public transport to take people to Middelburg which is the nearest town.

   - Loss of land to construct road alternative A, B, C, E and F.

   The construction of alternative A, B, C, E and F requires the extension of the existing farm road or new cut of a district road respectively. Where these options impact private farmers, the public consultation process will engage with these landowners on the options for the road realignment.

   - Growing pressure on existing road access should people migrate to the project area.

   In cases where new roads have to be constructed where there were no previous access to these area, this will create an avenue for movement of people to utilise the road through the farm areas. This issue comes with associated impacts like increased pedestrian and vehicular traffic.

   - Construction of new alternative roads:
     - Potential employment opportunities for construction companies to construct new road alternatives.

- Intrusion of environmental aspects while construction of the alternative roads such as air pollution and contamination of water sources (groundwater) which impact on residents.
- The economic costs for residents to take longer travel routes due to existing road closure.
- Crops and land belonging to adjacent landowners may be at risk of dust contamination due to increased vehicles travelling through areas which had no previous access roads (alternative B. C and E).

Given the total number of people who live adjacent to the road, the impact is expected to be of ***moderate*** significance.

2) **Air Quality**: The impacts will remain the same regardless of the preferred route chosen for the realignment, although different receptors will be affected. Potential impacts are likely to include:

   - Increased local PM_{10}, SO_2 and NO_2 concentrations from vehicle exhaust emissions as a result of the increased traffic volumes; and
   - Increased dust emissions associated with dust entrainment.

   With the current existing information about the traffic volumes, the overall impact is expected to be ***moderate to low***.

3) **Noise:** Noise generated as a result of project activities during the construction and operation stage of the development will result in an increase in ambient noise levels. The effects of this increase in noise will depend on the level of increase.

   An increase in ambient noise levels of over 3 dB(A) will be noticeable to most people, although such an increase is unlikely to cause disturbance to leisure activities or sleep. An increase of 10 dB(A), however, is likely to cause disturbance or require people to modify their behaviour to avoid that disturbance, depending on the absolute level of noise. With the current existing information about the traffic volumes, the overall impact is expected to be ***moderate*** during the construction phase and ***low*** during the operational phase***.***

4) **Traffic:** Increase in travel distance and time along the main road links, but the overall length of the proposed preferred route will be shorter than the sections of Roads D684 and D1048 that will be closed. Possible new access roads to affected properties in the area needs to be considered. With the current existing information, the overall impact is expected to be ***moderate*** during the construction phase and low during the ***operational*** phase.

5) **Palaeontological:** The impact of the road realignment on fossil heritage is very high, low and insignificant or zero and therefore mitigation or conservation measures may be necessary for this development. The topsoil, subsoil, overburden, inter-burden and bedrock may have to be surveyed for fossiliferous outcrops.

   Impacts from earth moving equipment / machinery (front end loaders, excavators, graders, dozers) during construction, the sealing-in or destruction of the fossils by development, vehicle traffic, mining activities, and human disturbance, are some possible identified impacts. Alternative A, E and preferred Alternative F traverse the Vryheid Formation, and a phase 1 palaeontological assessment will be included in the impact assessment phase of this project.

6) **Cultural and heritage**: The informal cemetery to the Southern point of the preferred road alternative F (GY07 on Figure 68) is located approximately 100m from the centre of the proposed road, but is unlikely to be affected by the activities. Unless unknown graves are unearthed during construction, the expected impact on cultural and heritage resources is likely to be of ***low*** significance.

7) **Ecology**: The road realignment will involve the removal of vegetation (mostly crops) from the combined footprint area (entire length of the road) of about 75 ha. Due to the destruction of their habitat, the current faunal population in the project area will have to relocate until suitable habitat has been restored

by the rehabilitation programme (should the road be closed when the mining activities cease). The long term impact is expected to be ***moderate to low***.

10.0 EIA PROCESS AND METHODOLOGY

During the Scoping phase the technical assessment focuses on identifying issues of concern. These will be taken into consideration during the impact assessment phase.

The overall process and methodology that will be followed for the scoping phase of the EIA will be based on best practice guidelines and the requirements of South African legislation (specifically NEMA and MPRDA).

The approach included the following key stages:

- Gap Analysis of existing information against the Project compliance criteria;
- Meetings to be held with the Mpumalanga Department of Public Works, Roads and Transport;
- Project definition and analysis of road route alternatives – inclusive of data review, input to alternatives analysis and preferred route layout planning and project description;
- Screening (legal and process review) – review of all applicable compliance criteria;
- Preparation of a Scoping Report (identification of key issues and development of plan of study for carrying out the impact assessment). This report is presented to the public for comment and to the South African Government departments dealing with environmental authorisations for a decision on whether the scope proposed for the EIA is appropriate;
- Environmental and Social baseline studies – carrying out monitoring, data collection and fieldwork to determine the baseline conditions of the environment that could be affected by the Project;
- Stakeholder Engagement (incl. communications and public meeting) – to be undertaken throughout the Scoping process to record issues and comments received from the public. These issues and comments will be integrated into the process and will be considered in the impact assessment phase of the EIA.

The following activities will be undertaken during the next phase of the EIA:

- Impact Assessment – evaluation of potential impacts and benefits of the Project utilising qualitative and quantitative evaluation as determined by the scoping phase;
- Environmental and Social Management Systems Development – establishment of a system for the management of environmental, social impacts supported by action plans;
- Preparation of an EIA report – documenting all processes and presenting the findings of the impact assessment. The EIA report will be presented to the public for comment and to the relevant South African Government departments for a decision on whether the Project may proceed and if so under what conditions; and
- Stakeholder Engagement – will continue throughout the remainder of the EIA process to record issues and comments received from interested and affected parties. All issues and comments will be integrated into the process and considered during the EIA.

The overarching principles that guide the EIA include:

- Sustainability – development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs;
- Mitigation hierarchy – The mitigation hierarchy describes a step-wise approach that illustrates the preferred approach to mitigating adverse impacts as follows (the governing principle is to achieve no net loss and preferably a net positive impact on people and the environment as a result of the Project):
  - The preferred mitigation measure is avoidance;

- Then minimisation;
- Then rehabilitation or restoration; and
- Finally offsetting residual, unavoidable impacts.

- Duty of care towards the environment and affected people.

The assessment of the impacts of the proposed activities will be conducted within the context provided by these principles and objectives.

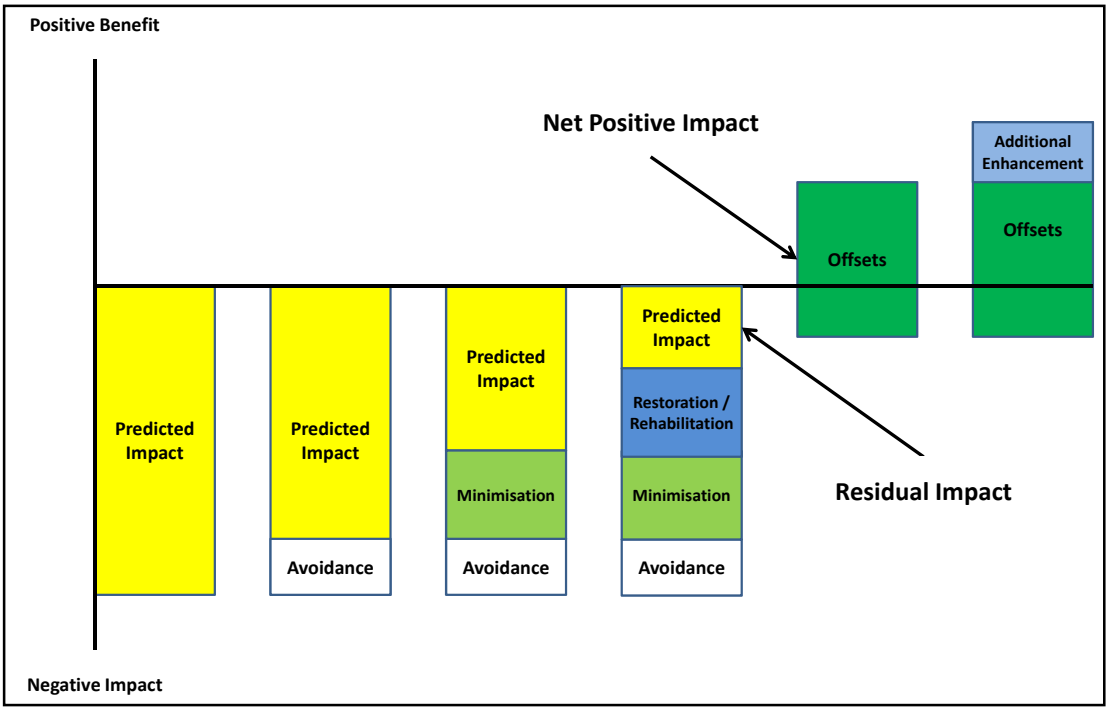


Figure 75: Mitigation Hierarchy Adapted from BBOP, 2009

10.1 Scoping Methodology

The methodology specifically adopted for the scoping phase included the following:

- Stakeholder consultation as described in section 7.0;
- Review of existing data;
- Workshop with the specialist team to identify possible route alternatives vs key impacts and issues;
- Fieldwork by the certain EIA specialist team members to obtain additional baseline data; and
- Compiling the Scoping report.

10.2 Positive and negative impacts of initial site layout and alternatives

The identified route alternative layouts must avoid the sterilisation of the open cast minable coal reserves. The preferred route realignment location was chosen to be the shortest, parallel route to the existing road, located on properties owned by AOL as to reduce the impact of the proposed route realignment on the local residents utilising the road on a daily basis.

See section 6.0 for a discussion on the alternative layouts and their positive and negative impacts.

10.3 Possible mitigation measures and levels of risk

The issues discussed with I&APs during the scoping process were as follows:

1) ***Air Quality***: The project's main potential effect on air quality will be increased PM_{10}, SO_2 and NO_2 concentrations from vehicle exhaust emissions as a result of the traffic volumes, and dust along the new proposed route and its surrounding areas. As this is a public district road, wet suppression for the entire LOM is not feasible. The preferred route alternative F falls within the current Mafube LifeX dust fallout monitoring (sampling) area (see Figure 44). Monitoring of these points will continue as per the approved Mafube LifeX monitoring programme.

2) **Socio-economic:** The preferred route alternative F is the shortest, parallel road to the existing D684 road. Given the number of people utilising the existing road, the impact is likely to be of ***moderate*** significance.

3) **Noise:** Noise generated as a result of project activities during the construction and operation stage of the development will result in an increase in ambient noise levels. The risk of people being exposed to unacceptable levels of noise is ***moderate*** to ***low***.

4) **Cultural and heritage**: The informal cemetery to the Southern point of the preferred road alternative F (GY07 on Figure 68) is located approximately 100m from the centre of the proposed road, but is unlikely to be affected by the activities. Unless unknown graves are unearthed during construction, the expected impact on cultural and heritage resources is likely to be of ***low*** significance.

5) **Palaeontological aspects**: Mitigation involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or excavation, recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before a Phase 2 may be implemented.

   Should further fossil material be discovered during the course of the development (e. g. during bedrock excavations), this must be safeguarded, where feasible in situ, and reported to a palaeontologist or to the Heritage Resources authority. In situations where the area is considered paleontologically sensitive (e. g. Karoo Supergroup Formations, ancient marine deposits in the interior or along the coast) the palaeontologist might need to monitor all newly excavated bedrock. The developer needs to give the palaeontologist sufficient time to assess and document the finds and, if necessary, to rescue a representative sample.

10.4 Site selection matrix and final site layout plan

10.4.1 Route Selection Criteria

The main route selection criteria were identified as engineering/technical, regulatory, constructability, usability, environmental, social/public acceptance and legal/regulatory criteria.

The procedure to be followed for the rating and ranking of alternative routes in terms of the main criteria would among others include the following:

- Assigning a relative weight to the main categories of criteria;
- Identification of various sub-criteria under the main categories of criteria;
- Defining the sub-criteria; and
- Rating and ranking based on the sub-criteria.

10.4.2 Weighting of the Main Criteria

The following weights (Table 53 were given to the main route selection criteria:

Table 53: Weighting allocated to main criteria

Criterion category	Weighting
Engineering / Technical	20
Regulatory (Complexity of Permitting)	20
Constructability	15
Usability (Accessibility)	10
Environmental	15
Social / Public	15
Time to Implement / Construct	5
Total Assigned Weights:	**100**

10.4.3 Identification of the Sub-criteria

10.4.3.1 Engineering/Technical Criteria

The following **engineering/technical** sub-criteria were used to identify suitable criteria to conduct the rating and ranking assessment:

- Route setting suitability:
  - Suitability of topography for the development of a road;
  - Road following property boundary lines;
  - Proximity of households making use of the road;
  - Location of existing servitudes, and proximity of pans and other water bodies; and
  - Land use not being affected by the road development and location.
- Interference with mining:
  - Potential to sterilize coal deposit; and
  - Distance from the buffer zone of the active mining activities (such as blasting).
- Geohydrological and hydrological suitability:
  - Presence of pans and water bodies;
  - Presence of rivers (crossings); and
  - The need for stormwater management and drainage systems.
- Route constructability:
  - Availability of borrow material; and
  - Ease of staged construction.
- Route Usability:
  - Accessibility of the route for local road users.

10.4.3.2 Environmental Criteria

Environmental criteria relate to the potential threat to the ecosystem and the geophysical environment. They include the following considerations:

- Ecological impact (Terrestrial, Aquatics and Wetlands):
  - Impact on vegetation, wildlife, wetlands and aquatic life;
  - The sensitivity of the local ecosystems to impacts;
  - The impact of the change in land use on the local ecosystem;
  - Presence of and impact on species of conservation importance (i.e. Red List, Protected and/or endemic species); and
  - Proximity to ecologically significant features such as a wetlands and pans.
- Surface water impact:
  - Potential surface water pollution; and
  - The impact on the local surface waters.
- Soil impact:
  - Potential impact and contamination of the soil due to the road construction activities;
  - Possible soil contamination associated with hydrocarbon spillages; and
  - Potential impact on Land use and Land capability.
- Air quality impact:
  - Prevailing wind direction and potential dust generation that may impact the adjacent residents.

10.4.3.3 Social / Public Criteria

Social / public criteria relate to issues such as the possible adverse impacts on public health, quality of life, local land and property values. They also relate to potential public opposition to the proposed road realignment.

It is important to note that no consultation process with affected landowners, or communities has taken place during this route selection process.

The following are important considerations:

- Archaeological / heritage Impact:
  - Possible impacts on areas of historical, archaeological or cultural significance.
- Noise impact:
  - Potential noise impact for local residents adjacent to the road; and
  - The distance from farm houses and farm communities.
- Proximity to people:
  - Distance from farm houses, farm communities, informal settlements and areas of human activity and
  - Public acceptability of the proposed road realignment project.

- Land use impact:
  - Acceptability of changing agricultural land to a public (district) road;
  - Acceptability of changing privately owned land into a public (district) road; and
  - Potential impact of the change in land use on neighbouring communities.
- Relocation of communities/settlements:
  - The displacement of farm houses, farm communities, informal settlements; and
  - Perception of local residents with respect to relocation and/or compensation.
- Land ownership/property rights:
  - The need for land acquisition.

10.4.3.4 Economic Criteria

Economic criteria relate to the cost of developing, maintaining and possible closure/rehabilitation of the selected route. The rating of the economic criteria did not form part of this route selection process.

10.4.3.5 Legal and Regulatory Criteria

Legal and regulatory criteria include the following considerations:

- Acceptance of project:
  - Acceptance from the Mpumalanga Roads Department;
  - Completion of legal and town planning processes for the closure of public roads; and
  - Completion of legal and town planning processes to register servitudes for proposed new district road.

10.4.4 Route Selection Matrix

A project specific route selection matrix was developed to assist with qualitative rating and ranking of the identified alternative routes.

The rating of all the alternative route options were based on the following values:

Table 54: Road realignment route selection rating values

Description	Score
Excellent	5
Above Average	4
Below Average	2
Poor	1

The route selection criteria were weighted according to pre-determined weighting values consisting of:

Table 55: Route selection weighting values

Route Selection Criteria	Weighting Value
Engineering / Technical	20
Legal / Regulatory (Complexity of Permitting)	20
Constructability	15

Route Selection Criteria	Weighting Value
Usability (Accessibility)	10
Environmental	15
Social / Public	15
Time to Implement / Construct	5

10.4.5 Route Selection Workshop and Site Visit

10.4.5.1 Route Selection Workshop Participants

The semi-qualitative rating and ranking was carried out in a workshop held at the Golder Associates Midrand offices on 25 August 2016. Following the workshop, a site visit was held on 1 September 2016 and all the identified alternative route options were visited and viewed by the specialists.

The workshop and site visit were attended by the following Golder project team members:

Table 56: Participants in the route selection workshop and site visit

Team Member	Designation
Michael Whitfield	Mafube LifeX client contact and overall Project Manager
Mariëtte Weideman	Mafube LifeX Road Realignment - Project Manager
Adam Bennett	Air Quality Specialist Noise Assessment Specialist
Ilse Snyman	Soil Scientist
Warren Aken	Senior Aquatic Ecologist
Andrew Zinn	Terrestrial Ecologist
Kylie Farrell	Aquatic Ecologist
Priya Ramsaroop	Social and Traffic
Osborne Gwamanda	Hydrologist
Gareth Isenegger	Environmental Practitioner - Water Resource Specialist

The route selection matrix was populated during the workshop and the alternative sites were rated and ranked. Following the site visit, the ratings were reviewed and adjusted by the abovementioned specialists.

10.4.5.2 Route Selection Rating / Ranking Outcome

Each of the identified route alternative were rated and ranked within the route selection matrix Golder specialist project team members.

