FINAL

SASOL MINING (PTY) LTD

BORROW PITS

EIA SCOPING REPORT
&
PLAN OF STUDY

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COMPILED FOR

SASOL MINING (Pty) Ltd
Borrow Pits

COMPILED BY

JMA Consulting (Pty) Ltd
Sustainable Environmental Solutions through Integrated Science and Engineering

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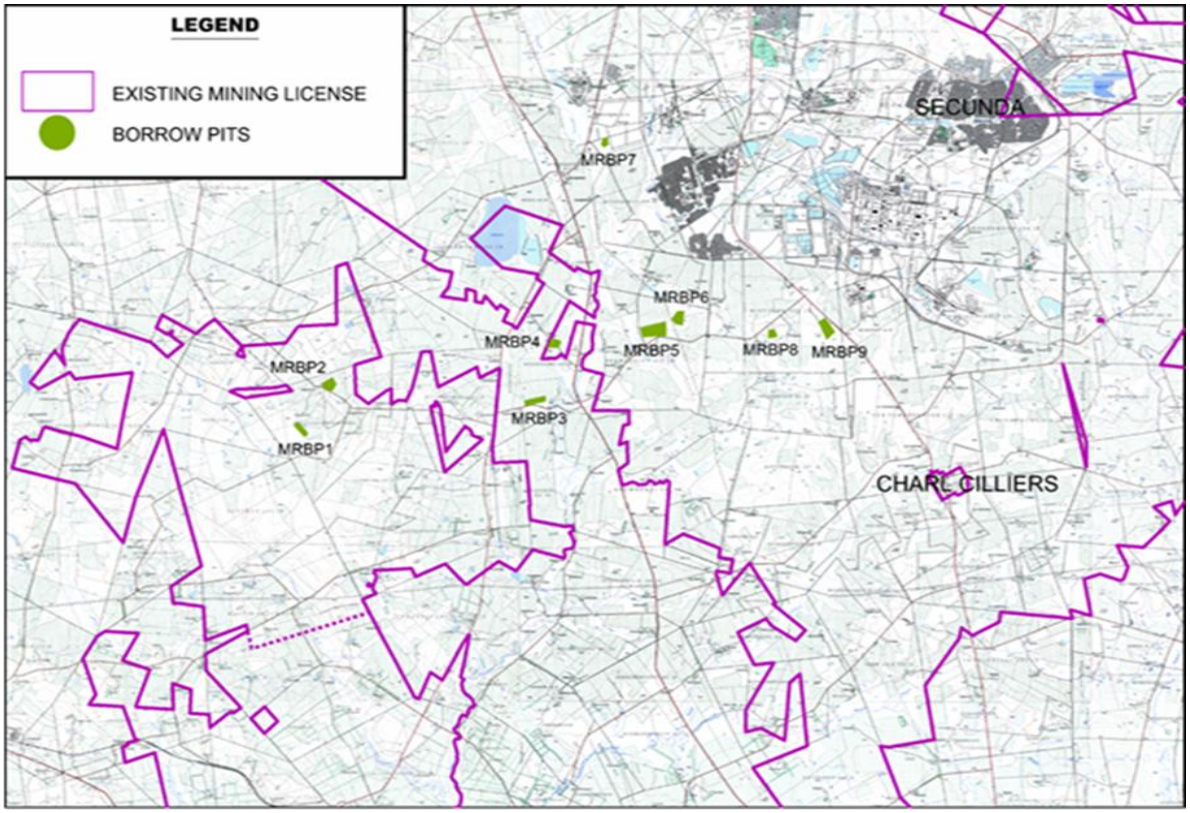
EXECUTIVE SUMMARY

This Report represents the **Final Scoping Report and Plan of Study** compiled in support of the Environmental Authorisations required for the **Sasol Mining Borrow Pits Project**. The Draft version of this report was subjected to a 40 days public review period and was finalized to include all issues and comments, as well as responses thereto – see APPENDIX 3.2(L) for the formal Issues, Comments and Response register.

Although the report was compiled in a format developed by JMA Consulting during 2010, this executive summary was compiled to support the information requirements as detailed in the most recent **DMR Guideline for the Compilation of a Scoping Report**, amended with sections to provide for information required by DEDET and which is not part of the DMR Guideline. However, the **EIA** and **EMP** following on this report will be compiled in strict compliance with the new format required by DMR.

The following information, as requested in the DMR Guideline, is provided in this summary:

1. The Methodology Applied to Conduct Scoping
2. A Description of the Existing Status of the Cultural, Socio-economic and Biophysical Environment
3. An Identification of the Anticipated Environmental, Social or Cultural Impacts
4. A Description of any Proposed Land Use or Development Alternatives
5. A Description of the most Appropriate Procedure to Plan and Develop the Proposed Mining Operation
6. A Description of the Process of Engagement
7. Plan of Study for the EIA Phase
8. Identification of Report



The Sasol Mining Borrow Pits Project Area

1. The Methodology Applied to Conduct Scoping

The information generated during the Scoping Phase of the project confirmed that no **"communities"** as defined in the MPRDA are directly affected by the proposed Borrow Pit development. The closest "communities" are located in sections of eMbalenhle which is located more than 2 km from any of the borrow pits. None of these communities represent land owners with respect to the project.

According to information at our disposal, there are no land claims on the relevant properties, and no Traditional Authority has any jurisdiction on any of the properties.

The land on which the proposed Borrow Pits are located, is owned by either Sasol Mining or else by individuals which hold formal Title Deeds in respect of the properties. A detailed property decription and land owner assessment is given in section 4.5 of Chapter 4 of this report. The current land owners also represent the lawful land occupiers at present.

The project is located in the Govan Mbeki and Lekwa Local Municipalities which form part of the Gert Sibande District Municipality. Full details are given in section 4.4.2 of Chapter 4 of the report.

Proof of project notifications to all stakeholders is attached as APPENDIX 3.2(C) of this report.

2. A Description of the Existing Status of the Cultural, Socio-economic and Biophysical Environment

Several Specialist Consultants were appointed by JMA Consulting, the project EAP, to compile Environmental Base Line Descriptions for all relevant Environmental Components. The information generated was assimilated in full into Chapter 5 of the the Scoping Report. The following aspects were covered:

Climate/Meteorology
Topography
Soils
Land Capability
Land Use
Geology/Geochemistry
Ground Water
Surface Water
Plant Life
Animal Life
Wetlands, Streams and Pans
Air Quality
Noise
Visual Aspects
Cultural and Heritage Aspects (Cultural and Archeaological)
Traffic
Socio-Economics

The base line information generated into the Scoping Report was made available to all I&AP's after the Scoping Phase Public Meeting. During the Public Meeting I&AP's were requested to review the base line information and to submit any comments which they may have to the project EAP. A review period of 40 days was allowed.

All comments received were dealt with via the formal Public Participation Comments and Response Register.

None of the comments received related to the Environmental Base Line descriptions, and **it is therefore deemed that the I&AP's have Confirmed the Status of the Existing Environment**.

3. An Identification of the Anticipated Environmental, Social or Cultural Impacts

A fully detailed Life Cycle Project Activity Description is contained in Chapter 4 of the Scoping Report. Using this information as reference, a comprehensive list of potential impacts (including cumulative impacts) on the Environment (Cultural, Heritage, Socio-Economic, Infrastructure and Biophysical) was compiled and included in Chapter 6 of the Scoping Report.

A full list of other listed activities and water uses occurring in the project is also included in Chapter 4 of the Scoping Report.

This information was made available to the I&AP's during the 40 day review period.

Comprehensive comments were received from one I&AP relating to the potential transport related impacts, all of which were dealt with extensively in the Comments and Response Register. The I&AP was also responded to directly.

The potential impacts are therefore deemed to have been fully consulted and confirmed with the I&AP's.

4. Description of any Proposed Land Use or Development Alternatives

Section 4.9 of the Scoping Report deals with Project Alternatives and how they will be assessed during the EIA Phase of the Project – this includes the No-Go Option.

5. A Description of the most Appropriate Procedure to Plan and Develop the Proposed Mining Operation

The Scoping Phase of this project is used to also influence the overall project planning. Changes to the transport plan are currently being considered as a result of comments received from I&AP's.

6. A Description of the Process of Engagement

Chapter 3 of the Scoping Report gives a detailed record of the Public Participation Process conducted to date. The Comments and Response Register is attached as APPENDIX 3.2(L).

7. Plan of Study for the EIA Phase

A comprehensive Plan of Study for the EIA Phase of the Project is included in Chapter 7 of the Scoping Report and was also consulted with the I&AP's. The Plan of Study was also made available during the 40 day review period, and is **therefore deemed to have been consulted with stakeholders**.

8. Identification of Report

Herewith I, the person whose name and identity number is stated below, confirm that I am the person authorized to act as representative of the applicant in terms of the resolution submitted with the application, and confirm that the above report comprises the results of consultation as contemplated in Section 16(4)(b) or 27(5)(b) of the Act, as the case may be.	
Full Names and Surname	Jasper Lodewyk Muller (Pr.Sci.Nat.)
Identity Number	571116 5104 081
Signature	

Prj5579

1. INTRODUCTION

This Report represents the **Final Scoping Report and Plan of Study** compiled in support of the Environmental Authorisations required for the **Sasol Mining Borrow Pits Project**. The draft version of this report was subjected to a 40 days public review period and was finalized to include all issues and comments, as well as responses thereto – see APPENDIX 3.2(L) for the formal Issues, Comments and Response register.

Sasol Mining needs to source Dolerite Gravels in order to support the construction of infrastructure for a number of expansion activities for their Coal Mines in the Secunda Area. Having identified several areas where extensive deposits of dolerite gravel are present, Sasol Mining now wishes to obtain the necessary Mining Rights to actively mine the dolerite from nine Borrow Pits.

The localities of the nine Borrow Pits are shown in Figure 1(a).

In order to successfully apply for the mining right to these deposits, an environmental authorization is required *inter alia* in terms of the Mineral and Petroleum Resources Development Act (MPRDA) (Act 28 of 2002). In this regard, the MPRDA requires that an Environmental Impact Assessment (EIA) and Draft Environmental Management Plan be submitted to DMR for approval.

Additional to this, the project requires Environmental Authorisation in terms of the National Environmental Management Act (NEMA) (Act 107 of 1998) for all listed activities related to the proposed mining, whilst a Water Use License Application (WULA) is also required in terms of the National Water Act (Act 36 of 1998) to authorize water uses related to the mining project.

A Waste License Application (WLA) in terms of the National Environmental Management Waste Act (Act 59 of 2008) is not deemed indicated at present.

This application for the Sasol Mining Borrow Pits is therefore an application *inter alia* in terms of section 24 of the NEMA, read with GNR 543 and in particular the application for **Scoping and Environmental Impact Assessment** described in regulations 26 to 35.

Various listed activities in GNR 544, GNR 545 and GNR 546 will be undertaken in order to give effect to the project and these have been identified and listed in the application that will be submitted to the Department of Economic Development, Environment, and Tourism (DEDET).

However, in view of the fact that listed activities related to mining have not yet become part of the application to DEDET, these activities must be authorized by DMR in terms of the provisions of the MPRDA and the MPRDA Regulations GNR 527, which similarly also requires both the Scoping and EIA processes.

In addition to this, the application for a Water Use License in terms of the NWA also requires a public participation process.

Although all these processes will be run concurrently, separate documents will be compiled for the authorities once the Scoping Phase has been concluded.

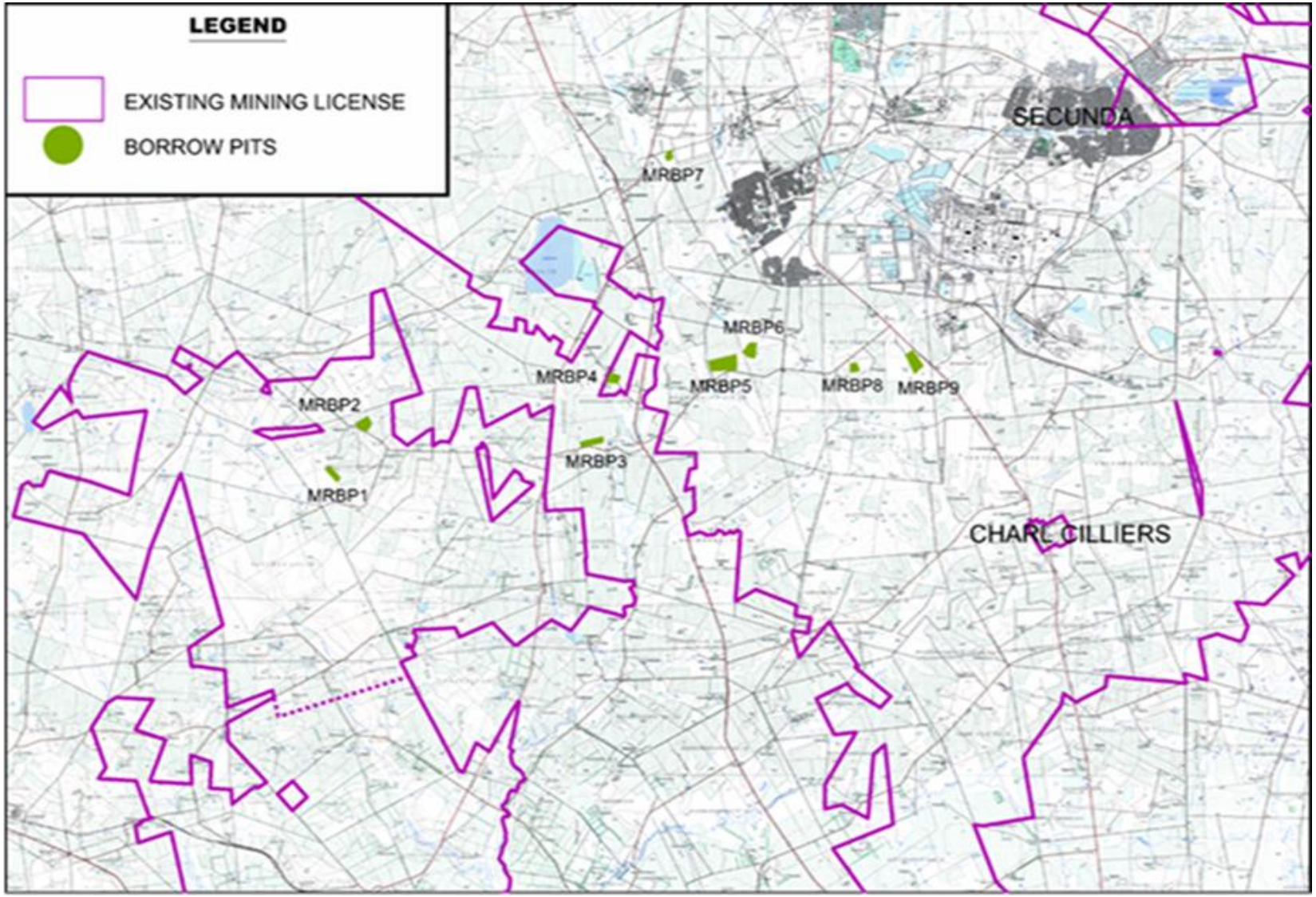


Figure 1(a): Localities of the Nine Proposed Sasol Mining Dolerite Borrow Pits

This document represents the **Final Scoping Report and Plan of Study** compiled in terms of the NEMA and MPRDA Regulations, and as such was compiled in strict accordance with the Regulations:

EIA Regulations GNR 543 – NEMA (107 of 1998)

28. Contents of Scoping Report

28. (1) A scoping report must contain all the information that is necessary for a proper understanding of the nature of issues identified during scoping, and must include-

(a) details of-

(i) the EAP who prepared the report; and

(ii) the expertise of the EAP to carry out scoping procedures;

(b) a description of the proposed activity;

(c) a description of any feasible and reasonable alternatives that have been identified;

(d) a description of the property on which the activity is to be undertaken and the location of the activity on the property, or if it is-

(i) a linear activity, a description of the route of the activity; or

(ii) an ocean-based activity, the coordinates where the activity is to be undertaken;

(e) a description of the environment that may be affected by the activity and the manner in which activity may be affected by the environment;

(f) an identification of all legislation and guidelines that have been considered in the preparation of the scoping report;

(g) a description of environmental issues and potential impacts, including cumulative impacts, that have been identified;

(h) details of the public participation process conducted in terms of regulation 27(a), including-

(i) the steps that were taken to notify potentially interested and affected parties of the application;

(ii) proof that notice boards, advertisements and notices notifying potentially interested and affected parties of the application have been displayed, placed or given;

(iii) a list of all persons or organisations that were identified and registered in terms of regulation 55 as interested and affected parties in relation to the application; and

(iv) a summary of the issues raised by interested and affected parties, the date of receipt of and the response of the EAP to those issues;

(i) a description of the need and desirability of the proposed activity;

(j) *a description of identified potential alternatives to the proposed activity, including advantages and disadvantages that the proposed activity or alternatives may have on the environment and the community that may be affected by the activity;*

(k) *copies of any representations, and comments received in connection with the application or the scoping report from interested and affected parties;*

(l) *copies of the minutes of any meetings held by the EAP with interested and affected parties and other role players which record the views of the participants; and*

(m) *any responses by the EAP to those representations and comments and views;*

(n) *a plan of study for environmental impact assessment which sets out the proposed approach to the environmental impact assessment of the application, which must include-*

(i) *a description of the tasks that will be undertaken as part of the environmental impact assessment process, including any specialist reports or specialised processes, and the manner in which such tasks wilt be undertaken;*

(ii) *an indication of the stages at which the competent authority will be consulted;*

(iii) *a description of the proposed method of assessing the environmental issues and alternatives, including the option of not proceeding with the activity; and*

(iv) *particulars of the public participation process that will be conducted during the environmental impact assessment process;*

(o) *any specific information required by the competent authority; and*

(p) *any other matters required in terms of sections 24(4)(a) and (b) of the Act.*

(2) *In addition, a scoping report must take into account any guidelines applicable to the kind of activity which is the subject of the application.*

(3) *The EAP managing the application must provide the competent authority with detailed, written proof of an investigation as required by section 24(4)(b)(i) of the Act and motivation if no reasonable or feasible alternatives, as contemplated in subregulation (1)(c), exist.*

Regulations – MPRDA (28 of 2002)

49. Contents of scoping report

(1) *A scoping report, in relation to a proposed mining operation, must-*

(a) *describe the methodology applied to conduct scoping;*

(b) *describe the existing status of the environment prior to the mining operation;*

(c) *identify and describe the anticipated environmental, social and cultural impacts, including the cumulative effects, where applicable;*

(d) *identify and describe reasonable land use or development alternatives to the proposed operation, alternative means of carrying out the proposed operation and the consequences of not proceeding with the proposed operation;*

(e) *describe the most appropriate procedure to plan and develop the proposed mining operation;*

(f) describe the process of engagement of identified interested and affected persons, including their views and concerns; and

(g) describe the nature and extent of further investigations required in the environmental impact assessment report.

(2) The scoping report must be submitted to the office of the Regional Manager where the application was lodged, within 30 days from the date of the notification contemplated in section 39(1) of the Act.

(3) The Regional Manager must evaluate the scoping report and request the relevant Government departments and organs of State, as the case may be, to submit written comments on the scoping report within 30 days from the date of the request.

(4) The Regional Manager may request the applicant to forward specific and additional information or to conduct further investigations regarding the scoping report submitted in terms of subregulation (2).

(5) The Regional Manager must collate and forward all comments contemplated in subregulation (3) to the applicant who must address and incorporate such comments in the environmental impact assessment report and environmental management programme.

(6) The applicant contemplated in subregulation (5) must compile the environmental management programme based on the environmental impact assessment report.

In terms of the above, this Scoping Report contains the following information:

- Chapter 1 gives an **Introduction** to the project.
- Chapter 2 gives a detailed **Description of the EIA Process** as required by the two sets of relevant legislation (NEMA and MPRDA) and also gives **Details of the Environmental Assessment Practitioner** and the **Project Team** appointed to undertake the EIA.
- Chapter 3 gives a detailed description of the **Public Participation Process** conducted in support of the Scoping Phase.
- Chapter 4 discusses the overall **Project Description** and gives details on the Project Applicant, Project Location, Properties Affected, Project Resource Attributes, Project Enviro-Legal Framework, Project Motivation and a Synoptic Project Description for the Construction Phase, Operational Phase, Decommissioning and Closure Phase, as well as the Post Closure Phase. The chapter also deals with the identification and consideration of **Project Alternatives**.
- Chapter 5 describes the **Current Environment** that could be impacted on by the proposed activity. This description contains a fair amount of detail as relevant information could be abstracted from recently conducted EIA studies for other Sasol Mining Projects (Impumelelo Mine and Shondoni Mine), as well as from specialist studies conducted specifically for this Borrow Pits Project. The **Manner of Potential Environmental Impacts** on the environment is also summarized in this chapter.

- Chapter 6 deals with **Environmental Issues and Impacts**. It contains a summarized description of Identified Issues and Impacts, a listing of Potential Cumulative Impacts, a discussion on the proposed Impact Assessment Methodology and concludes with a listing of Proposed Specialist Studies required during the EIA Phase.

- Chapter 7 gives the **Plan of Study** for the EIA. It lists the Actions to be performed, describes the Consultation Time Line with the Authorities and eludes to the Proposed Public Participation Programme for the EIA Phase.

The **Draft Scoping Report and Plan of Study** was made available to I&AP's for review and comments. The review period, as was agreed upon during the Scoping Phase Public Meeting, was set at 40 days and ran from 30 March 2012 till and including 8 May 2012.

All comments (issues, concerns, suggestions, etc.) submitted to JMA Consulting at the following address are reflected in the comments register to be appended as APPENDIX 3.2(L):

JMA Consulting (Pty) Ltd
P O Box 883
Delmas
2210

Attn: Jasper Muller

Tel: + 27 (0) 13 665 1788
Fax: + 27 (0) 13 665 2364
e-mail: jasper@jmaconsult.co.za

Once comments were received, the Draft report was updated to reflect and address all comments, after which the report has been finalized for submission to the relevant authorities – this **Final Scoping Report and Plan of Study**.

The **Final Scoping Report and Plan of Study** will again be made available to I&AP's in order for them to confirm that their comments have been addressed. Any comments on the **Final Scoping Report and Plan of Study** must be submitted to the relevant Authorities within 30 days of the report being made available.

2. THE EIA & SCOPING PROCESS

2.1 INTRODUCTION

With effect from 2 August 2010, the Environmental Impact Assessment (EIA) Regulations, 2010 (GNR 543 of 18 June 2010 ("GN R. 543")) and three Listing Notices promulgated in terms of the NEMA and as set out in detail below, commenced (save for those listed activities in respect of prospecting, mining, exploration, production, and reconnaissance which will commence at a date to be published). The old notices promulgated in terms of the NEMA (GN R. 386 and 387 of 21 April 2006) and the Environmental Impact Assessment (EIA) Regulations, 2006 (GN R. 385 of 21 April 2006) have been repealed.

Accordingly, the listed activities have been promulgated in three different government notices, namely Government Notice R. 544 of 18 June 2010 ("GN R. 544"), which identifies those activities for which a **basic assessment** must be undertaken in accordance with the procedure set out in regulation 21 to 25 of GN R. 543; Government Notice R. 545 of 18 June 2010 ("GN R. 545"), which identifies those activities for which a **scoping and environmental impact assessment** must be undertaken in accordance with the procedure, set out in regulations 26 to 35 of GN R. 543; and Government Notice R. 546 of 18 June 2010 ("GN R. 546"), which identifies those activities for which a **basic assessment** must be undertaken in accordance with the procedure set out in regulation 21 to 25 of GN R. 543, based on the activities being undertaken in specific identified geographical areas.

The Schedules to GN R. 544, GN R. 545, and GN R. 546 set out those activities that have been identified in terms of section 24(2)(a) of the NEMA which may not commence without environmental authorisation from the competent authority and for which the investigation, assessment and communication of potential impacts of the activities must follow the procedure described in regulation 21 to 25 of the regulations in respect of those activities that require a "basic assessment" or in terms of regulation 26 to 35 of the regulations in respect of those activities that require "scoping and an environmental impact assessment".

This application for Sasol Mining Borrow Pits is done in terms of section 24 of the NEMA referred to above read with GN R 543 of 18 June 2010 and in particular the application for scoping and environmental impact assessment described in regulations 26 to 35. Activities listed in GN R. 544, GN R. 545 and GN R. 546 of 18 June 2010 will be undertaken in the project and these have been identified and listed in the application that will be submitted to the Mpumalanga Department of Economic Development, Environment and Tourism (DEDET).

However, in view of the fact that listed activities related to mining have not yet become part of the application to DEDET, these activities must be authorized by DMR in terms of the provisions of the MPRDA and the MPRDA Regulations GNR 527, which similarly also requires both the Scoping and EIA processes. Although both processes will be run concurrently, separate documents will be submitted to the two authorities once the Scoping Phase has been concluded. Other applications in terms of provisions contained in *inter alia* the NEMWA also require the EIA Process to be followed.

2.1.1 EIA Process Flow Diagram

The diagram below, Figure 2.1.1(a), illustrates the processes for both a Basic Assessment, and a Scoping and Environmental Impact Assessment. As described in Section 2.1, listed activities in GNR 544, GNR 545 and GNR 546 have been identified for the Sasol Mining Borrow Pit Project and will be incorporated into one Scoping and Environmental Impact Assessment Process for this project.

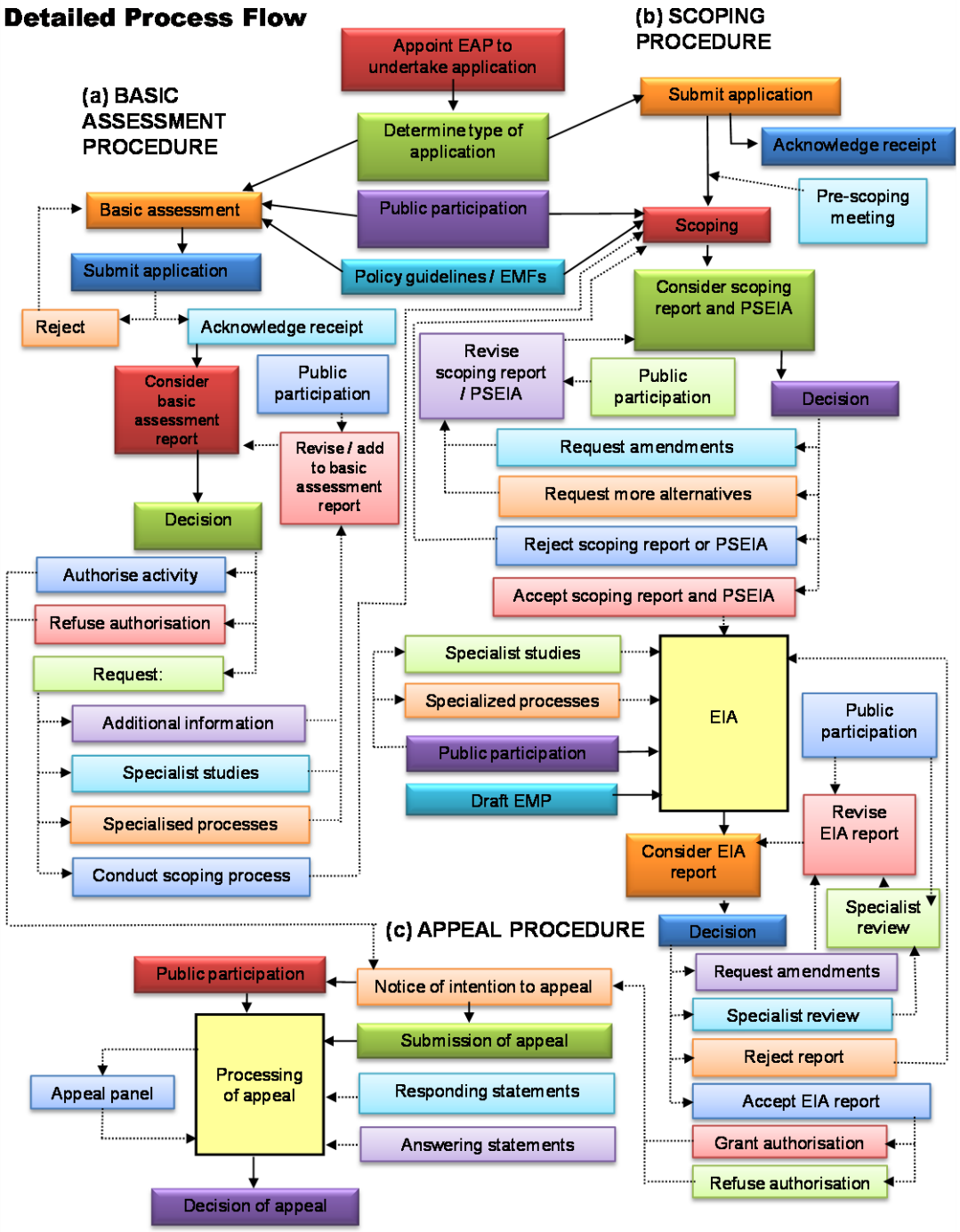


Figure 2.1.1(a): EIA Process Flow Diagram

2.1.2 Scoping Process and Objectives

As described in the DEAT Scoping Guideline Document, (Scoping, Integrated Environmental Management, Information Series 2; 2002), distributed by the, then, Department of Environmental Affairs and Tourism (DEAT), the scope of an environmental assessment is defined by the **range of issues and alternatives** it considers, and the approach towards the assessment that will follow it.

Scoping is a critical stage in the Integrated Environmental Management (IEM) procedure, since it is an important tool for **involving the public** in the environmental assessment process, and for **structuring assessment** studies. IEM is an approach that integrates environmental considerations into all stages of the planning and development process.

Through scoping, the priorities of the environmental assessment are set. As an open and iterative process, it may continue throughout planning and assessment, depending on whether or not additional issues or alternatives are introduced or eliminated because of new information.

The terms of reference for the assessment phase will be based on issues and concerns raised during scoping. If issues are inadequately identified, the assessment will be of poor quality. A consequence would be further delays in decision-making while further environmental information is gathered and assessed. On the other hand, if insignificant issues are not excluded from the assessment process during scoping a great deal of unnecessary work and wasted resources can be expended.

Internationally there are slight variations from country to country in the approach to scoping. Typically, the procedural aspects of scoping are determined by the legal, policy and administrative requirements and guidelines within a particular jurisdiction. Those that have a stake in a proposed activity are provided with the opportunity to contribute to the scoping process. When effectively done, it will involve the relevant authority, the proponent, other authorities, as well as Interested and Affected Parties (I&APs) in discussions about the proposed activity and the issues raised. The process for the identification of project alternatives must be documented, as well as the criteria used to evaluate these alternatives. Such criteria would include social, economic, and ecological/biophysical issues.

Scoping is typically divided into three phases:

- Planning the scoping procedure;
- A process of stakeholder engagement to identify the key issues; and
- Reporting on the terms of reference for the next phase of the assessment.

Though scoping is described as a discrete step in the environmental assessment procedure, in practice the process of identifying the significant issues usually continues throughout the assessment process, as well as decision-making, detailed design, implementation and monitoring.

2.2 DETAILS OF AND DECLARATION BY THE EAP

The EIA and associated EMP for this project have been compiled by fully qualified and duly registered Professional Scientists and Engineers. Synoptic CV's of all personnel which contributed to the project are attached in APPENDIX 2.2(A) to this report.

The duly appointed **EAP for the Project is JMA Consulting (Pty) Ltd**. JMA Consulting sub-contracted the services of the following Professional Consultancies and Certified Laboratories for specialist inputs into the project:

Sub-Consultancies

Terrasoil Science
Jones & Wagener (Pty) Ltd
Environmental and Health Risk Consulting (Pty) Ltd
Wetland Consulting Services (Pty) Ltd
M2 Environmental Connections CC
Dr Julius C C Pistorius Heritage Consultant
De Wit Sustainable Options (Pty) Ltd

Table 2.2(a): Details of Project Consultancy

Project Consultancy:	JMA Consulting (Pty) Ltd
Company Registration:	2005/039663/07
Professional Affiliations:	South African Council for Natural Scientific Professions (SACNASP)
Contact Person:	Mr Jasper Muller (Pr.Sci.Nat.)
Physical Address:	15 Vickers Street DELMAS 2210
Postal Address:	P O Box 883 DELMAS 2210
Telephone no:	+27 13 665 1788
Fax no:	+27 13 665 2364
E-mail:	jasper@jmaconsult.co.za

2.2.1 Details and Expertise of the Principal EAP

The principle Environmental Assessment Practioner on this project is Mr Jasper L Muller (Pr.Sci.Nat.) Jasper Muller holds a M.Sc. (cum laude) in Geohydrology from the University of the Free State and has been active as an earth scientist and environmental scientist since 1986. He has, since 1993, been involved in the compilation of more than 200 EMPR's, EIA's, IWWMP's and EMP's.

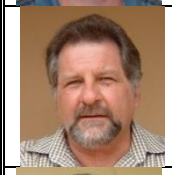
Jasper L Muller (Pr.Sci.Nat.)
(M.Sc. Geohydrology)

Jasper Muller is responsible for the overall project and specifically for EIA Process and Time Line Management, Project Technical Management (commissioning of specialist studies), and finally all the EIA/EMP Report Compilation including the full integration of all specialist study findings into the EIA/EMP.

2.2.2 Details and Expertise of the EIA Team

The following Scientists and Engineers were directly (specific inputs into this project) and indirectly (inputs incorporated from previous studies) involved with the Environmental Impact Assessment for this project:

Photo	Name Qualification Registration	Consultancy	Responsibility
	**Jasper Muller** **M.Sc.** **Geohydrology** **Pr.Sci.Nat.**	**JMA Consulting**	**EIA Process** **Project Description** **Impact Assessment** **Management Plan** **Monitoring Plan**
	**Jaco van der Berg** **M.Sc.** **Geohydrology** **Pr.Sci.Nat.**	**JMA Consulting**	**Geochemistry** **Mine Planning** **Materials Balance** **Ground Water Balance** **Salt Balance**
	**Genevieve Cloete** **B.Sc.Hons.** **Environmental Sciences** **Pr.Sci.Nat.**	**JMA Consulting**	**GIS** **Topography** **Visuals** **Terrestrial Ecology**
	**Shane Turner** **B.Sc. Hons.** **Geology** **Cand.Sci.Nat.**	**JMA Consulting**	**Meteorology** **Geology** **Ground Water**
	**Riaan Fourie** **B.Sc.Hons.** **Environmental Sciences** **Cand.Sci.Nat.**	**JMA Consulting**	**Public Participation** **Property Assessment**
	**Johan van der Waals**	**Terra Soil Science**	**Soils** **Land Capability** **Land Use**
	**Michael Palmer**	**Jones & Wagener**	**Surface Hydrology** **Storm Water Balances** **Water Management** **Civil Designs**
	**Dieter Kassier**	**Wetland Consulting Services**	**Wetlands** **Aquatic Ecology**
	**Uno Neveling**	**EHRCON**	**Air Quality (Dust)**

	**Morne de Jager**	**MENCO**	**Noise**
	**Julius Pistorius**	**JCC Pistorius Heritage Consultant**	**Heritage**
	**Martin de Wit**	**De Wit Sustainable Options**	**Socio Economics**

2.2.3 Details and Expertise of the EMP Design Team

The following Scientists and Engineers were directly (specific inputs into this project) and indirectly (inputs incorporated from previous studies) involved with the scoping and design of the Environmental Management Plan for this project:

Photo	Name Qualification Registration	Consultancy	Responsibility
	**Jasper Muller** **M.Sc.** **Geohydrology** **Pr.Sci.Nat.**	**JMA Consulting**	**EIA Process** **Project Description** **Impact Assessment** **Management Plan** **Monitoring Plan**
	**Jaco van der Berg** **M.Sc.** **Geohydrology** **Pr.Sci.Nat.**	**JMA Consulting**	**Geochemistry** **Mine Planning** **Materials Balance** **Ground Water Balance** **Salt Balance**
	**Genevieve Cloete** **B.Sc.Hons.** **Environmental Sciences** **Pr.Sci.Nat.**	**JMA Consulting**	**GIS** **Topography** **Visuals** **Terrestrial Ecology**
	**Shane Turner** **B.Sc. Hons.** **Geology** **Cand.Sci.Nat.**	**JMA Consulting**	**Meteorology** **Geology** **Ground Water**
	**Riaan Fourie** **B.Sc.Hons.** **Environmental Sciences** **Cand.Sci.Nat.**	**JMA Consulting**	**Public Participation** **Property Assessment**
	**Johan van der Waals**	**Terra Soil Science**	**Soils** **Land Capability** **Land Use**
	**Michael Palmer**	**Jones & Wagener**	**Surface Hydrology** **Storm Water Balances** **Water Management** **Civil Designs**
	**Dieter Kassier**	**Wetland Consulting Services**	**Wetlands** **Aquatic Ecology**
	**Uno Neveling**	**EHRCON**	**Air Quality (Dust)**

	**Morne de Jager**	**MENCO**	**Noise**
	**Julius Pistorius**	**JCC Pistorius Heritage Consultant**	**Heritage**

2.2.4 Declaration by the EAP

I, **Jasper Lodewyk Muller**, declare that:

- I act as the independent environmental practitioner in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting environmental impact assessments, including knowledge of the National Environmental Management Act (107 of 1998), the Environmental Impact Assessment Regulations of 2010, and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in regulation **8** of the regulations when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will ensure that the comments of all interested and affected parties are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by interested and affected parties in respect of a final report that will be submitted to the competent authority may be attached to the report without further amendment to the report;
- I will keep a register of all interested and affected parties that participated in a public participation process; and
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- all the particulars furnished by me in this form are true and correct;
- will perform all other obligations as expected from an environmental assessment practitioner in terms of the Regulations; and
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

Disclosure of Vested Interest

- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2010.

_____
Signature of the environmental practitioner:

JMA CONSULTING (PTY) LTD_____
Name of company:

_____
Date:

_____
Signature of the Commissioner of Oaths:

_____
Date:

_____
Designation:

2.3 PROJECT EIA STAGE 1 – PRE-APPLICATION & APPLICATION

2.3.1 Appointment of EAP

An independent Environmental Assessment Practitioner must be appointed to conduct the EIA. In this instance, the proponent, Sasol Mining formally appointed JMA Consulting (Pty) Ltd (JMA) on 18 July 2011 for the EIA for the proposed new Sasol Mining Borrow Pits Project.

2.3.2 Determine Type of Application

The type of application to be launched must be determined with due consideration of the project details, as well as the relevant Environmental Legal Framework applicable to the project.

JMA studied the terms of reference for the project and concluded that the environmental authorizations relevant to this project would include:

- A Scoping and Environmental Impact Assessment (EIA) process (application to DEDET);
- A Mining Right Application comprising submission of an EIA and Draft EMP (application to DMR), and
- An Integrated Water Use License Application (IWULA) (application to DWA), including applications for General Authorisations and Exemptions from GN 704.

Details of the relevant activities applied for are given in section 4.2.3 of this report.

2.3.3 Authority Consultation

Authority Consultation is conducted with all of the identified authorities prior to the formal application being lodged. This is done in order to ascertain whether all relevant legislatures were investigated and to identify whether the different preferences/requirements of the relevant authorities were met.

Full details of the authority consultation undertaken during this project are documented in Chapter 3 of this Scoping Report and will later be contained in the formal Public Participation Programme Report to be attached as an APPENDIX of the EIAR.

2.3.4 Focus Group Meetings

Focus Group Meetings are meetings that are scheduled for I&AP's that have more or less similar issues pertaining to the proposed project. Such meetings are usually on a smaller scale than the I&AP Public Meeting and has the function of providing additional opportunities for communication between the applicant and I&APs in order to prevent any misunderstanding and/or to address sensitive issues that may arise during the formal public participation process.

The requirement for focus group meetings will be determined throughout the Scoping Phase. Full details of Focus Group meetings undertaken during this project are documented in the Chapter 3 of this Scoping Report and will later be contained in the formal Public Participation Programme Report attached as an APPENDIX of the EIAR.

2.3.5 Submit Applications

The relevant Environmental Impact Assessment application forms have been completed and were submitted to **DEDET** in Ermelo during March 2012.

The Final Scoping Report & Plan of Study will be submitted to **DEDET** in Ermelo and to **DMR** in Witbank. The formal Mining Rights Application will only be lodged with DMR on submission of the Final Scoping Report and Plan of Study in order to support the stringent DMR time line for submission of the EIAR and Draft EMP.

A Water Use License Application will be lodged with DWA in due course.

2.4 PROJECT EIA STAGE 2 – SCOPING

2.4.1 Scoping Process and Objectives

As described in the DEAT Scoping Guideline Document, (Scoping, Integrated Environmental Management, Information Series 2; 2002), distributed by the, then, Department of Environmental Affairs and Tourism (DEAT), the scope of an environmental assessment is defined by the **range of issues and alternatives** it considers, and the approach towards the assessment that will follow it.

Scoping is a critical stage in the Integrated Environmental Management (IEM) procedure, since it is an important tool for **involving the public** in the environmental assessment process, and for **structuring assessment** studies. IEM is an approach that integrates environmental considerations into all stages of the planning and development process.

Through scoping, the priorities of the environmental assessment are set. As an open and iterative process, it may continue throughout planning and assessment, depending on whether or not additional issues or alternatives are introduced or eliminated because of new information.

The terms of reference for the assessment phase will be based on issues and concerns raised during scoping. If issues are inadequately identified, the assessment will be of poor quality. A consequence would be further delays in decision-making while further environmental information is gathered and assessed. On the other hand, if insignificant issues are not excluded from the assessment process during scoping a great deal of unnecessary work and wasted resources can be expended.

Internationally there are slight variations from country to country in the approach to scoping. Typically, the procedural aspects of scoping are determined by the legal, policy and administrative requirements and guidelines within a particular jurisdiction. Those that have a stake in a proposed activity are provided with the opportunity to contribute to the scoping process. When effectively done, it will involve the relevant authority, the proponent, other authorities, as well as Interested and Affected Parties (I&APs) in discussions about the proposed activity and the issues raised. The process for the identification of project alternatives must be documented, as well as the criteria used to evaluate these alternatives. Such criteria would include social, economic, and ecological/biophysical issues.

Scoping is typically divided into three phases:

- Planning the scoping procedure;
- A process of stakeholder engagement to identify the key issues; and
- Reporting on the terms of reference for the next phase of the assessment.

Though scoping is described as a discrete step in the environmental assessment procedure, in practice the process of identifying the significant issues usually continues throughout the assessment process, as well as decision-making, detailed design, implementation and monitoring.

2.4.2 Background Information Document

A Background Information Document (BID) provides additional information to that which must be contained in the notice. Information usually included in the BID is:

- A more detailed description of the proposed project, accompanied by a map showing its location;
- The need and desirability of the proposed activity;
- An explanation of the process that will be followed;
- The environmental evaluations that will be conducted;
- The time schedule for the environmental assessment;
- The role of I&AP's;
- How and when decisions will be made and by whom; and
- The name and contact details of the Environmental Assessment Practitioner.

Full details of the BID compiled and distributed during this project are documented in Chapter 3 of this Scoping Report and will later be contained in the formal Public Participation Programme Report attached as an APPENDIX of the EIAR.

2.4.3 Notification

Notification of all identified I&AP's regarding this project is done via formal letters, press advertisements, e-mails and site notices that are put up in the surrounding area adjacent to the Sasol Mining Borrow Pit Sites.

Full details on notifications undertaken during this project are documented in the Chapter 3 of this Scoping Report and will later be contained in the formal Public Participation Programme Report attached as an APPENDIX of the EIAR.

2.4.4 Compilation of Scoping Report and Plan of Study (Specialist Studies)

The Scoping Report and Plan of Study for the scoping phase of the project was compiled by members of JMA and made available for public review after the Scoping Phase Public Meeting was conducted.

2.4.5 Scoping Public Meeting

Once all identified I&AP's are notified and the project is advertised, a Scoping Phase public meeting was held where further information and feedback was given to all I&AP's present at the meeting. Opportunity was given to ask questions or raise any concern/objection that they may have had regarding the proposed project. During this meeting I&AP's were also notified of the I&AP review period where project documentation is made available to the public for review.

Full details on the Scoping Phase Public Meeting undertaken during this project are documented in the Chapter 3 of this Scoping Report and will later be contained in the formal Public Participation Programme Report attached as an APPENDIX of the EIAR.

2.4.6 Comments from I&AP's

All comments received from I&APs are documented in a formal I&AP Comments Register, and are addressed in this Final Scoping Report – APPENDIX 3.2(L).

A fully detailed and formal "Comments Register" for the project is compiled and updated throughout the project. Details are documented in the Chapter 3 of this Scoping Report and will later be contained in the formal Public Participation Programme Report attached as an APPENDIX of the EIAR.

2.4.7 Finalize and Submit Scoping Report and Plan of Study

Upon receipt of the comments, the Scoping Report and Plan of Study was finalized and submitted to DEDET in Ermelo and DMR in Witbank. The report will also be available to I&AP's for final comments, which should there be any, must be submitted directly to DEDET and DMR.

2.4.8 Authority Review & Decision

DEDET and DMR must now review the Scoping Report and will either accept or decline the Scoping Report. Details will be appended to the formal Public Participation Programme Report attached as an APPENDIX of the EIAR.

2.5 PROJECT EIA STAGE 3 – ENVIRONMENTAL IMPACT ASSESSMENT

2.5.1 Conduct Specialist Studies

In the *Integrated Environmental Management Information Series, Specialist Studies Guideline 4; 2002,* it is stated that it is important to note that not all EIA's have specialist studies. The requirement to undertake specialist studies depends on the outcome of the scoping process. For example, if all the issues that are raised during the scoping can be addressed with the available information, then it may not be necessary to proceed through the full EIA process.

The issues raised in the scoping phase of an EIA which cannot be effectively addressed with the currently available information, form the basis for the terms of reference of specialist studies. These specialist studies are commissioned to provide the information necessary to respond to the key issues associated with the proposed project. Specialists are appointed to analyse the current situation and assess the various impacts in terms of their anticipated magnitude.

The aim of the specialist study phase is to provide information on the positive and negative impacts associated with the project alternatives. The studies also present recommendations for mitigation actions that may either enhance potential benefits or minimize harmful effects. EIA is a process designed to facilitate and improve decision-making on development projects.

The role of the specialist in the EIA process is to:

(1) address issues raised during scoping, and
(2) provide sufficient information that can be used by decision-makers.

In most countries, especially in developing countries, there are no established decision-making frameworks or criteria. Specialists thus have a critical role to play in ensuring that decision-makers have sufficient information to make rational and informed decisions.

EIA practitioners draw on inputs from a range of traditional scientific disciplines for example social sciences, earth sciences, and life sciences. The main benefit of using science in this manner in EIA is that the interdisciplinary nature of the process provides an effective way of translating good theory into good practice.

Inter-disciplinarity is the open information exchange and linkages between various scientific disciplines. However, scientific inter-disciplinarity in EIA is not just a matter integrating scientific results in an environmental report. More importantly, it is the basis for applying scientific knowledge in innovative and fresh ways to identify, define, interpret, analyse, and solve environmental problems.

Copies of the Specialist Studies (including base line studies) conducted in support of this EIA, will be attached as APPENDICES to the EIAR and will be referenced in Chapter 5 of the EIAR.

2.5.2 Conduct EIA, Design EMP and Compile EIAR's

Once the Scoping Phase has been completed, and all comments and issues raised by the I&APs have been collected, the actual environmental impact assessment will be conducted on the different areas of concern identified during the scoping phase.

Once the EIA investigation is completed, environmental impact assessment Tables, listing all of the predicted impacts and their expected magnitude and significance for the different areas of the receiving environment are compiled. After the impact magnitude and significance ratings are completed, a Draft Environmental Management Plan (EMP) is compiled containing measures to address and mitigate the identified environmental impacts.

The Draft and Final EIAR give compliance with the above objectives.

2.5.3 EIA/EMP Public Meeting

As was the case during the Scoping Phase of the EIA process, a second round of public participation is also required during the EIA/EMP phase of the process. During this second round of public participation, the outcomes of the Specialist Studies, the Impact Assessment, as well as the Draft Environmental Management Plan are discussed and explained to the I&AP's. This meeting is currently scheduled for July/August 2012.

Full details on the EIA/EMP Public Meeting undertaken during this project will be documented in the formal Public Participation Programme Report attached as an APPENDIX of the EIAR.

2.5.4 Comments from I&AP's

After the second Public Meeting I&AP's will again have the opportunity to review and comment upon the all of the results of the EIA for an agreed review period. All of the reports generated during the EIA will be made available for public review.

All comments received from I&AP's are documented in the I&AP Comments Register, and will be addressed in the Final EIAR.

A fully detailed and formal "Comments Register" for this project will be contained in the Public Participation Programme Report attached as an APPENDIX of the EIAR.

2.5.5 Finalize and Submit EIA/EMP/EIAR

Once the review period has expired, all of the comments raised by I&AP's will be tabulated and will then subsequently be addressed by the EAP before submitting the final version of the various reports to the relevant authorities. The updated "Comments Register" will be contained in the formal Public Participation Programme Report attached as an APPENDIX of the EIAR. The Final Reports will also be made available to I&AP's for final comments, which should there be any, must be submitted directly to DEDET and DMR.

2.5.6 Authority Review & Decision

For the EIA documentation, to be submitted to DEDET and DMR, the authorities have a period of 60 days to accept or reject the reports, and 45 days to make a decision, with the further option of sending them for specialist review which will take another 45 days, after which they will have 10 days to notify the applicant of their decision.

3. PUBLIC PARTICIPATION PROCESS TO DATE

3.1 NEED FOR SCOPING PHASE PUBLIC PARTICIPATION

Public participation is one of the most important aspects of the environmental authorization process. Public participation is the only requirement for which exemption cannot be given, unless no rights are affected by an application.

This stems from the requirement that people have a right to be informed about potential decisions that may affect them and that they must be afforded an opportunity to influence those decisions. Effective public participation also improves the ability of the competent authority to make informed decisions and result in improved decision-making as the views of all parties are considered.

The public participation process:

- provides an opportunity for Interested and Affected Parties (I&APs) to obtain clear, accurate and comprehensible information about the proposed activity, its alternatives or the decision and the environmental impacts thereof;
- provides I&APs with an opportunity to indicate their viewpoints, issues and concerns regarding the activity, alternatives and/or the decision;
- provides I&APs with the opportunity of suggesting ways of avoiding, reducing or mitigating negative impacts of an activity and for enhancing positive impacts;
- enables an applicant to incorporate the needs, preferences and values of affected parties into the activity;
- provides opportunities to avoid and resolve disputes and reconcile conflicting interests; and
- enhances transparency and accountability in decision-making.

Public participation therefore allows I&AP's the opportunity to give their viewpoints, and influence the process and the decisions of the competent authority.

This is of particular importance during the scoping phase of an EIA as this stage constitutes the timeframe where most of the planning and design for the EIA/EMP phase of the EIA is done. Inputs from I&AP's during this stage can therefore be addressed and incorporated in the planning of studies and investigations that are to follow.

3.2 PUBLIC PARTICIPATION FOR SCOPING PHASE

3.2.1 The Scope of the Public Participation Program (Scoping Phase)

The public participation program that was designed for the Scoping Phase of the Sasol Mining Borrow Pits Project, was derived from, and based on, the regulations stipulated in regulation's 54 – 57 of Government Notice R 543 (GNR 543), which contains the EIA Regulations in terms of Chapter 5 of NEMA. The *Guideline 4: Public Participation in support of the EIA Regulations; 2005*, produced by the, then, Department of Environmental Affairs and Tourism, was also used for guidance.

In the guideline document it is stated that the extent or scope of the public participation should be based on the extent of the envisaged impact, and not on the extent of the proposed development. Also, it states that minimum requirements set for one project will not necessarily be sufficient for another, and that each project should be considered on its own merit.

The above mentioned was taken into consideration and it was decided that for the scoping phase of the EIA all of the identified I&AP's would be notified according to regulations stipulated in GNR 543 informing them of the proposed project and inviting them to attend the public meeting that was scheduled for the 29th of March 2012 at Sasol Mining Conference Centre. Along with these notifications were sent a Background Information Document, a comments sheet on which the I&AP's could raise any concern they might have, or comment on a specific issue, and a map indicating the location of the venue for the Public Meeting.

3.2.2 Identification/Registration of Authorities and I&AP's

During the pre-application phase of the EIA process members of JMA sat down and discussed the proposed project, investigating all of the proposed actions and determining what environmental authorisations will be required, and who the relevant lead authorities will be. During this discussion it was concluded that the Department of Mineral Resources (DMR), Department of Economic Development, Environment & Tourism (DEDET), and Department of Water Affairs (DWA) will be the lead authorities on this project.

During meetings held with the abovementioned authorities JMA inquired from them which other authorities do they also deem as important with regards to this project. The results of these queries amounted to the Regional Department's of Agriculture and Health, and the Mpumalanga Parks Board. Also representatives of Gert Sibande District Municipality and Govan Mbeki Local Municipality were identified. These authorities were notified of the project and invited to attend the Public Meeting that was held on 29 March 2012.

For the identification of the I&APs to the proposed project, members of JMA consulted I&AP databases of previous projects obtained from Sasol Mining Rights and Property Department (SMRD). JMA also used I&AP databases of previous projects done in the area.

Furthermore anybody that responded to the newspaper advertisements, or notices were added to the I&AP database for this project. At the Public Meeting the I&APs were ask to provide details of persons that they deem necessary to be registered as an I&AP to the project. The current I&AP data base for this project is attached as APPENDIX 3.2(A).

3.2.3 Notification of Authorities and I&AP's

As prescribed in GNR 543 written notices were compiled containing information on the proposed project, details of the Applicant, the appointed Consultant, and the Public Meeting that was scheduled for 29 March 2012. Along with this notification letter, sent to the I&APs, was a BID (Background Information Document) that contained additional information regarding the Sasol Mining, Borrow Pits project, and a comment sheet on which the I&AP could raise issues or concerns that he/she may have regarding the project. A copy of the BID is attached in APPENDIX 3.2(B) and a copy of the notification letters in APPENDIX 3.2(C).

Press advertisements were also compiled and published in two regional newspapers, these being the Daily Sun (Mpumalanga Edition) and the Highveld Tribune. The advertisements also contained some information regarding the project along with details and invitation to the public meeting. The advertisements were placed during the two weeks preceding the public meeting. Please see proof of these adverts in APPENDIX 3.2(D).

Various site notices were put on site itself, and throughout the surrounding communities. These notices also contained information regarding the proposed project, its location, and an invitation to attend the public meeting. Please see proof of these Notices in APPENDIX 3.2(E).

3.2.4 Information to Authorities and I&AP's

The information that was sent to the I&APs contained details of the following:

- Background to the Project;
- Description of actions to be undertaken for the current proposed project;
- Environmental authorisations that are required for the proposed project;
- Location of the project;
- Invitation to the public meeting that was scheduled, and the role of the I&APs in the public participation process as a whole;

3.2.5 Meetings with Authorities and I&AP's

Three pre-application consultations were held with the lead authorities for each of the three authorization processes included in this Project.

The Regional DMR office in Witbank was consulted telephonically to inform them of the proposed applications and to obtain their inputs on aspects related to process and document review. A copy of the Note for the Record of this consultation is attached in APPENDIX 3.2(F).

A pre-application meeting was held with Mr Bheki Mnduwe of DEDET in Ermelo on 6 March 2012. The relevant listed activities in terms of the EIA Regulatons were confirmed and the selected process of full Scoping and EIA was also confirmed. A copy of the Note for the Record of this meeting is attached in APPENDIX 3.2(G).

A pre-application meeing was held with officials from the Gauteng Regional DWA Office, as well as with officials from DWA Head Office in Pretoria on 22 March in order to discuss the proposed application for authorization of identified water uses. During this meeing the alignment of the different application processes, the identification of water uses to be applied for, aspects related to the Reserve Determination, aspects pertaining to investigation, consultation and information requirements, the risk classification of the proposed activities and the requierements for documentation from other processes, were discussed. A copy of the Note for the Record of this meeting is attached in APPENDIX 3.2(H).

Focus group meetings will be held on request from I&AP's. Minutes of these meetings will be attached as APPENDIX 3.2(I).

A Soping Phase Public Meeting was held on 29 March 2012. The minutes of the Scoping Phase Public Meeting are attached to this report as APPENDIX 3.2(J).

3.2.6 Obtaining Comments from Authorities and I&AP's

Contained in all of the notifications sent out, and advertisements that was placed, were the full contact details of JMA along with an invitation to contact them regarding any issue or concerns that they may have regarding the project. A comment sheet was also attached to all notifications that was sent to the I&APs.

During the Public Meeting it was conveyed to the I&AP's that the Draft Scoping Report will be made available on 30 March 2012. The draft scoping report was made available for review at the following locations:

- Secunda Public Library
- Evander Public Library
- Kinross Public Library
- eMbalenhle Public Library

Draft Scoping Reports were also submitted to DWA Gauteng Region, to the Govan Mbeki Local Municipality and the Mpumalanga Tourism and Parks Agency.

Furthermore the document was distributed to some of the I&AP's, that indicated that they will not be able to visit a library to review the document, in electronic format on a CD-ROM.

The I&AP's had up until 8 May 2012 to submit their comments, raise issues, propose investigations that needs to be conducted during the EIA/EMP phase of the EIA process. Comments received from I&AP's are attached in APPENDIX 3.2(K).

3.2.7 Responding to Comments from Authorities and I&AP's

After the review period, JMA collated all of the issues raised and comments that were submitted into an I&AP Issues, Comments and Response Register. Comments were all addressed and responded to in the Register after which the report was finalized for submission to the relevant competent authorities. A copy of the updated Issues, Comments and Response Register is attached as APPENDIX 3.2(L).