The outcome of the route selection rating process, is summarised in Table 57 below and the detailed matrix is appended to this report in APPENDIX F.

Table 57: Route selection rating and ranking outcome

Identified Route Alternatives	Route Selection – Main Criteria							Score	Rank
	Engineering / Technical	Legal / Regulatory	Constructability	Usability	Environmental	Social / Public	Time to Implement		
Alternative A	2.4	0.4	1.2	0.4	1.5	1.8	0.1	7.80	**5**
Alternative B	2.6	0.4	1.2	0.4	1.95	1.8	0.1	8.45	**4**
Alternative C	1.4	0.4	1.2	0.2	1.5	1.8	0.1	6.60	**6**
Alternative D	3.6	0.4	0.9	0.5	2.7	2.55	0.2	10.85	**1**
Alternative E	2.4	0.4	1.2	0.4	2.25	2.1	0.1	8.85	**2**
Alternative F	2.4	0.4	1.2	0.5	1.95	2.25	0.1	8.80	**3**

10.5 Motivation for not considering alternative sites

Not applicable. Alternative sites were considered as discussed in section 6.2 above.

10.6 Statement motivating the preferred site and layout

The proposed road realignment layout shown on Figure 22 represent the best overall option as determined via the site selection and layout process, as it is the shortest, parallel route to the existing D684 road, and will not affect any privately owned property owners as all the affected properties are either already owned by AOL or are in the process of being purchased.

11.0 ENVIRONMENTAL IMPACT ASSESSMENT

The proposed road realignment has a potential to impact on some biophysical and socio-economic aspects of the local environment.

One of the main purposes of the EIA process is to understand the significance of these potential impacts and to determine to what extent they can be minimised or mitigated. Based on experience with and past studies, supported by site-specific specialist studies, the impacts on soils, surface water, air quality, the ecology and the local socio-economic fabric can be predicted and appropriate mitigation measures can be formulated.

The EIA process for this project has been designed to comply with the requirements of the MPRDA and the EIA Regulations that commenced on 7 April 2017 (See section 4.1.1). Cognisance has also been taken of the following key principles contained in the National Environmental Management Act (Act 107 of 1998) (NEMA), which is South Africa's framework environmental legislation:

- Sustainability – development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs;
- Mitigation hierarchy – avoidance of environmental impact, or where this is not possible, minimising the impact and remediating the impact; and
- The duty of care of developers towards the environment.

The assessment of the impacts of Mafube LifeX proposed road realignment will be conducted in accordance with these principles.

Based on the findings of the EIA, a comprehensive Environmental Management Programme (EMPr) will be developed and implemented to control and minimise the impacts during construction, operation and possible decommissioning of the proposed district road.

11.1 Plan of study for impact assessment

The impact assessment component of the EIA is subdivided into several specialist fields of study. The findings of the specialist studies will be integrated into the EIA report. The significance of the impacts will be assessed in terms of the methodology described in section 11.1.10 of this report.

The terms of reference for the specialist investigations are set out below. The description is presented in fairly general terms, but all the issues that need to be addressed by the studies are captured. Where applicable, the cumulative effects of this project on the existing impacts experienced in the surrounding areas will be assessed.

11.1.1 Air Quality

A professional opinion will be provided on the impacts of the proposed road realignment on the current air quality in the surrounding area. Current and historical monitoring data providing the characteristics of the area will be used to assess the impact of the proposed road realignment location. Including:

- A review of applicable air quality legislation, policies and standards;
- Identification of sensitive receptors in the vicinity of the site;
- Identification of any gaps in the available baseline information;
- Professional opinion on the air quality impacts of the proposed road realignment project; and
- Development of appropriate mitigation measures and criteria for monitoring for inclusion in the EMPr.

11.1.2 Terrestrial and Wetland Ecology

The ecosystem assessment aims to establish a baseline ecological characterisation of the study area and to assess the ecological / wetland impacts of the construction, operational and possible closure phases of the road. The baseline assessment included a desktop literature study and a field survey undertaken during late February 2017 and August 2017 to establish the pre-road construction baseline conditions described in section 8.9.

The potential impacts of the proposed project will be identified and assessed. Potential mitigation and management measures will be defined for inclusion in the environmental management programme (EMPr).

11.1.3 Noise

The characterisation of the study area in terms pre-road construction noise levels, topographical features and locations of sensitive receptors, as described in section 8.11. The noise impacts of the proposed road realignment route will be assessed by comparing the predicted levels against pre-road construction baseline conditions and acceptable levels in terms of standards, guidelines and good practice. Suitable mitigation measures will be recommended.

11.1.4 Surface hydrology

The impact assessment will be done by exploring and predicting the effects of the proposed road realignment route on the pre-road construction baseline conditions described in section 8.6 and acceptable levels as defined by standards, guidelines and good practice. The surface water study will also take cognisance of Regulation 704 under the National Water Act (Act 36 of 1998) (NWA) and make recommendations for achieving compliance with the requirements of this regulation. Suitable mitigation measures will be recommended.

11.1.5 Socio-economics

The impacts of the proposed road realignment route on the current socio-economic fabric of the surrounding area, as described in section 8.15 will be identified. Recommendations for mitigation of adverse impacts and enhancement of positive effects will be provided.

11.1.6 Palaeontological Assessment

A phase I palaeontological study will be undertaken to assess the impacts of the proposed road realignment route on the baseline situation as described in section 8.14. Where appropriate, mitigation measures will be formulated. These may include topsoil, subsoil, overburden, inter-burden and bedrock surveyed for fossiliferous outcrops. Included will be a Protocol and Management Plan for palaeontological importance finds.

11.1.7 Cultural and Heritage Resources

As required in terms of Section 38 of the National Heritage Resources Act 25 of 1999 (NHRA), the South African Heritage Resources Agency (SAHRA) will be notified of the intended road development and a phase I heritage study will be undertaken to assess the impacts of the proposed project on the baseline situation as described in section 8.13. Where appropriate, mitigation measures will be formulated. These will include chance find procedures, as the possibility of unearthing buried artefacts or human remains during construction and stripping of topsoil and overburden cannot be ruled out.

11.1.8 Soils, Land Capability and Land Use

In addition to having determined the baseline conditions as described in section 8.5, this study will involve the following:

- Classification and mapping of soil types on a scale of 1:10 000;
- Sampling soils with a 100 mm hand auger on areas that will be affected by the project;
- Performing the analyses;
- Wetland delineation, based on soil properties;
- Determining the effective depth of the soils;
- Assessment of the agricultural potential of the soils under dry land and irrigated conditions;
- Assessment of anticipated positive and negative environmental impacts on soils during the construction, operational and possible closure phases; and
- Description of recommended mitigation measures for incorporation into the EMPr.

11.1.9 Visual Impact

The visual impact assessment will be undertaken against the backdrop of the baseline characterisation provided in section 8.10 and will involve the following:

- Identification of potentially sensitive receptors;
- Impact assessment by visual observation and photographic; and

- Professional opinion and recommendations for mitigation measures.

11.1.10 Traffic Impact

The traffic impact assessment will be undertaken by Techworld Consulting Engineers with a review and update of the complete traffic impact assessment conducted by them during the 2012 environmental impact assessment process for the Mafube LifeX project. The impact assessment will involve the following:

- Comparison of route alternatives from the viewpoint of the motorist; i.e. travel time and travel cost;
- Comparison of route alternatives from the viewpoint of the authority; i.e. long-term maintenance and improvement; and
- Investigation of accesses of affected properties and landowners.

11.2 Impact Assessment Methodology

The significance of the identified impacts will be determined using the approach outlined below (terminology from the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998). This approach incorporates two aspects for assessing the potential significance of impacts, namely occurrence and severity, which are further sub-divided as follows:

Occurrence		**Severity**	
Probability of occurrence	Duration of occurrence	Scale / extent of impact	Magnitude (severity) of impact

To assess each of these factors for each impact, the following four ranking scales are used:

Probability	**Duration**
5 - Definite/don't know	5 - Permanent
4 - Highly probable	4 - Long-term
3 - Medium probability	3 - Medium-term (8-15 years)
2 - Low probability	2 - Short-term (0-7 years) (impact ceases after the operational life of the activity)
1 - Improbable	1 – Immediate
0 - None	
Scale	**Magnitude**
5 - International	10 - Very high/don't know
4 - National	8 - High
3 - Regional	6 - Moderate
2 - Local	4 - Low
1 - Site only	2 - Minor
0 - None	

Once these factors are ranked for each impact, the significance of the two aspects, occurrence and severity, is assessed using the following formula:

SP (significance points) = (magnitude + duration + scale) x probability

The maximum value is 100 significance points (SP). The impact significance will then be rated as follows:

SP >75	Indicates high environmental significance	An impact which could influence the decision about whether to proceed with the project regardless of any possible mitigation.
SP 30 – 75	Indicates moderate environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP <30	Indicates low environmental significance	Impacts with little real effect and which should not have an influence on or require modification of the project design.
+	Positive impact	An impact that constitutes an improvement over pre-project conditions

11.3 Method of assessing duration significance

See section 11.1.10, where it is explained how durations ranging from immediate to permanent are assigned scores ranging from 1 to 5.

11.4 Stages at which competent authority will be consulted

The competent authority will be consulted:

- Pre-consultation with the Department of Water and Sanitation (DWS) regarding the integrated water use licence application linked to this application for environmental authorisation;
- Upon submission of the application environmental authorisation;
- During the 30 day period for public review of the draft scoping report;
- During the 43 day period of evaluation of the scoping report by the DMR;
- During the 106 day period of development of the EIR and EMPr;
- During the 30 day period for public review of the draft EIR and EMPr;
- During the 107 day period of evaluation of the EIR and EMPr by the DMR; and
- In the event of an appeal.

11.5 Public Participation during the Impact Assessment Phase

Public participation during the impact assessment phase of the EIA will entail a review of the findings of the EIA, presented in the EIA Report and Environmental Management Programme (EMPr), and the specialist studies. These reports will be made available for public comment for a period of 30 days.

11.5.1 Notification of interested and affected parties

All registered I&APs will be advised timeously and by e-mail, fax or telephone call of the availability of these reports, which they could either download from Golder's public website or request from Golder's Public Participation Office. They will be encouraged to comment either in writing (mail or email) or by telephone. Ample notification of due dates will be provided.

11.5.2 Engagement process to be followed

All the issues, comments and suggestions raised during the comment period on the Draft EIA Report/EMPr will be added to the Comments and Response Report (CRR) that will accompany the Final EIA Report/EMPr.

The Final EIA Report/EMPr will be submitted to the Department of Mineral Resources (DMR) and the Department of Water and Sanitation (DWS) for a decision about the proposed project.

On submission of the Final EIA Report/EMPr to the authorities, a personalised letter will be sent to every registered I&AP to inform them of the submission and the opportunity to request copies of the final reports.

11.5.3 Information to be provided to I&APs

In addition to all the information provided in this scoping report, specifically the road realignment plan shown in Figure 4 and Figure 22, the project description provided in section 3.0, the description of the baseline environment provided in section 8.0, the potential impacts identified in section 9.0 and the potential mitigation measures discussed in section 10.3, the results of the specialist assessments and their recommended mitigation measures will be provided to I&APs during the impact assessment phase.

11.6 Tasks to be undertaken during environmental impact assessment process

The various specialist studies that will be undertaken during the environmental impact assessment process are described in section 11.1.

12.0 OTHER INFORMATION REQUIRED BY COMPETENT AUTHORITY

12.1 Impact on socio-economic conditions of any directly affected persons

The socio-economic impacts on the local residents close enough to be directly affected can only be determined properly after the specialist studies described in section 11.1 (Plan of Study for Impact Assessment) have been completed. No relocation requirements are foreseen.

12.2 Impact on any national estate

No cultural/heritage resources close enough to the proposed road realignment activities were identified through the baseline assessment by the specialist, but the possibility of chance finds during construction and mining cannot be ruled out.

13.0 OTHER MATTERS REQUIRED IN TERMS OF SECTIONS 24(4)(A) AND (B) OF THE NEMA

- Section 24(4)(a) (iii) requires that a description of the environment likely to be significantly affected by the proposed activity be provided. This has been done – see section 8.0 of this report;
- Section 24(4)(a) (iv) requires an investigation of the potential consequences for or impacts on the environment of the activity and assessment of the significance of those potential consequences or impacts. See section 10.2 of this report, where potential impacts were identified. Their assessment, as detailed in the Plan of Study for Impact Assessment (section 11.1) will be done during the impact assessment phase of the EIA;
- Section 24(4)(a) (v) references public information and participation procedures, which have been dealt with in section 7.0 and 11.5 of this report.

14.0 UNDERTAKING REGARDING CORRECTNESS OF INFORMATION

I, Mariëtte Weideman herewith undertake that the information provided in the foregoing report is correct, and that the comments and inputs from stakeholders and Interested and Affected parties have been correctly recorded in this report.

March 2018

15.0 UNDERTAKING REGARDING LEVEL OF AGREEMENT

I, Mariëtte Weideman herewith undertake that the information provided in the foregoing report is correct, and that the level of agreement with Interested and Affected parties and stakeholders has been correctly recorded and reported herein.

March 2018

16.0 REFERENCES

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APPENDIX A

Document Limitations

DOCUMENT LIMITATIONS

This Document has been provided by Golder Associates Africa Pty Ltd ("Golder") subject to the following limitations:

i) This Document has been prepared for the particular purpose outlined in Golder's proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose.

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iii) Conditions may exist which were undetectable given the limited nature of the enquiry Golder was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required.

iv) In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. Golder's opinions are based upon information that existed at the time of the production of the Document. It is understood that the Services provided allowed Golder to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

v) Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Document.

vi) Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Golder for incomplete or inaccurate data supplied by others.

vii) The Client acknowledges that Golder may have retained sub-consultants affiliated with Golder to provide Services for the benefit of Golder. Golder will be fully responsible to the Client for the Services and work done by all of its sub-consultants and subcontractors. The Client agrees that it will only assert claims against and seek to recover losses, damages or other liabilities from Golder and not Golder's affiliated companies. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any legal recourse, and waives any expense, loss, claim, demand, or cause of action, against Golder's affiliated companies, and their employees, officers and directors.

viii) This Document is provided for sole use by the Client and is confidential to it and its professional advisers. No responsibility whatsoever for the contents of this Document will be accepted to any person other than the Client. Any use which a third party makes of this Document, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this Document.

GOLDER ASSOCIATES AFRICA (PTY) LTD

document3

APPENDIX B

Database of Potentially Interested and Affected Parties

Title	Salutation	Surname	Organisation
Mrs	Carolyn	Ah Shene-Verdoorn	Birdlife South Africa
Mr	Steven	Bloy	South32
	Gawie	Bosman	Anglo Coal - Mafube Colliery
Mr	Adriaan Johannes	Botha	Anglo Coal - Mafube Colliery
Mr	Christofel Jacobus	Botha	Bayview Mari-Lo CC
Mrs	Christa	Cass	Postnet
Mr	Leon	Cass	Arnot V L U
Mr	Cain M	Chunda	Mpumalanga Provincial Government
Mrs	Megan	Dickson	Samancor Middelburg Ferrochrome
Mr	Mandla	Dlamini	Middelburg Youth Business Association
Mr	Gerrie	du Toit	ALZU Enterprises
	Gerrie	du Toit	Statutis Trading (Pty) Ltd
Mr	Hannes	Eserhuizen	Mafube Coal Mining (Pty) Ltd
Mrs	C	Hlatshwayo	Steve Tshwete Municipality
Mr	Johannes Jurie	Human	Chrometec
Mr	Jurie	Human	Chrometec
Mr	Peter	Kane-Berman	Beestepan Boerdery
Ms	Leketso	Khaile	Inkomati Usuthu Catchement Management Agency
	B	Khenisa	Steve Tshwete Local Municipality
Mr	Sikhumbuzo	Kholwane	Mpumalanga Provincial Government
	Jona	Khomo	Anglo Coal - Mafube Colliery
Ms	Irene	Koenze	Department of Environmental Affairs
Mr	Christo	Laas	Mafube Colliery
	Lavhe	Lalamani	Anglo Coal - Mafube Colliery
Mr	Stephen	Law	Environmental Monitoring Group (EMG)
Mrs	L	Legabi	Steve Tshwete Municipality
Mr	Solly	Links	Steve Tshwete Local Municipality
	Pfanelo	Mabada	Anglo Coal - Mafube Colliery
Mr	Philmon	Mabena	Middelburg Employable Peoples' Structure (MEPS)
Ms	Noxolo	Mabuza	Steve Tshwete Municipality
Mr	Stanford	Macevele	Department of Water Affairs (DWA)
Ms	Sylvia	Machimana	Inkomati Catchment Management Agency (ICMA)
Mr	Duane	MacPhereson	Anglo Operations - Landau Colliery District
Mr	Meshack	Mahamba	Steve Tshwete Municipality
Mr	Tsietsi	Mahema	Department of Environmental Affairs
Mr	Vusi	Mahlangu	Nkangala District Municipality
Mr	Peter	Mahlangu	Nkangala District Municipality