4. PROJECT/ACTIVITY DESCRIPTION

4.1 PROJECT TITLE

Project Title
Sasol Mining Borrow Pits - EMPR, EIA and IWULA

4.2 PROJECT ENVIRO-LEGAL FRAMEWORK

4.2.1 Listing of Relevant Acts, Regulations and Technical Guidance

A review of the project components was conducted against the following Environmental Acts, Regulations and Technical Guidance in order to establish which to be relevant to this application:

Legislation Considered for Application	
1.	Constitution Act 108 0f 1996
2.	National Environmental Management Act 107 of 1998 (NEMA)
3.	Environment Conservation Act 73 of 1989 (ECA)
4.	National Water Act 36 of 1998 (NWA)
5.	National Heritage Resources Act 25 of 1999 (NHRA)
6.	National Environmental Management Air Quality Act 39 of 2004 (NEMAQA)
7.	Atmospheric Pollution Prevention Act 45 of 1965 (APPA)
8.	National Environmental Management Biodiversity Act 10 of 2004 (NEMBA)
9.	National Environmental Management Waste Act 59 of 2008 (NEMWA)
10.	National Forests Act 84 of 1998 (NFA)
11.	Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA)
12.	National Environmental Management Integrated Coastal Management Act 24 of 2008 (NEMICMA)
13.	National Building Regulations and Building Standards Act 103 0fof 1997 (NBRBSA)
14.	Conservation of Agricultural Resources Act 43 of 1983 (CARA)

The following regulations published in terms of three of these Acts, have pertinent bearing on inputs into this report:

Pertinent Regulations	
NEMA	
1.	GNR 543 of 18 June 2010 – EIA Regulations
2.	GNR 544 of 18 June 2010 – Basic Assessment Listed Activities
3.	GNR 545 of 18 June 2010 – Scoping and EIA Listed Activities
4.	GNR 546 of 18 June 2010 – Basic Assessment Listed Activities - Geograhical Areas
NWA	
1.	GNR 704 of 4 June 1999 – Regulations on use of water for mining and related activities aimed at the protection of water resources
2.	GNR 1352 of 12 November 1999 – Regulations requiring that a water use be registered
3.	GN 398 of 26 March 2004 – General authorizations in terms of Section 39 of the National Water Act: ss 21(c), (i) and (j).
4.	GNR 399 of 26 March 2006 – General authorizations in terms of Section 39 of the National Water Act; ss 21(a), (b), (f) and (g).
5.	GNR 1198 of 18 December 2009 – General authorizations in terms of Section 39 of the National Water Act: ss 21(c) and (i) for the purpose of rehabilitating a wetland.
6.	GNR 1199 of 18 December 2009 – Replacement of Schedules 1 and 2 of GNR 398 of 26 March 2004.

MPRDA	
1.	GNR 527 of 23 April 2005 – Mineral and Petroleum Resources Development Regulations

Applicable Technical Guidelines	
DEDET	
1.	Integrated Environmental Management, Information Series 0, Overview of Integrated Environmental Management
2.	Integrated Environmental Management, Information Series 1, Screening
3.	Integrated Environmental Management, Information Series 2, Scoping
4.	Integrated Environmental Management, Information Series 3, Stakeholder Engagement
5.	Integrated Environmental Management, Information Series 4, Specialist Studies
6.	Integrated Environmental Management, Information Series 5, Impact Significance
7.	Integrated Environmental Management, Information Series 6, Ecological Risk Assessment
8.	Integrated Environmental Management, Information Series 7, Environmental Resource Economics
9.	Integrated Environmental Management, Information Series 8, Cost Benefit Analyses
10.	Integrated Environmental Management, Information Series 9, Project Alternatives in EIA
11.	Integrated Environmental Management, Information Series 10, Environmental Impact Reporting
12.	Integrated Environmental Management, Information Series 11, Review in EIA
13.	Integrated Environmental Management, Information Series 12, Environmental Management Plans
14.	Integrated Environmental Management, Information Series 13, Environmental Auditing
15.	Integrated Environmental Management, Information Series 14, Life Cycle Assessment
16.	Integrated Environmental Management, Information Series 15, Strategic Environmental Assessment
17.	Integrated Environmental Management, Information Series 16, Cumulative Effects Assessment
18.	Integrated Environmental Management, Information Series 17, Environmental Reporting
19.	Integrated Environmental Management, Information Series 18, Environmental Assessment of Trade Related Agreements and Policies in South Africa
20.	Integrated Environmental Management, Information Series 19, Environmental Assessment of International Agreements
21.	Integrated Environmental Management, Information Series 20, Linking EIA and EMS
22.	Integrated Environmental Management, Information Series 21, Environmental Monitoring Committees
23.	Integrated Environmental Management, Information Series 22, Socio-Economic Impact Assessment
24.	Integrated Environmental Management, Information Series 23, Risk Management
25.	Guideline 3: General Guide to the Environmental Impact Assessment Regulations
26.	Guideline 4: Public Participation
27.	Guideline 5: Assessment of Alternatives and Impacts
28.	Guideline 6: Environmental Management Frameworks
29.	Guideline 7: Detailed Guide to Implementation of the EIA Regulations
DMR	
1.	Aide Memoire for the Preparation of Environmental Management Programme Reports for Prospecting and Mining, DME, 1992
2.	Guideline for Environmental Management Programme Compilation and Format, DME.
3.	Social and Labour Plan Guidelines for the Mining and Production Industries
4.	A Guideline for a Mining Work Programme to be submitted for Applications for a Mining Right in terms of the MPRDA
5.	Series of Guidelines for the Determination of Financial Provision for the Mining Industry
DWA	
1.	External Guideline: Generic Water Use Authorisation Application Process, 2007
2.	Internal Guideline: Generic Water Use Authorisation Application Process, 2007
3.	External Guideline: Section 21(c) and (i) Water Use Authorisation Application Process (impeding or diverting the flow of water in a watercourse and /or altering the bed, banks, course or characteristics of a watercourse)

4.	Internal Guideline: Section 21(a) and (b) Water Use Authorisation Application Process (taking and/or storing water)
5.	Internal Guideline: Section 21(c) and (i) Water Use Authorisation Application Process (impeding or diverting the flow of water in a watercourse and /or altering the bed, banks, course or characteristics of a watercourse)
6.	Internal Guideline: Section 21(e), (f), (g), (h) and (j) Water Use Authorisation Application Process (waste discharge related)
7.	Operational Guideline to Assist in the Compilation of an IWWMP, 2008
8.	Best Practice Guideline A2 – Water Management for Mine Residue Deposits; 2006
9.	Best Practice Guideline A4 – Pollution Control Dams; 2006
10.	Best Practice Guideline A6 – Water Management for Underground Mines; 2006
11.	Best Practice Guideline G1 – Storm Water Management; 2006
12.	Best Practice Guideline G2 – Water and Salt Balances; 2006
13.	Best Practice Guideline G3 – Water Monitoring Systems; 2006
14.	Best Practice Guideline G4 – Impact Prediction; 2006
15.	Best Practice Guideline H1 – Integrated Mine Water Management; 2006
16.	Best Practice Guideline H2 – Pollution Prevention and Minimization ; 2006
17.	Best Practice Guideline H3 – Water Reuse and Reclamation; 2006
18.	Best Practice Guideline H4 – Water Treatment; 2006

4.2.2 Existing Authorizations

No existing authorizations are relevant to this application.

4.2.3 Environmental Authorizations Required for this Project

Based on the Enviro-Legal framework and having regard to the relevant and specific project attributes, a number of authorizations will be applied for during the course of the Environmental Authorization Phase of this Project.

4.2.1.1 Authorizations in terms of the MPRDA

Mineral and Petroleum Resources Development Act, Act No. 28 of 2002	
MPRDA Section 22	**Application for a Mining Right - EIA/EMP (EMPR)**
Aspect 1	Borrow Pit Fencing
Aspect 2	Clearing of Vegetation
Aspect 3	Removal of Topsoil
Aspect 4	Stockpiling of Topsoil
Aspect 5	Storm Water Management Berms
Aspect 6	Excavation of Dolerite
Aspect 7	Storm Water Management
Aspect 8	Transport of Dolerite
Aspect 9	Dust Suppression
Aspect 10	Shaping for Rehabilitation
Aspect 11	Placement of Topsoil for Rehabilitation
Aspect 12	Re-vegetation for Rehabilitation

4.2.1.2 Authorizations in terms of the NEMA

National Environmental Management Act, Act No. 107 of 1998		
Section 24	**Environmental Authorisation Application**	
GNR 544		
Identification of the competent authority	The competent authority in respect of the activities listed in this part of the schedule is the environmental authority in the province in which the activity is to be undertaken unless it is an application for an activity contemplated in section 24C(2) of the Act, in which case the competent authority is the Minister or an organ of state with delegated powers in terms of section 42(1) of the Act, as amended.	
Activity 11	The construction of: (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.	Quarrying of Dolerite form Open Pits No's: 1,2,3,4,6,7,8.
Activity 18	The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from (i) a watercourse; (ii) the sea; (iii) the seashore; (iv) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater- but excluding where such infilling, depositing, dredging, excavation, removal or moving (i) is for maintenance purposes undertaken in accordance with a management plan agreed to by the relevant environmental authority; or (ii) occurs behind the development setback line.	Quarrying of Dolerite form Open Pits No's: 1,2,3,4,6,7,8.

National Environmental Management Act, Act No. 107 of 1998		
Section 24	**Environmental Authorisation Application**	
GNR 545		
Identification of the competent authority	The competent authority in respect of the activities listed in this part of the schedule is the environmental authority in the province in which the activity is to be undertaken, unless- (a) it is an application for an activity contemplated in section 24C(2) of the Act, in which case the competent authority is the Minister or an organ of state with delegated powers in terms of section 42(1) of the Act, as amended; or (b) the activity is to be conducted in or on a mining area or is to transform the area where the activity is to be conducted into a mining area in which case the competent authority is the Minister of Minerals and Energy. The exception mentioned in (b) above does not apply to the following activities contained in this Notice: 1; 2; 5; 8; 9; 10; 12; 13; 14; 17; 24; and 25.	
Activity 5	The construction of facilities or infrastructure for any process or activity which requires a permit or license in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent and which is not identified in Notice No. 544 of 2010 or included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case that Act will apply.	Possible application for IWUL in terms of sections 21(c), 21(i), 21(g) and 21(f) of the NWA for Borrow Pit No's: 1,2,3,4,5,6,7,8 and 9.

National Environmental Management Act, Act No. 107 of 1998		
Section 24	**Environmental Authorisation Application**	
GNR 546		
Identification of competent authority	The competent authority in respect of the activities listed in this part of the schedule is the environmental authority in the province in which the activity is to be undertaken unless it is an application for an activity contemplated in section 24C(2) of the Act, in which case the competent authority is the Minister or an organ of state with delegated powers in terms of section 42(1)(d) of the Act, as amended.	
Activity 12	The clearance of an area of 300 square metres or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation.	(a) 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; (b) Within critical biodiversity areas identified in bioregional plans; (c) Within the littoral active zone or 100 metres inland from high water mark of the sea or an estuary, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas.
Activity 13	The clearance of an area of 1 hectare or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for: (1) the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), in which case the activity is regarded to be excluded from this list. (2) the undertaking of a linear activity falling below the thresholds mentioned in Listing Notice 1 in terms of GN No. 544 of 2010.	**(**a) Critical biodiversity areas and ecological support areas as identified in systematic biodiversity plans adopted by the competent authority. (b) National Protected Area Expansion Strategy Focus areas. **(c) In Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga, Northern Cape and Western Cape:** i. In an estuary; ii. Outside urban areas, the following: (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (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) Core areas in biosphere reserves; (ff) 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; (gg) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined. iii. In urban areas, the following: (aa) Areas zoned for use as public open space; (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose; (cc) Areas seawards of the development setback line; (dd) Areas on the watercourse side of the development setback line or within 100 metres from the edge of a watercourse where no such setback line has been determined.
Activity 14	The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for. (1) purposes of agriculture or	**(a) In Eastern Cape, Free State, KwaZulu-Natal, Gauteng, Limpopo, Mpumalanga, Northern Cape, Northwest and Western Cape:** i. All areas outside urban areas.

	afforestation inside areas identified in spatial instruments adopted by the competent authority for agriculture or afforestation purposes; (2) the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the activity is regarded to be excluded from this list; (3) the undertaking of a linear activity falling below the thresholds in Notice 544 of 2010.	
Activity 16	The construction of: (i) jetties exceeding 10 square metres in size; (ii) slipways exceeding 10 square metres in size; (iii) buildings with a footprint exceeding 10 square metres in size; or (iv) infrastructure covering 10 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.	**(a) In Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga and Northern Cape:** **i**. In an estuary; ii. Outside urban areas, in: (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; (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; (ii) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined. iii. In urban areas: (aa) Areas zoned for use as public open space; (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority, zoned for a conservation purpose; or (cc) Areas seawards of the development setback line.

4.2.1.3 Authorizations in terms of the NWA

National Water Act, Act No. 36 of 1998		
Section 40	**Integrated Water Use License Application (Includes Registrations)**	
Section 21(c)	Impeding or diverting the flow of water in a watercourse;	Development of all 9 Dolerite Borrow Pits within 500 m upstream from a water course.
Section 21(f)	Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;	Discharge of storm water run-off after settlement of solids in suspension in a sump, silt trap or settlement pond into the environment/water course.
Section 21(g)	Disposing of water containing waste in a manner which may detrimentally impact on a water resource.	Temporary storage of storm water run-off in a sump, silt trap or settlement pond to settle solids in suspension prior to release.
Section 21(i)	Altering the bed, banks, course or characteristics of a watercourse;	Development of all 9 Dolerite Borrow Pits within 500 m upstream from a water course.

National Water Act, Act No. 36 of 1998		
Section 39	**General Authorisations in terms of Section 39 of the National Water Act 36 of 1998**	
Section 21(c)	Impeding or diverting the flow of water in a watercourse;	Development of all 9 Dolerite Borrow Pits within 500 m upstream from a water course.
Section 21(f)	Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;	Discharge of storm water run-off after settlement of solids in suspension in a sump, silt trap or settlement pond into the environment/water course.
Section 21(g)	Disposing of water containing waste in a manner which may detrimentally impact on a water resource.	Temporary storage of storm water run-off in a sump, silt trap or settlement pond to settle solids in suspension prior to release.
Section 21(i)	Altering the bed, banks, course or characteristics of a watercourse;	Development of all 9 Dolerite Borrow Pits within 500 m upstream from a water course.

National Water Act		
GNR 704	**Exemption from Requirements of Regulations**	
4.	**Restrictions on locality**	
4(a)	No person in control of a mine or activity may- locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked;	Development of 9 Dolerite Borrow Pits.
4(b)	No person in control of a mine or activity may- except in relation to a matter contemplated in regulation 10, carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, whichever is the greatest;	Development of 9 Dolerite Borrow Pits.

4.3 PROJECT PROPONENT/APPLICANT

Project Applicant:	Sasol Mining (Pty) Ltd
	Private Bag X 1015
	Secunda
	2302
Mineral Rights Holder:	Sasol Mining (Pty) Ltd
	Private Bag X 1015
	Secunda
	2302
Mining Authorisation Holder:	Sasol Mining (Pty) Ltd
	Private Bag X 1015
	Secunda
	2302
Mine:	Borrow Pits
	Private Bag X 1015
	Secunda
	2302
Mine Manager:	Pierre Jordaan
Contact Person:	Dr Gail Nussey
Telephone no:	+ 27 17 614 2207
Fax no:	+ 27 11 522 9272
E-mail:	gail.nussey@sasol.com

4.4 PROJECT LOCATION/RELEVANT GOVERNING AUTHORITIES

4.4.1 Regional Setting

The proposed 9 Dolerite Borrow Pits are located in the Mpumalanga Province of South Africa. The general project locality in relation to neighbouring towns/cities, is given in Table 4.4.1(a) below.

Table 4.4.1(a): Locality of Project Site in relation to nearest Towns/Cities

Town	Distance from Site (km)	Direction from Site
eMbalenhle	**7**	**South**
Kinross	**7**	**North**
Evander	**6**	**East**
Secunda	**15**	**East**
Trichardt	**17**	**East**

The regional setting of the project site is delineated on the map shown in Figure 4.4.1(a) below.

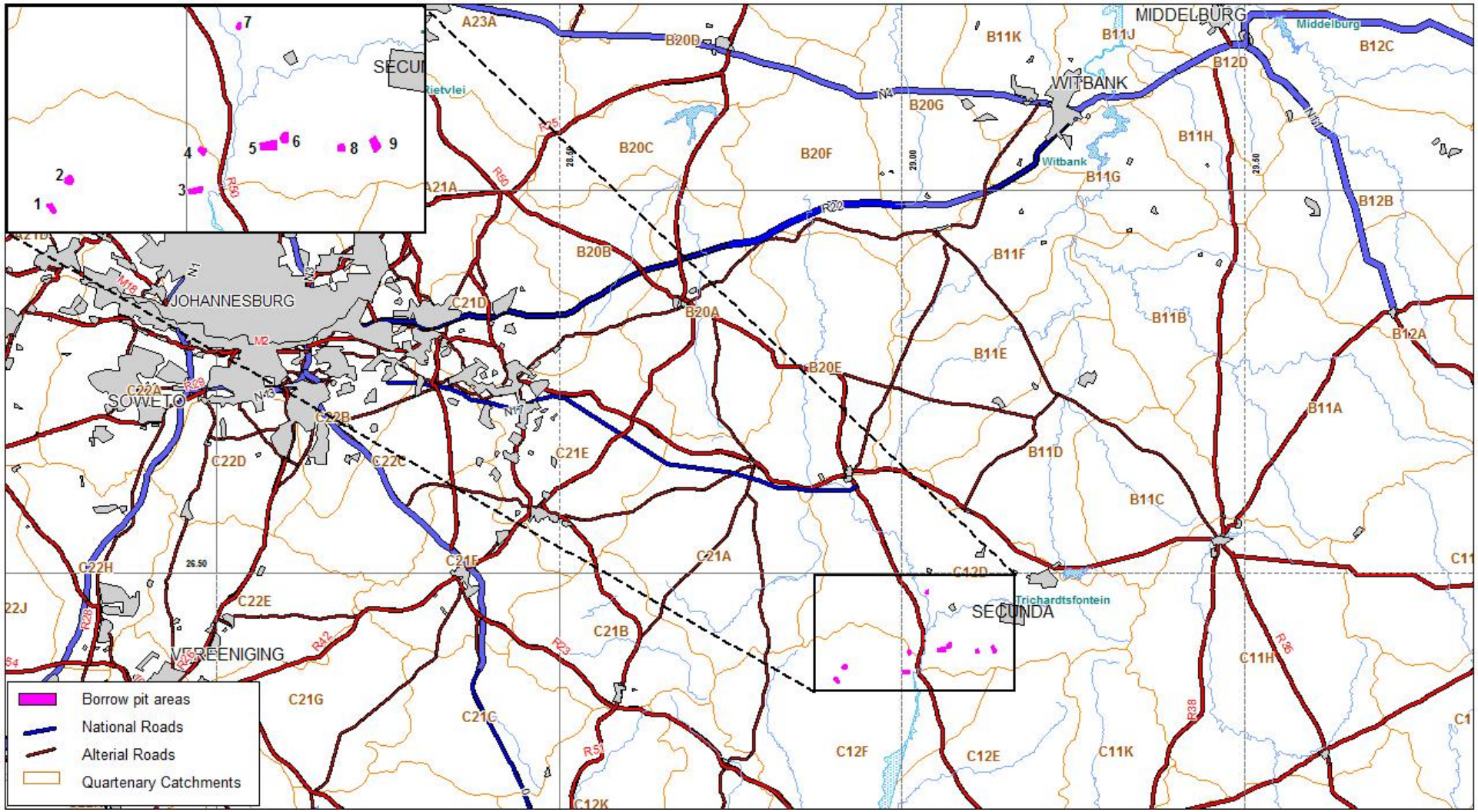


Figure 4.4.1(a): Regional Setting of the Project (see enlarged box for Borrow Pit Numbers)

4.4.2 Relevant Authorities

The following national, regional and local authorities have been consulted during the obtainment of the required Environmental Authorizations for the Project.

4.4.2.1 Provincial/Regional Authorities

Department of Water Affairs (DWA)

Regional Department:	Gauteng Region
Directorate/Designation:	SWPCO
Contact Person:	Joyce Lekoane
Postal Address:	Private bag X 995, Pretoria, 0001
Telephone no:	+ 27 12 392 1381
Fax no:	+ 27 12 392 1359
Cellular Phone:	+ 27 82 600 5669
E-mail:	lekoanej@dwaf.gov.za
Water Management Area	Waterval Catchment

Department of Mineral Resources (DMR)

Regional Department:	Mpumalanga Region
Directorate/Designation:	Witbank Office
Contact Person:	Bethuel Matodzi
Postal Address:	Private Bag X 7279, Witbank, 1035
Telephone no:	+ 27 13 656 1448
Fax no:	+ 27 13 690 3288
Cellular Phone:	+ 27 82 621 3559
E-mail:	bethuel.matodzi@dme.gov.za

Department of Economic Development, Environment and Tourism

Regional Department:	Mpumalanga
Directorate/Designation:	Ermelo
Contact Person:	Surgeon Marebane
Postal Address:	P O Box 2777, Ermelo, 2350
Telephone no:	+ 27 17 819 1155
Fax no:	0 86 516 3658
Cellular Phone:	+ 27 72 408 3138
E-mail:	surgeon@environ1.agric.za

Department of Agriculture, Rural Development and Land Administration

Regional Department:	Mpumalanga
Directorate/Designation:	Nelspruit
Contact Person:	Love Shabane
Postal Address:	P O Box 8866, Nelspruit, 1200
Telephone no:	+ 27 13 755 1420
Fax no:	+ 27 13 755 1961
Cellular Phone:	+ 27 82 428 4480
E-mail:	loves@nda.agric.za

Mpumalanga Tourism & Parks Agency (MTPA)

Office:	Ermelo
Directorate/Designation:	Environmental Authorisations
Contact Person:	Vaino Prinsloo
Postal Address:	P O Box 1250, Groblersdal, 0470
Telephone no:	+ 27 17 819 5346
Fax no:	0 86 609 0238
Cellular Phone:	+ 27 82 468 5447
E-mail:	vaino@vodamail.co.za

4.4.2.2 District/Local Authorities

District Municipality

District Authority:	Gert Sibande District Municipality
Designation:	Health & Social
Contact Person:	Mr D Hlanyane
Postal Address:	P O Box 550, Secunda, 2302
Telephone no:	+ 27 17 620 3000
Fax no:	+ 27 17 631 1607
Cellular Phone:	+ 27 82 904 0736
E-mail:	dan.hlanyane@gsibande.gov.za

Local Municipality

Local Authority:	Govan Mbeki Local Municipality
Designation:	HOD: Public Safety
Contact Person:	Mrs A Aphane
Postal Address:	Private Bag X 1017, Secunda, 2302
Telephone no:	+ 27 17 620 6000
Fax no:	+ 27 17 634 8019
E-mail:	kgomotso.a@govanmbeki.gov.za

Local Municipality

Local Authority:	Lekwa Local Municipality
Designation:	Speaker
Contact Person:	Cllr AT Ndlovu
Postal Address:	P.O. Box 66, Standerton, 2430
Telephone no:	(017) 712 9600
Fax no:	(017) 712 6808

4.5 PROPERTY DESCRIPTION/LAND OWNER/ZONING STATUS

No	PropertyName	Portion	Owner		Zoning Status	21 Digit Surveyor General ID Number
Borrow Pit No.1	Holgatsfontein 535 IR	Portion 16	Name	Sasol Mining (Pty) Ltd	Agricultural	T0IR00000000053500016
			Contact Person	AS Potgieter		
			Postal Address	P O Box 699, Trichardt, 2300		
			Telephone	(017) 614 8000		
			Facsimile	(011) 522 5882		
			Cellular	082 499 4379		
			e-mail	ampie.potgieter@sasol.com		
Borrow Pit No.2	Holgatsfontein 535 IR	Portion 1	Name	Sasol Mining (Pty) Ltd	Agricultural	T0IR00000000053500001
			Contact Person	AS Potgieter		
			Postal Address	P O Box 699, Trichardt, 2300		
			Telephone	(017) 614 8000		
			Facsimile	(011) 522 5882		
			Cellular	082 499 4379		
			e-mail	ampie.potgieter@sasol.com		
Borrow Pit No.3	Roodebank 323 IS	Portion 23	Name	AH Wessels (Passed Away)	Agricultural	T0IS00000000032300023
			Contact Person	Jan Wessels		
			Postal Address	P O Box 652, Standerton, 2430		
			Telephone	(017) 702 3233		
			Facsimile	(017) 702 3233		
			Cellular	082 871 9350		
			e-mail	jawessels@vodamail.co.za		
Borrow Pit No.4	Roodebank 323 IS	Portion 24	Name	Sasol Mining (Pty) Ltd	Agricultural	T0IS00000000032300024
			Contact Person	AS Potgieter		
			Postal Address	P O Box 699, Trichardt, 2300		
			Telephone	(017) 614 8000		
			Facsimile	(011) 522 5882		
			Cellular	082 499 4379		
			e-mail	ampie.potgieter@sasol.com		
Borrow Pit No.5	Branddrift 322 IS	Portion 3	Name	Sasol Mining (Pty) Ltd	Agricultural	T0IS00000000032200003
			Contact Person	AS Potgieter		
			Postal Address	P O Box 699, Trichardt, 2300		
			Telephone	(017) 614 8000		
			Facsimile	(011) 522 5882		
			Cellular	082 499 4379		
			e-mail	ampie.potgieter@sasol.com		

Borrow Pit No.6.	**Branddrift 322 IS**	**Portion 2 Portion 3**	**Name**	**Sasol Mining (Pty) Ltd**	**Agricultural**	**T0IS00000000032200002 T0IS00000000032200003**
			Contact Person	**AS Potgieter**		
			Postal Address	**P O Box 699, Trichardt, 2300**		
			Telephone	**(017) 614 8000**		
			Facsimile	**(011) 522 5882**		
			Cellular	**082 499 4379**		
			e-mail	**ampie.potgieter@sasol.com**		
Borrow Pit No.7	**Grootspruit 279 IS**	**Remaining Extent**	**Name**	**Evander Gold Mines Ltd**	**Urban Influence**	**T0IS00000000027900000**
			Contact Person	**B Conradie**		
			Postal Address	**Private Bag X1012, Evander**		
			Telephone	**(017) 620 1620**		
			Facsimile	**(017) 632 4046**		
			Cellular	**072 603 0622**		
			e-mail	**boet.conradie@harmony.co.za**		
Borrow Pit No.8	**Rietvley 320 IS**	**Portion 8**	**Name**	**Sasol Synfuels (Pty) Ltd**	**Utilities**	**T0IS00000000032000008**
			Contact Person	**AS Potgieter**		
			Postal Address	**P O Box 699, Trichardt, 2300**		
			Telephone	**(017) 614 8000**		
			Facsimile	**(011) 522 5882**		
			Cellular	**082 499 4379**		
			e-mail	**ampie.potgieter@sasol.com**		
Borrow Pit No.9	**Rietvley 320 IS**	**Portion 2**	**Name**	**Sasol Synfuels (Pty) Ltd**	**Utilities**	**T0IS00000000032000002**
			Contact Person	**AS Potgieter**		
			Postal Address	**P O Box 699, Trichardt, 2300**		
			Telephone	**(017) 614 8000**		
			Facsimile	**(011) 522 5882**		
			Cellular	**082 499 4379**		
			e-mail	**ampie.potgieter@sasol.com**		

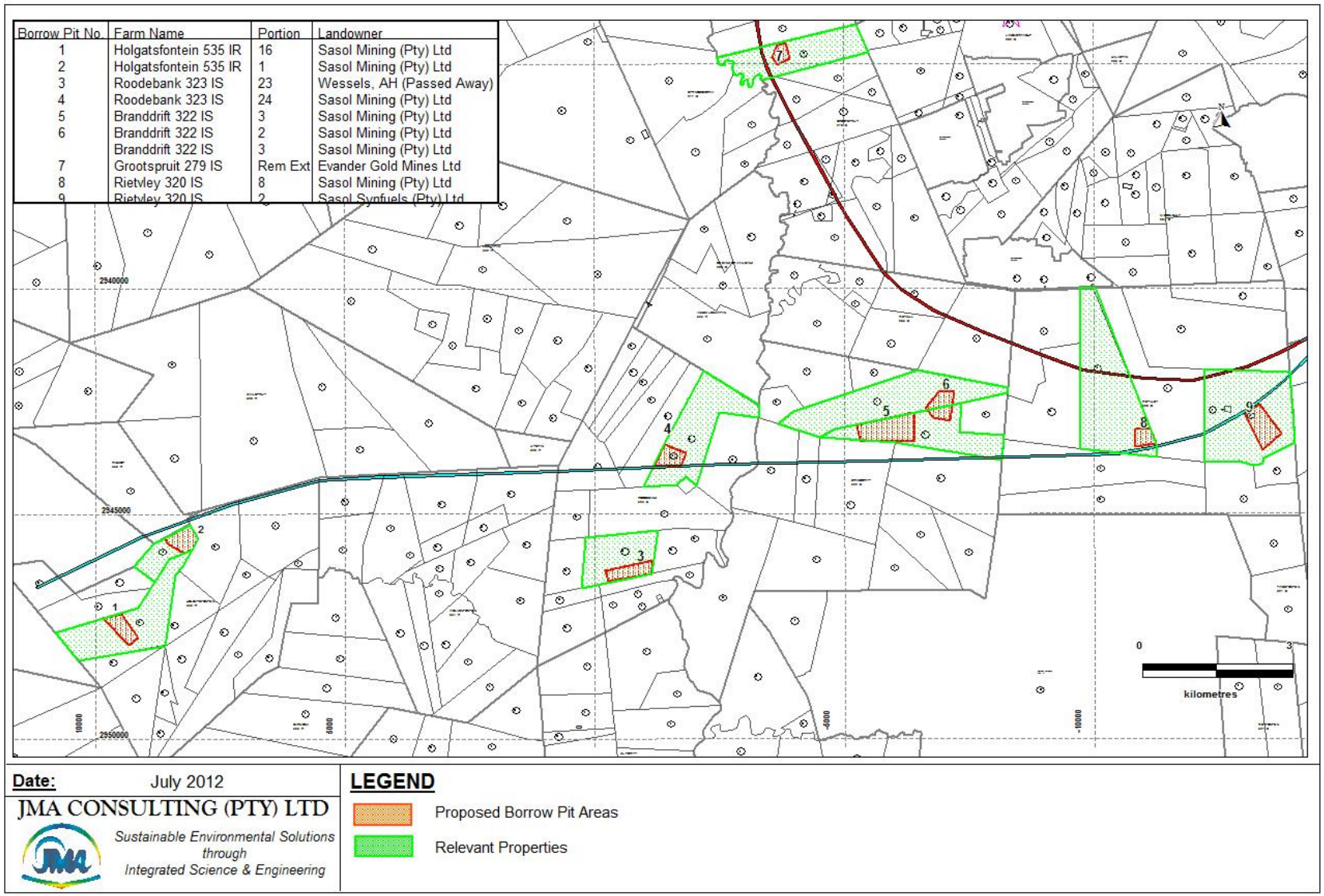


Figure 4.5(a): Borrow Pit Localities in relation to Land Owners Property Delineation

4.6 PROJECT RESOURCE ATTRIBUTES

4.6.1 Mineral Deposit

The mineral deposit to be mined comprises of dolerite. Overburden to be removed consists of topsoil, hill-wash, sandstone and siltstone.

4.6.2 Depth Below Surface and Dip

The dolerite reserve to be mined varies in depth between 0.6 m and 1.0 m below surface. The dolerite to be mined is from the top of the dolerite sill and the floor of mining will essentially be determined by the weathering profile. The dip is therefore essentially horizontal.

4.6.3 Dolerite Reserves

The estimated dolerite reserve is currently put at 4 295 500 m^3 – which suggests an average thickness of some 1.37 m of dolerite to be mined.

4.6.4 Dolerite Quality

Table 4.6.4 (a) shows the laboratory test results of material in the nine borrow pits.

Table 4.6.4 (a): Estimated Qualities for different areas of Sasol Mining

Laboratory test category	Unit of measurement	Result
Liquid limit	%	0-63
Plastic Index	%	14-43
PI whole sample	%	4-18
Clay content	%	1-58
Grading modulus	%	0.5-2.42
Mod.AASHTO MDD	kg/m3	1466-3152
CBR @ 93%	%	9-38
CBR @ 95%	%	10-47
swell % at 100%	%	0-0.9
Optimum moisture content	%	9.1-15.2
TRH 14 classification	-	G7-G9

4.6.5 Product Market

All dolerite excavated from the nine Borrow Pits will be used internally by Sasol Mining during the construction of their Impumelelo and Shondoni projects.

4.6.6 Product Price

The dolerite required by Sasol Mining will not be sold to external parties and therefore there are no price assumptions.

4.6.7 Planned Production Rates

Table 4.6.7 (a) indicates the volume of material to be removed per annum for four years, from the nine borrow pits.

Table 4.6.7 (a): Production Schedule for Dolerite from Nine Borrow Pits

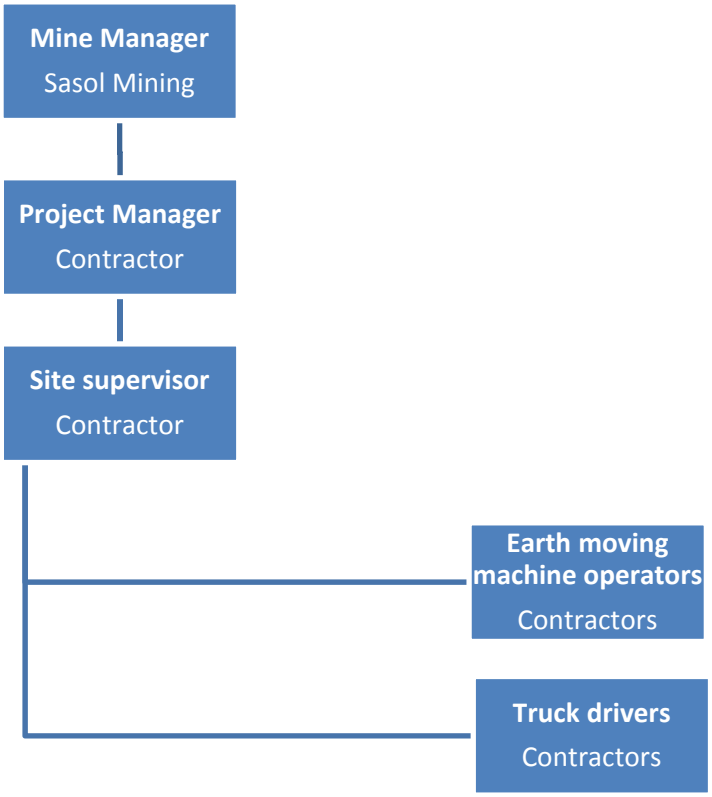
Year 1	Year 2	Year 3	Year 4
916 063 m^3	916 063 m^3	610 709 m^3	610 709 m^3

4.6.8 Planned Life of Mine

The planned life of the mining operation is four years.

4.6.9 Mine Organogram (Including Contractor)

Although managed by Sasol Mining, the actual quarrying at the Borrow Pits will be performed by an appointed contractor.



4.6.10 Estimated Work Force

Table 4.6.10 (a) reflects the number of contractors required for the mining of the borrow pits. This is only required for the duration of the borrow pit projects. These individuals are hired as part of the various packages, from different contracting companies. During the time of work at Sasol Mining sites, all Sasol Mining safety policies and procedures are adhered to. Each contracting company has their own supervisory and managerial team, which are also overseen by Sasol Mining representatives.

Table 4.6.10 (a): Estimated Work Force for the Borrow Pits

Category	Year 1	Year 2	Year 3	Year 4
Top Management	**0**	**0**	**0**	**0**
Senior Management	**0**	**0**	**0**	**0**
Professionally qualified and experienced specialists and mid-management	**1**	**1**	**1**	**1**
Skilled technical and academically qualified workers, junior management, supervisors, foreman and superintendents	**0**	**0**	**0**	**0**
Semi-skilled and discretionary decision making	**1**	**1**	**1**	**1**
Unskilled	**13**	**13**	**13**	**13**
Total Contract Man Power Budget	**16**	**16**	**16**	**16**

4.7 PROJECT MOTIVATION (NEED AND DESIRABILITY)

4.7.1 Legal Standing

The nine Borrow Pits will be operated by Sasol Mining (Pty) Ltd (Sasol Mining) which is legally authorized to mine coal from inter alia the Impumelelo and Shondoni Mining Reserves within which the proposed sites are located.

4.7.2 Need for Product

Sasol Mining (Pty) Ltd has been mining coal in the Secunda area, situated in the Mpumalanga Province, for more than 30 years. Sasol Mining supplies coal to Sasol Synfuels which has a coal consumption of approximately 41 million tons per annum. Sasol Synfuels, by utilising various processes, beneficiates the coal into a number of products such as petrol, diesel, chemicals, etc. In addition, a certain amount of the coal is exported to European and Asian markets. Coal is currently mined by five production operations within Sasol Mining's mining area, consisting of the Twistdraai, Middelbult, Syferfontein, Brandspruit and Bosjesspruit Operations. Even though the Secunda Complex consists of these five operations, it is a single integrated mining area operated by Sasol Mining, and does not constitute individual mines.

Three projects are currently under way to expand the business; the Thubelisha shaft (extension of Twistdraai Colliery), Impumelelo Mine (replacement of Brandspruit Colliery) and Shondoni (Brown fields project for Middelbult Colliery).

The dolerite to be sourced from the nine Borrow Pits, is required for construction of the infrastructure (shafts and overland conveyor systems) for the Impumelelo and Shondoni Projects.

4.7.3 Strategic Importance of the Resource/Product

The strategic importance of the dolerite is related to the successful completion of the Impumelelo and Shondoni expansion projects as they relate to securing a continuous supply of coal to Sasol Synfuels.

Sasol Synfuels in Secunda arguably represents one of the single most strategic industries in South Africa. Without quoting figures, it is obvious that its contribution to the supply of the national liquid petroleum, industrial chemical and agricultural chemical markets, to name but a few of the more obvious, is of national strategic significance.

The coal to be produced at Impumelelo and Shondoni will contribute a significant portion of the critically required feed into the Sasol Synfuels Plant at Secunda. The sustained maintenance of the coal mining production rates to source the SSF Plant is of the utmost importance.

4.7.4 Contribution to Gross Domestic Product

The commissioning and operation of the Impumelelo and Shondoni Projects will contribute significantly to the GDP. Estimates in 2003, puts a shaft development cost, similar to what is envisaged at both Impumelelo and Shondoni, at an estimated R 900 million. The annual expense budget estimated in 2003, puts annual expenditure at each shaft during full production, at some R 700 million per year.

4.7.5 Contribution to Foreign Earnings

Although none of the dolerite will be sold, its use will facilitate mining at both Impumelelo and Shondoni. Although none of the coal from these two shafts will be sold directly into the foreign markets, the indirect contribution to the South African Balance Sheet is obvious due to the significant contribution to the local economy via the Sasol Synfuels contribution to fuel and chemicals supply.

4.7.6 Socio-Economic Benefits

Both Impumelelo and Shondoni (and therefore the nine Borrow Pits), as part of the overall mining and industrial industry in the Govan Mbeki Municipal Area, contributes quite significantly to the socio-economic wellbeing of the region. Studies conducted in the area clearly show the dominant contribution of the mining and associated industrial sectors to the socio-economic fabric of the area. The influence of the mining and industrial sectors clearly manifest in aspects related to age distribution, employment, income and the provision of services and housing.

The number of people employed in the Govan Mbeki Municipality amounts to some 67 172 people (or 32 % of the total population). Not reflected in these figures is the amount of informal employment within the district. In a study conducted by DPR (2000), the number of people involved in the informal employment sector in the Highveld Ridge District was ±7 000.

Information available for the various sectors of the economy and the number of people employed in these sectors, indicate that mining accounts for the highest number of employees at 9,54% (20 018 people) followed by manufacturing at 4,35% (9 130 people). However, these figures only reflect the direct employment in these sectors and do not account for the peripheral employment created around these sectors.

4.8 DETAILED PROJECT DESCRIPTION

The project description provided in this Draft Scoping Report is based on currently available information. Whereas information given for, for instance the resource attributes are highly accurate and on a high level of confidence, it must be accepted that details related to the mining infrastructure, the proposed mining plan and water management infrastructure, is still provisional and will therefore change during the EIA Phase of this project.

The benefits of iterative mine planning throughout the EIA phase cannot be over-emphasized as it affords the project planners the opportunity to design the mine optimally from an environmental management perspective. The consideration of project alternatives is also an on-going exercise throughout the EIA process.

4.8.1 General Borrow Pit Infrastructure

Mining of the dolerite from the nine Borrow Pits will require the minimum of infrastructure.

4.8.1.1 Localities and Delineation of Borrow Pits

The localities and delineation of the Nine Borrow Pits, as well as the Impumelelo and Shondoini Overland Coal Conveyors, in relation to existing roads to be used for dolerite transport are shown on the map depicted as Figure 4.8.1.1 (a).

Information pertaining to the aerial extent and expected mining volumes for the nine Borrow Pits are given in Table 4.8.1.1 (a).

Table 4.8.1.1 (a): Details of Borrow Pits

Borrow Pit No	Total Area	Exclusion	Mineable Area (ha)	Overburden		Borrow Thickness		Total Volume (m^3)
				Thickness (m)	Volume (m^3)	Thickness (m)	Volume (m^3)	
1	18.6	4.4	14.2	1.0	143 427	1.5	215 141	358 568
2	24.3	7.9	16.4	0.6	97 833	1.5	244 583	342 416
3	24.0	7.9	16.1	0.6	96 481	1.5	241 203	337 684
4	19.4	2.0	17.4	0.1	17 330	1.0	173 302	190 632
5	60.0	7.2	52.8	0.7	369 733	0.5	264 095	633 828
6	26.0	1.9	24.1	1.0	144 630	0.5	361 575	506 205
7	10.0	2.5	7.5	0.7	52 367	0.5	119 696	172 063
8	12.0	4.4	7.6	0.7	75 345	1.6	37 672	113 017
9	35.0	1.7	33.3	0.6	232 827	1.5	166 305	399 132

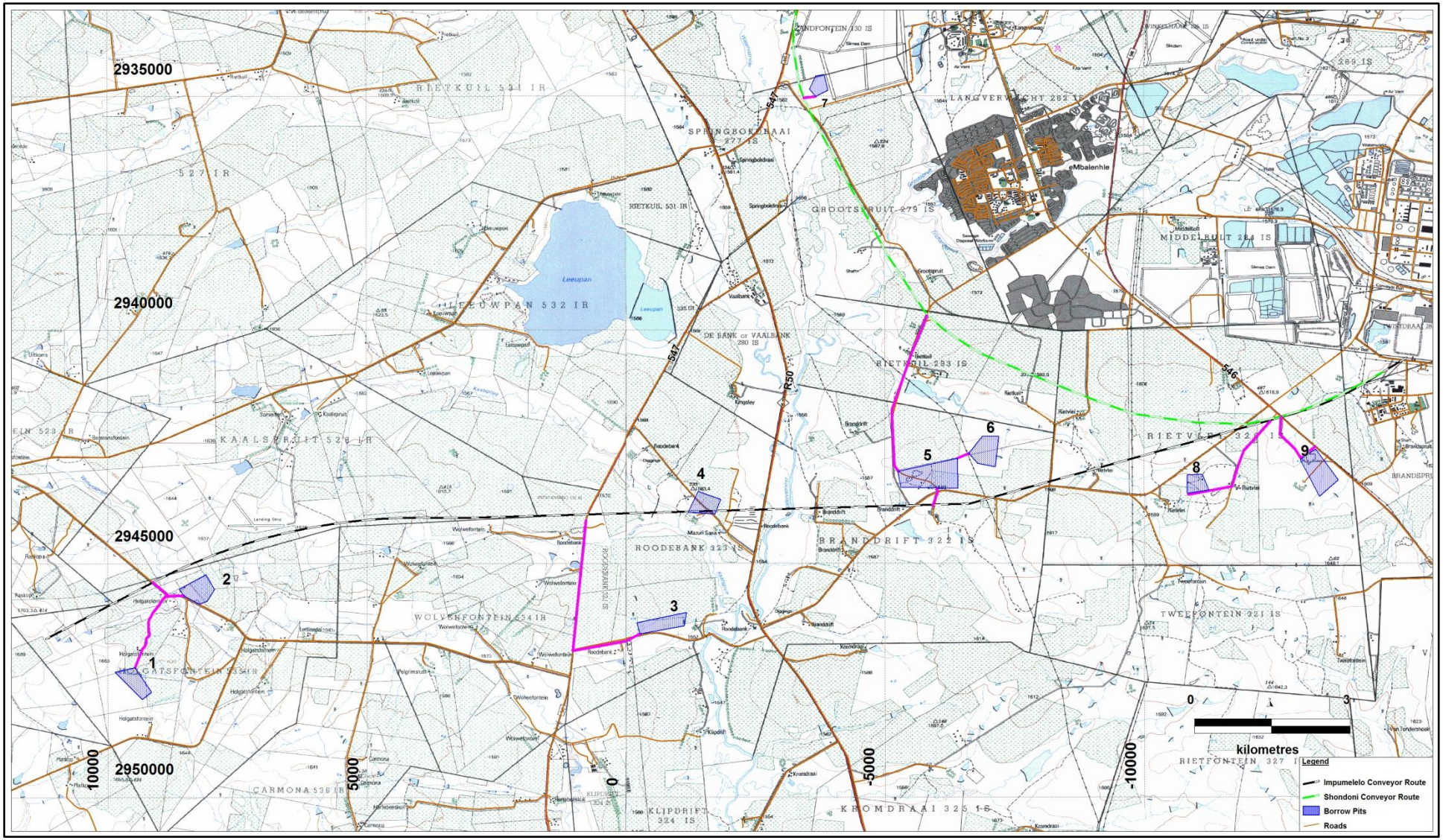


Figure 4.8.1.1(a): Localities and Extent of Borrow Pits in relation to Transport Routes

4.8.1.2 Access Roads

New access roads will not be constructed. The proposed dolerite Borrow Pits are all located along existing gravel roads (see Figure 4.8.1.1 (a)) from which access will be gained directly into the Borrow Pit Areas.

4.8.1.3 Fences

Each of the nine borrow pits will be fenced off with a 1.2 m high security fence. A boom gate will control access to the site.

4.8.1.4 Internal Roads and Parking Areas

No internal roads or parking areas will be required.

4.8.1.5 Site Office

No site office facilities will be required.

4.8.1.6 Ablutions

Each Borrow Pit will be provided with one mobile toilet unit.

4.8.1.7 Workshops and Wash Bays

No workshops or wash bay facilities will be required.

4.8.1.8 Electricity Supply and Substations

No electrical power is required on site.

4.8.1.9 Fuels Storage

No fuels storage is required on site.

4.8.1.10 Servitudes (roads/rails/pipes/power lines)

No servitudes are required for roads, rails, water pipes or power lines.

4.8.2 Mining and Beneficiation Infrastructure

The dolerite mining will comprise a typical quarrying activity, occurring in real time and simultaneous to the daylight hours only construction activities at the two overland conveyor systems.

4.8.2.1 Borrow Pit Delineation

The detailed delineations of the nine dolerite Borrow Pits are shown in Figures 4.8.2.1 (a) through 4.8.2.1 (i).

4.8.2.2 Soil/Overburden Stockpiles

Soils and overburden stripped during the mining operation will be used to construct storm water management berms. Excessive topsoil containing vegetative material will be stockpiled separately in piles not exceeding 2 m in height.

Overburden material that is unsuitable for construction purposes, and which could be used in the reshaping of the site during rehabilitation, will also be stockpiled separately. To minimise any impacts on the value of the surrounding land, care will be taken to limit the extent of the area disturbed during excavation activities.

NB! None of the soil or overburden material has the capacity to geochemically generate any water soluble pollution.

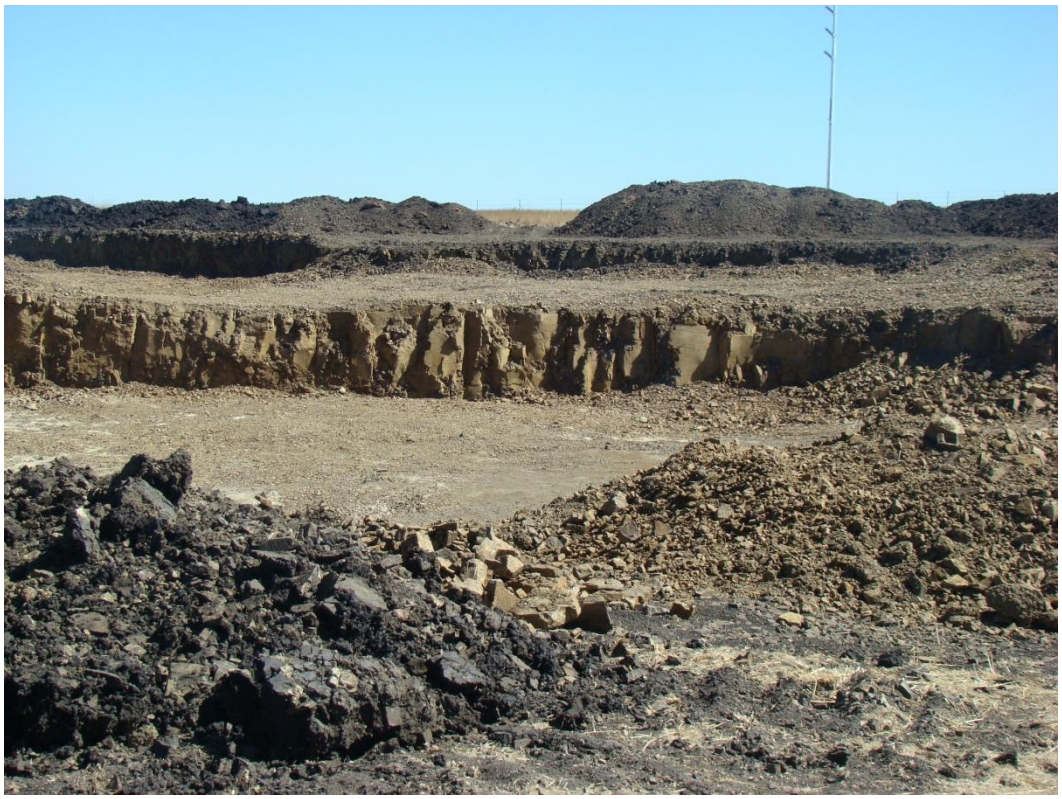


Figure 4.8.2.2 (a): Soil stockpiles in the background, the excavated dolerite horizon in the middle and overburden in the foreground