Title	Salutation	Surname	Organisation
Mr	Dancy	Malatji	Mpumalanga Provincial Government: Department of Public Works, Roads and Transport
Mr	Samuel Nditsheni	Maliaga	Department of Water and Sanitation (DWS)
Mr	Sam	Maluleka	Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs
Ms	Dunisani	Maluleke	Department of Water and Sanitation (DWS)
Ms	Linah	Manchidi	National Union of Mine Workers South Africa (NUM)
Mr	Johan	Mangani	Nkangala District Municipality
Ms	Sasekani	Manzini	Mpumalanga Provincial Government
Ms	Lydia	Maphopha	Department of Mineral Resources
Mr	Abraham	Maphoso	Department of Mineral Resources
Ms	Zanele	Maphumulo	Department of Water Affairs (DWA)
	Fikile	Maseko	Nkangala District Municipality
Mr	R M	Masemola	Steve Tshwete Municipality
Mr	Pat	Mashiane	Department of Public Works
Ms	Angel	Masia	Steve Tshwete Local Municipality
Mr	Boetie	Mathe	Nkangala District Municipality
Mr	Joseph	Matjila	Exxaro Arnot Coal
Ms	Lebogang	Matlala	Department of Water and Sanitation (DWS)
Cllr	Johan	Matshiane	Steve Tshwete Municipality
Mr	Terrence	Matsie	Anglo Coal - Mafube Colliery
Mr	Thulane	Mdakane	Mpumalanga Provincial Government
Mr	Sibulelo	Mekhule	Middelburg Employable Peoples (Structure (MEPS)
Ms	Ningi	Mlangeni	Mpumalanga Provincial Government
Mr	Benjamin	Moduka	Provincial Heritage Resources Authority
Mr	PS	Mohlala	Mpumalanga Provincial Government
Ms	Martha	Mokonyane	Department of Mineral Resources (DMR)
Mr	Edward	Moripa	Hlagisa Mining
Mr	Success	Moripa	Hlagisa Mining
Mr	Victor	Moshapo	Department of Mineral Resources (DMR)
Mrs	Charity	Mthimunye	Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA)
Mr	Jabu	Mthimunye	TRAC - MP
Ms	Refilwe	Mtsweni	Mpumalanga Provincial Government
Mr	Masala	Mulaudzi	Department of Water Sanitation
	Kesavan	Muniappen	Anglo Coal - Mafube Colliery
Ms	Makgomo	Mushwana	Department of Environmental Affairs
	Brighton	Ncube	Anglo Coal - Mafube Colliery

Title	Salutation	Surname	Organisation
Mr	Rendani	Ndou	Department of Water and Sanitation (DWS)
Ms	Mpho	Nembilwi	Nkangala District Municipality
Mr	Aubrey	Nhlabathi	Samancor Middelburg Ferrochrome
Mr	Stephen	Nhlapo	Lekwa Combined Business Chamber
Mr	Themba	Nkabinde	Middelburg Employable Peoples' Structure (MEPS)
Mr	Michael	Nkosi	Steve Tshwete Municipality
	Charl	Nolte	Exxaro Arnot Coal
Mr	Thabang	Ntjoboko	Eskom
Mrs	Thuledu	Ntshingila	Mafube Coal Mining (Pty) Ltd
Mr	Jan	Olivier	South African National Roads Agency Limited (SANRAL)
	Anna-Marth	Ott	Middelburg Chamber of Commerce
Mr	Michael	Padi	Anglo Coal - Mafube Colliery
Mr	Stephan	Pienaar	Mpumalanga Provincial Government
	Theddious	Pongweni	Anglo Coal - Mafube Colliery
Dr	Koos	Pretorius	Federation for a Sustainable Environment
Mr	Gawie	Roux	
Mr	Johan	Roux	
Mr	M	Selepe	Inkomati Catchment Management Agency
Mr	Thuso	Selepe	Steve Tshwete Local Municipality
Mr	Thabo	Shabangu	Middelburg Youth Business Association
Ms	Busi	Shiba	Mpumalanga Provincial Government
Mr	Vusi	Shongwe	Mpumalanga Provincial Government
Mr	Vusi	Shongwe	Middelburg Employable Peoples' Structure (MEPS)
Mrs	Ingrid	Sithole	Mafube Coal Mining (Pty) Ltd
Mr	Harold	Skhosana	Department of Rural Development and Land Reform
Mr	Zolani	Skosana	Mafube Coal Mine
Cllr	Johannes	Skosana	Steve Tshwete Municipality
Ms	Maggie Millicent	Skosana	Nkangala District Municipality
Mr	Koos	Smit	Exxaro Arnot Coal
Mrs	Cindy	Smith	Mafube Coal Mining (Pty) Ltd
Mr	Billy	Smith	Middelburg Bird Club
Ms	Elise	Tempelhoff	Beeld Newspaper
		The Manager	Atseun (Pty) Ltd
		The Manager	Hooggenoeg Boerdery cc
Mrs	Dineo	Thwi	Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA)

Title	Salutation	Surname	Organisation
Mr	Aubrey	Tshivhandekano	Department of Mineral Resources (DMR)
Mr	Johan	Uys	Anglo Coal - Mafube Colliery
Mr	Johann	van Aswegen	Department of Water Affairs
Mr	Marthinus Johannes Christiaan	van der Merwe	Anglo Coal - Mafube Colliery
Mr	Charles	van Wyk	A J D van Wyk Farms
	Louis /Anneke	Wessels	
Mr	Pieter	Williamson	Anglo Coal - Mafube Colliery
	The Manager		Andries Jacobus Van Wyk -Trustees
	The Manager		Atseun Pty Ltd

APPENDIX C

Letter of Invitation and Registration, Comment and Reply Sheet

16 March 2018 Project No. 1776031_Let002_DSR_PP period

INVITATION TO REGISTER AND POVIDE COMMENTS: APPLICATION FOR ENVIRONMETAL AUTHORISATION FOR THE PROPOSED ROAD REALIGNMENT AND WATER USE LICENCE APPLICATION PROCESS FOR THE MAFUBE LIFE EXTENSION PROJECT, MPUMALANGA PROVINCE

DMR REFERENCE NUMBER: MP 30/5/1/2/3/2/1 (10026) EM
DARDLEA Reference number: 17/2/6/3 (101) N-1

INVITATION TO REGISTER AS AN INTERESTED AND AFFECTED PARTY

This letter serves to notify interested and affected parties (I&APs) that, in terms of the National Environmental Management Act (NEMA), (Act 107 of 1998), and the National Water Act (NWA), (Act 36 of 1998), Mafube Coal Mining (Pty) Ltd Life Extension Project (Mafube LifeX), are submitting an application for Environmental Authorisation (EA) along with an application for an integrated water use licence (IWULA) for the proposed realignment of section of three (3) district roads. Future mining activities will affect sections of the D684, D1048 and D1574 district roads.

Golder Associates Africa (Pty) Ltd, an independent environmental and engineering company, has been appointed to undertake the above authorisation processes on behalf of Mafube LifeX.

The Draft Scoping Report is available for public review and comment from **Friday, 16 March 2018 until Wednesday, 18 April 2018.**

The Draft Scoping Report contains:

- A description of the proposed road realignment activity, including all the proposed route alternative;
- An overview of the EIA process, including public participation;
- A description of the existing environment in the proposed project area;
- The identified environmental issues and potential impacts; and
- The proposed scope of specialist studies planned for the Impact Assessment phase.

AVAILABILITY OF THE DRAFT SCOPING REPORT FOR PUBLIC REVIEW

The Draft Scoping Report will be available for public review and comment from **Friday, 16 March 2018 until Wednesday 18 April 2018**. The Draft Scoping Report and on-line Registration and Comment Sheet can be downloaded from our website: http://www.golder.com/public. The Draft Scoping Report will also be made available for review at the following public places:

Name of Public Place	Contact Person	Contact Number	Address
Mafube LifeX project office	Chantelle Gerber	(011) 638 3479	Mafube LifeX Project Office, D684 road, Farm Springboklaagte
eMalahleni Main Library	Ms Johanette Rozmiarek	(013) 690 6232	Cnr. Hofmeyer and Elizabeth Avenue, eMalahleni
Golder Associates, Midrand	Antoinette Pietersen	(011) 254 4800	Golder Associates, Maxwell Office Park, Midrand
Golder Associates website	http://www.golder.com/public		

Golder Associates Africa (Pty) Ltd.
Building 1, Maxwell Office Park, Magwa Crescent West, Waterfall City, Midrand, 1685
P.O. Box 6001, Halfway House, 1685
Tel: [+27] (11) 254 4800 Fax: [+27] (0) 86 582 1561 www.golder.com
Golder Associates: Operations in Africa, Asia, Australasia, Europe, North America and South America

Your comments are valuable

Please provide your comments by e-mail, post, fax or telephonically to the Golder Associates Public Participation Office at the contact details provided below.

Comments on the Draft Scoping Report must be submitted before or on Wednesday 18 April 2018. Comments received will be acknowledged and recorded in the Final Scoping Report, which must be submitted to the Department of Mineral Resources (DMR).

Register as an I&AP

Stakeholders are invited to register as I&APs, and to participate in the EIA/EMPr and IWULA process in any of the following ways:

- Completing the enclosed Registration and Comment Sheet or on-line via the Golder website and submitting it to the Public Participation Office; and
- Submitting any comments you may have or the request to be registered by mail, email, letter, fax or telephonically to the contact details indicated below.

INVITATION TO ATTEND A PUBLIC MEETING

Stakeholders are hereby also invited to attend a Public Meeting and the Draft Scoping Report will serve to focus the discussions at the meeting. Details of the Public Meeting:

Date: Wednesday 4 April 2018
Time: 11:00 – 13:00
Venue: Arnot Vroue Landbou-Unie Saal, Farm Springboklaagte, Middelburg District
RSVP: Before/on 4 April 2018, by contacting the Public Participation Office

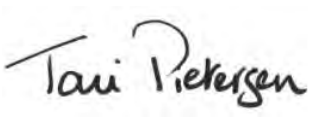
Please contact me should you have any questions, would like more information, to obtain a copy of the Draft Scoping Report; or would like to contribute comments.

You can reach me at the following contact details:
P.O. Box 6001, Halfway House, 1685
Tel: +27(011) 254 4800/4805
Fax: +27(0)86 582 1561
E-mail: apietersen@golder.co.za

I look forward to your participation in the project.

Sincerely,

GOLDER ASSOCIATES AFRICA (PTY) LTD.



Antoinette Pietersen
Stakeholder Engagement Specialist

Mariëtte Weideman
Project Manager

MW/AP/mw

CC: [Click here and type list of CCs]

Attachments: Registration and Comment Form
Locality Map

g:\projects\1776031 - mafube env input 2017\7.0 public participation\road eia_emp process\announcement letter\1776031_mafube road eia_ann letter_final_13.03.2018.docx

APPLICATION FOR ENVIRONMETAL AUTHORISATION FOR THE PROPOSED ROAD REALIGNMENT AND WATER USE LICENCE APPLICATION PROCESS FOR THE MAFUBE LIFE EXTENSION PROJECT, MPUMALANGA PROVINCE

DRAFT SCOPING REPORT AVAILABLE FOR PUBLIC REVIEW

Registration and Comment Sheet

16 March 2018 until 18 April 2018

Your comments are an important contribution to this permitting process. We would like to interact directly with you and encourage you to register as a stakeholder. By registering, we will be able to keep you updated as this project moves forward and respond to any questions or concerns that you may wish to raise.

PERSONAL DETAILS			
Name	**Surname**	**Title**	**Organisation / Department** *(If applicable)*

CONTACT INFORMATION				
Cell Number	**Land Line Contact Number**		**Fax Number**	**Preferred Language**
		Office		
		Home		
E-mail	**Postal Address**			**Postal code**

LANDOWNERS	
If your property falls within the boundary of the road construction area, please tell us your farm name and erf and portion number	

WOULD YOU LIKE TO REGISTER AS AN INTERESTED AND AFFECTED PARTY?		
Please register me as an interested and affected party for this project so that I may receive further information and notifications as the project develops	**YES**	**NO**

Preferred Method of Communication *(Mark with an X)*	**POST**	**E-MAIL**	**FAX**

In terms of GNR 326 (EIA Regulations) I disclose below any direct business, financial, personal or other interest that I may have in the approval or refusal of the application:	**Date**	
	Signature	

For internal use to confirm capture of stakeholder details into the stakeholder database	
Stakeholder database reference number	
	Signature of data capturer

COMMENT(S)

You are welcome to use different pages should you so wish.

I have the following comments on the Draft Scoping Report and/or the public consultation process:

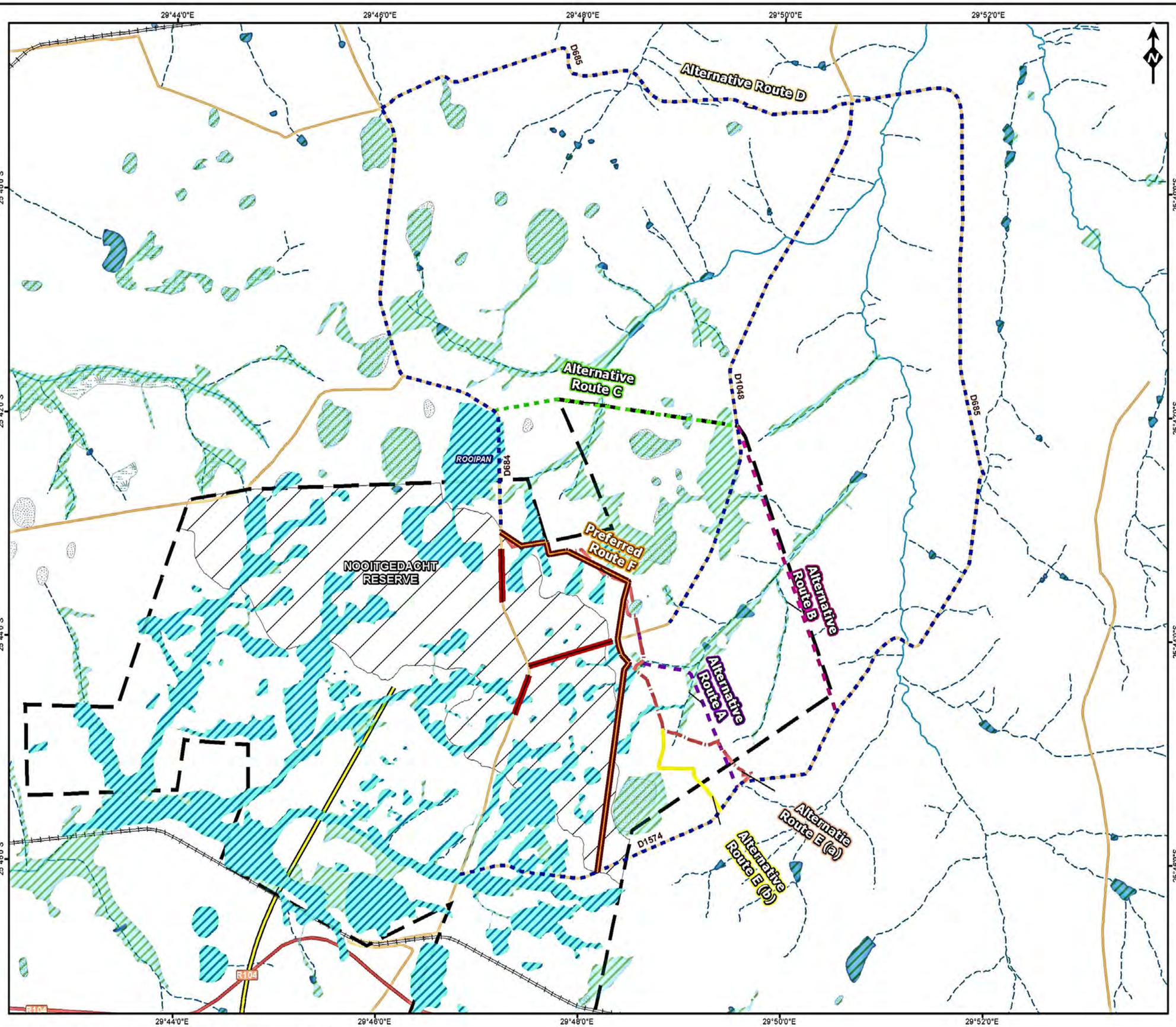
Please ask the following of my colleagues / friends to register as Interested and Affected Persons for this environmental authorisation process:

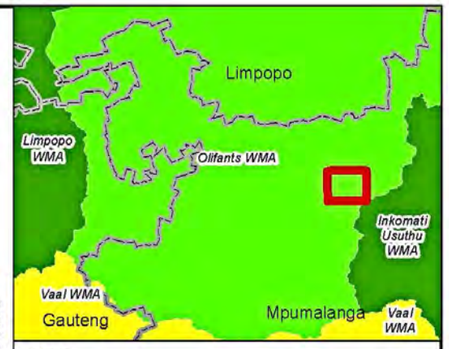
NAME	CONTACT DETAILS

PLEASE RETURN THE REGISTRATION AND COMMENT SHEET TO:

Golder Associates Africa
PUBLIC PARTICIPATION OFFICE
Antoinette Pietersen
P.O. Box 6001, Halfway House, 1685
Tel: +27(011) 254 4800/4805
Fax:+27(0)86 582 1561
E-mail: apietersen@golder.co.za
Website : http://www.golder.com

THANK YOU





LEGEND

- Affected Road Sections
- Alternative Route D
- Alternative Route
- Alternative Route B
- Alternative Route C
- Preferred Route F
- Alternative Route E (a)
- Alternative Route E (b)
- Wetlands (WCS 2015)
- Mafube (MRA)
- Railway
- Conveyor
- Dam
- Pan
- Marsh vlei

RESOURCES\NOTES

0 0.45 0.9 1.8 2.7 3.6
Kilometers

REFERENCE
Coordinate System: WGS Lo29

PROJECT
MAFUBE

TITLE

REALIGNMENT ROADS

PROJECT No. 1660730		REV 0
SCALE 1:60,000		A3
GIS	MM	2/10/2018
CHECK	KF	2/10/2018
REVIEW	MW	2/10/2018

Golder Associates
Johannesburg, South Africa

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APPENDIX D

Site Notices

APPLICATION FOR ENVIRONMETAL AUTHORISATION FOR THE PROPOSED ROAD REALIGNMENT AND WATER USE LICENCE APPLICATION PROCESS FOR THE MAFUBE LIFE EXTENSION PROJECT, MPUMALANGA PROVINCE

INVITATION TO REGISTER AS AN INTERESTED AND AFFECTED PARTY AND COMMENT ON DRAFT SCOPING REPORT

In terms of the National Environmental Management Act (NEMA), (Act 107 of 1998), and the National Water Act (NWA), (Act 36 of 1998), Mafube Coal Mining (Pty) Ltd Life Extension Project (Mafube LifeX), is submitting an application for Environmental Authorisation (EA) along with an application for an Integrated Water Use Licence (IWUL) for the proposed realignment of section of three (3) district roads, which will be affected by their future mining activities. The affected roads are sections of the D684, D1048 and D1574 district roads.