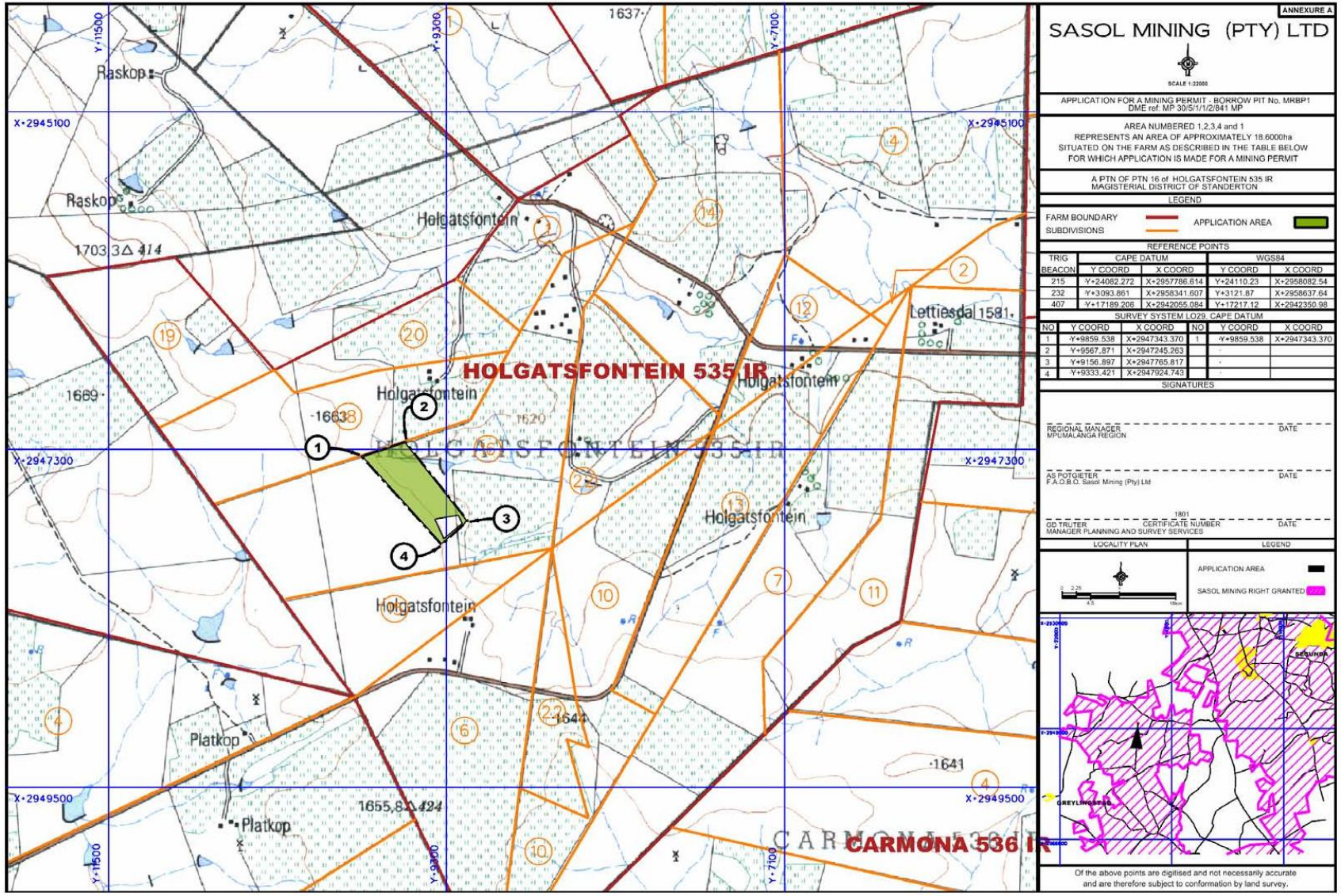


Figure 4.8.2.1(a): Locality and Extent of Sasol Mining Borrow Pit No.1

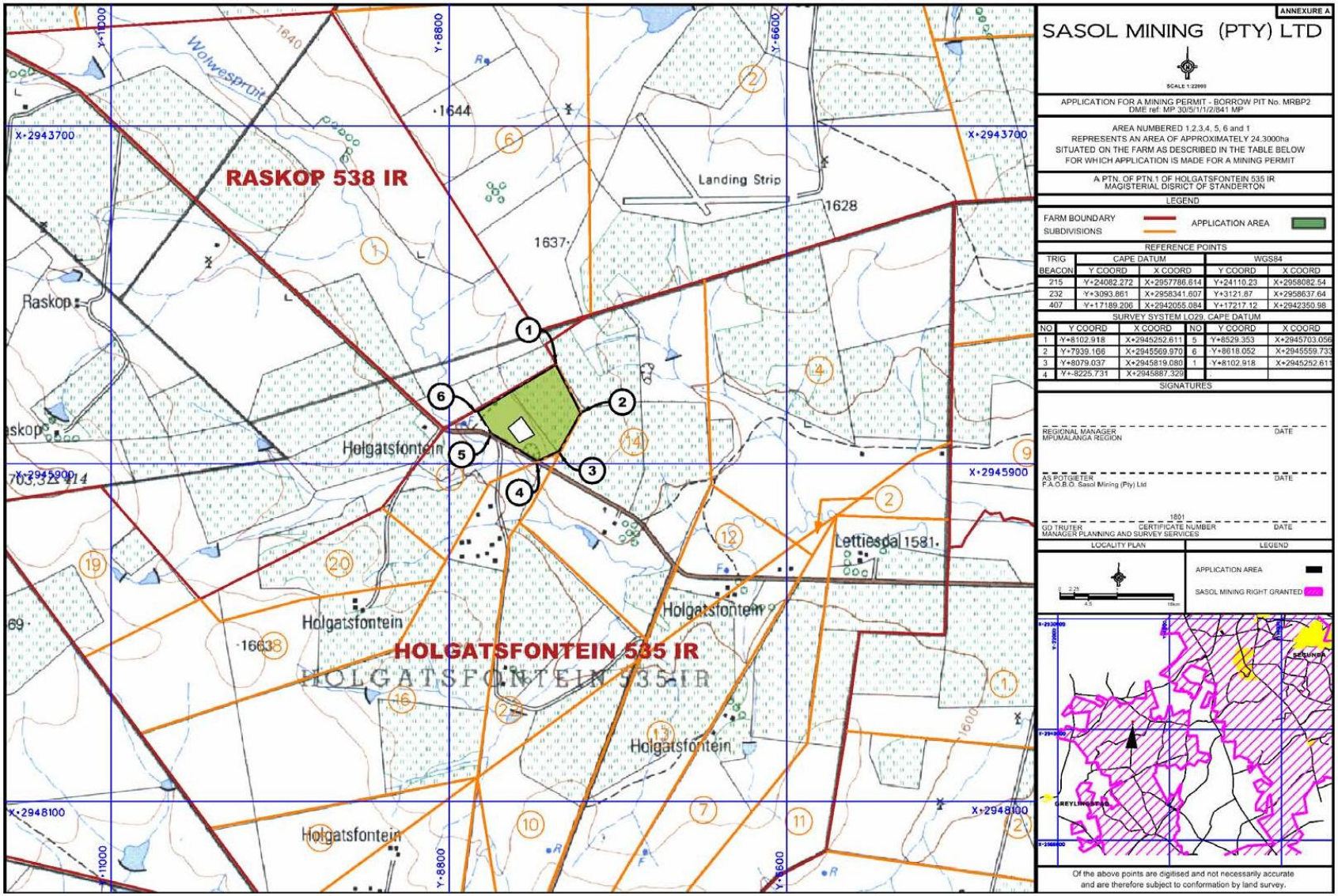


Figure 4.8.2.1(b): Locality and Extent of Sasol Mining Borrow Pit No.2

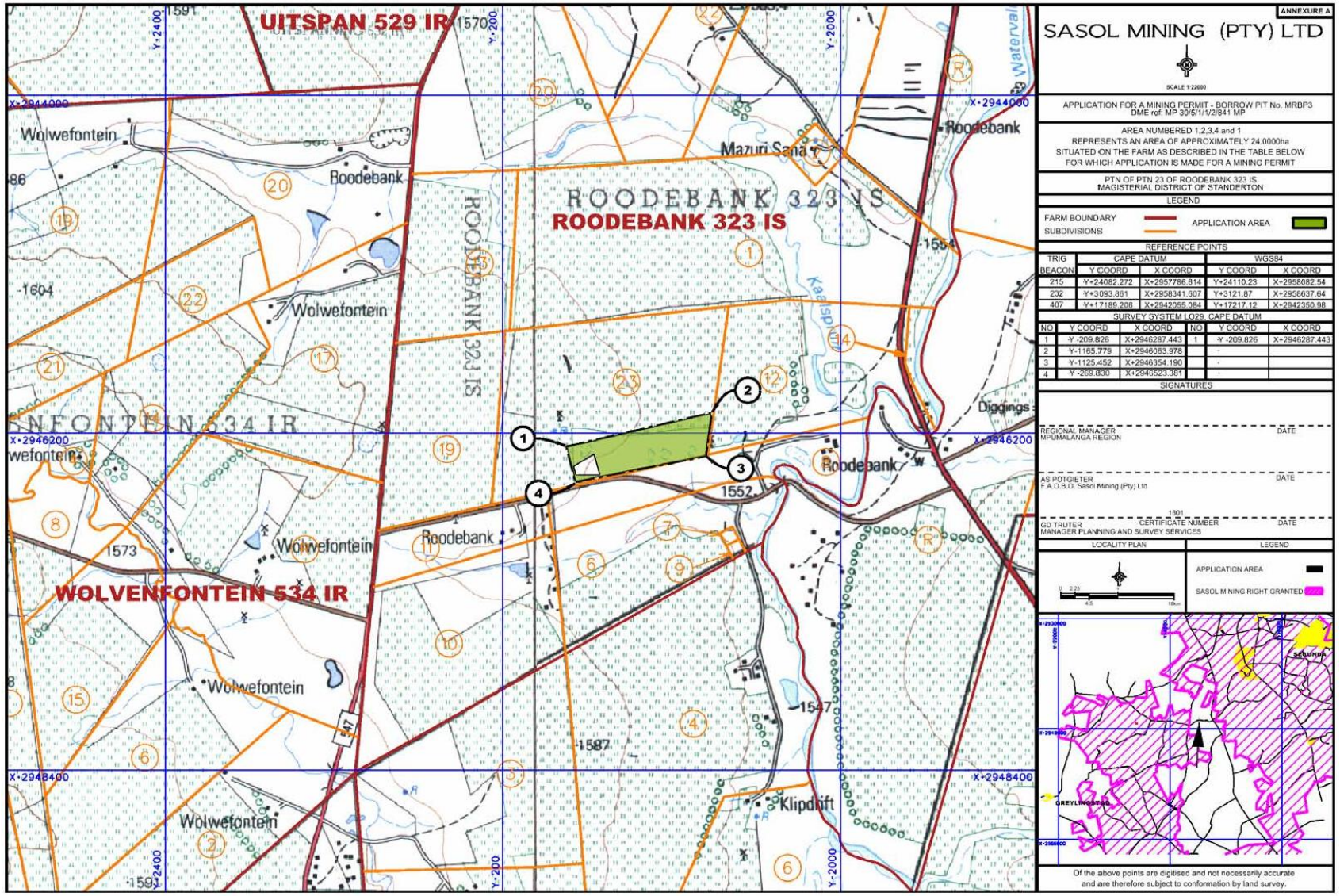


Figure 4.8.2.1(c): Locality and Extent of Sasol Mining Borrow Pit No.3

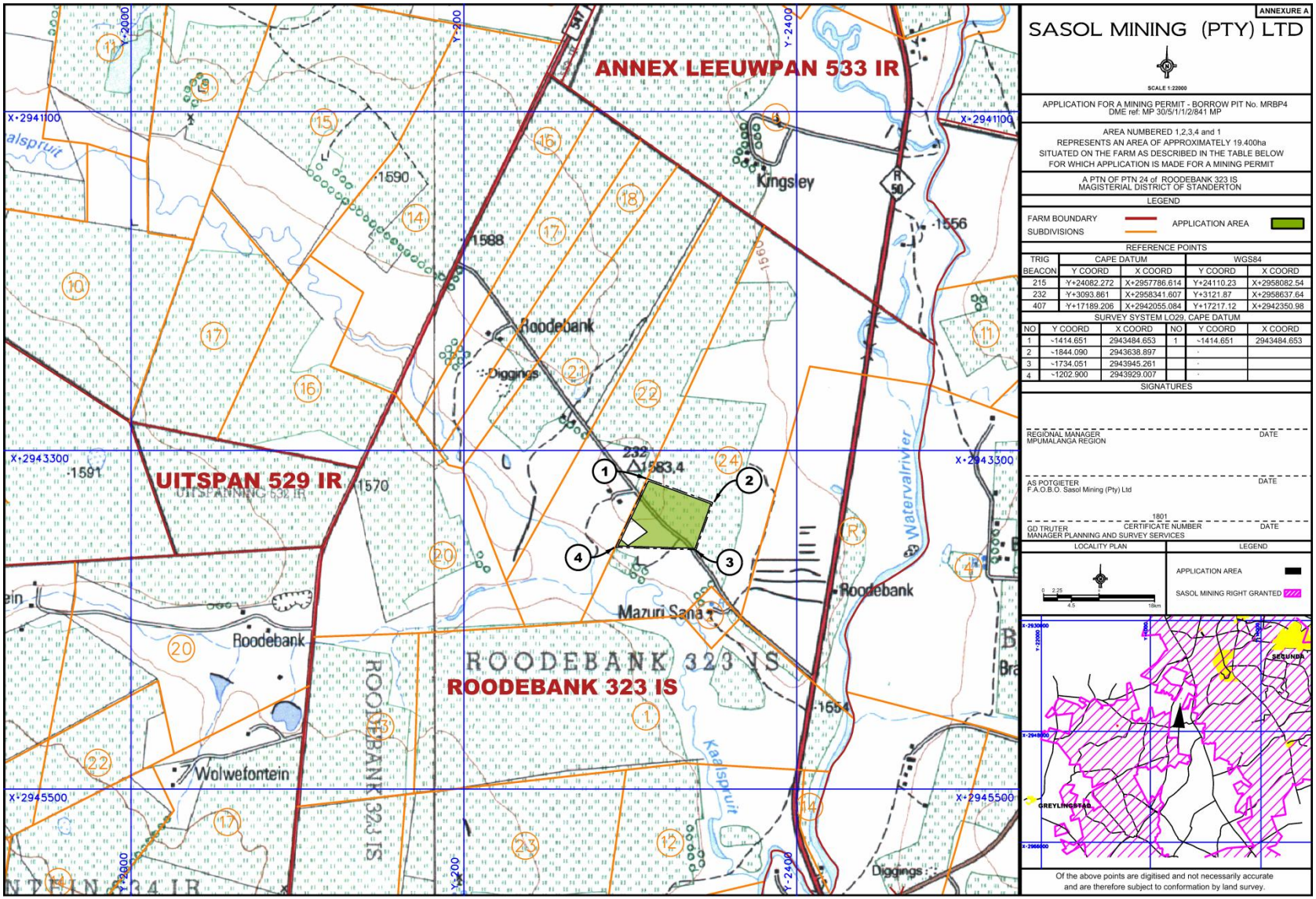


Figure 4.8.2.1(d): Locality and Extent of Sasol Mining Borrow Pit No.4

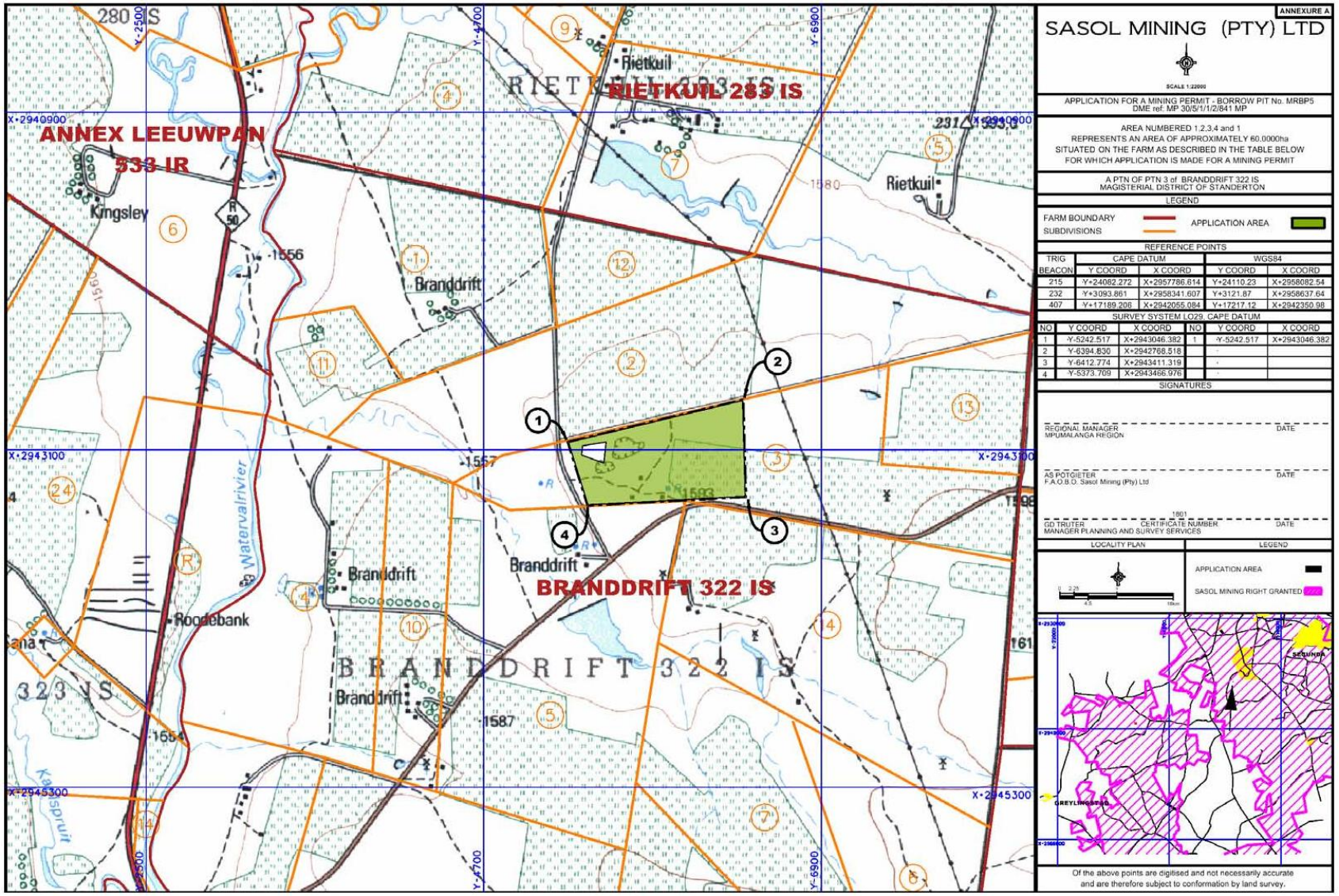


Figure 4.8.2.1(e): Locality and Extent of Sasol Mining Borrow Pit No.5

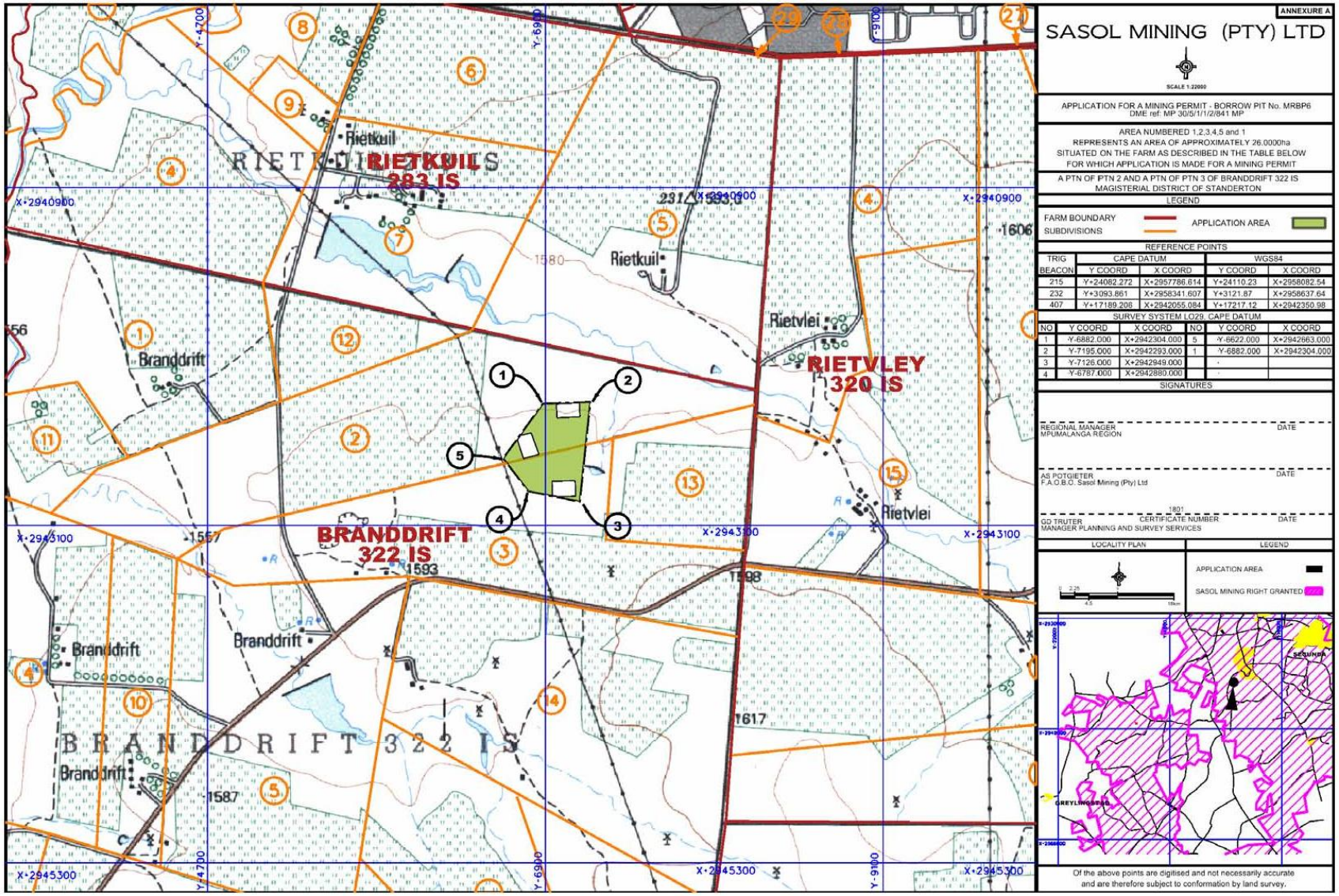


Figure 4.8.2.1(f): Locality and Extent of Sasol Mining Borrow Pit No.6

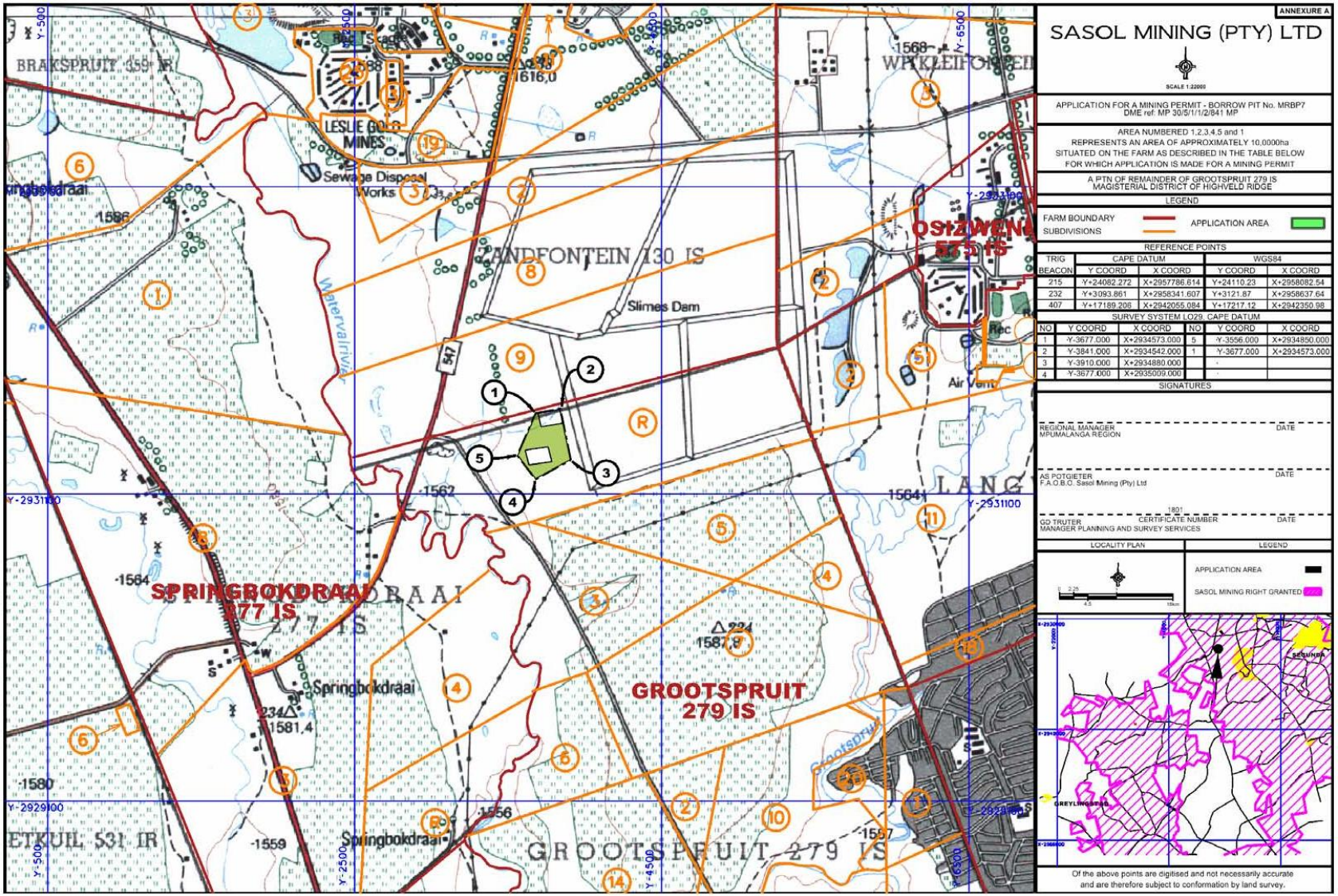


Figure 4.8.2.1(g): Locality and Extent of Sasol Mining Borrow Pit No.7

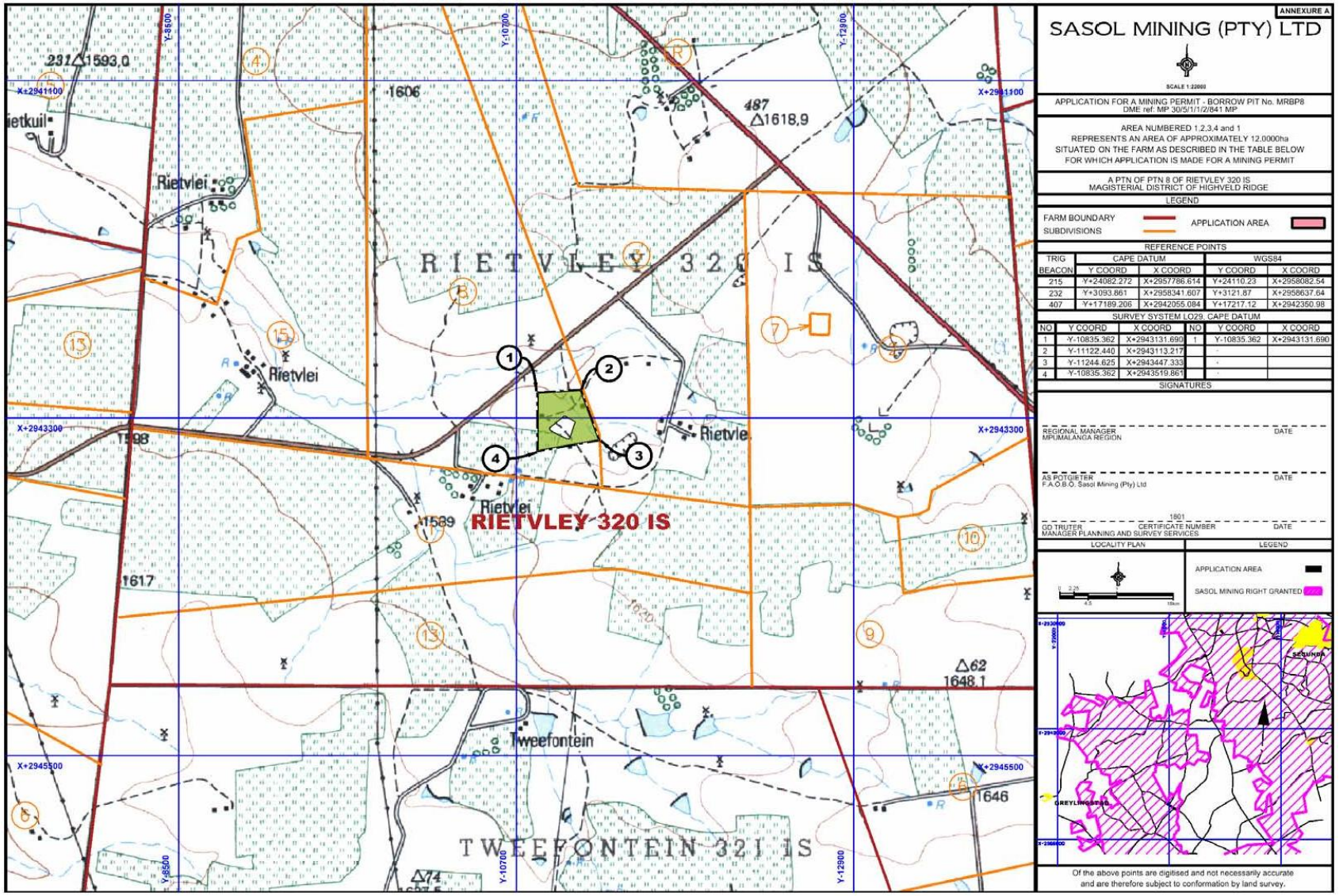


Figure 4.8.2.1(h): Locality and Extent of Sasol Mining Borrow Pit No.8

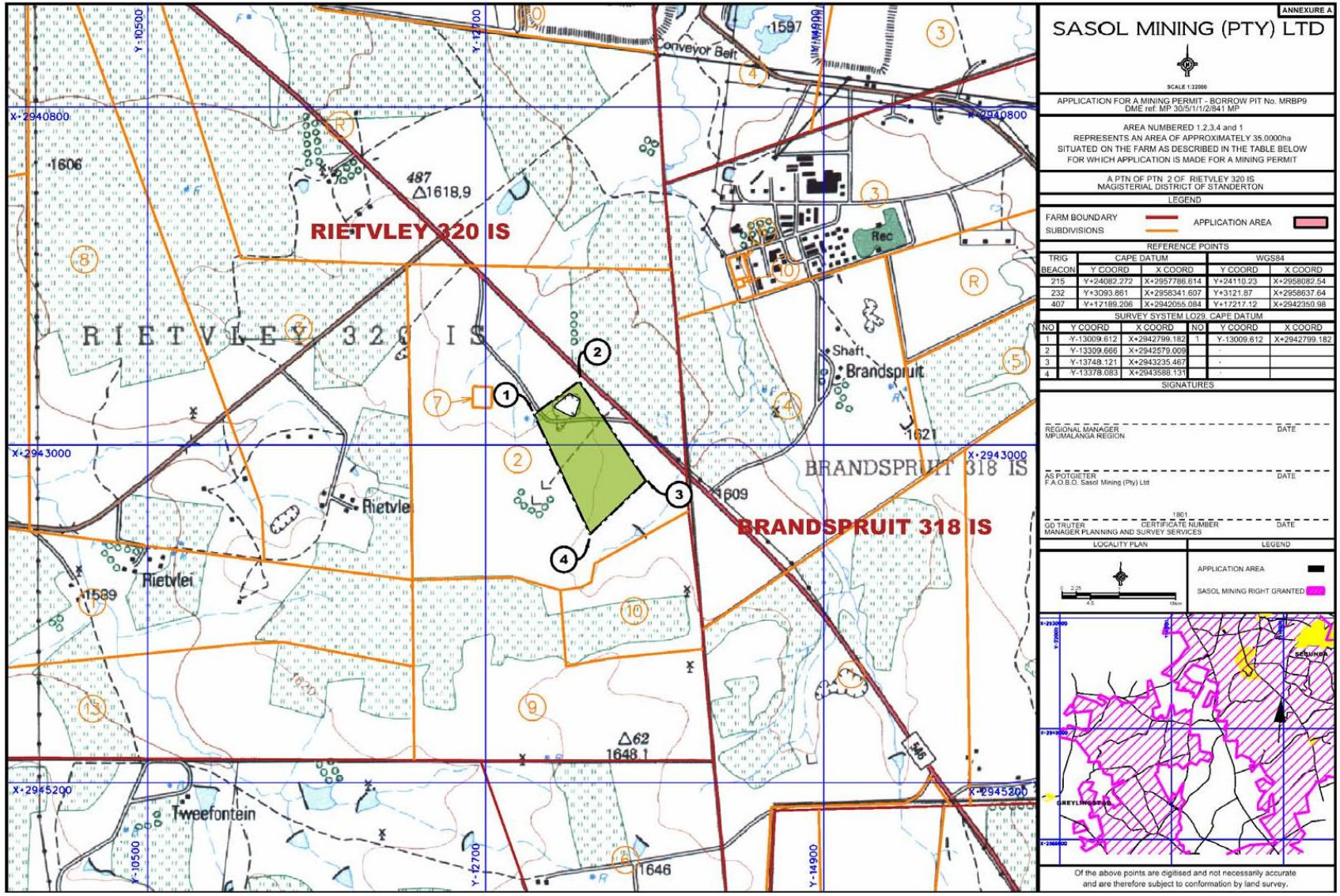


Figure 4.8.2.1(i): Locality and Extent of Sasol Mining Borrow Pit No.9

4.8.2.3 Material Excavation and Loading Equipment

Each borrow pit will be excavated by means of ripping and loading with an excavator directly onto the haul vehicles. Material would then be transported to the construction area.

The teams working at the borrow pits will utilize two 30 ton earth moving machines and approximately ten * 10 cubic meter tipper trucks.

Figure 4.8.2.3 (a): Excavator and Transport Tipper Trucks

4.8.2.4 Excavation Mining Plan

Excavation of the dolerite will occur in a fashion similar to strip mining. No formal mining layout plans are deemed necessary.

Figure 4.8.2.4 (a): Typical Strip Mining

4.8.2.5 Materials Crushing, Screening and Washing Plant

The dolerite materials will be used as excavated from the Borrow Pits and no crushing, screening or washing is required.

4.8.2.6 Materials Stockpiling Area

Dolerite will be excavated and loaded directly onto tipper trucks for transport to the construction sites. Only limited stockpiling will occur as the excavator may excavate when no truck is available. The excavated material will be loaded out before new materials are excavated.

Figure 4.8.2.6 (a): Limited dolerite gravel stockpile on left

4.8.3 Materials Transport Infrastructure

The dolerite will be transported via road.

4.8.3.1 Materials Transport Vehicles

The dolerite will be transported to the construction sites (Impumelelo and Shondoni Conveyors) with 10 x Tipper Trucks, each with a 10 m^3 load capacity.

Figure 4.8.3.1(a): Tipper Trucks to be used for Dolerite Transport

4.8.3.2 Materials Transport Routes

The dolerite will be transported along the shortest possible route, along existing roads, from the Borrow Pits to the two Conveyor Alignments. Once at the Conveyor Alignment, materials will be transported along the Conveyor Servitude. The full extent of transport along existing farm and public roads is shown as **magenta** lines on Figure 4.8.3.2 (a) below.

4.8.3.3 Materials Transport Schedule

A maximum of 1 288 650 m^3/annum of material will be transported at the peak production rate, for 300 days per year, 10 hours per day by 10 trucks with a 10 m^3 capacity from 2 sites at a time. A truck will leave each borrow pit every 3 minutes. Operations will be restricted to day light hours.

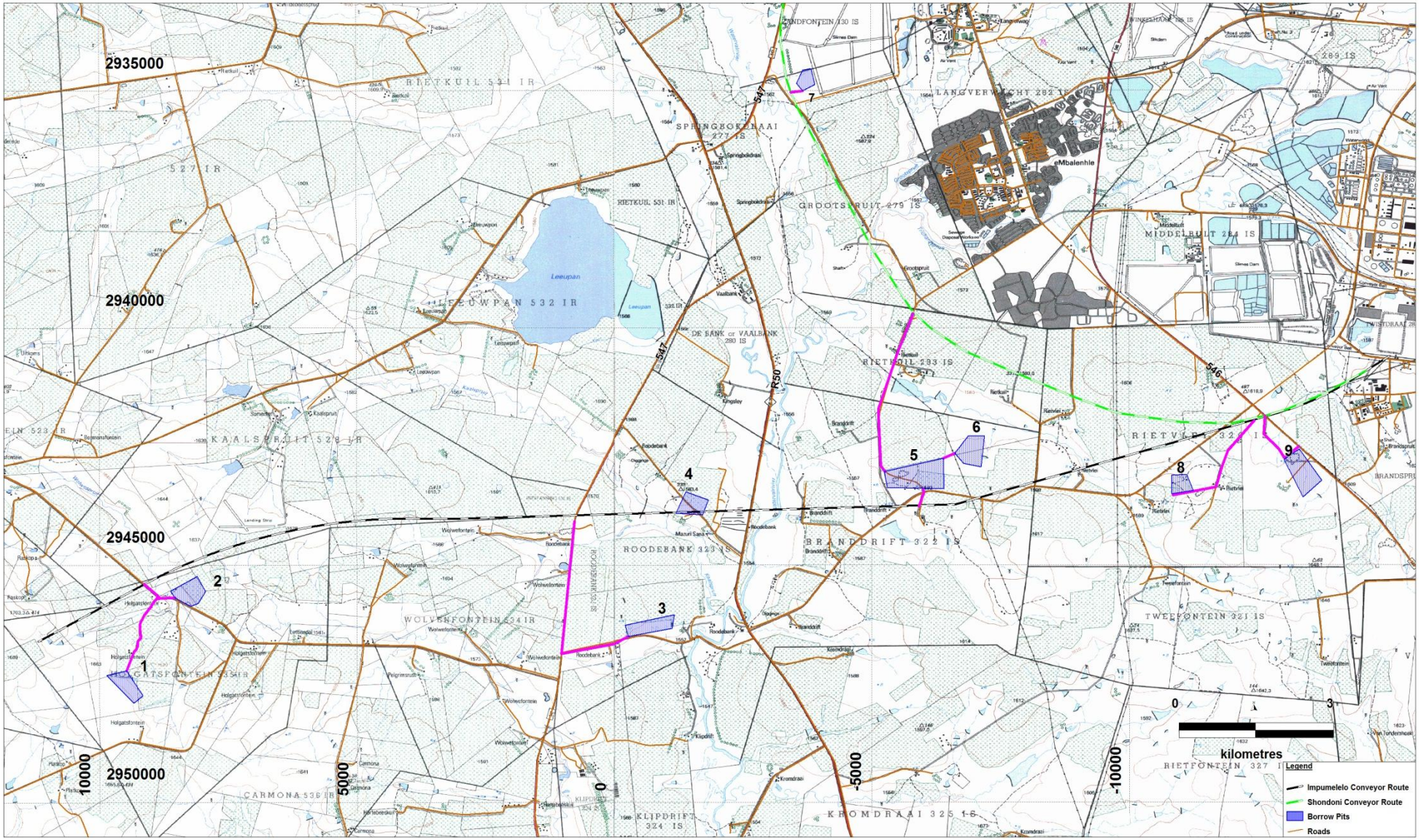


Figure 4.8.3.2(a): Extent of Transport including along Public Roads shown as Magenta Lines

4.8.4 Water Management Infrastructure

4.8.4.1 Water Supply for Dust Suppression

A water tanker for dust suppression along gravel roads and at the Borrow Pits will be operated between the Borrow Pits and the Construction site on a continuous daily basis. No other water will be supplied at the Borrow Pits. The tanker will be filled from a Rand Water supply from one of the Shaft construction sites at either Impumelelo or Shondoni.