The proposed project area is located in the Magisterial District of Steve Tshwete Local Municipality in the Mpumalanga Province, 39 km east of the town of Middelburg via the R104 regional road, and 45 km west of Belfast.

Golder Associates Africa (Pty) Ltd, an independent environmental and engineering company, has been appointed to undertake the above authorisation processes on behalf of Mafube LifeX.

INVITATION TO REGISTER AS INTERESTED AND AFFECTED PARTY AND TO COMMENT

Stakeholders are invited to register as Interested and Affected Parties (I&APs) and to participate in the above process by commenting on the Draft Scoping Report and/or identifying issues of concern and suggestions for enhanced benefits.

The Draft Scoping Report will be available for public review and comment for a period of 30 days from **16 March 2018 until 18 April 2018**. The report, as well as an on-line Registration and Comment Sheet, will be available at the public places listed below and also on the following website: www.golder.com/public.

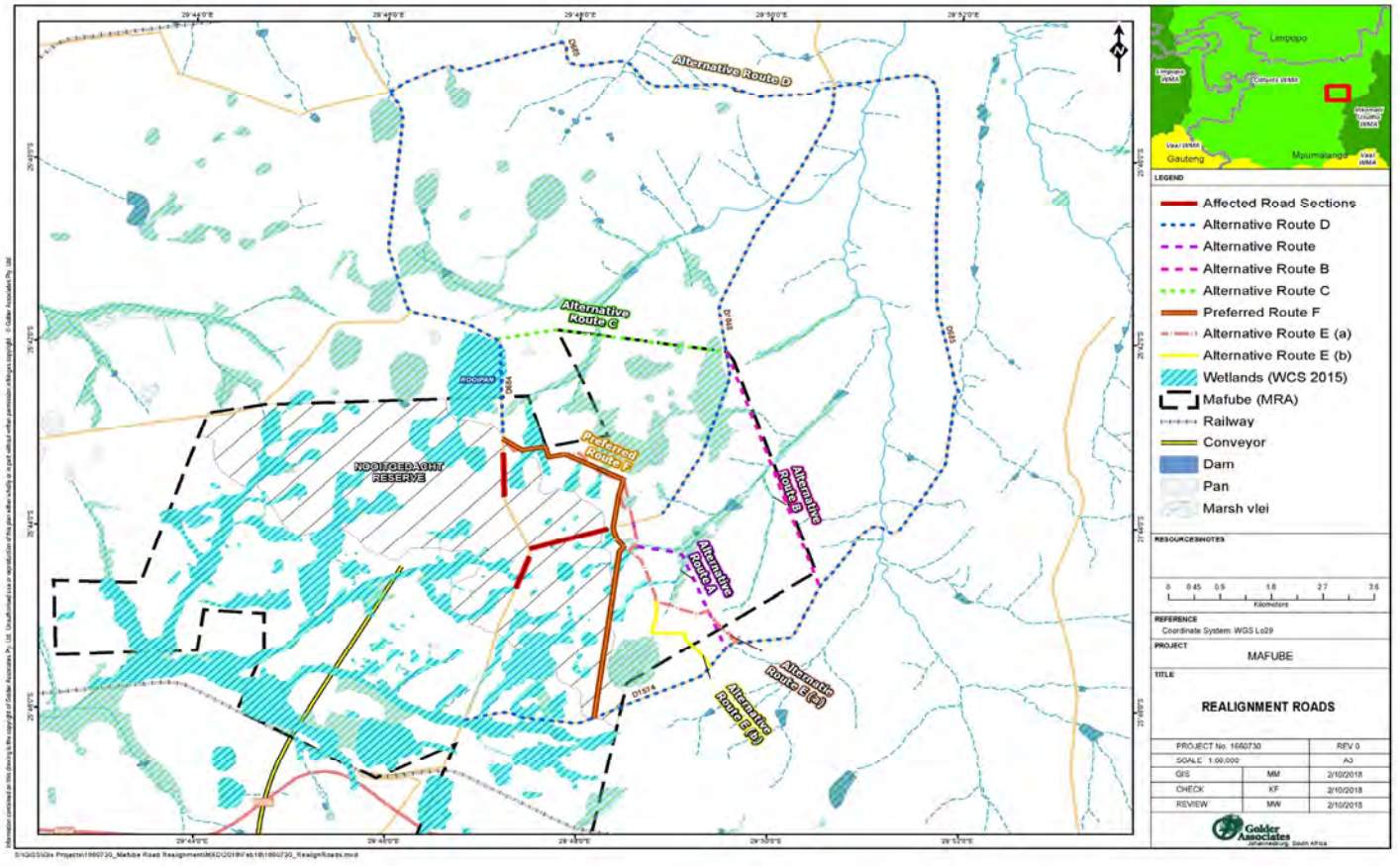
Name of Public Place	Contact Person	Contact Number	Address
Mafube LifeX project office	Chantelle Gerber	(011) 638 3479	Mafube LifeX Project Office, D684 road, Farm Springboklaagte
eMalahleni Main Library	Johanette Rozmiarek	(011) 690 6232	Cnr. Hofmeyer and Elizabeth Avenue, eMalahleni
Colder Associates, Midrand	Antoinette Pietersen	(011) 254 4800	Golder House, Building 1, Maxwell Office Park Midrand
Golder Associates Website	http://www.golder.com/public		

INVITATION TO ATTEND A PUBLIC MEETING:

Stakeholders are hereby also invited to attend a Public Meeting and the Draft Scoping Report will serve to focus the discussions at the meeting. Details of the Public Meeting:

Date: Wednesday 4 April 2018 **Time:** 11:00 – 13:00 **Venue:** Arnot Vroue Landbou-Unie Saal, Farm Springboklaagte, Middelburg District

RSVP: Before/on 4 April 2018, by contacting the Public Participation Office



To register as an I&AP and/or obtain more information please contact:
Antoinette Pietersen
Public Participation Office:
Golder Associates Africa (Pty) Ltd.
PO Box 6001, Halfway House, 1685
Tel: (011) 254 4805
E-mail: apietersen@golder.co.za

Date of Site Notice : 16 March 2018

APPENDIX E

Newspaper Advertisements, List of Registered I&APs, and CRR – To be included in the Final Scoping Report

APPENDIX F

Route Selection Report

14 June 2017

MAFUBE COAL MINING (PTY) LTD

Road Realignment Route Selection Report - Rev 3

Submitted to:
Cindy Smith
Mafube Coal Mining (Pty) Ltd
PO Box 3385
Middelburg
1035

REPORT

Report Number: 1660730-307643-1

Distribution:

1 x copy to Mafube Coal Mining (Pty) Ltd
1 x Copy to GAA Library

Golder Associates

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION AND BACKGROUND

Mafube Coal, an existing operation outside of Middelburg in Mpumalanga, is a 50/50 joint venture involving Anglo Operations Limited and Exxaro Coal Mpumalanga (Pty) Ltd. The expansion of the existing Mafube opencast operations onto the Nooitgedacht reserve (Mafube LifeX project) extends the life of the existing Mafube operations. Mafube LifeX project will supply power station and A-grade thermal export coal.

Golder Associates Africa (Pty) Ltd (Golder) has been conducting environmental authorisation process, studies and monitoring for the Mafube LifeX project since 2008. The project plan has evolved during this time and a number of updates and amendments have taken place.

The Mafube LifeX project is in the final stages of planning and onsite activities are imminent.

Coal extracted from the life expansion pits on Nooitgedacht will be transported by conveyor approximately 6 km to the existing plant, at Springboklaagte, for processing. Construction is due to commence on 10 December 2016 and is scheduled to take18 months. First coal is planned for 1 April 2018 and over the life of mine, of 13 years, approximately 63 million tonnes of coal will be extracted.

In 2011 Golder was appointed by Mafube to conduct the Environmental Impact Assessment (EIA) process for the proposed Mafube LifeX project, which included the mining operations at Nooitgedacht and Wildfontien. An Environmental Management Programme (EMP) was also submitted to the Department of Mineral Resources (DMR) for approval as part of their mining rights application, as required under the Mineral and Petroleum Resources Act (Act No. 28 of 2002) (MPRDA).

Environmental authorisation (EA) conducted under the National Environmental Management Act (NEMA) for the Mafube Nooitgedacht and Wildfontein opencast coal expansion project (Mafube LifeX) was received from the Mpumalanga Department of Environmental Affairs and Tourism (MDEDET) in April 2013 (17/2/6/3 (101) N-1). An approval for the mining right's application was granted by the Mpumalanga Department of Minerals Resources (DMR) on 30 August 2013 (MR 30/5/1/2/2/10026 MR) and the EMP approved by them on 14 November 2013.

In terms of the National Water Act (Act No. 36 of 1998) (NWA), an Integrated Water Use Licence application & Waste Water Management Plan was also required for the LifeX project, and this application was submitted in December 2013 and approved 1 December 2014.

During the feasibility phase investigations, it was assessed that sections of district road D684 and district road D1048 traverse the Nooitgedacht Coal Reserve and their closure and/or re-alignment are required before this operation can commence (Figure 1). These roads fall under the jurisdiction of the Mpumalanga Department of Public Works, Roads and Transport (DPWRT) their approval will ultimately be required to re-align these roads.

Mafube has appointed Golder to conduct the EIA/EMP and public participation process (under NEMA) for the proposed realignment of sections of the D684 and D1048 district roads. Part of this process is to identify potential route realignment alternatives and follow an alternative analysis process to identify the most preferred alternative route.

1.1 Study Area

During the 2012 Mafube LifeX EIA/EMP authorisation process, a traffic impact assessment was conducted by Techworld Consulting Engineers (TW553 - Traffic Report_Mafube Opencast Coal Expansion_25Jun12) to assess the likely impact of the closure and/or re-alignment of the abovementioned roads. From this study, it is evident that the roads that traverse the coal reserves does not serve a mobility function but rather provides access to the farms in the area. The re-alignment of these roads will therefore not have a significant impact on traffic flows and transportation in the area (Techworld Consulting Engineers, June 2012).

A further study was conducted in 2016 (Golder, 1650906 – 304345 – 3) to assess the impacts of using the D684 as access to the Nooitgedacht operations area during construction. The methodology for the study was a combination of qualitative and quantitative data gathering approach to generate a baseline and assess impacts. Data was gathered through secondary sources in the desktop review, verified by a site visit and

sample traffic survey undertaken on 18 May 2016. The results were analysed through content analysis techniques (Golder Associates Africa (Pty) Ltd, 2016).

All the route realignment alternatives identified in Section 2.1 to 2.4 would also need to include the closure of D684 over a distance of approximately 2.8km from the start of East Pit 1 in the South to the Northern boundary of East Pit 3 in the North, and the closure of D1048 over a distance of approximately 1.6km from the T-junction with D684 in an eastern direction to the Eskom Powerline intersection to the east of East Pit 2. These road closures are required because of the location of the Nooitgedacht East Pits 1, 2 and 3 (Figure 2).

Two route realignment alternatives (Alternative A and B) discussed in this report were identified by Kruger in 2012 as part of the traffic impact assessment study and an additional two route realignment alternatives (Alternative C and D) were identified by the Golder project team.

Figure 2 and Figure 3 below illustrates the existing heritage resources (2012 data) and households (2009 data) located in the project area.

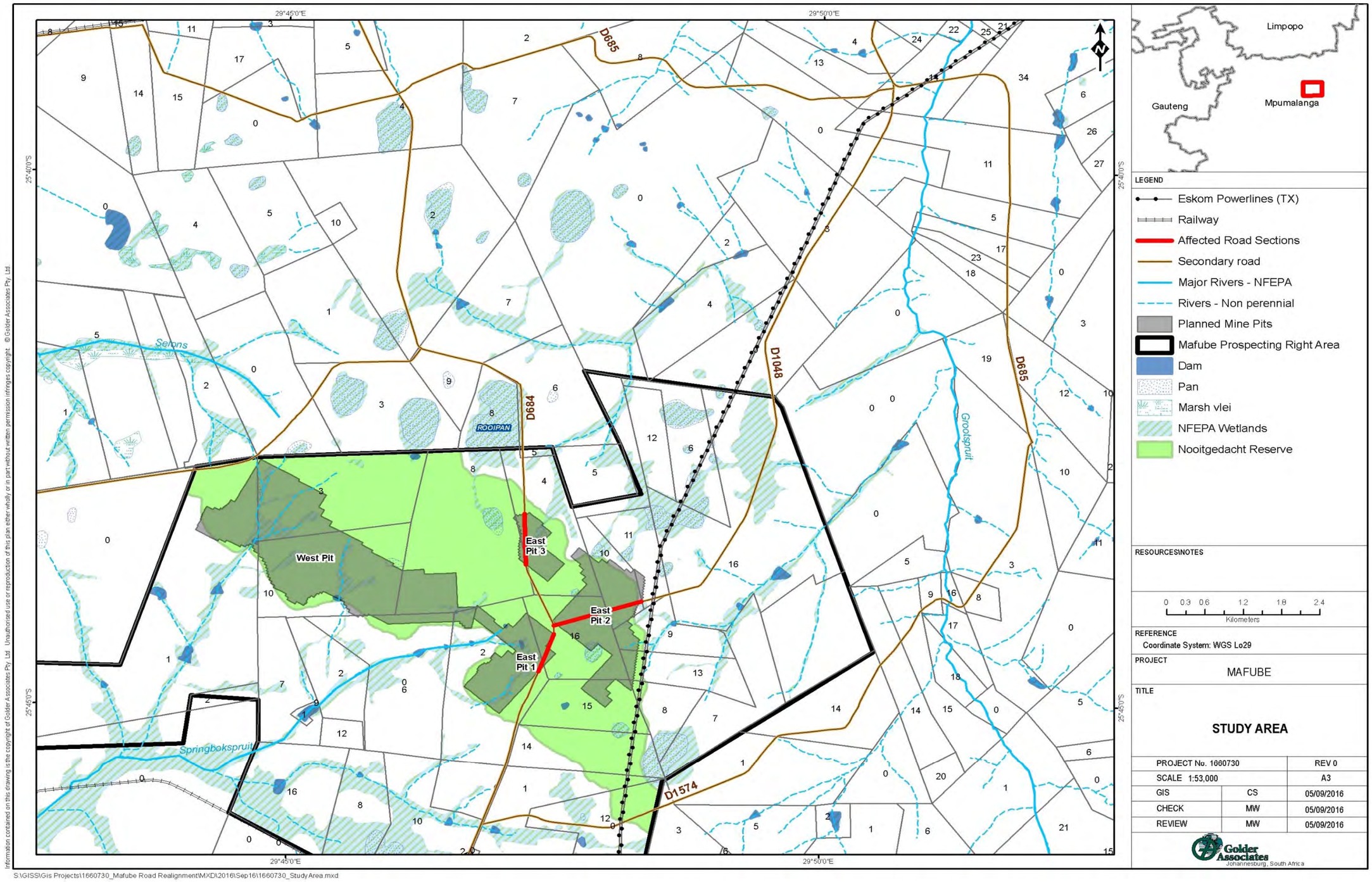


Figure 1: Mafube LifeX Road Realignment Study area

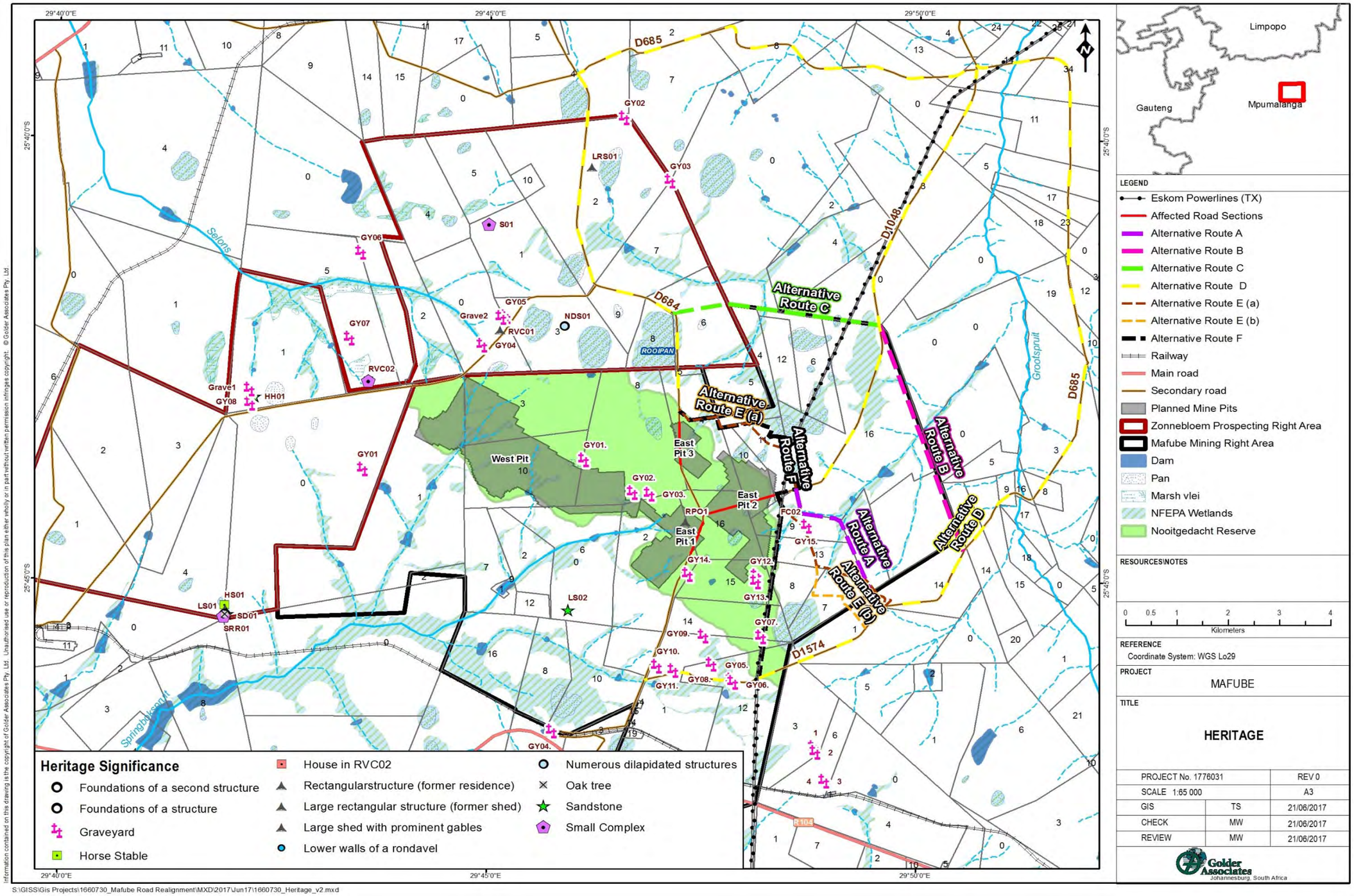


Figure 2: Mafube LifeX Road Realignment project - Identified Route Alternatives and Identified Heritage Resources