4.8.4.2 Storm Water Management System

A dedicated Storm Water Management System is currently being developed for each of the nine Borrow Pits. Details of the system will be contained in the Draft EIA, EMP and IWWMP to be compiled in support of the MPRDA, NEMA and NWA Authorization Applications.

The Storm Water Management System will be compiled to give fulfilment with all DWA requirements as specified in the NWA and related Regulations, including GN 704, as well as the series of DWA Best Practice Guidelines related to Water Management at Mines.

The Storm Water Management System will address inter alia the following:

- Storm Water Balance
- Storm Water Berms and Canals
- Storm Water Pollution Control Dams

4.8.4.3 Ground Water Management System

A dedicated Ground Water Management System is currently being developed for each of the nine Borrow Pits. Details of the system will be contained in the Draft EIA, EMP and IWWMP to be compiled in support of the MPRDA, NEMA and NWA Authorization Applications.

The Ground Water Management System will be compiled to give fulfilment with all DWA requirements as specified in the NWA and related Regulations, including GN 704, as well as the series of DWA Best Practice Guidelines related to Water Management at Mines.

The Ground Water Management System will address inter alia the following:

- Ground Water Balance
- Ground Water Storage and Discharge

4.8.4.4 Overall Mine Water Balance

The Water Consumption and Supply, Storm Water and Ground Water Balances will be combined into an overall Mine Water Balance for each of the nine Borrow Pits.

4.8.4.5 Overall Mine Salt Balance

Based on the above Mine Water Balance, a Mine Salt Balance will also be compiled.

4.8.5 Waste Management Infrastructure

4.8.5.1 Mine Residue Disposal

No mine residue disposal will take place at the Borrow Pits. The topsoil and overburden removed during operations at the Borrow Pits are not deemed to represent Mine Residue.

4.8.5.2 Domestic Waste Disposal

No facilities for domestic waste disposal will be provided at the Borrow Pits. The only waste generated on site will be food and drink packaging materials imported as the workers on site access the site on a daily basis. All waste brought onto site will be taken off site on the same day by the persons bringing it onto the site.

4.8.5.3 Hazardous Waste Disposal

No hazardous waste will be generated or disposed of on site. Vehicles will not be washed or serviced on site.

4.8.5.4 Sewage Treatment Plant

One portable toilet will be provided at each Borrow Pit.

Figure 4.8.5.4 (a): Portable Toilet to be provided at each Borrow Pit.

4.8.5.5 Water Treatment Plant

No water treatment will be required/done at the Borrow Pits.

4.8.5.6 Salvage Yard

Salvage yards are not required at the Borrow Pits.

4.8.6 Construction Phase Activity Description

The Borrow Pits require the minimum of construction activities in order to come into operation:

- Fence the area with a 1.2 m high fence.
- Install a boom gate to control access.
- Put up the required site notices.
- Provide a portable toilet.
- Clear vegetation from the initial area for quarrying.
- Strip top soil from first cut.
- Construct storm water run-off berms with topsoil.
- Construct a Storm Water Setting Pond.
- Stockpile the remaining soils in a pre-determined area.

All vegetation would be cleared from the site. Any seed-bearing material would be kept separate for use during rehabilitation or mulched into the topsoil. Topsoil would, where possible, be stripped to a depth of about 200 mm and stockpiled, together with cleared plant material, separately from other soil layers in piles not exceeding 2 m in height.

4.8.7 Operational Phase Activity Description

Operation would entail the following sequential actions:

- Clear vegetation.
- Strip topsoil and stockpile.
- Remove unsuitable overburden materials.
- Excavate suitable dolerite materials and load onto tipper trucks.
- Transport material with tipper trucks along the shortest possibly route along public roads to conveyor construction sites.
- Return to Borrow Pits to repeat cycle.

To minimise any impacts on the value of the surrounding land, care shall be taken to limit the extent of the area disturbed during operational activities.

4.8.8 Decommissioning and Closure Phase Activity Description

During Decommissioning and Closure the following activities will occur:

- All machinery (excavators and trucks) and limited infrastructure (toilets, boom gate, etc) will be removed from site.
- Excavated material unsuitable for construction purposes, and which was stockpile separately as overburden, will be used to reshape the Borrow Pits to be free draining.
- The shaped areas will be re-soiled, fertilized and re-vegetated.
- As soon as vegetation has re-established the storm water diversion berms will be removed.

4.8.9 Post Closure Phase Activity Description

The rehabilitated sites will be closely monitored after closure to ensure that the vegetation establishes effectively and that the sites generate clean surface run-off. Alien and/or invader plant species will be controlled to facilitate a sustainable growth of the vegetation.

4.9 PROJECT ALTERNATIVES

The EIA regulations require that all reasonable/feasible alternatives for any specific project component which could have significant environmental impacts must be assessed in order to select the preferred alternative. The responsibility for this lies with the project proponent (Sasol Mining) and the project Environmental Assessment Practitioner (EAP) – in this instance JMA Consulting.

From an environmental perspective the preferred alternative is defined as the Best Practicable Environmental Option (BPEO). The existing guidelines suggest the use of a numerical assessment and selection matrix that considers *inter alia* the following aspects:

- Technical feasibility considerations
- Cost considerations
- Bio-physical environmental considerations
- Socio environmental considerations

Each of the identified alternatives will be considered using such a matrix and the preferred alternative will be selected by the EAP. The details and the outcomes of the alternatives selection process will be documented in the EIA and will be provided to the I&AP's for consideration during the EIA public participation phase.

The following project components have provisionally been identified for assessment:

- Location of Borrow Pits
- Number of Borrow Pits
- Mining Method (excavation only, or blasting and excavation)
- Transport Routes
- Post Closure Land Use
- The No-Go Option

5. DESCRIPTION OF ENVIRONMENT

5.1 CLIMATE/METEOROLOGY

The meteorological assessment comprised a regional and quantitative site specific investigation pertaining to the climate and meteorology of the study area. The approach and methodology that was followed for the compilation of this Meteorology Base Line is synoptically described below.

- Obtain, review and verify available meteorological information obtained from published meteorological maps and contained in both recent and previous specialist study reports for the study area.

- Discuss the meteorological setting based on the information obtained from the published meteorological maps, data obtained from the various weather monitoring stations as well as the information obtained from other specialist study reports compiled for the study area.

5.1.1 Regional Climate/Meteorology

The South African Weather Service has partitioned the country into 15 climatic regions. This division is based firstly on geographic considerations, more specifically the prominent mountain ranges (great escarpment) which after all constitutes the main climatic divides, besides also other features such as rivers and political boundaries; secondly, on the interior plateau, use has been made of the change from BW to BS and from BS to C climates according to the Köppen classification.

The average annual precipitation in the Highveld region varies from about 900 mm on its eastern border to about 650 mm in the west. The rainfall is almost exclusively due to showers and thunderstorms and falls mainly in summer (85% of annual rainfall), from October to March, the maximum fall occurring in January. Heavy falls of 125 mm to 150 mm occasionally fall in a single day. The annual average number of thunderstorms is 75. These storms are often violent with severe lightning and strong gusty south-westerly winds and are sometime accompanied by hail. The region has the highest hail frequency in South Africa; about 4 to 7 occurrences can be expected annually in one spot.

Average daily maximum temperature is roughly 27° C in January and 17° C in July but in extreme cases these may rise to 30° C and 26° C respectively. Average daily minima range from about 13°C in January to 0°C in July, whereas extremes can sink to 1°C and -13° respectively. The period during which frost is likely to form lasts on the average for about 120 days from May to September.

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the plume and the ambient air, the higher the plume is able to rise), and determining the development of mixing and inversion layers.

5.1.2 Precipitation

The study area is located within the C12D and C12F quaternary catchments of the Upper Vaal Water Management Area and falls within the C1D rainfall zone, as defined in the WR90. The Mean Annual Precipitation (MAP) recorded at the various rainfall stations within the C1D rainfall zone (WR90) is listed in Table 5.1.2 (a) below.

Table 5.1.2 (a): MAP at the Rainfall Stations within the C1D Rainfall Zone

Details of Rainfall Station (WR90)		MAP (mm/annum)
Number	Name	
0404727	Prospect	631.4
0404187	Brakfontein	666.6
0405001	Robertsdrift	650.6
0440435	Greylingstad SAR	681.3
0440449	Wittebank	619.5
0440637	Rasrand	730.6
0440885	Sandbaken	699.3
0441113	Beersheba	669.7
0441261	Jonkersdam	667.0
0441309	Charl Cilliers	698.7
0477772	Leslie Mun	697.9
0478029	Zandfontein	683.6
0478360	Driefontein	734.0
Average Recorded MAP for the C1D Rainfall Zone (mm)		**679**

The summary of the MAP recorded at the rainfall stations within the C1D rainfall zone indicate that the MAP of the study may range between 619 mm/annum and 734 mm/annum with an average MAP of 679 mm/annum expected for the study area.

A summary of the average expected monthly rainfall of the study area is indicated in Table 5.1.2 (b) and depicted on Figure 5.1.2 (a).

Table 5.1.2 (b): Average Monthly Rainfall recorded within the C1D Rainfall Zone (WR90)

Month	Average Precipitation (mm)	Average Precipitation (% MAP)
January	116.24	17.11
February	90.83	13.37
March	75.41	11.10
April	42.05	6.19
May	18.55	2.73
June	7.47	1.10
July	8.22	1.21
August	8.63	1.27
September	26.90	3.96
October	74.05	10.90
November	107.07	15.76
December	104.01	15.31
Annual	**679**	**100**

The data obtained from the WR90 regarding the average monthly rainfall within the C1D Rainfall Zone indicates the seasonality of the rainfall, with the majority of the precipitation (576.61 mm) occurring between the months of October and March. Only 24.32 mm of precipitation falls during the months of the June to August, which account for only 3.58% of the MAP.

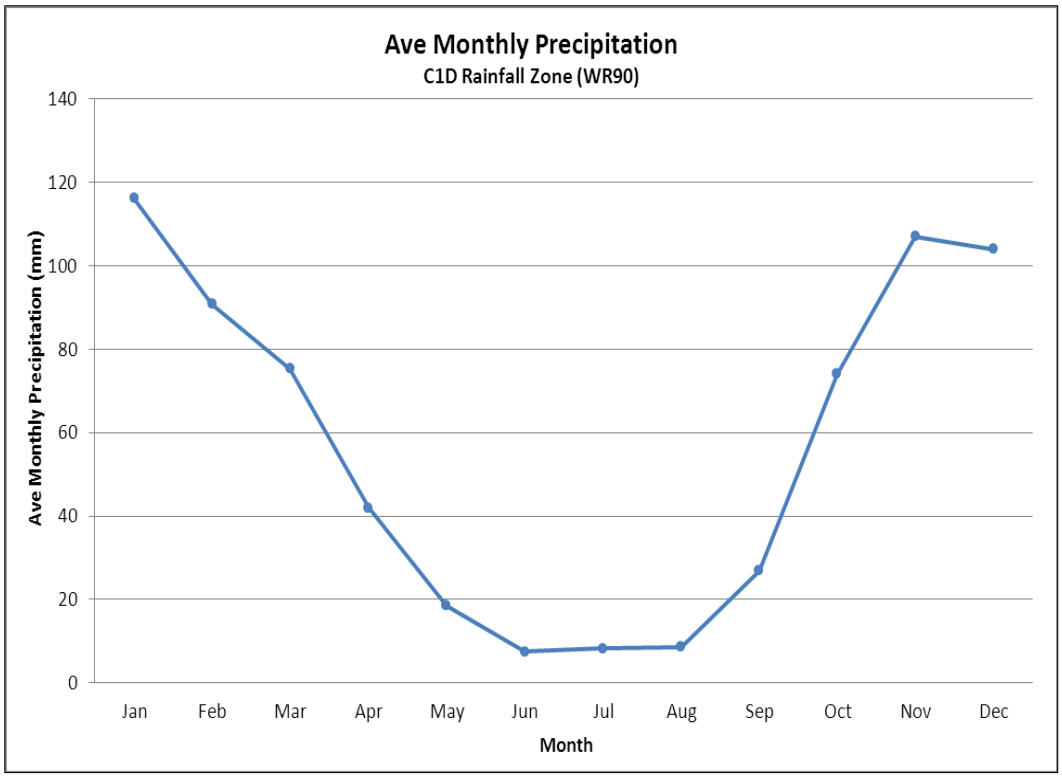


Figure 5.1.2 (a): Average Monthly Rainfall recorded within the C1D Rainfall Zone (WR90)

The extreme rainfall intensities over a 24 hour period based on the data obtained from the Welgelegen Weather Monitoring Station between 1950 and 2001 is summarized in Table 5.1.2 (c).

Table 5.1.2 (c): Extreme Rainfall Intensities for a 24 Hour Rainfall Period (*Ermelo Welgelegen 1950 - 2001 – SA Weather Service*)

Month	1:5 yrs.	1:10 yrs.	1:15 yrs.	1:20 yrs.	1:25 yrs.	1:50 yrs.
January	49.5	61.1	67.7	72.3	75.8	86.7
February	45.7	57.2	63.8	68.3	71.8	82.7
March	36.4	44.8	49.5	52.8	55.4	63.2
April	28.2	35.4	39.5	42.3	44.5	51.2
May	12.3	16.3	18.6	20.2	21.5	25.2
June	8.8	12.1	14.0	15.3	16.3	19.4
July	6.1	8.4	9.7	10.6	11.3	13.5
August	10.6	14.3	16.4	17.8	19.0	22.5
September	27.0	35.3	40.0	43.2	45.7	53.5
October	40.1	48.6	53.4	56.8	59.3	67.3
November	44.1	54.0	59.6	63.6	66.6	75.9
December	42.4	52.0	57.4	61.1	64.1	73.0
Annual	**70.9**	**82.6**	**89.2**	**93.8**	**97.4**	**108.3**

Site Specific Mean Monthly and Annual Rainfall

The Daily Rainfall Extraction Utility, developed by the Institute for Commercial Forestry Research (ICFR) in conjunction with the School of Bio-resources Engineering and Environmental Hydrology (BEEH) at the University of KwaZulu-Natal, Pietermaritzburg, was used to obtain summary data for all rainfall stations within the vicinity of the proposed Borrow Pit areas. These data were assessed in terms of length of record, completeness of the data set, mean annual precipitation (MAP) and location with respect to the site and the catchment.

Key data extracted from the database for the three most reliable stations are shown in Table 5.1.2 (d**)**. The ICFR database contains daily patched rainfall data for all official South African Weather Service (SAWS) stations, and includes data up to August 2000.

Table 5.1.2 (d): Key data for selected Rainfall Stations (ICFR database)

Station Number	Station Name	MAP (mm)	Length of Record
0440 885	Sandbaken	653*	1909-2000 (92 years)
0441 104	Bosmanspruit	630	1914-1975 (62 years)
0440 767	Val (SAR)	623	1905-1988 (84 years)

* This MAP value differs from that given in Tables 5.1.2 (a) and 5.1.2 (e) as it is based on different record lengths.

Mass plots were produced for each station. A mass plot is a graph showing the cumulative rainfall depth vs. time for the full rainfall record, and is a good indication of the reliability of the data set. A good mass plot should produce a straight line (with slight oscillations for seasonality). Any changes in slope indicate a potential problem in the data set. The mass plot for the Sandbaken station is shown in Figure 5.1.2 (b).

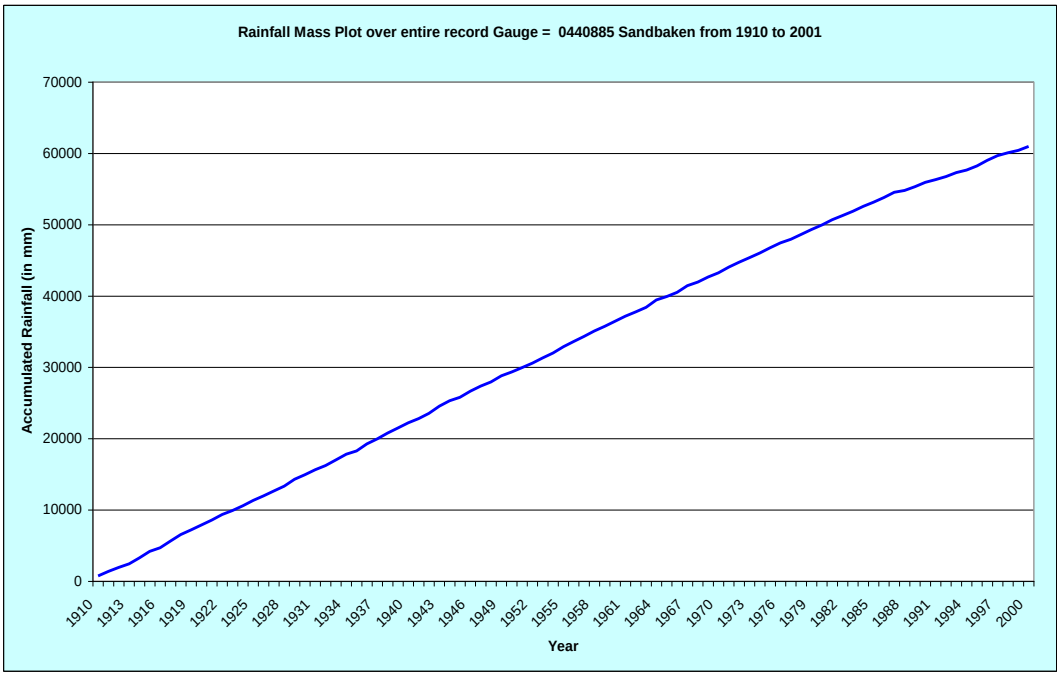


Figure 5.1.2 (b): Mass plot for Station 0440885 Sandbaken

Based on its proximity to the site (approximately 8 km) and its reasonable length of reliable record, station number 0440885 Sandbaken was selected as the representative rainfall data set for the site and will be used for floodline computations. Average monthly rainfall depths for this station are presented in Table 5.1.2 (e).

Table 5.1.2(e): Average monthly rainfall depths for SAWS station 0440885 Sandbaken (based on the period 1910 to 2000)

Month	Average rainfall (mm)
October	75.1
November	105.7
December	104.7
January	117.9
February	90.8
March	80.2
April	36.6
May	17.1
June	6.8
July	7.6
August	8.3
September	22.8
Mean Annual Precipitation	**673.6***

* This MAP value differs from that given in Tables 5.1.2 (a) and 5.1.2 (d) as it is based on a different record length.

5.1.3 Evaporation

The mean annual WR90 S-pan evaporation assigned to the study area is indicated to be between 1500 mm/annum and 1600 mm/annum, whilst the mean annual WR90 A-pan evaporation assigned to the study area is indicated to be between 1800 mm/annum and 2000 mm/annum. The WRC Report No 298/2.1/94, dated 1994 (and associated maps) indicate that the C12D and C12F quaternary catchments fall within the 12A Evaporation Zone, as defined by the Water Research Commission (WR90). The Evaporation Monitoring Stations within the 12A evaporation zone are listed in Table 5.1.3 (a), as well as the respective MAE recorded at each station.

Table 5.1.3 (a): MAE recorded at Evaporation Stations within the 12A Evaporation Zone

Gauge Number	Station Name	MAE	
		S-Pan	A-Pan
C8E001	Matjiesvlei	1161	-
C8E002	Frankfort	-	1966
C8E003	Bethlehem	1519	1930

The mean annual evaporation (MAE) recorded at the evaporation stations within the 12A evaporation zone indicates that the mean annual S-pan evaporation ranges between 1161 mm/annum and 1519 mm/annum, whilst the mean annual A-pan evaporation ranges slightly between 1930 mm/annum and 1966 mm/annum.

5.1.4 Temperature

The temperature within any region affects a wide range of processes and activities and according to Schulze et al (1997) it "has a direct effect on all forms of life". Temperature variations such as diurnal and seasonal variations are of vital importance from an agricultural perspective. The average daily maximum and average daily minimum temperatures for the Mpumalanga Province taken from Schulze et al (1997) have been calculated for each individual month and are indicated in Table 5.1.4 (a) and on Figure 5.1.4 (a).

Table 5.1.4 (a): Monthly Average Daily Max and Min Temperatures

Month	Average Daily Maximum (°C)	Average Daily Minimum (°C)
January	26.8	15.3
February	26.5	15.0
March	25.6	13.8
April	23.6	13.5
May	21.7	6.9
June	19.1	3.8
July	19.4	3.7
August	21.7	6.0
September	27.0	9.3
October	28.5	11.7
November	29.3	13.4
December	26.4	14.7
Annual	**24.6**	**10.6**

The average monthly temperatures indicate that the study area is characterized by mild summers with average maximum daily temperatures of 27.5°C and average minimum temperatures of 14.0°C. The winters are cold with average maximum daily temperatures of 20.1°C and average minimum temperatures of 4.5°C. Frost and morning mist is common between the months of May and September as well.

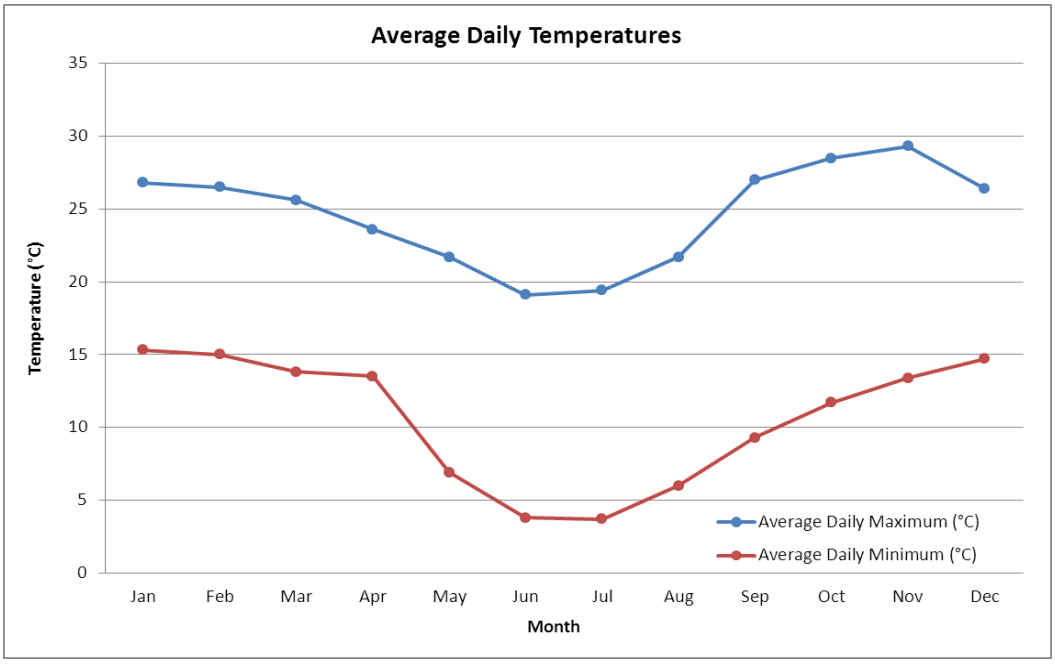


Figure 5.1.4(a): Monthly Average Daily Maximum and Minimum Temperatures

5.1.5 Wind

Surface Wind Field

Dispersion comprises vertical and horizontal components of motion. The wind field largely determines the horizontal dispersion of pollution in the atmospheric boundary layer. The wind speed determines both the distance of downwind transport and the rate of dilution as a result of plume stretching. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness. The wind direction and the variability in wind direction, determine the general path pollutants will follow, and the extent of cross-wind spreading.

In the study area, the mean daytime surface winds are predominantly northwesterly as a result of the prevalent anti-cyclonic circulation, with easterly winds being the next most frequent. In the winter, the frequency of southwesterly winds increases because of the passage of cyclonic westerly waves. Light topographically induced winds from the eastern sector are common at night. The so-called Escarpment Breeze that develops at night under weak pressure gradients is up to 1 000 m deep.

Winds are mostly light except during thunderstorms. Very occasionally tornadoes do occur. Sunshine duration in summer is about 60% and in winter about 80% of the possible.

An annual average surface wind speed of 3.2 m/s was recorded from 1 August 2010 to 31 July 2011.

Period, diurnal, and seasonal wind roses for the period 1 August 2010 to 31 July 2011 are presented in Figure 5.1.5 (a – h). Wind roses comprise 16 spokes, which represents the directions from which winds blew during the period. The colors used in the wind roses reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The value given in the center of the circle describes the frequency with which calms occurred, i.e. periods during which the wind speed was below 1 m/s.