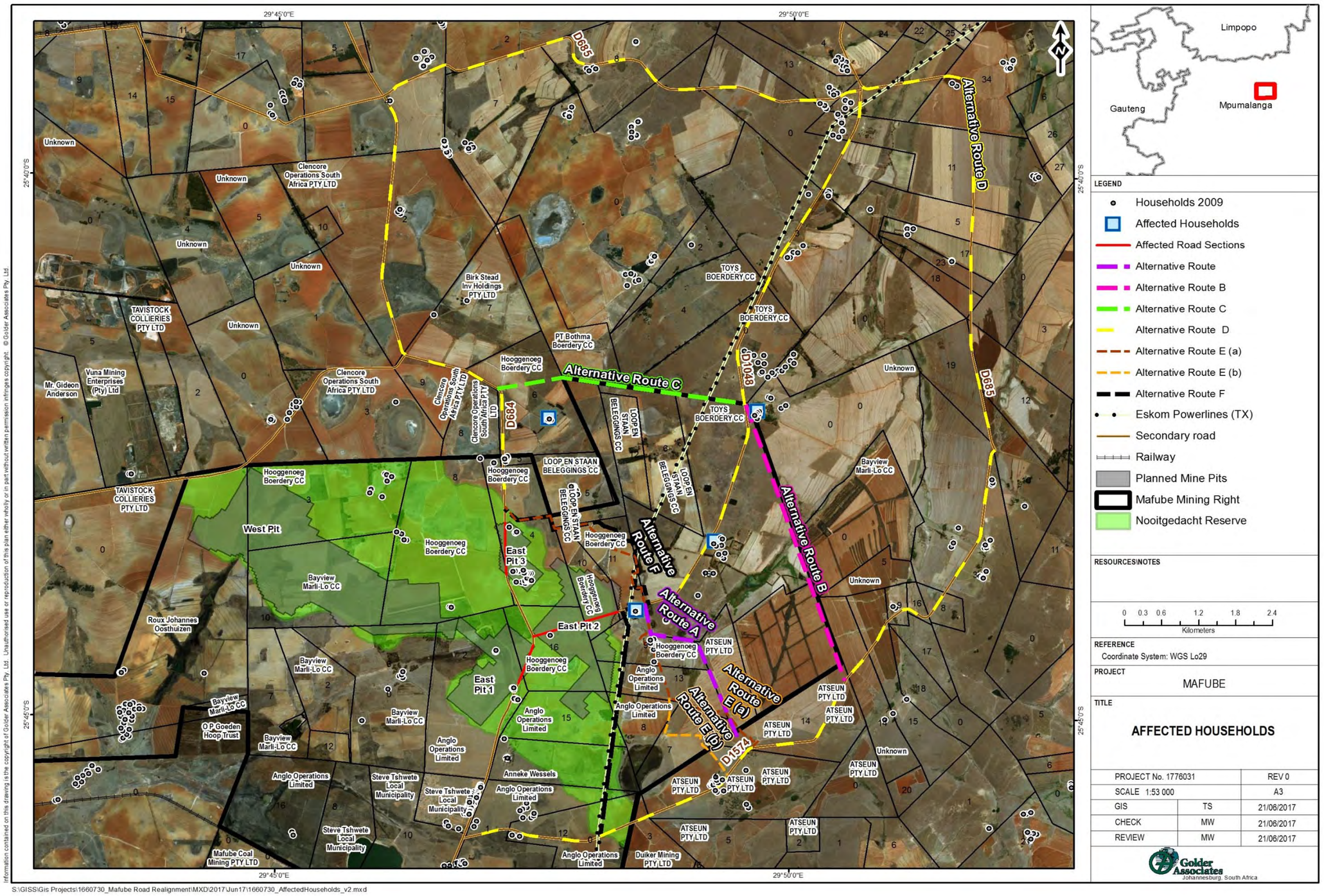


Figure 3: Affected Households in the study area

2.0 OBJECTIVE OF THE ROUTE SELECTION STUDY

The key objective of the road realignment route selection process was:

To identify a suitable road realignment route that will pose minimal risk to the environment, and not restrict access or movement of residents in the area, and not have a negative impact on the current land use of the affected private properties. The preferred route would also be associated with acceptable cost of development, and maintenance and would need to comply with legal and regulatory requirements.

2.1 Alternative A – Construction of new D683/D1048 link Road

Alternative A entails the proposed closure of the affected road as described in Section 1.1 above, and the construction of a new gravel road as indicated in Figure 6 below. This alternative route is approximately 3.51 km long and will run along exiting property boundaries. The last 600 m of this proposed alternative route, follows an existing farm road that may need upgrading should this route be selected as the preferred route alternative. Approximately 1.54 km of the proposed alternative route will traverse existing agricultural fields, and will also require the construction of at least two (2) watercourse crossings.

The properties and landowners details in Table 1 below, will be the properties directly affected by the construction of this Alternative route option.

Table 1: Alternative A - Properties and Landowner Details

Property Details	Landowner Details
Roodepoort 418 JS Portion 7	ATSEUN (Pty) Ltd
Roodepoort 418 JS Portion 9	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 11	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 13	Anglo Operations Limited
Roodepoort 418 JS Portion 14	ATSEUN (Pty) Ltd
Roodepoort 418 JS Portion 16	Toys Boerdery Pty Ltd

ATSEUN and Toys Boerdery will be the landowners mostly affected by this proposed route alternative and Golder still needs to understand what process Mafube will follow regarding landowner negotiations and compensations. Landowner consultation will need to take place to assess the by-in from the landowners regarding this proposed alternative route option.

Figure 4: View of the Alternative A route option taken from its proposed beginning just off the D1574 road

Figure 5: View of the Alternative A route option taken from its proposed end where it will link into the D1048 road

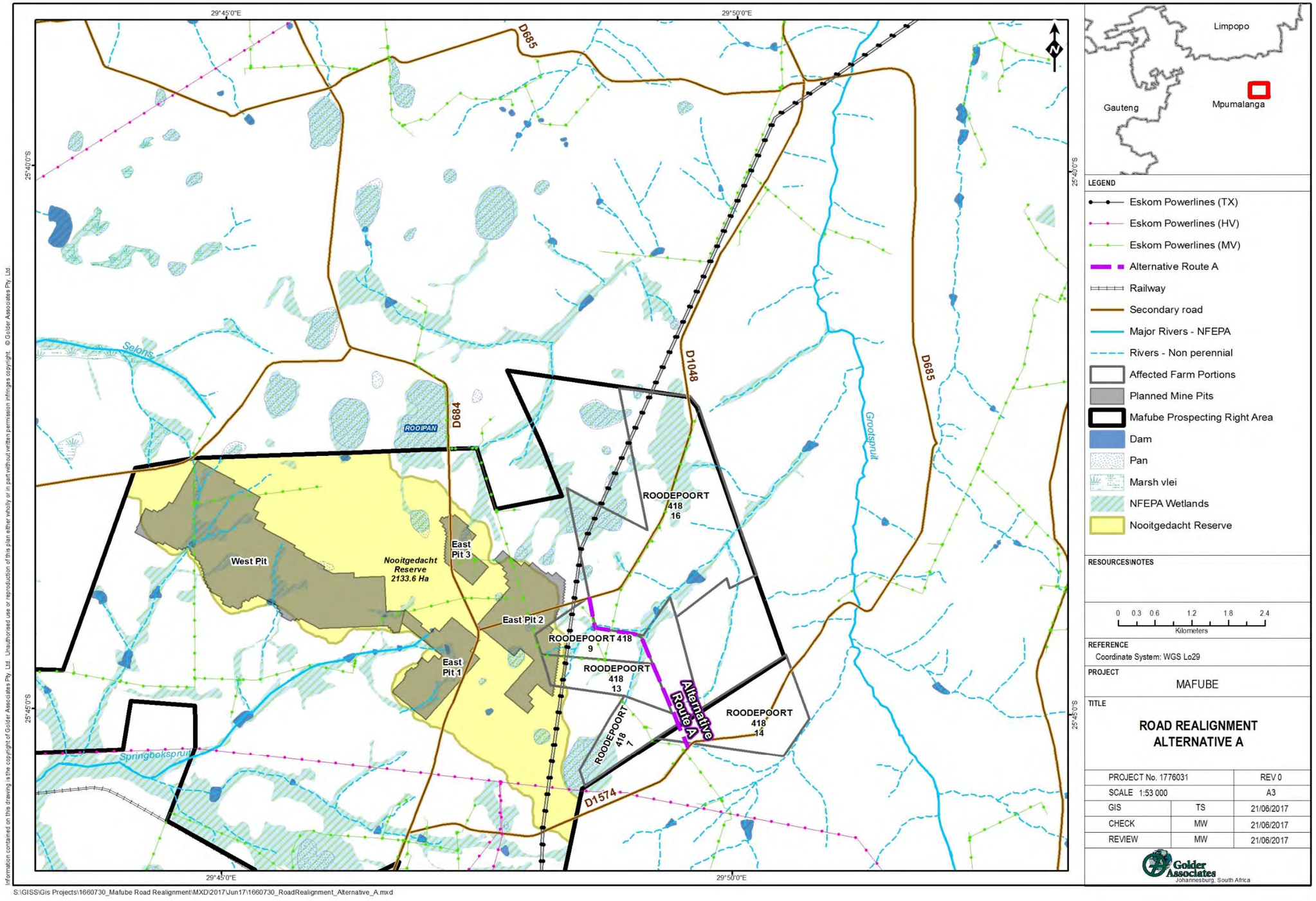


Figure 6: Mafube LifeX - Road Realignment Route Alternative A

2.2 Alternative B – Construction of new D683/D1048 link Road

Alternative B entails the proposed closure of the affected road as described in Section 1.1 above, and the construction of a new gravel road as indicated in Figure 9 below. This alternative route has an approximate length of 5.0 km and will run along exiting property boundaries although currently there is no boundary fences. The entire length of the proposed alternative route run along existing agricultural field boundaries or have agricultural fields on one side and grazing veld on the other side. The alternative route will also require the construction of at least two (2) watercourse crossings.

The properties and landowners details in Table 2 below, will be the properties directly affected by the construction of this Alternative route option.

Table 2: Alternative B - Properties and Landowner Details

Property Details	Landowner Details
Roodepoort 418 JS Portion 14	ATSEUN (Pty) Ltd
Roodepoort 418 JS Portion 16	Toys Boerdery Pty Ltd
Bayview 430 JS Portion RE	Bayview MARI-LO CC
Jubilatum 401 Portion RE (0)	Toys Boerdery (Pty) Ltd
Witklip 391 JS Portion 5	Kusic Prop CC – (Not confirmed)
Witklip 391 JS Portion 14	ATSEUN (Pty) Ltd

Figure 7: View of the Alternative B route option taken from its proposed beginning just off the D684 road

Figure 8: View of the Alternative B route option – photo taken from the D1048 road

Toys Boerdery will be the landowner mostly affected by this proposed route alternative. It should be noted, that even though the proposed route will follow the property bound lines as indicated on Figure 9, the top section of Alternative D will affect the flowing properties: Roodepoort 818 JS Portion 16 and Jubilatum 401 JS Portion RE (0) – these properties are both owned by Toys Boerdery, and so there are currently no boundary fences (see Figure 8 above). Should this alternative be selected as the most preferred alternative, traversing these properties with the proposed dirt road may have an impact on the current and future land use of these properties.

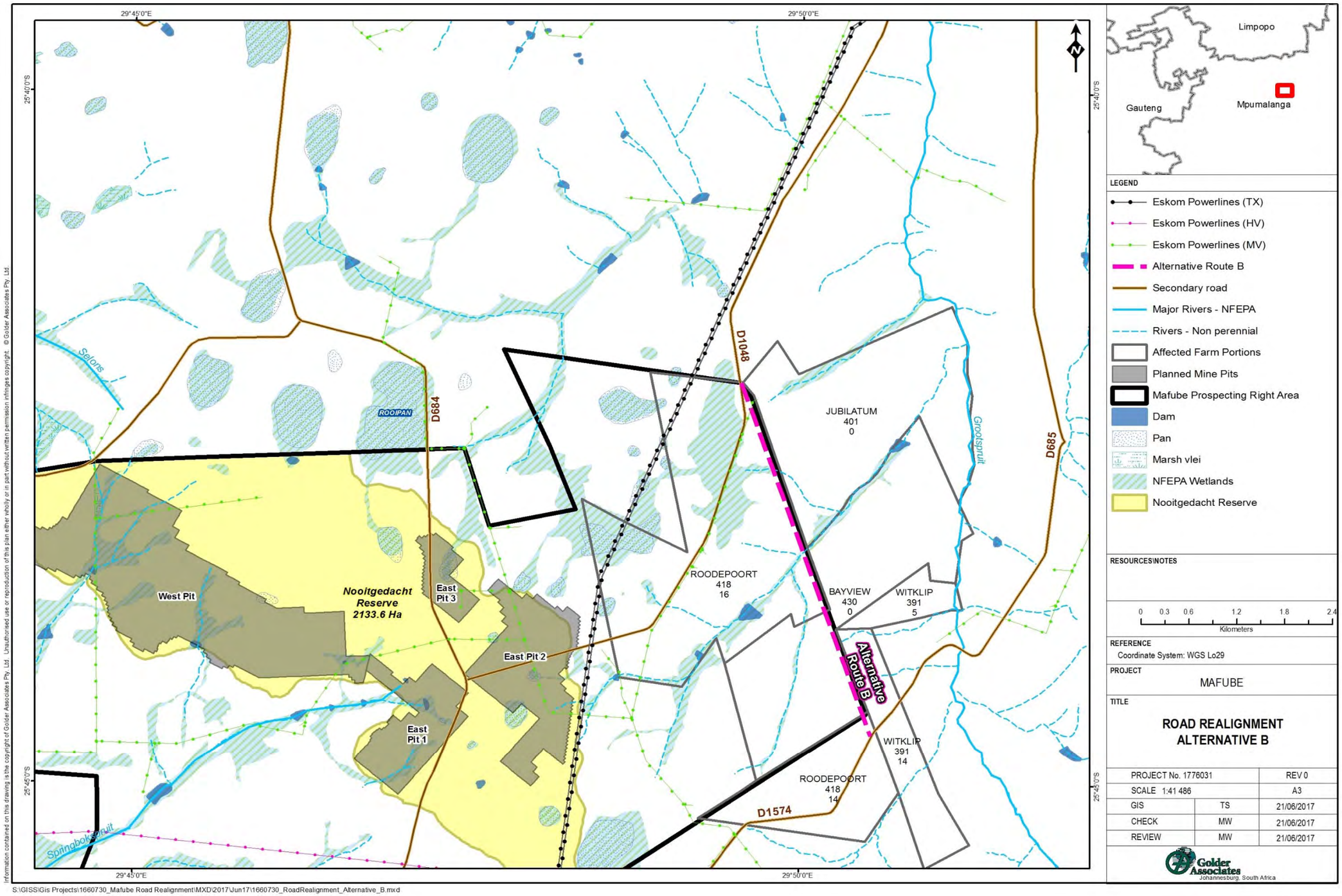


Figure 9: Mafube LifeX - Road Realignment Route Alternative B

2.3 Alternative C – Construction of new D683/D1048 link Road

Alternative C entails the proposed closure of the affected road as described in Section 1.1 above, and the construction of a new gravel road linking the existing D684 and the existing D1048 roads as indicated in Figure 11 below. This alternative route is approximately 4.06 km long. The first 2.47 km will cut through natural vegetation and grazing land, and the last section (approximately 1.59 km) will run through existing agricultural fields. The proposed alternative route will require the construction of at least one (1) watercourse crossing, and there are two (2) small pans that will be affected by this alternative route option as it is currently illustrated on Figure 11.

The properties and landowners details in Table 3 below, will be the properties directly affected by the construction of this Alternative route option.

Table 3: Alternative C - Properties and Landowner Details

Property Details	Landowner Details
Roodepoort 418 JS Portion 4	Loop & Staan Beleggings CC
Roodepoort 418 JS Portion 6	Loop & Staan Beleggings CC
Roodepoort 418 JS Portion 12	Loop & Staan Beleggings CC
Roodepoort 418 JS Portion 16	Toys Boerdery (Pty) Ltd
Hartbeesthoek 393 JS Portion RE (0)	Toys Boerdery (Pty) Ltd
Hartbeesthoek 393 JS Portion 4	ATSEUN (Pty) Ltd
Genadebult 121 JS Portion 1	PT Bothma Boerdery CC
Panplaats 395 JS Portion 6	Hooggenoeg Boerdery CC

Figure 12 illustrates the latest available Life of Mine plans for the Mafube LifeX and Zonnebloem operations, which falls into this study area. According to this mine plan, Zonnebloem will mine through a section of the D684 road in the year 2023. Currently, Golder is unaware of any alternative process underway by Zonnebloem to realign this section of the D684 road which will be affected by their mining operations. Thus Alternative C may be classed as a 'fatal flaw' alternative because to northern section of the D684 will not be accessible from 2023 until the decommissioning and closure of the Zonnebloem operations.

Figure 10: View of the Alternative C route option taken from its proposed link at D684 just above Rooipan

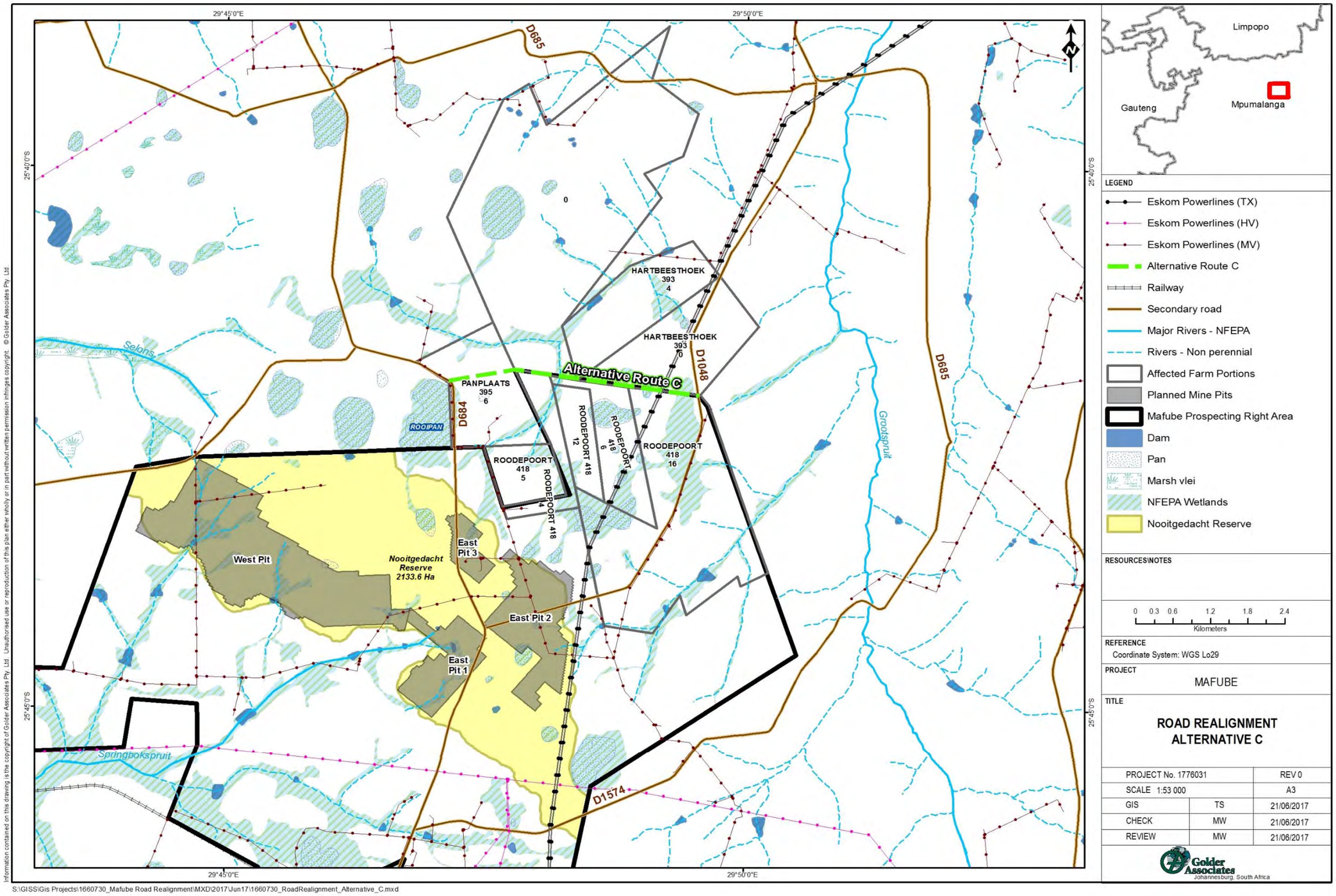


Figure 11: Mafube LifeX - Road Realignment Route Alternative C

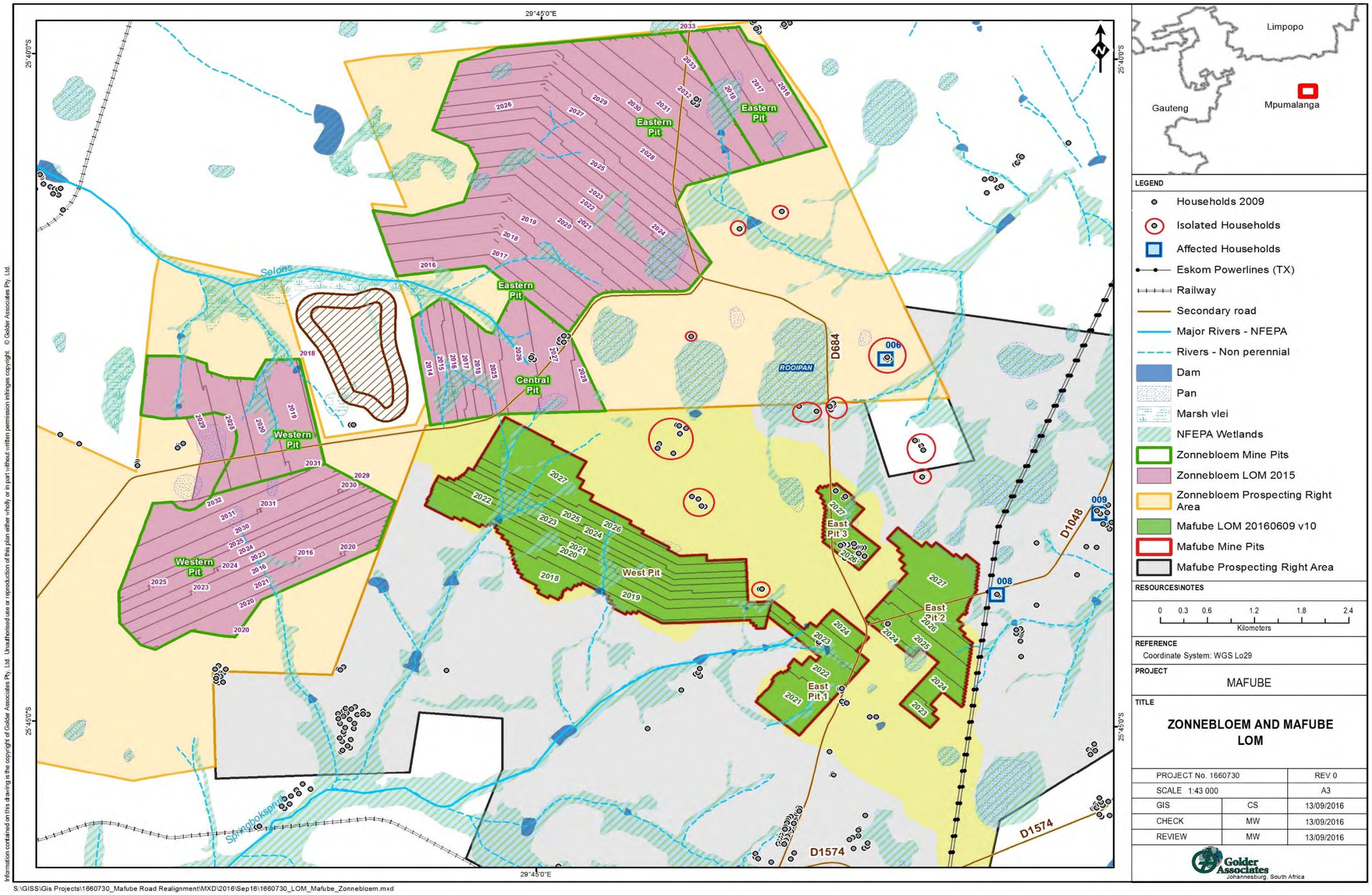


Figure 12: Mafube LifeX - Road Realignment Route Alternative C - Zonnebloem and Mafube LifeX Mine Plans and Affected Households

2.4 Alternative D – Upgrade and Maintenance of Existing D1574, D685, and Sections of D684 and D1048

The last option identified, would entail not constructing any additional 'link' road connecting the D1574 and the D1048 district roads, which will affectively by-pass the effected D684 section of road. This option will only include some upgrades to be done at the existing river/watercourse crossings on the D1574, D685 and D1048 roads, as well as maintenance of these roads during the operational phase of the Mafube LifeX project (Figure 15).

The combined distance from the intersection of the D1574 and D684 roads to the point where the D684 road will be closed below Rooipan is 37.45 km (traveling via the loop road formed by the D1574, D685, and D684 roads). In this section of road, there are two existing river/watercourse crossings that would require upgrading and an overall distance of approximately 10.4 km of existing road surface currently in a poor state that would also need attention if this alternative route option be selected as the most preferred option.

Figure 13: Current state and quality of river crossings

Figure 14: Current state and quality of the existing road

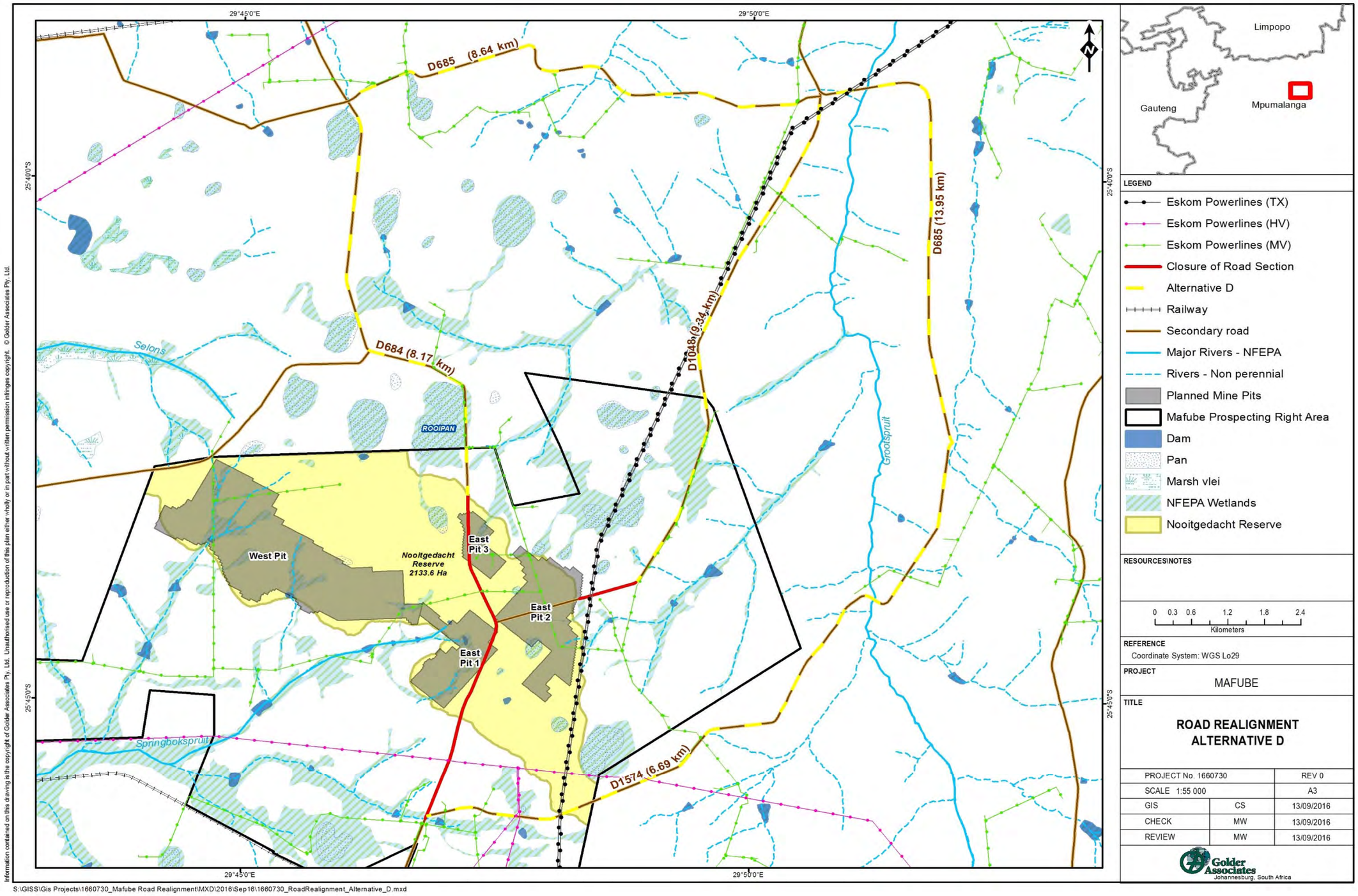


Figure 15: Mafube LifeX - Road Realignment Route Alternative

2.5 Alternative E – Construction of new D683/D1048 link Road

Alternative E entails the proposed closure of the affected road as described in Section 1.1 above, and the construction of a new gravel road as indicated in Figure 18 below. This alternative route has an approximate length of 7.52 km and will run along exiting property boundaries although currently there is no boundary fences. The entire length of the proposed alternative route run along existing agricultural field boundaries or have agricultural fields on one side and grazing veld/natural vegetation on the other side. The alternative route will also require the construction of at least two (2) watercourse crossings.

The properties and landowners details in Table 4 below, will be the properties directly affected by the construction of this Alternative route option.

Table 4: Alternative E - Properties and Landowner Details

Property Details	Landowner Details
Roodepoort 418 JS Portion 1	ATSEUN Pty Ltd
Roodepoort 418 JS Portion 7	ATSEUN Pty Ltd
Roodepoort 418 JS Portion 8	Anglo Operations Limited
Roodepoort 418 JS Portion 9	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 10	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 11	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 13	Anglo Operations Limited
Roodepoort 418 JS Portion 14	ATSEUN Pty Ltd
Nooitgedacht 417 JS Portion 4	Hooggenoeg Boerdery CC

Preliminary consultation with ATSEUN (Pty) Ltd, one of the property owners has highlighted this alternative route option as a less preferred route alternative. The property owner has voiced his concerns regarding safety as the proposed route will pass close to the existing farm house. It should be noted, that even though the proposed route will follow the property boundary lines as indicated on Figure 18, the bottom section of Alternative E will affect the flowing properties: Roodepoort 418 JS Portion 1 and 7, these properties are both owned by ATSEUN (Pty) Ltd, and there are currently no boundary fences. Should this alternative be selected as the most preferred alternative, traversing these properties with the proposed district access road may have an impact on the current and future land use of these properties, and some possible negative acceptance by the current landowner.