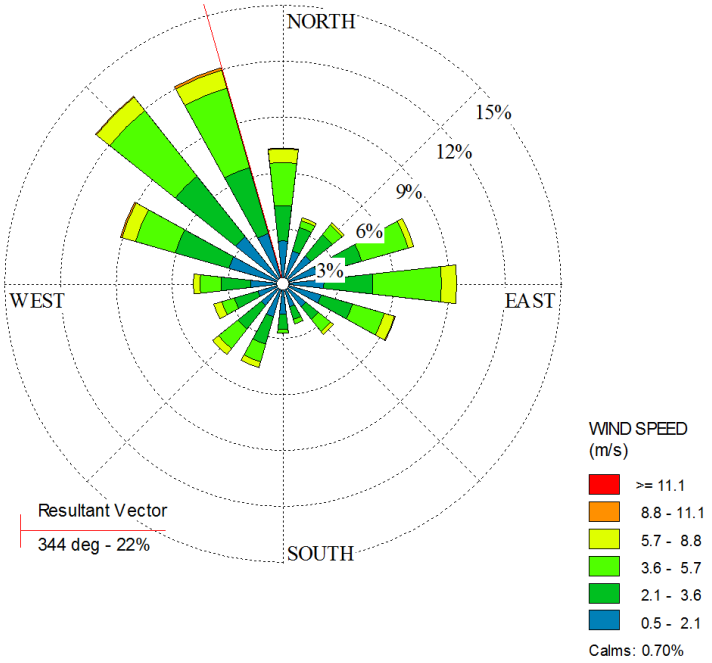


Figure 5.1.5 (a): Annual Wind Rose

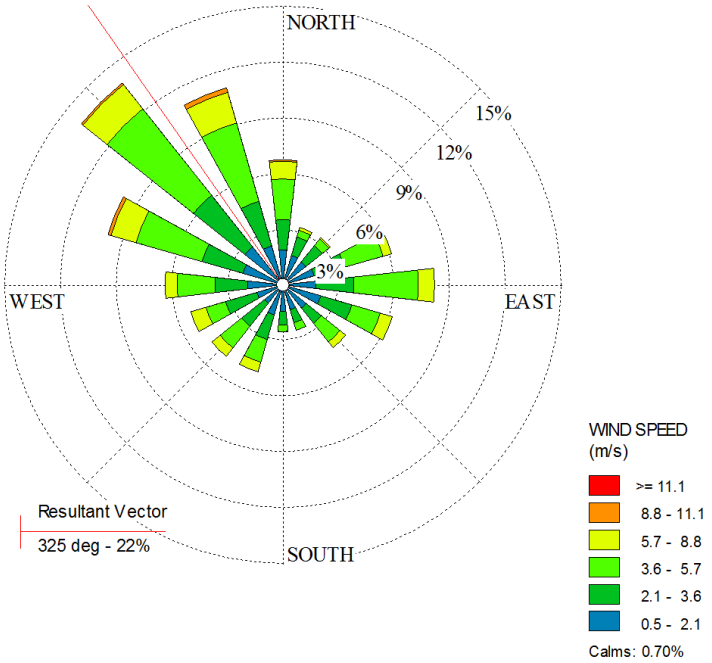


Figure 5.1.5 (b): Day-time Wind Rose

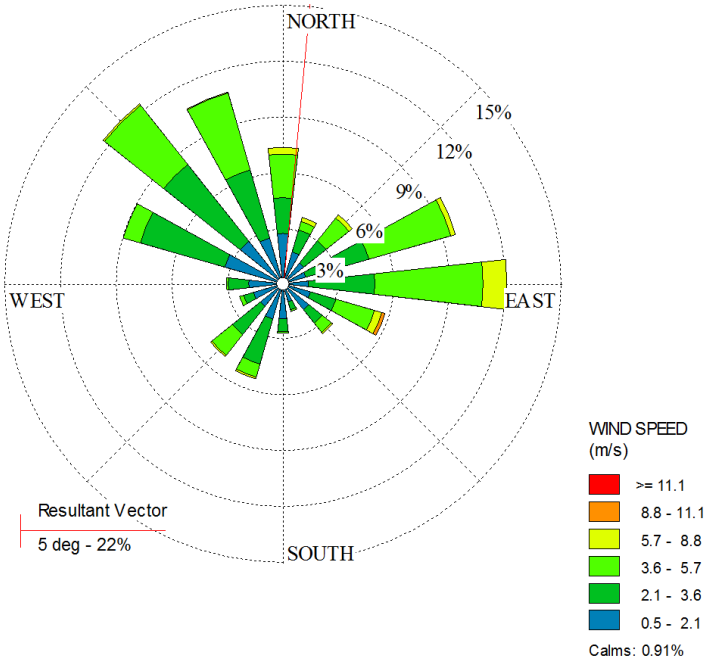


Figure 5.1.5 (c): Evening Wind Rose

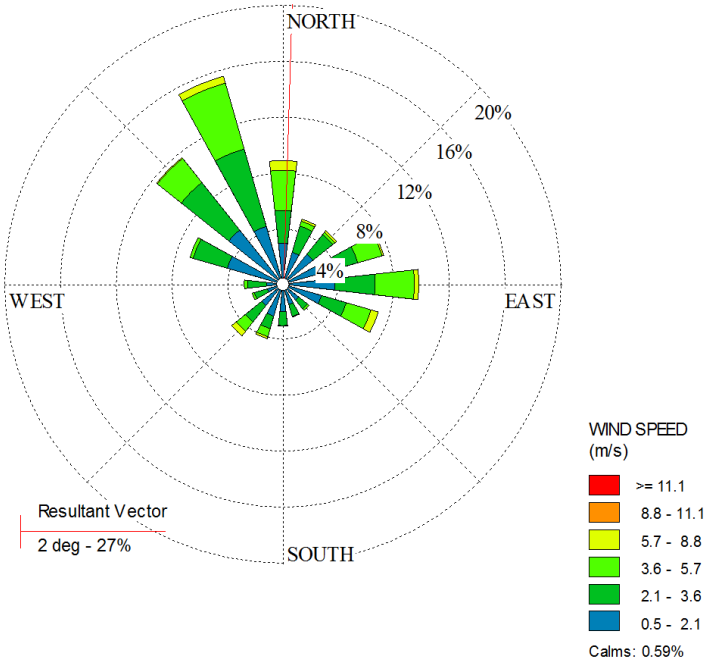


Figure 5.1.5 (d): Night-time Wind Rose

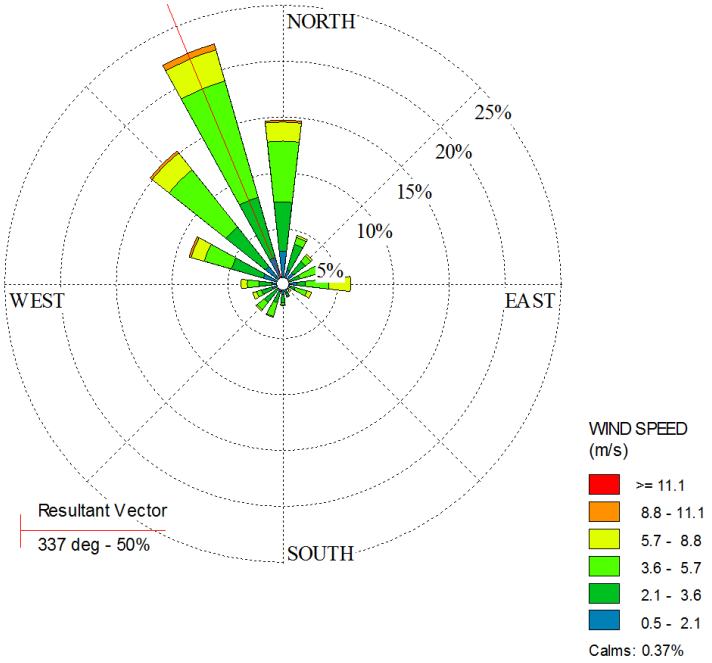


Figure 5.1.5 (e): Spring Wind Rose

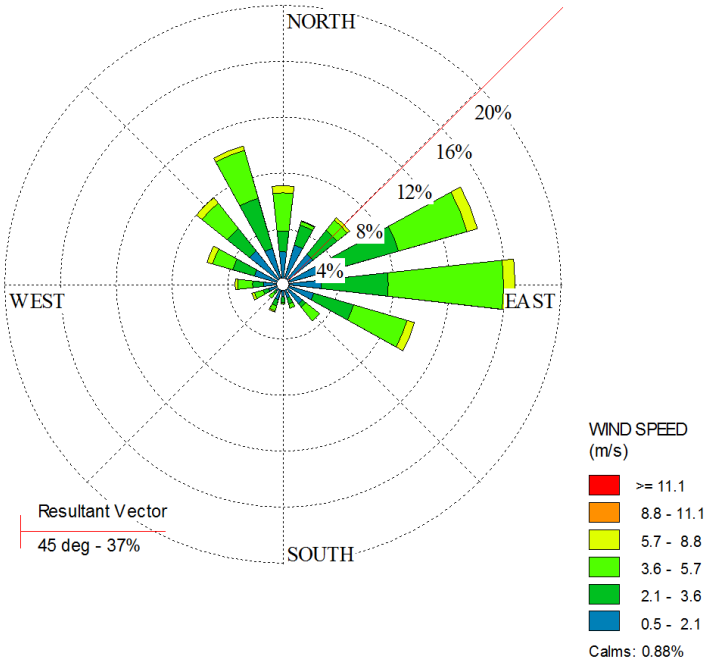


Figure 5.1.5 (f): Summer Wind Rose

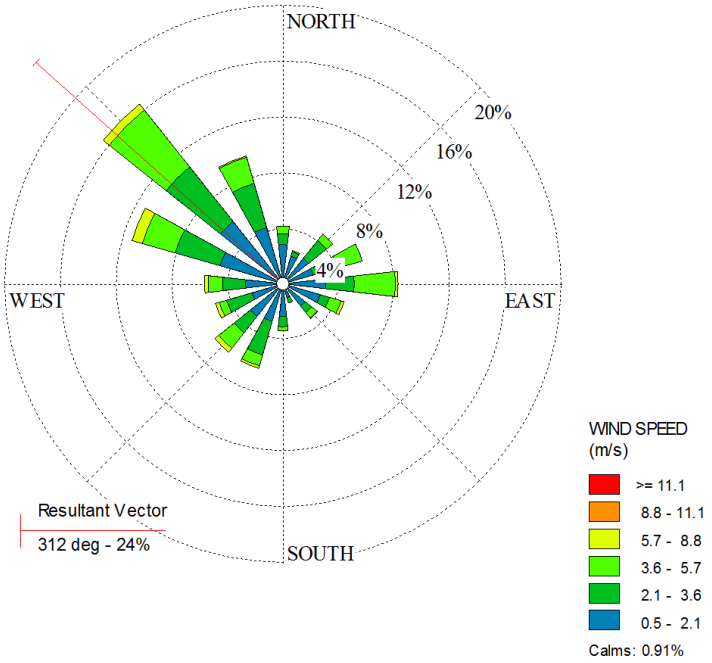


Figure 5.1.5 (g): Autumn Wind Rose

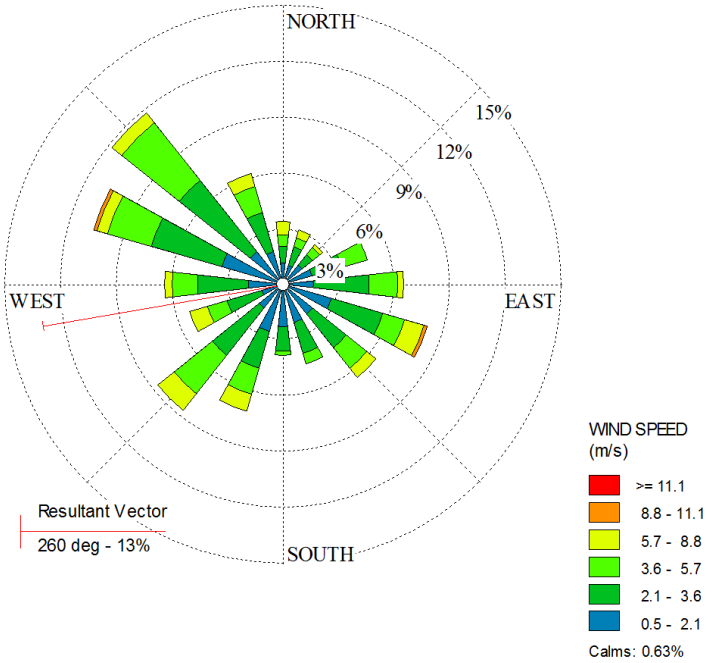


Figure 5.1.5 (h): Winter Wind Rose

Mixing Height & Atmospheric Stability in the Highveld Priority Area (HPA)

The high frequency of anti-cyclonic circulation and associated subsidence in the upper air reaches a maximum in winter. The subsidence is conducive to the formation of elevated temperature inversions throughout the year with a frequency of 60% and winter base height of about 1 300 m AGL and 2 600 m AGL in summer.

Stable and clear conditions are ideal for the formation of surface temperature inversions at night. The winter inversions in the HPA region vary in strength from 5° C to 7° C and in depth from 300 m to 500 m AGL. These inversions occur between 80% and 90% of winter nights, varying in n strength from 3° C to 11° C and from 100 m to 400 m in depth. Inversions of more than 10° C occur more than 25% of winter nights. In summer, the surface inversions are weaker and seldom exceeded 2° C in strength. The maximum midday mixing depths vary between 1 000 m and 2 000 m AGL in winter and may exceed 2 500 m in summer.

The presence of subsidence induced semi-permanent absolutely-stable layers at approximately 800 hPa (about 350 m AGL) and 500 hPa (about 3 500 m AGL) were shown to extend over the southern African sub-continent. The vertical transport of aerosols between the surface and the tropopause is controlled by these stable layers. Aerosols typically accumulate below the base of the respective layers and in turn, the layers promote transport of the aerosols at their respective levels. Trajectories pass through different height levels, but become trapped between absolutely-stable layers.

Atmospheric Transport into and out of the HPA

Considerable research effort has focused on the meteorological circulation responsible for the accumulation and recirculation of pollutants in the HPA region. Westerly ventilation (WV) of the HPA region occurs mostly during winter with the passage of westerly waves across or south of the subcontinent. The westerly airflow over the HPA region is warm, dry and relatively free of pollutants as it originates from a source-free area. The easterly ventilation (EV) originates with a strongly ridging (or budding) anticyclone up the east coast, resulting in an onshore flow and easterly winds over the HPA. The ridging anticyclone to result in a recirculation path that loops to the north of the HPA in winter (see Figure 5.1.5 (i)) and to the east and south of the HPA region in summer due to the seasonal north-south shift of the anti-cyclonic high-pressure belt.

Four major transport pathways exist to the HPA region in the lower troposphere. The most frequently occurring transport mode is from the Atlantic Ocean, occurring 43% of times. Transport from the Indian Ocean (26%) and from the African continent (25%) account for half of the transport to the HPA region. Regional-scale advection exclusively over southern Africa accounts for less than 10% of the transport. Air from the south and central Atlantic reaching the HPA region is likely to be free of industrial pollutants, while African transport may carry pollutants from central and southern Africa, particularly industrial pollutants from the Zambian copper-belt, from biomass burning in winter, and Aeolian dust.

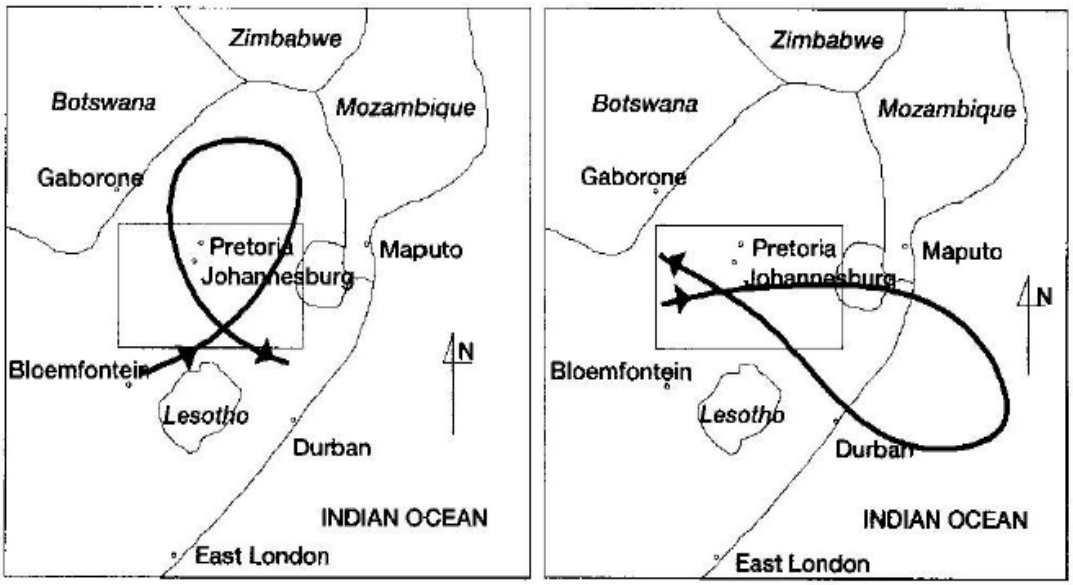


Figure 5.1.5 (i): Characteristic wind paths during strong anti-cyclonic ridging in from May to June (left) and August to April (right) (from Air Quality Management Plan for the HPA, DEA 2010)

Significant seasonal variation exists in the transport of air to the HPA region. Noteworthy is the high percentage of Indian Ocean transport (51%) in summer and by contrast, the high percentage of Atlantic transport (51%) in winter. The sub-continental scale recirculation does not vary much with season.

There are two main transport modes out of the HPA region, direct and re-circulated transport. In the direct transport mode (45%), material is transported out of the HPA region with little decay in a westerly (to the Indian Ocean), easterly (to the Atlantic Ocean), northerly (to the south Indian Ocean, or southerly (equatorial Africa) transport mode. The second mode is re-circulated transportation where material re-circulates over the subcontinent towards the point of its origin, on a regional or sub-continental scale (33%). The overall re-circulating time ranges from 2 days to 9 days, depending on the scale of the re-circulation.

Approximately 41% of all air transported from the HPA region affects countries bordering South Africa through either direct or re-circulated transport. Transport to Mozambique occurs more than 35% of the time, and more than 30% of the time to Botswana. Transport to Swaziland, Namibia and Zimbabwe is between 15% and 23% with less to other southern African countries.

HPA Air Quality Dispersion

The predominant anti-cyclonic circulation over the HPA, particularly in winter, results in light winds, clear skies and the development of surface temperature inversions at night that persist well into the morning. The mechanisms to disperse pollutants that are released at or near ground level into this stable atmosphere are typically weak. Pollutants tend therefore to accumulate near their source or to travel under the light near-surface drainage winds.

Relatively high ambient concentrations may occur especially at night and in the morning when the surface inversions are strongest. This meteorology is particularly relevant to low-level industrial stacks, domestic fuel burning and motor vehicles.

During the day, surface warming induces the break-up of the surface inversion and promotes convection, which enhances the dispersion the nigh-time pollution build-up. Convection, on the other hand, may bring emissions from taller stacks down to ground level, so-called fumigation, that result in episodes of high ambient pollutant concentrations.

Immediately above the surface inversion, the low-level jet (LLJ), a strong nocturnal wind system, provides an effective mechanism to transport pollutants from taller stacks away from their source. The LLJ occurs over the much of the HPA at night and is stronger and more persistent in winter.

Westerly flow into the HPA is associated with the introduction of clean, mostly maritime, air. Hence, ambient air quality improves with the passage of wintertime westerly waves over the HPA and ambient pollutant concentrations decrease. Convective summer showers and thundershowers wash pollutants out of the atmosphere on a relatively local scale, while widespread convective rain activity can reduce ambient pollutant concentrations on a larger scale.

Pollutants released in the HPA do not only affect the HPA. Easterly airflow associated with a ridging Indian Ocean Anticyclone results in recirculation over the subcontinent. Pollutants emitted in the HPA are recirculated at different spatial and temporal scales depending on the strength of the ridging anticyclone. The recirculation may be limited to the HPA for a few days only or for a number of days of resulting in increases in ambient pollutant concentrations. Recirculation on larger spatial scales may transport pollutants emitted in the HPA well beyond its boundaries and into neighboring municipalities and even across international borders.

5.1.6 Manner of Potential Environmental Impacts

The proposed activities at the Sasol Mining Borrow Pits will have no impact on the climate/meteorology of the area.

5.2 TOPOGRAPHY

5.2.1 Regional Topography

The larger study area lies in the Highveld region of Mpumalanga characterised by rolling hills and valleys. The Sasol Mining Borrow Pits are located on two of these maps namely 2628DB and 2629CA near the town of Secunda.

JMA Consulting purchased the electronic versions of these maps from the Surveyor General and extracted relevant topographical information for the purposes of this report. Figure 5.2.1 (a) below shows the 20 m surface topographical contours for the study area, together with the surface drainage lines indicated on the 1:50000 topographical maps. The Borrow Pits are indicated with red polygons. The study area falls within the Vaal River catchment.

The study area stretches for some 24 km from west to east and some 12 km from north to south. The surface elevation ranges from 1720 mamsl in the west along the catchment divide to 1550 mamsl at the Waterval River in the center of the study area. The eastern catchment divide reaches an elevation of 1640 mamsl. The ground surface is gently undulating with steeper slopes next to the surface streams.

The surface water run-off from the entire study area, with the exception of a small area in the far north, drains along 4 major stream systems towards the Vaal River in the south. The westernmost stream system is a combination of the Kaalspruit and the Wolwespruit. It drains in a generally south-easterly direction and joins the Waterval River in the far south of the study area.

The Waterval River, which essentially drains from north to south, runs to the east of the former system, and represents the main surface drainage feature which conveys all the surface run-off in the study area to the Vaal River. Due east from the Waterval River, and draining from the north-east, is the Grootspruit. The easternmost tributary of the Grootspruit, and which drains the area from the east, is the Trichardtspruit.

Table 5.2.1 (a) below indicates the drainage pattern of the individual borrow pits.

Table 5.2.1 (a): Water Resource associated with each Borrow Pit

Borrow Pit	Associated Water Resource
Pit 1	Wolwespruit
Pit 2	Wolwespruit
Pit 3	Unnamed non-perennial tributory of the Waterval River
Pit 4	Kaalspruit
Pit 5	Unnamed non-perennial tributory of the Waterval River
Pit 6	Unnamed perennial tributory of the Waterval River
Pit 7	Waterval River
Pit 8	Unnamed perennial tributory of the Waterval River
Pit 9	Unnamed perennial tributory of the Trichardtspruit

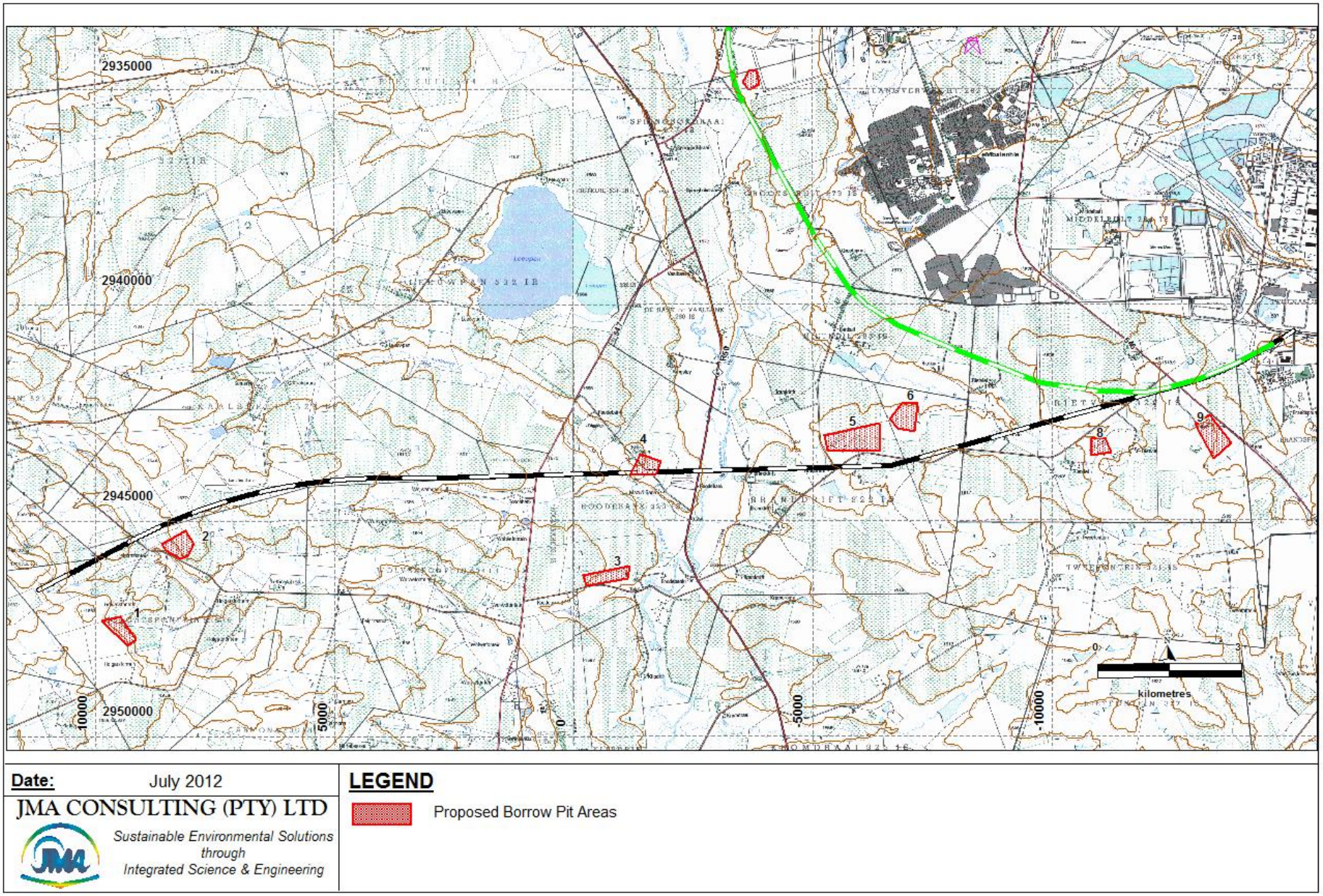


Figure 5.2.1 (a): Surface Topographical Map with 20 m Elevation Contours

Figure 5.2.1 (b) represents the 5 m surface elevation contours of the study area. These contours were used to generate a to create a 3-D image of the surface topography as well which is indicated as Figure 5.2.1 (c) This image is useful in obtaining an understanding of the general relief/morphology of the study area. The drainage valleys of the Waterval River, the Grootspruit and the Trichardtspruit is clearly visible on the map. The red areas on the map indicates the proposed localities of the Borrow pits.

The 5 m surface elevation contour data was further used to create a viewshed analysis of the surface topography within the proposed borrow pit boundaries. The generated viewshed analysis is indicated on Figure 5.2.1 (d).

The viewshed analysis indicates the surface areas adjacent to the proposed pit boundaries where the pits are visible (green) and where the pits are not visible (red).

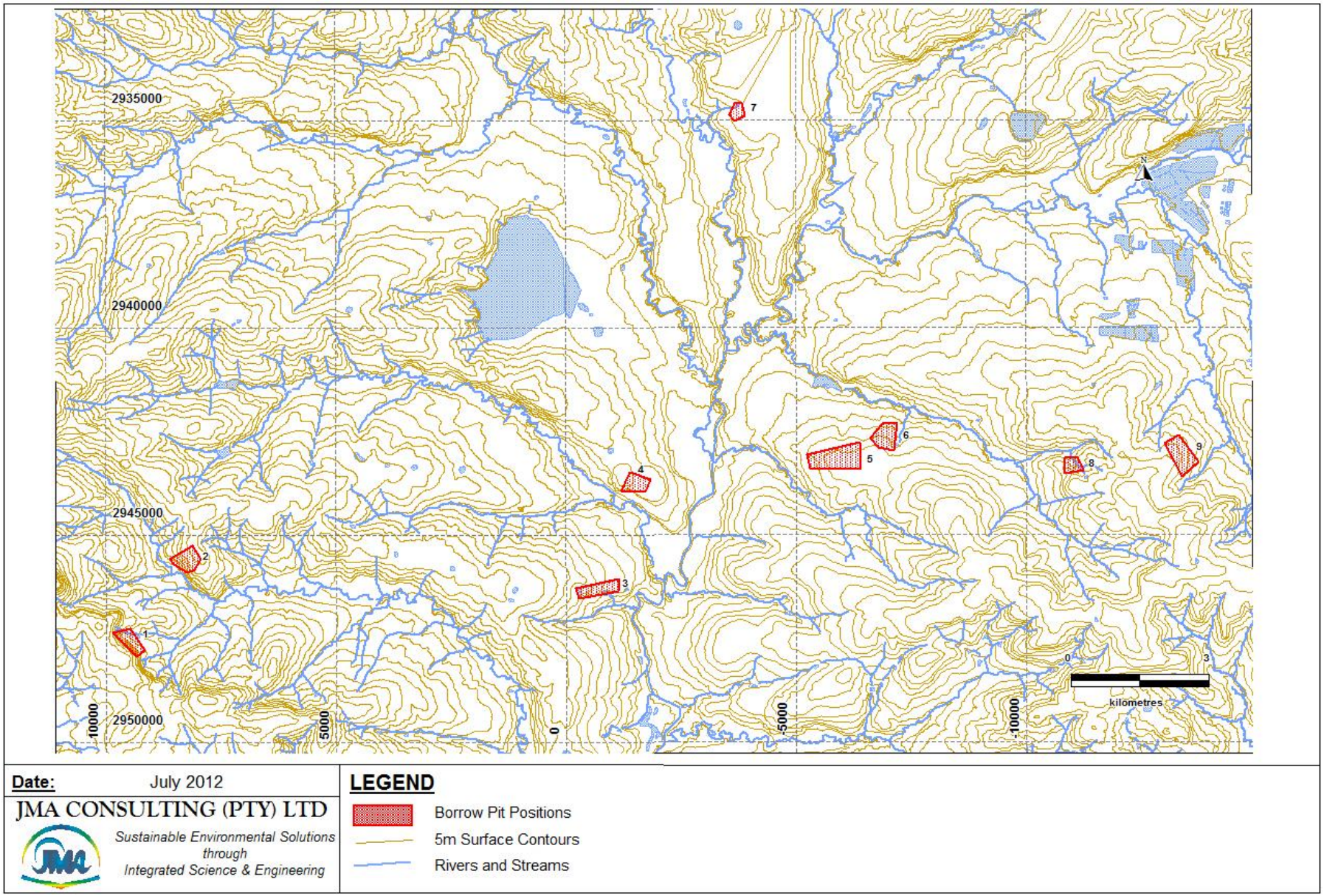


Figure 5.2.1 (b): 5 m Surface Elevation Contours of the Study Area

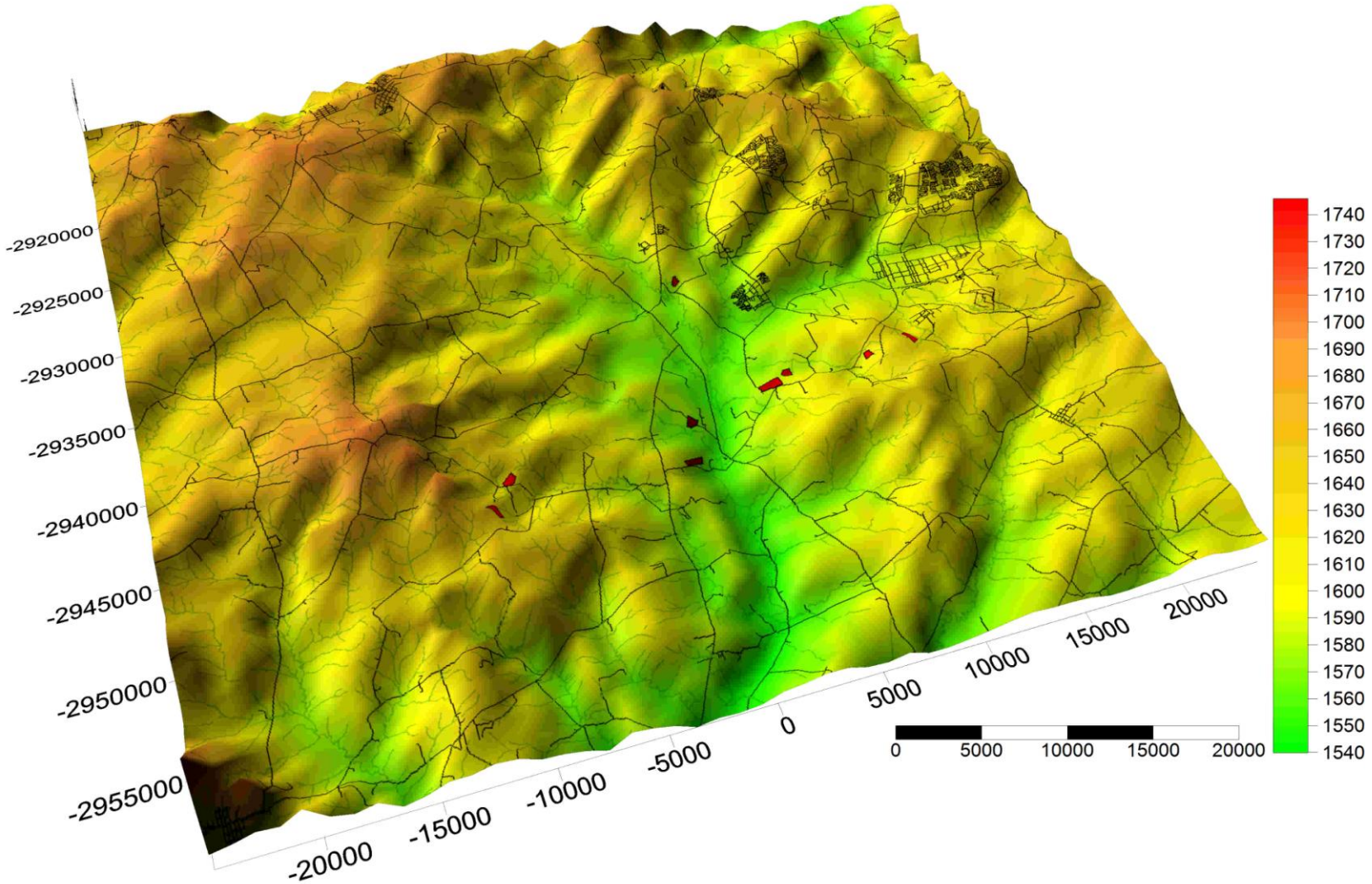


Figure 5.2.1 (c): Tilted 3-D Image of the Topography of the Study Area (Low lying areas shown in green)