Figure 16: View of the Alternative E route option taken from its proposed beginning just off the D684 road

Figure 17: View of the Alternative E route option – photo taken from the D1048 road

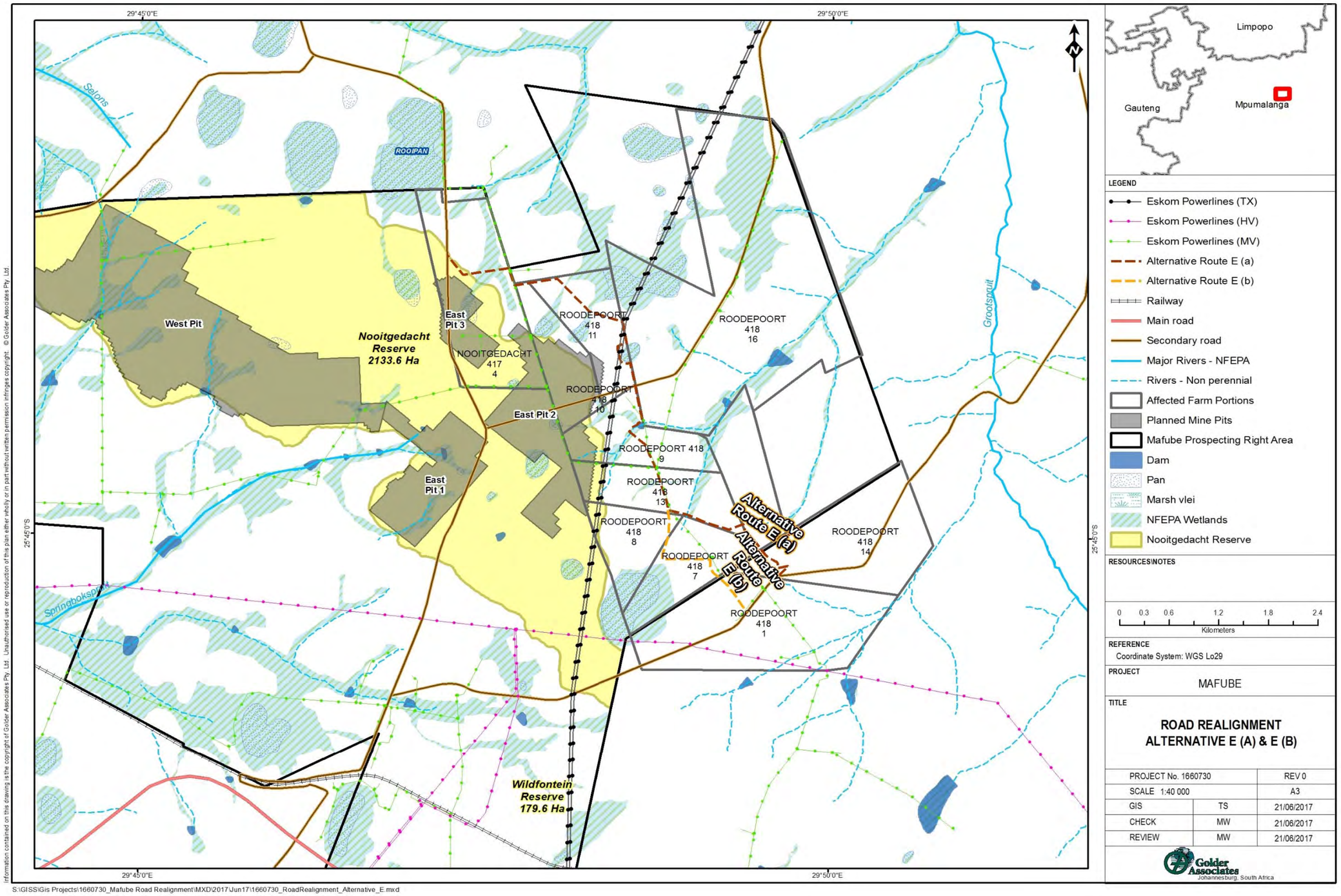


Figure 18: Mafube LifeX - Road Realignment Route Alternative E

2.6 Alternative F – Construction of new D683/D1048 link Road

Alternative F entails the proposed closure of the affected road as described in Section 1.1 above, and the construction of a new gravel road as indicated in Figure 21 below. This alternative route has an approximate length of 5.0 km and will run along exiting property boundaries although currently there is no boundary fences. The entire length of the proposed alternative route run along existing agricultural field boundaries or have agricultural fields on one side and grazing veld on the other side. The alternative route will also require the construction of at least two (2) watercourse crossings.

The properties and landowners details in Table 5 below, will be the properties directly affected by the construction of this Alternative route option.

Table 5: Alternative F - Properties and Landowner Details

Property Details	Landowner Details
Springboklaagte 416 JS Portion 1	Anglo Operations Limited
Springboklaagte 416 JS Portion 12	Anglo Operations Limited
Nooitgedacht 417 JS Portion 4	Hooggenoeg Boerdery CC
Nooitgedacht 417 JS Portion 14	Wessels Anneke
Nooitgedacht 417 JS Portion 15	Anglo Operations Limited
Roodepoort 418 JS Portion 8	Anglo Operations Limited
Roodepoort 418 JS Portion 9	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 10	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 11	Hooggenoeg Boerdery CC
Roodepoort 418 JS Portion 13	Anglo Operations Limited

Figure 19: View of the Alternative F route option taken from its proposed beginning just off the D684 road

Figure 20: View of the Alternative F route option – photo taken from the D1048 road

All farm portions affected by Alternative F, are/will be owned by Anglo Operation Limited / Mafube Coal Mining (Pty) Ltd. It should be noted, that a big percentage of the affected portions are currently agricultural maize fields that will be traversed by the proposed road. Should this alternative be selected as the most preferred alternative, traversing these properties with the proposed dirt road may have an impact on the current and future land use of these properties.

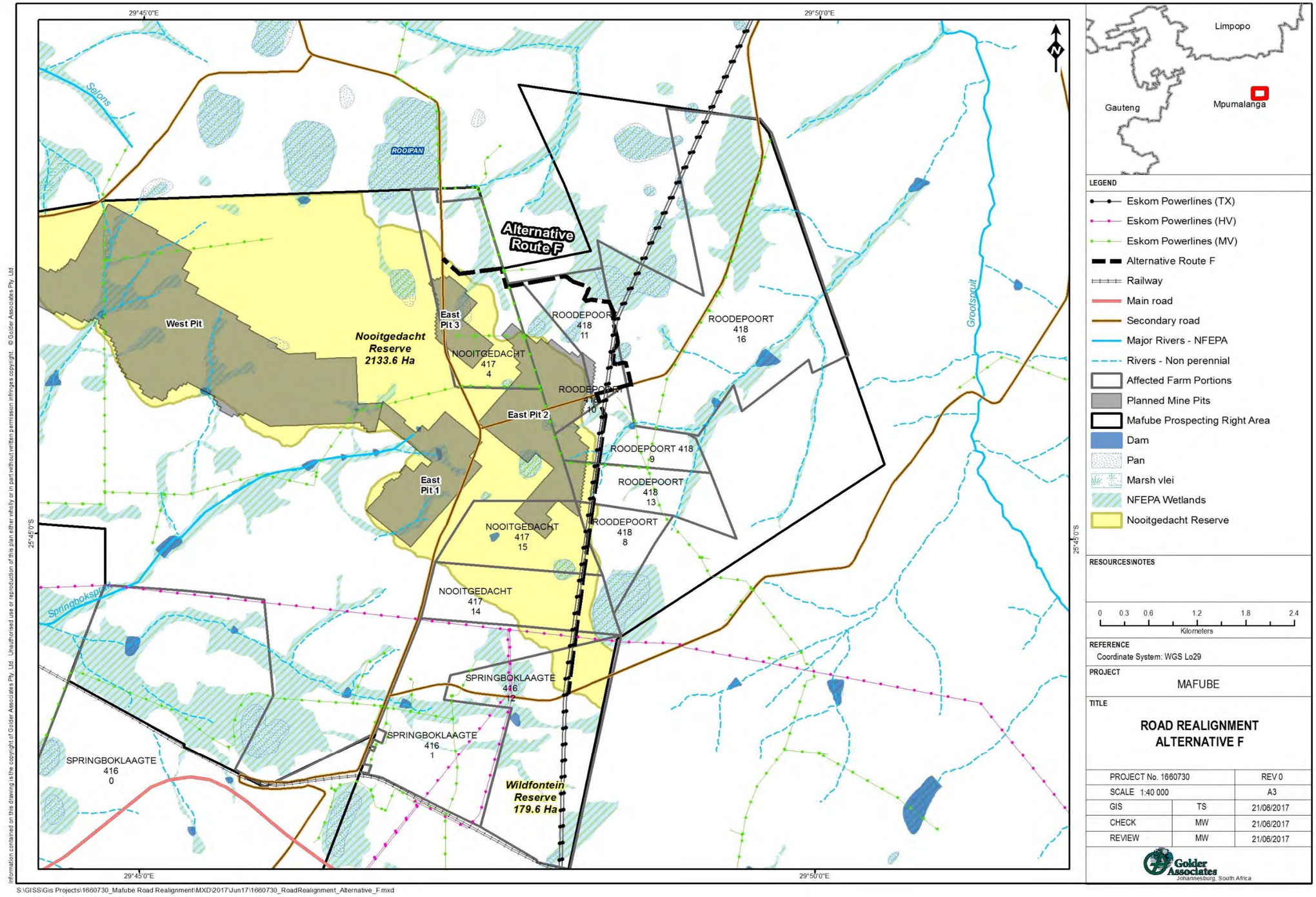


Figure 21: Mafube LifeX - Road Realignment Route Alternative F

3.0 ROUTE SELECTION PROCESS

3.1 Route Selection Criteria

The main route selection criteria were identified as engineering/technical, regulatory, constructability, usability, environmental, social/public acceptance and legal/regulatory criteria.

The procedure to be followed for the rating and ranking of alternative routes in terms of the main criteria would among others include the following:

- Assigning a relative weight to the main categories of criteria;
- Identification of various sub-criteria under the main categories of criteria;
- Defining the sub-criteria; and
- Rating and ranking based on the sub-criteria.

3.2 Weighting of the Main Criteria

The following weights (Table 6 were given to the main route selection criteria:

Table 6: Weighting allocated to main criteria

Criterion category	Weighting
Engineering / Technical	20
Regulatory (Complexity of Permitting)	20
Constructability	15
Usability (Accessibility)	10
Environmental	15
Social / Public	15
Time to Implement / Construct	5
Total Assigned Weights:	**100**

3.3 Identification of the Sub-criteria

3.3.1 Engineering/Technical Criteria

The following **engineering/technical** sub-criteria were used to identify suitable criteria to conduct the rating and ranking assessment:

- Route setting suitability:
  - Suitability of topography for the development of a road;
  - Road following property boundary lines;
  - Proximity of households making use of the road;
  - Location of existing servitudes, and proximity of pans and other water bodies; and
  - Land use not being affected by the road development and location.
- Interference with mining:
  - Potential to sterilize coal deposit; and
  - Distance from the buffer zone of the active mining activities (such as blasting).

- Geohydrological and hydrological suitability:
  - Presence of pans and water bodies;
  - Presence of rivers (crossings); and
  - The need for stormwater management and drainage systems.
- Route constructability:
  - Availability of borrow material; and
  - Ease of staged construction.
- Route Usability:
  - Accessibility of the route for local road users.

3.3.2 Environmental Criteria

Environmental criteria relate to the potential threat to the ecosystem and the geophysical environment. They include the following considerations:

- Ecological impact (Terrestrial, Aquatics and Wetlands):
  - Impact on vegetation, wildlife, wetlands and aquatic life;
  - The sensitivity of the local ecosystems to impacts;
  - The impact of the change in land use on the local ecosystem;
  - Presence of and impact on species of conservation importance (i.e. Red List, Protected and/or endemic species); and
  - Proximity to ecologically significant features such as a wetlands and pans.
- Surface water impact:
  - Potential surface water pollution; and
  - The impact on the local surface waters.
- Soil impact:
  - Potential impact and contamination of the soil due to the road construction activities;
  - Possible soil contamination associated with hydrocarbon spillages; and
  - Potential impact on Land use and Land capability.
- Air quality impact:
  - Prevailing wind direction and potential dust generation that may impact the adjacent residents.

3.3.3 Social / Public Criteria

Social / public criteria relate to issues such as the possible adverse impacts on public health, quality of life, local land and property values. They also relate to potential public opposition to the proposed road realignment.

It is important to note that no consultation process with affected landowners, or communities has taken place during this route selection process.

The following are important considerations:

- Archaeological / heritage Impact:
  - Possible impacts on areas of historical, archaeological or cultural significance.
- Noise impact:
  - Potential noise impact for local residents adjacent to the road; and
  - The distance from farm houses and farm communities.
- Proximity to people:
  - Distance from farm houses, farm communities, informal settlements and areas of human activity and
  - Public acceptability of the proposed road realignment project.
- Land use impact:
  - Acceptability of changing agricultural land to a public (district) road;
  - Acceptability of changing privately owned land into a public (district) road; and
  - Potential impact of the change in land use on neighbouring communities.
- Relocation of communities/settlements:
  - The displacement of farm houses, farm communities, informal settlements; and
  - Perception of local residents with respect to relocation and/or compensation.
- Land ownership/property rights:
  - The need for land acquisition.

3.3.4 Economic Criteria

Economic criteria relate to the cost of developing, maintaining and possible closure/rehabilitation of the selected route. The rating of the economic criteria did not form part of this route selection process.

3.3.5 Legal and Regulatory Criteria

Legal and regulatory criteria include the following considerations:

- Acceptance of project:
  - Acceptance from the Mpumalanga Roads Department;
  - Completion of legal and town planning processes for the closure of public roads; and
  - Completion of legal and town planning processes to register servitudes for proposed new district road.

3.4 Route Selection Matrix

A project specific route selection matrix was developed to assist with qualitative rating and ranking of the identified alternative routes.

The rating of all the alternative route options were based on the following values:

Table 7: Road realignment route selection rating values

Description	Score
Excellent	5
Above Average	4
Below Average	2
Poor	1

The route selection criteria were weighted according to pre-determined weighting values consisting of:

Table 8: Route selection weighting values

Route Selection Criteria	Weighting Value
Engineering / Technical	20
Legal / Regulatory (Complexity of Permitting)	20
Constructability	15
Usability (Accessibility)	10
Environmental	15
Social / Public	15
Time to Implement / Construct	5

3.5 Route Selection Workshop and Site Visit

3.5.1 Route Selection Workshop Participants

The semi-qualitative rating and ranking was carried out in a workshop held at the Golder Associates Midrand offices on 25 August 2016. Following the workshop, a site visit was held on 1 September 2016 and all the identified alternative route options were visited and viewed by the specialists.

The workshop and site visit were attended by the following Golder project team members:

Table 9: Participants in the route selection workshop and site visit

Team Member	Designation
Michael Whitfield	Mafube LifeX client contact and overall Project Manager
Mariëtte Weideman	Mafube LifeX Road Realignment - Project Manager
Adam Bennett	Air Quality Specialist / Noise Assessment Specialist
Ilse Snyman	Soil Scientist
Warren Aken	Senior Aquatic Ecologist
Andrew Zinn	Terrestrial Ecologist
Kylie Farrell	Aquatic Ecologist
Priya Ramsaroop	Social Scientist
Osborne Gwamanda	Hydrologist
Gareth Isenegger	Environmental Practitioner - Water Resource Specialist

The route selection matrix was populated during the workshop and the alternative sites were rated and ranked. Following the site visit, the ratings were reviewed and adjusted by the abovementioned specialists.

3.5.2 Route Selection Rating / Ranking Outcome

Each of the identified route alternative were rated and ranked within the route selection matrix Golder specialist project team members.

The outcome of the route selection rating process, is summarised in Table 10 below and the detailed matrix is appended to this report as APPENDIX B:

Table 10: Route selection rating and ranking outcome

Identified Route Alternatives	Route Selection – Main Criteria							Score	Rank
	Engineering / Technical	Legal / Regulatory	Constructability	Usability	Environmental	Social / Public	Time to Implement		
Alternative A	2.4	0.4	1.2	0.4	1.5	1.8	0.1	7.80	**5**
Alternative B	2.6	0.4	1.2	0.4	1.95	1.8	0.1	8.45	**4**
Alternative C	1.4	0.4	1.2	0.2	1.5	1.8	0.1	6.60	**6**
Alternative D	3.6	0.4	0.9	0.5	2.7	2.55	0.2	10.85	**1**
Alternative E	2.4	0.4	1.2	0.4	2.25	2.1	0.1	8.85	**2**
Alternative F	2.4	0.4	1.2	0.5	1.95	2.25	0.1	8.80	**3**

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusions

This route selection process is in compliance with the regulatory requirements to obtain the necessary regulatory approval for construction of the proposed realignment of the D684 district road and will form part of the EIA scoping and Impact Assessment process according to NEMA and its regulations.

The preferred route will have to be ultimately confirmed, once the scoping process of the EIA has been signed-off and agreed by the competent Authority and the Mpumalanga Roads Department.

The construction phase of the overall Mafube LifeX project will thus proceed on the preferred alternative route, based on the assumption that the scoping process and ultimately the EIA will be approved.

4.2 Route Selection Recommendations

At conclusion of the study it is recommended that the following activities be taken forward as indicated below:

- For permitting purposes: All alternative routes identified (A-F) should be discussed and included in the scoping process;
- Because of the future Zonnebloem operations, it is recommended that Alternative C can be classed as a ‘Fatal Flaw’ route option, or constructed in conjunction with Alternative A or B;
- The EIA will be done on only the preferred route, once the EIA scoping process has been concluded and approved by the competent Authority and the Mpumalanga Roads Department; and
- The following processes needs to be conducted in parallel with the EIA regulatory processes:
  - Application and acceptance from the Mpumalanga Roads Department;

- Completion of legal and town planning processes for the closure of public roads; and
- Completion of legal and town planning processes to register servitudes for proposed new district road.

This will require collective and joint management by the Mafube LifeX team and the Golder Associates project team.

4.3 Specialist Recommendations per Alternative Route

4.3.1 Social

The farm portions surrounding the Nooitgedacht reserve area and the road route alternatives are mainly agricultural land with farming operations. Golder assumes that the households remaining in the mine reserve area will be relocated (Figure 3). In terms of closing the D684 road within the reserve area, the following considerations are proposed:

- Households along the northern part of the D684 just outside the Nooitgedacht reserve area on the Hooggenoeg farm and across from Rooi Pan would lose access to roads in and out of the study area. Especially when considering the cumulative impact of the Zonnebloem operations north of Nooitgedacht reserve.
- The remainder north section of the D684 road connecting to the D685 will be removed for the Zonnebloem operations which leaves the households on Hooggenoeg, Loop en Staan and Toys Boerdery in an isolated area with no access in and out of their farms portions.
- Households on the D1048 on the Hooggenoeg Farm near the East pit boundary will be impacted by blasting activities, dust and noise from the opencast operations. Their access will also be limited to a longer route along the D1048 onto the D685 route loop (Alternative D) in order to get back to the N4 highway.

Alternative A:

- This route cuts through Atsean (Pty) Ltd's farm at the junction with the D1574. This section doesn't follow a farm road so the construction of the road would create a loss of land impact.
- The northern junction of Alternative A (existing farm road) and the D1048 has household developments on either side of the D1048. This is a busy intersection with household fences ending within the servitude of the D1048. The powerline crossing overhead just east of the proposed intersection.

Alternative B:

- This route would be depend on landowner consent from either side of the farm boundaries where the proposed new road would be built.
- The route follows farm boundary roads and fence lines to link the D1048 to the D1574. Affected landowners of Toys Boerdery, Bayview Boerdery and Atsean (Pty) Ltd would need to be consulted.
- There may be potential loss of sections of agricultural fields within the proposed road servitude. This is dependent on consultations with affected landowners and negotiations between landowners and Mafube.

Alternative C:

- This option is a no-go from a social perspective as the proposed new route would cut through agricultural fields as there is no existing farm boundary or road. The loss of farmland would be more than that for the other options.
- Also, this proposed route option connects into a "dead end" considering the placement of the Zonnebloem pits (Figure 12). If however the isolated households are not to be relocated this option would need to go ahead in conjunction with one of the other identified alternative route options.

- The proposed route crosses through Hooggenoeg Farm, PT Bothma Boerdery, Loop en Staan and Toys Boerdery.

Alternative E:

- From a social perspective, this route would run mainly along farm boundaries.
- The farms which would be affected by this route are owned by the mine with the exception of the Atseun (Pty) Ltd property on the southern part of the route.
- Most of this route follows existing farm access roads and tracks between maize fields which limits the impacts of constructing a new road.
- This route E has two options on the southern part of the route. Option A is a bit further but may be better from the landowner's perspective. Option B is closer and is the existing road accessing the farm house infrastructure. The choice of option A or B would be dependent on consultation with the landowner and their preference.

Alternative F:

- This route is proposed to run parallel to the existing powerline servitude, through farm portions mainly owned by Anglo Operations Limited.
- The southern part of the route, between the D1574 and the D1048 cuts through agricultural fields farmed by private owners leasing the land from Anglo.
- The northern part of this route (above the D 1048) follows existing farm roads and joins the D684 above the mining lease area.
- This route would entail loss of agricultural fields as a new road will have to be constructed. However, the mine can negotiate with the farmers using this land to terminate their lease agreements prior to the next planting season. Thus the existing crops can be harvested and no further farming input would be lost due to the road construction.

4.3.2 Ecology

Remaining patches of natural vegetation in the Mafube area comprise grassland and wetland habitat that are important for sustaining local fauna and flora population and associated ecological processes. From a terrestrial ecology perspective, the main selection criterion is to limit disturbance, transformation and fragmentation of these remaining natural habitat patches.

- Alternative D is the most preferred option, as this route follows existing roads that will be upgraded and additional habitat disturbance will be minimal.
- Alternative B is closely aligned with an existing vehicle track that border agricultural fields for much of its length. It also traverses across a fairly short patch of natural habitat (Approx. 0.48 km). Compared to Alternatives A and C this route will cause the least habitat disturbance and fragmentation and is therefore the preferred of the proposed 'new' routes.
- Alternatives A and C traverses across fairly large patches of natural habitat (0.97 km and 0.97 km respectively), causing disturbance and fragmentation. Both these options are therefore the not preferred from a terrestrial ecology perspective.
- Alternative E is the third longest option and traverses across a number of separate patches of natural/semi-natural habitat. Collectively, these habitat patches constitute about 1.31 km of the route and this will cause disturbance and fragmentation. Alternative E is therefore also not a preferred option from a terrestrial ecology perspective.
- Alternative F is the second longest option (Approx. 7.71 km). For much of its length, this option traverses along existing farm tracks adjacent to various cultivated fields (northern portion) and parallel to a large Eskom power line servitude (southern portion). It does however, traverse across several

patches of natural/semi-natural habitat, comprising grassland and wetland. This alternative is therefore also not a preferred option.

Route Alternative	Total approximate length of route	Approximate length of associated natural habitat loss/disturbance
A	3.51 km	0.97 km
B	5.0 km	0.48 km
C	4.06 km	0.97 km
D	37.45 km	-
E	7.52 km	1.31 km
F	7.71 km	1.6 km

4.3.3 Soils and Agricultural Productivity

The soils and agricultural productivity rating was determined by considering the existing agricultural activities observed during the specialists site visit conducted on 1 September 2016 and evaluating the land capability along the various route alternatives. Agricultural activities noted during the site visit included cultivated commercial land, most likely maize (maize stubble was noted on cultivated fields) and planted and/ natural pastures. The soils along the various alternative routes mostly are Class II (high potential arable land) and Class III (moderately potential arable land), with smaller portions of Class VII (Wilderness) capability. The rating for each route alternative and the observations recorded is provided in Table 11 below.

Table 11: Soil and agricultural rating and observations from site visit

Sub-criteria	Land Capability intersected	Site visit comment
Alternative A: New D1048 link road	Class III - Moderate potential arable land	Northern portion of route cuts through what appears to be a grazing camp/land. Property Owner – Toys Boerdery
Alternative B: New D1048 link road	Class III - Moderate potential arable land and Class VII – Wilderness (top/northern end of route)	Route runs along property boundaries, but along cultivated land on either side of road. Road widening/upgrade is likely to affect cultivated lands. Cultivated crop: maize
Alternative C: Constructing only the New D684 Road	Class II - High potential arable land and Class VII – Wilderness (middle & eastern end of route)	Most of route could run along property boundaries, with the western portion cutting through Hooggenoeg Boerdery property, cultivated land, with high agricultural potential Cultivated crop: maize
Alternative D: No new link roads constructed - Existing district roads will be used by locals	N/A	Existing route
Alternative E:	Class II - High potential arable land and Class III – Moderate potential arable land	Of the total 7.52 km of the route, 1.3 km cuts through natural/grazing fields and 1.73 km cuts through existing maize field, presumable moderate to high agricultural potential land.

Sub-criteria	Land Capability intersected	Site visit comment
Alternative F:	Class II - High potential arable land	With the exception of approx. 30 m of the Northern portion of this route which cuts through the lower (south-western) portion of a cultivated field, the northern portion of the Northern portion of this route mostly runs along cultivated fields. The southern portion of this route intersects a number of cultivated fields.

The northern portion of Alternative A intersects what appears to be a grazing camp/land. Alternative B is along property boundaries, but along cultivated land on either side of the farm road. Road widening/upgrade is likely to affect the cultivated lands along this route. Alternative C is mostly along property boundaries, with the western portion intersecting high agricultural potential cultivated land.

Based on the land capability and recorded agricultural activities along each alternative route, the route which least impacts the existing agricultural activities and soils is Alternative D as this is an existing route.

4.3.4 Surface water / Storm Water Management

Alternative A

- Road realignment Alternative A was allocated a rating of 2 (below average);
- This road alignment cuts across a wetland, meaning that two (2) watercourse crossings would be required.
- Although this cluster of non-perennial streams are high up in the drainage path, constructing a road across the wetland would pose a challenge in terms of stormwater management; and
- This alternative is therefore less favourable.

Alternative B

- Road realignment Alternative B was allocated a rating of 4 (above average);
- This road alignment cuts across one well-defined stream. And even though the road would cross the stream much lower down the catchment (than Alternative A), meaning that higher flows are anticipated, a single river crossing rather than multiple crossings would be required;
- Since this stream is non-perennial, constructing a road across it would pose little challenge in terms of stormwater management; and
- This alternative is therefore more favourable.

Alternative C

- Road realignment Alternative C was allocated a rating of 2 (below average);
- This road alignment cuts across one well-defined non-perennial stream, but it also cuts through a pan;
- Constructing a road across a pan is not ideal in terms of stormwater management (i.e. low lying bridge may be required), so changing the route to go around the pans will need to be investigated; and

- This alternative is therefore less favourable.

Alternative D

- Road realignment Alternative D was allocated a rating of 4 (above average);
- This existing road alignment cuts across one well-defined and non-perennial stream, but its current surface condition is poor in sections and an upgrade to these sections will be required. The existing stormwater culvert at this stream is in good condition and appears to have adequate capacity;
- River crossing along Alternative D at Grootspruit River may require an upgrading; and
- This alternative is therefore more favourable.

Alternative E (Option A)

- Road realignment Alternative D was allocated a rating of 1 (poor);
- The proposed road alignment cuts through a drainage line that leads to the Grootspruit. Construction at this section may require the erection of a culvert as well;
- Constructing a road across this drainage line may lead to an increase in dust deposition into the non-perennial stream which leads into the Grootspruit; and
- This alternative is therefore less favourable

Alternative E (Option B)

- Road realignment Alternative D was allocated a rating of 1 (poor);
- Constructing a road across a pan is not ideal in terms of stormwater management (i.e. low lying bridge may be required), this route may need to be investigated; and
- This alternative is therefore less favourable.

Alternative F

- Road realignment Alternative B was allocated a rating of 4 (above average)
- Culverts may be required at natural drainage and stream crossings
- The alternative is favourable

Alternative B, Alternative D, Alternative F were both allocated a rating of 4 (above average) and have been deemed as the more favourable alternatives. Due to the fact that only upgrades would be required, Alternative D is proposed as the most appropriate road realignment alternative as far as surface water / storm water management is concerned.

4.3.5 Air Quality

Alternative A

- Road realignment Alternative A was allocated a rating of 2 (below average);
- This road alignment results in the need for the construction of a new road. The development of the new road will result in air quality impacts within the project footprint which have not existed previously;
- Sensitive receptors (i.e. Residences) are located near to:
  - The intersection of the D684 and Alternative A; and

- Along the northern section of Alternative A.

  Negative air quality impacts from dust fallout and fine particulates are anticipated at these identified sensitive receptors with Alternative A's alignment; and

- This alternative is therefore less favourable.

Alternative B

- Road realignment Alternative B was allocated a rating of 2 (below average);
- This road alignment results in the need for the construction of a new road. The development of the new road will result in air quality impacts within the project footprint which have not existed previously;
- Sensitive receptors (i.e. Residences) are located near to the intersection of the northern section of Alternative B with the D1048. Negative air quality impacts from dust fallout and fine particulates are anticipated at these identified sensitive receptors with Alternative B's alignment; and
- This alternative is therefore less favourable.

Alternative C

- Road realignment Alternative C was allocated a rating of 2 (below average);
- This road alignment results in the need for the construction of a new road. The development of the new road will result in air quality impacts within the project footprint which have not existed previously;
- Sensitive receptors (i.e. Residences) are located near to the intersection of the eastern section of Alternative C with the D1048. And approximately 600 m south of the western section of Alternative C. Negative air quality impacts from dust fallout and fine particulates are anticipated at these identified sensitive receptors with Alternative C's alignment; and
- This alternative is therefore less favourable.

Alternative D

- Road realignment Alternative D was allocated a rating of 4 (above average);
- This road alignment does not need the construction of a new road as existing roads will be used. Minor road upgrading may however be required. As a result, the air quality impacts within the project footprint will remain along the existing routes; and
- This alternative is therefore more favourable.

Alternative E

- Road realignment Alternative E was allocated a rating of 2 (below average);
- This road alignment results in the need for the construction of a new road. The development of the new road will result in air quality impacts within the project footprint which have not existed previously;
- Sensitive receptors (i.e. Residences) are located near to the intersection of the northern section of Alternative E with the D1048. Negative air quality impacts from dust fallout and fine particulates are anticipated at these identified sensitive receptors with Alternative E's alignment; and
- This alternative is therefore less favourable.

Alternative F

- Road realignment Alternative F was allocated a rating of 2 (below average);
- This road alignment results in the need for the construction of a new road. The development of the new road will result in air quality impacts within the project footprint which have not existed previously;
- Sensitive receptors (i.e. Residences) are located near to the intersection of the northern section of Alternative F with the D1048. Negative air quality impacts from dust fallout and fine particulates are anticipated at these identified sensitive receptors with Alternative F's alignment; and
- This alternative is therefore less favourable.

4.3.6 Noise

Alternative A

- Road realignment Alternative A was allocated a rating of 2 (below average);
- This road alignment results in the need for the construction of a new road. The development of the new road will result in negative noise impacts within the project footprint which have not existed previously;
- Sensitive receptors (i.e. Residences) are located near to:
  - The intersection of the D684 and Alternative A; and
  - Along the northern section of Alternative A.

  Negative noise impacts from vehicle traffic are anticipated at these identified sensitive receptors with Alternative A's alignment; and
- This alternative is therefore less favourable.

Alternative B

- Road realignment Alternative B was allocated a rating of 2 (below average);
- This road alignment results in the need for the construction of a new road. The development of the new road will result in negative noise impacts air quality impacts within the project footprint which have not existed previously;
- Sensitive receptors (i.e. Residences) are located near to the intersection of the northern section of Alternative B with the D1048. Negative noise impacts from vehicle traffic are anticipated at these identified sensitive receptors with Alternative B's alignment; and
- This alternative is therefore less favourable.

Alternative C

- Road realignment Alternative C was allocated a rating of 2 (below average);
- This road alignment results in the need for the construction of a new road. The development of the new road will result in negative noise impacts within the project footprint which have not existed previously;
- Sensitive receptors (i.e. Residences) are located near to the intersection of the eastern section of Alternative C with the D1048. And approximately 600 m south of the western section of Alternative C. Negative noise impacts from vehicle traffic are anticipated at these identified sensitive receptors with Alternative C's alignment; and
- This alternative is therefore less favourable.

Alternative D

- Road realignment Alternative D was allocated a rating of 4 (above average);
- This road alignment does not need the construction of a new road as existing roads will be used. Minor road upgrading may however be required. As a result, the noise impacts within the project footprint will remain along the existing routes; and
- This alternative is therefore more favourable.

Alternative E

- Road realignment Alternative E was allocated a rating of 2 (below average);
- This road alignment results in the need for the construction of a new road. The development of the new road will result in noise impacts within the project footprint which have not existed previously;
- Sensitive receptors (i.e. Residences) are located near to the intersection of the northern section of Alternative E with the D1048. Negative air quality impacts from dust fallout and fine particulates are anticipated at these identified sensitive receptors with Alternative E's alignment; and
- This alternative is therefore less favourable

Alternative F

- Road realignment Alternative F was allocated a rating of 2 (below average);
- This road alignment results in the need for the construction of a new road. The development of the new road will result in air quality impacts within the project footprint which have not existed previously;
- Sensitive receptors (i.e. Residences) are located near to the intersection of the northern section of Alternative F with the D1048. Negative noise impacts from dust fallout and fine particulates are anticipated at these identified sensitive receptors with Alternative F's alignment; and
- This alternative is therefore less favourable.

Closing Remarks

It is important to note that the requirements and movements of the isolated and affected households and communities identified in Figure 12, did not form part of this alternative route selection identification process and that it is recommended that this be completed as soon as possible.

Once the preferred alternative route option is identified, then the baseline assessments can be completed per discipline, to inform the Draft Scoping Report (DSR). The impact assessment studies will commence once the preferred alternative route option is communicated to Golder Associates in writing.

5.0 REFERENCES

Golder Associates Africa (Pty) Ltd. (1 September 2016). *Route Selection Site Visit.*

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APPENDIX A

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APPENDIX B

Complete Route Selection Matrix

	Main evaluation criteria	Engineering/Technical					Legal / Regulatory	Constructability		Usability	Environmental						Social and Public					Time to Implement		
	Identified Sub-criteria	Ease of engineering	Existing servitudes	River crossings	Storm water Management	Financial (Cost)	Regulatory (By-in from Roads Agency)	Availability of borrow material	Ease of Staged construction	Accessibility	Terrestrial Ecology (Site disturbance)	Aquatics (Presence / Impact on Rivers)	Wetlands (Presence / Impact from road footprint)	Surface Water (Proximity to water, floodlines, water balance etc.)	Soils (Agricultural productivity)	Air quality (Dust Impact)	Heritage Impact	Traffic (Impact on local traffic)	Noise (Construction noise and use of road in new location)	Social Acceptance	Land owner consent	Time to construct and implement	Total Score per option	Ranking
	Weighting	20%				0%	20%	15%		10%	15%						15%					5%		
No.	***OPTION DESCRIPTION***																							
1	Alternative A: New D1048 link road	4	4	2	2	0	2	4	4	4	1	2	2	2	1	2	4	2	2	2	2	2	7.80	5
		2.4				**0**	**0.4**	**1.2**		**0.4**	**1.5**						**1.8**					**0.1**		
2	Alternative B: New D1048 link road	4	4	1	4	0	2	4	4	4	2	1	2	4	2	2	4	2	2	2	2	2	8.45	4
		2.6				**0**	**0.4**	**1.2**		**0.4**	**1.95**						**1.8**					**0.1**		
3	Alternative C: Constructing only the New D684 Road	2	1	2	2	0	2	4	4	2	1	2	2	2	1	2	4	2	2	2	2	2	6.60	6
		1.4				**0**	**0.4**	**1.2**		**0.2**	**1.5**						**1.8**					**0.1**		
4	Alternative D: No new link roads constructed - Existing district roads will be used by locals	5	5	4	4	0	2	4	2	5	4	2	2	4	4	2	5	2	4	1	5	4	10.85	1
		3.6				**0**	**0.4**	**0.9**		**0.5**	**2.7**						**2.55**					**0.2**		
5	Alternative E: New D684 link road	4	4	2	2	0	2	4	4	4	1	2	2	4	4	2	4	2	2	4	2	2	8.85	2
		2.4				**0**	**0.4**	**1.2**		**0.4**	**2.25**						**2.1**					**0.1**		
5	Alternative F: New D684 link road	4	4	2	2	0	2	4	4	5	1	2	2	4	2	2	4	2	2	2	5	2	8.80	3
		2.4				**0**	**0.4**	**1.2**		**0.5**	**1.95**						**2.25**					**0.1**		

100%

Rating System

Score	Description
5	Excellent
4	Above Average
2	Below Average
1	Poor

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