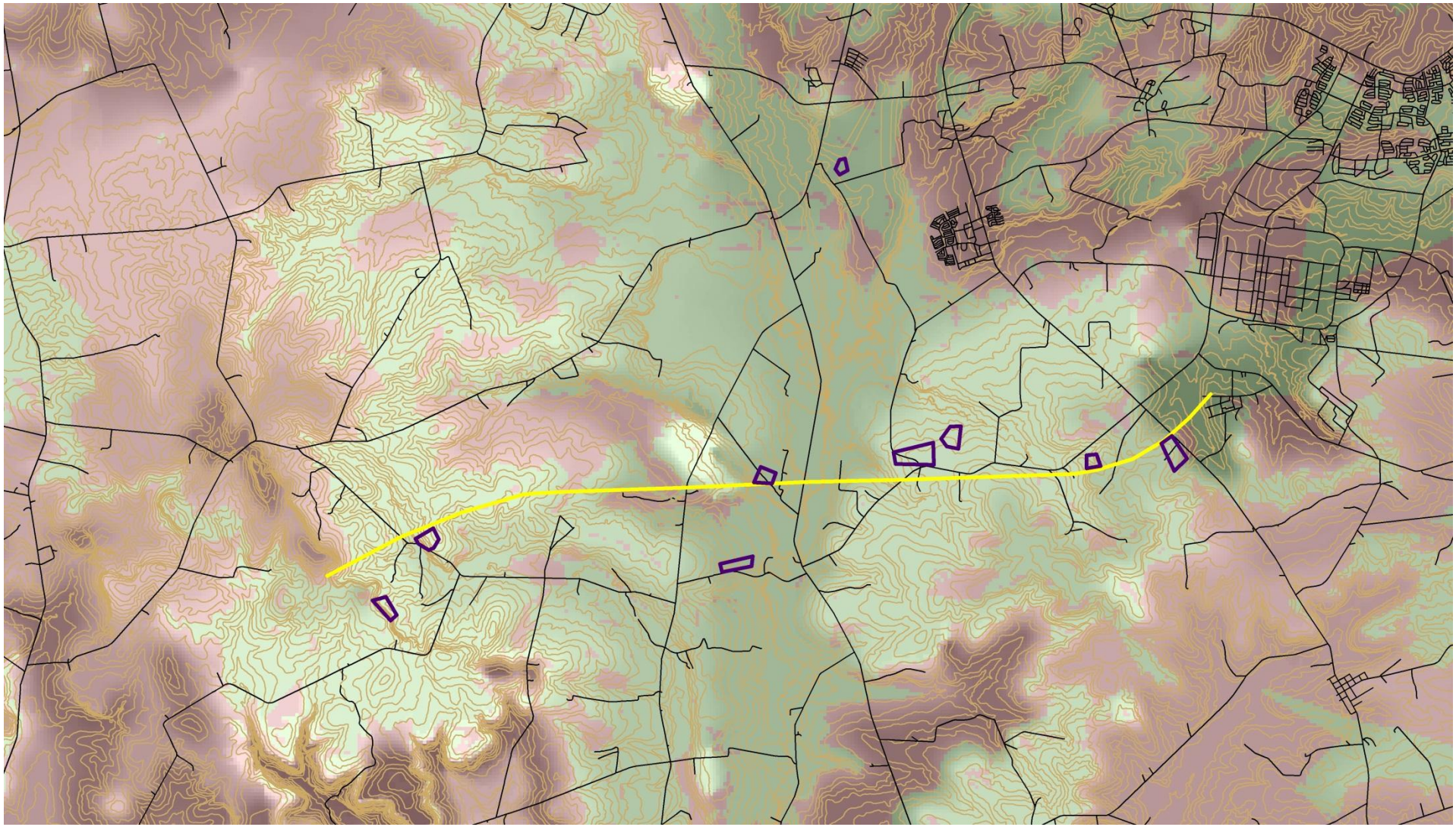


Figure 5.2.1 (d): Viewshed Analysis of the Study Area

**** Note:** The viewshed analysis is based entirely on the surface elevation data obtained from the 5 m contours and does not take vegetation or surface infrastructure into consideration*

5.2.2 Detailed Local Topography

Local site topography is available at 5 m and 2 m elevation contour intervals. The 5 m contours were obtained from the ortho-photos of the sites and 2 m contour intervals were generated by Sasol Mining. The 5 m contours were used to generate detailed site topography maps. The 2 m data will be used for detailed surface water calculations and to design the storm water management plans for the sites.

Five maps were compiled from the 5 m data and are shown in:

Figure 5.2.2 (a) – Borrow Pit 1 and Borrow Pit 2
Figure 5.2.2 (b) – Borrow Pit 3 and Borrow Pit 4
Figure 5.2.2 (c) – Borrow Pit 5 and Borrow Pit 6
Figure 5.2.2 (d) – Borrow Pit 7
Figure 5.2.2 (e) – Borrow Pit 8 and Borrow Pit 9

5.2.3 Manner of Potential Environmental Impacts

The quarry mining will fully alter the existing topography within the bounds of the mined area by virtue of the creation of the Borrow Pit. The total depth of quarrying will however not exceed 2 m and each pit will be backfilled with overburden and soils after the mining operation and will be subject to a final shaping and rehabilitation after mining has been completed to ensure that the mined area is free draining and that it emulates the pre-mining topography in order to naturalize the surface water run-off from the site. A materials deficit will cause the post closure topography to be at a slightly lower surface elevation than the pre-mining topography – estimated to not exceed 1 m on average.

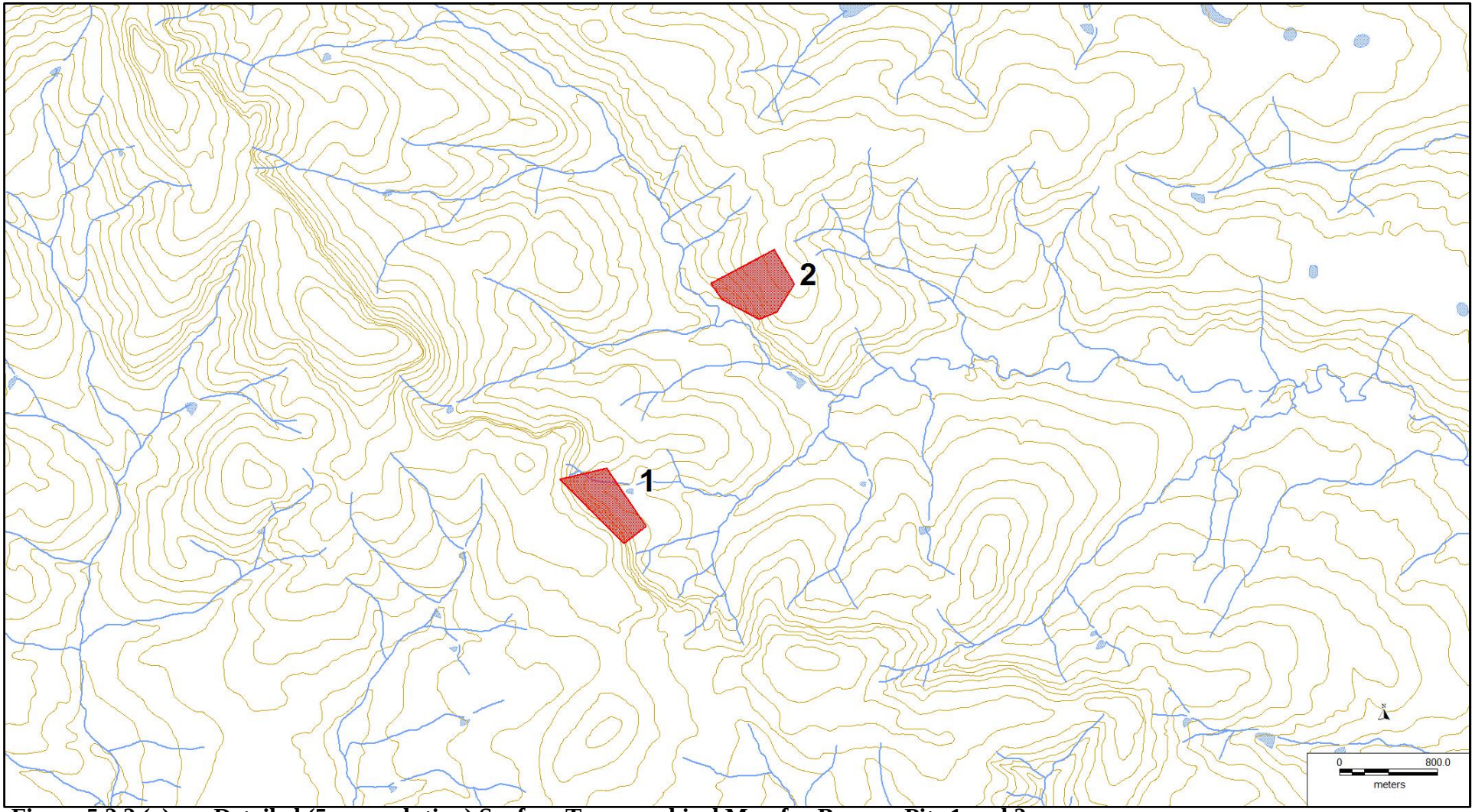


Figure 5.2.2 (a): Detailed (5 m resolution) Surface Topographical Map for Borrow Pits 1 and 2

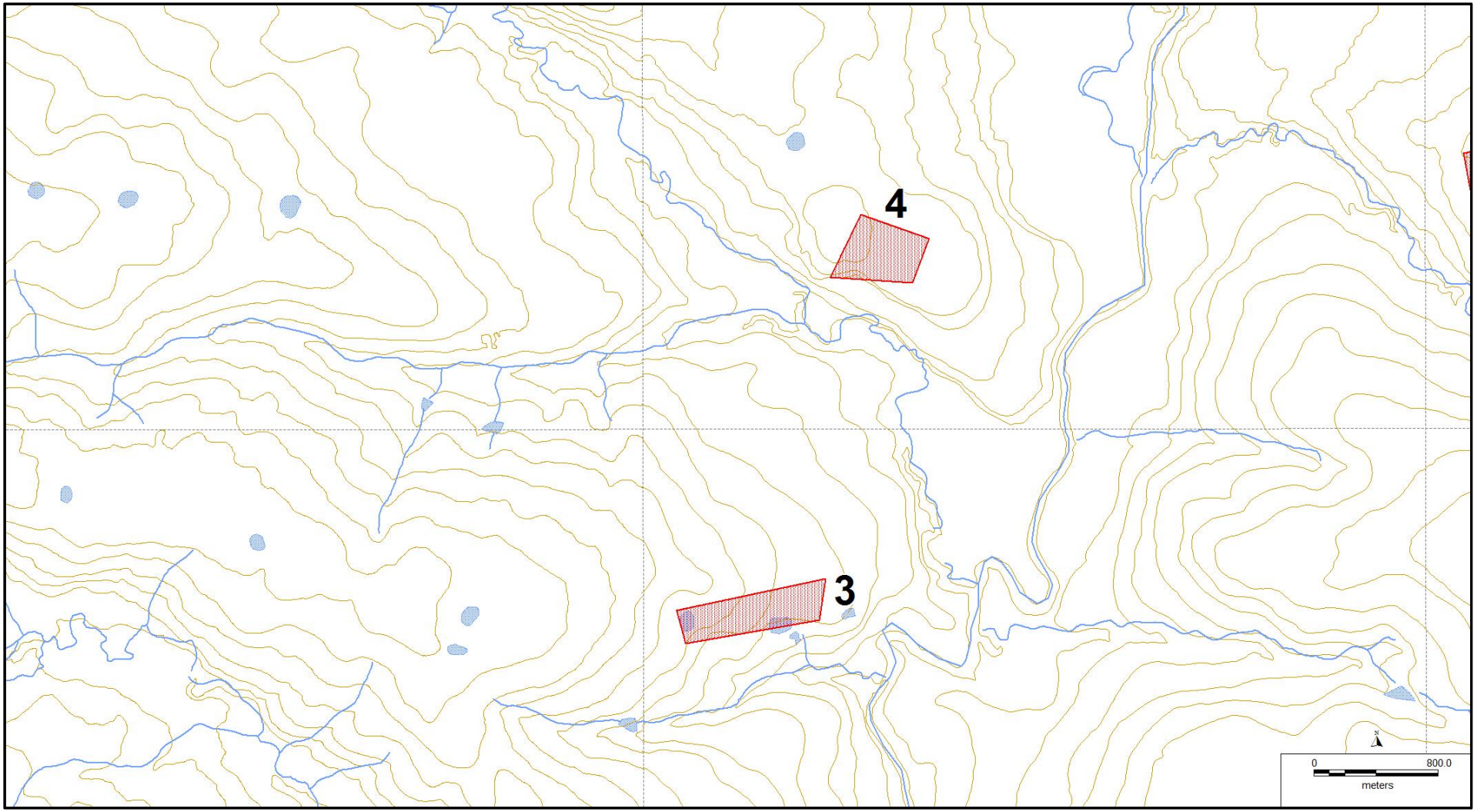


Figure 5.2.2 (b): Detailed (5 m resolution) Surface Topographical Maps for Borrow Pits 3 and 4

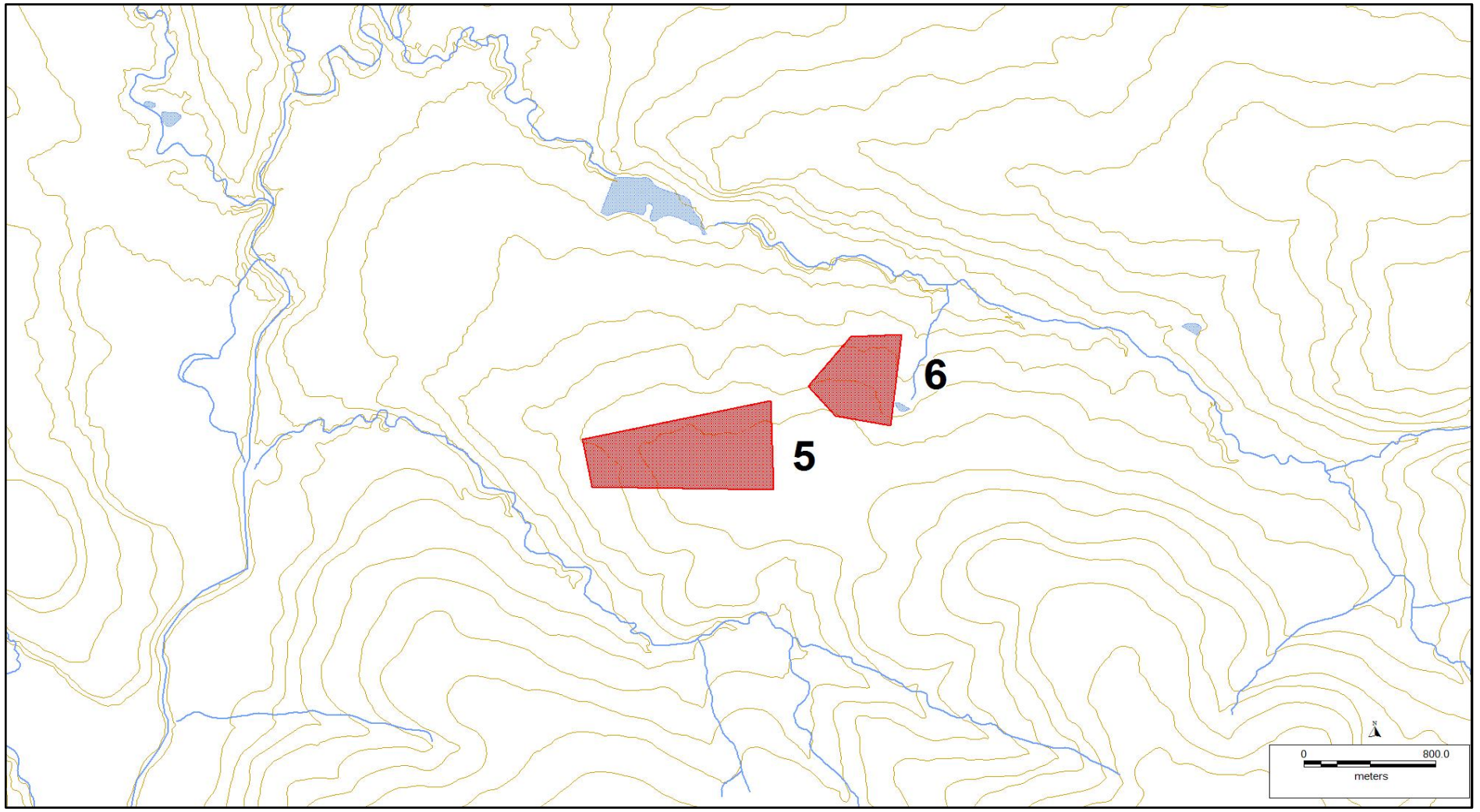


Figure 5.2.2 (c): Detailed (5 m resolution) Surface Topographical Map for Borrow Pits 5 and 6

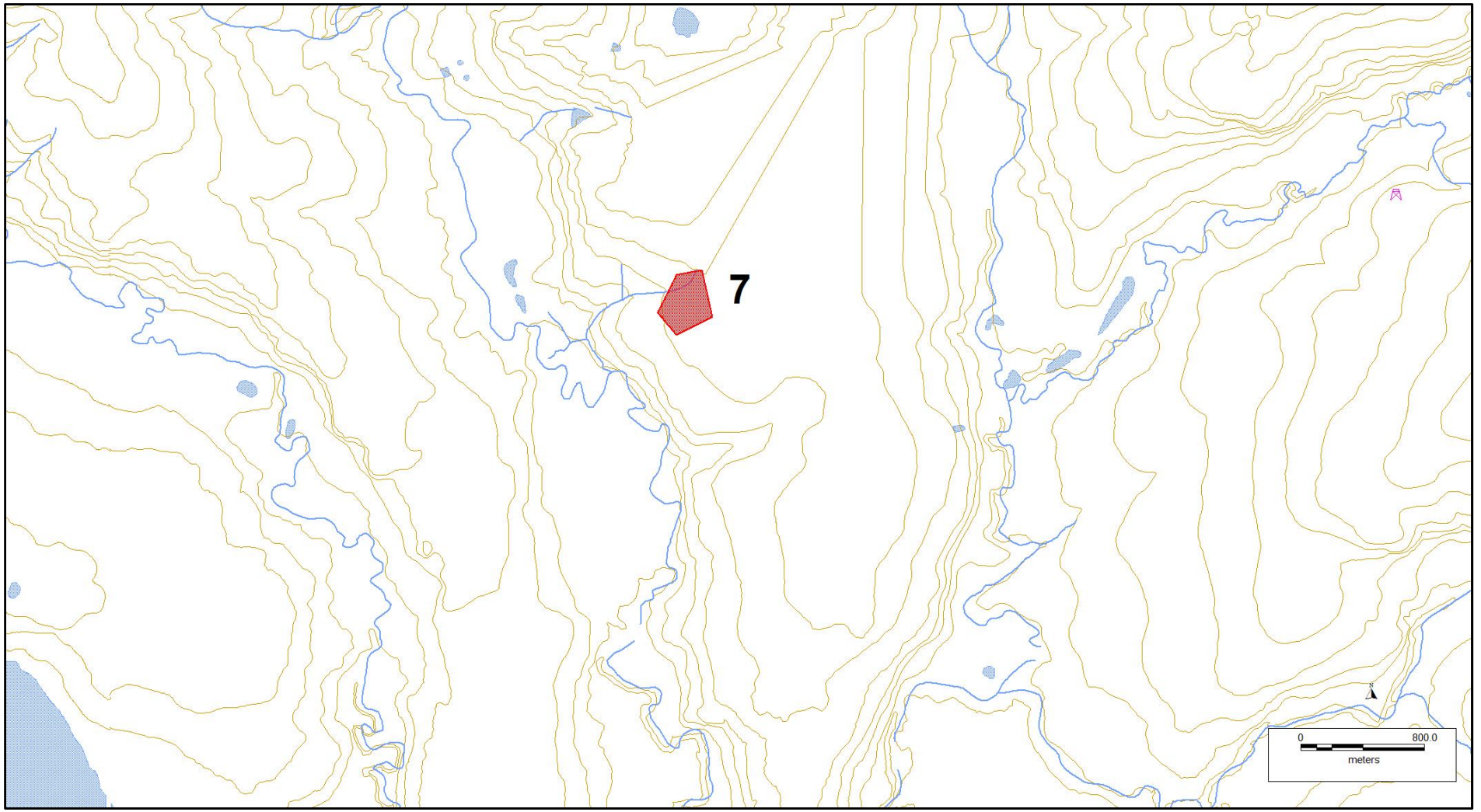


Figure 5.2.2 (d): Detailed (5 m resolution) Surface Topographical Map for Borrow Pit 7

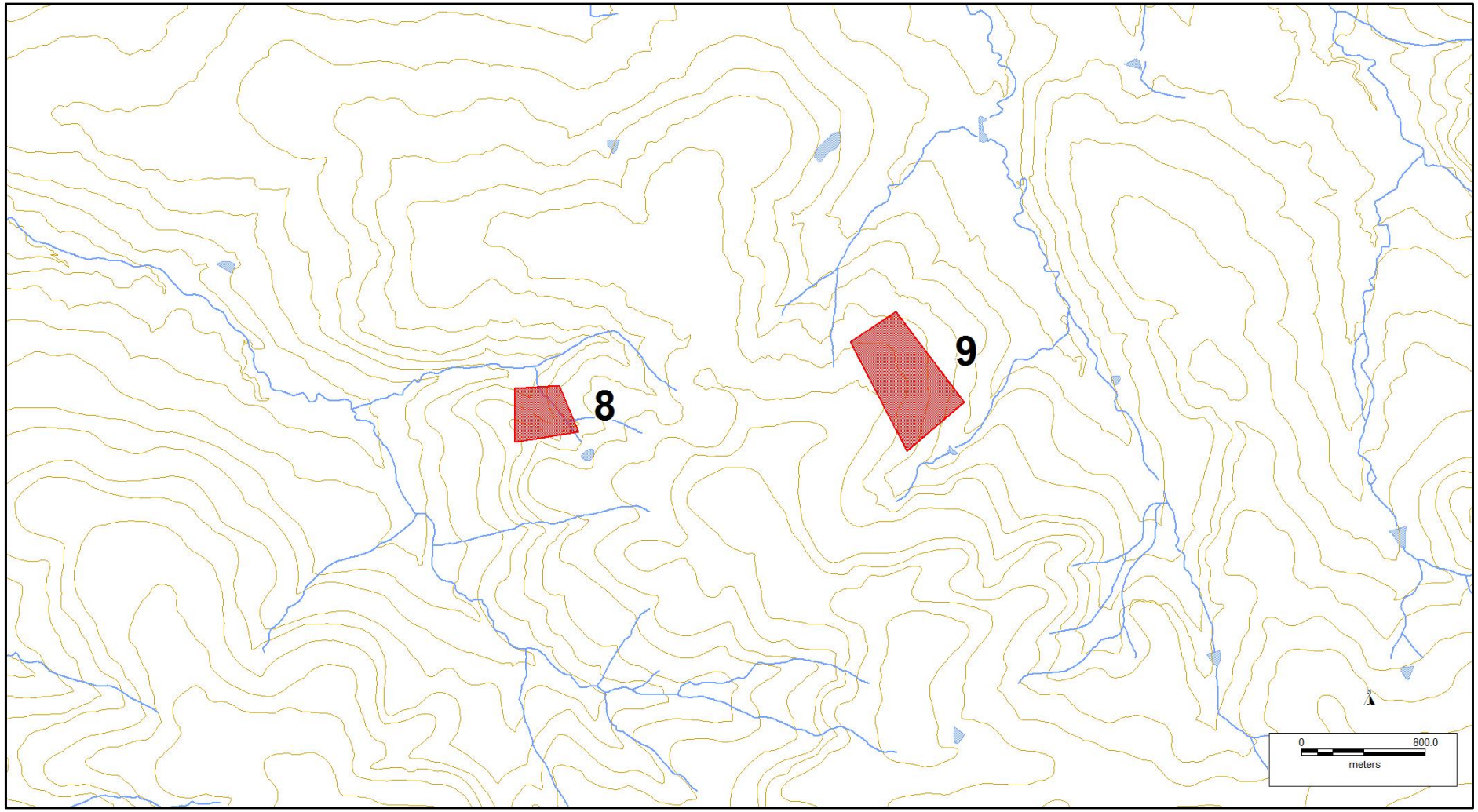


Figure 5.2.2 (e): Detailed (5 m resolution) Surface Topographical Map for Borrow Pits 8 and 9

5.3 SOILS, LAND CAPABILITY & LAND USE

Terra Soil Science (TSS) was commissioned by JMA Consulting to undertake a baseline report level soil, land use, land capability and agricultural potential survey for the areas covered by the proposed Sasol Mining Borrow Pits in the Mpumalanga Province.

A scoping level soil, land use, land capability and agricultural potential survey was conducted for the areas covered by the proposed Sasol Mining Borrow Pits in the Mpumalanga Province.

The distribution of 10 potential Borrow Pit sites is provided below as well as in Figure 5.3(a). Sasol Mining, has after this assessment was completed, removed one of the potential sites (Borrow Pit 2) and have renumbered some of the remaining sites. The pits were also delineated more accurately and now represent only smaller areas within the original delineations. The report does however, remain relevant and the **new numbers** allocated by Sasol Mining will be referenced in **(brackets)** in the text.

Borrow Pit 1 **(Borrow Pit 1)**: Between 26° 38’ 07’’ and 26° 38’ 44’’ south and 28° 54’ 05’’ and 28° 54’ 30’’ east
Borrow Pit 2 **(removed):** Between 26° 38’ 04’’ and 26° 38’ 22’’ south and 28° 54’ 19’’ and 28° 54’ 49’’ east
Borrow Pit 3 **(Borrow Pit 2)**: Between 26° 37’ 03’’ and 26° 37’ 38’’ south and 28° 54’ 45’’ and 28° 55’ 22’’ east
Borrow Pit 4 **(Borrow Pit 3)**: Between 26° 37’ 34’’ and 26° 37’ 59’’ south and 28° 59’ 32’’ and 29° 00’ 45’’ east
Borrow Pit 5 **(Borrow Pit 4)**: Between 26° 35’ 29’’ and 26° 36’ 38’’ south and 28° 59’ 45’’ and 29° 01’ 00’’ east
Borrow Pit 6 **(Borrow Pit 5)**: Between 26° 35’ 42’’ and 26° 36’ 43’’ south and 29° 02’ 38’’ and 29° 03’ 52’’ east
Borrow Pit 7 **(Borrow Pit 6)**: Between 26° 35’ 39’’ and 26° 36’ 06’’ south and 29° 03’ 56’’ and 29° 04’ 22’’ east
Borrow Pit 8 **(Borrow Pit 8)**: Between 26° 36’ 06’’ and 26° 36’ 40’’ south and 29° 06’ 29’’ and 29° 06’ 55’’ east
Borrow Pit 9 **(Borrow Pit 9)**: Between 26° 35’ 28’’ and 26° 36’ 21’’ south and 29° 07’ 43’’ and 29° 08’ 11’’ east
Borrow Pit 10 **(Borrow Pit 7)**: Between 26° 31’ 31’’ and 26° 31’ 46’’ south and 29° 02’ 08’’ and 29° 02’ 23’’ east

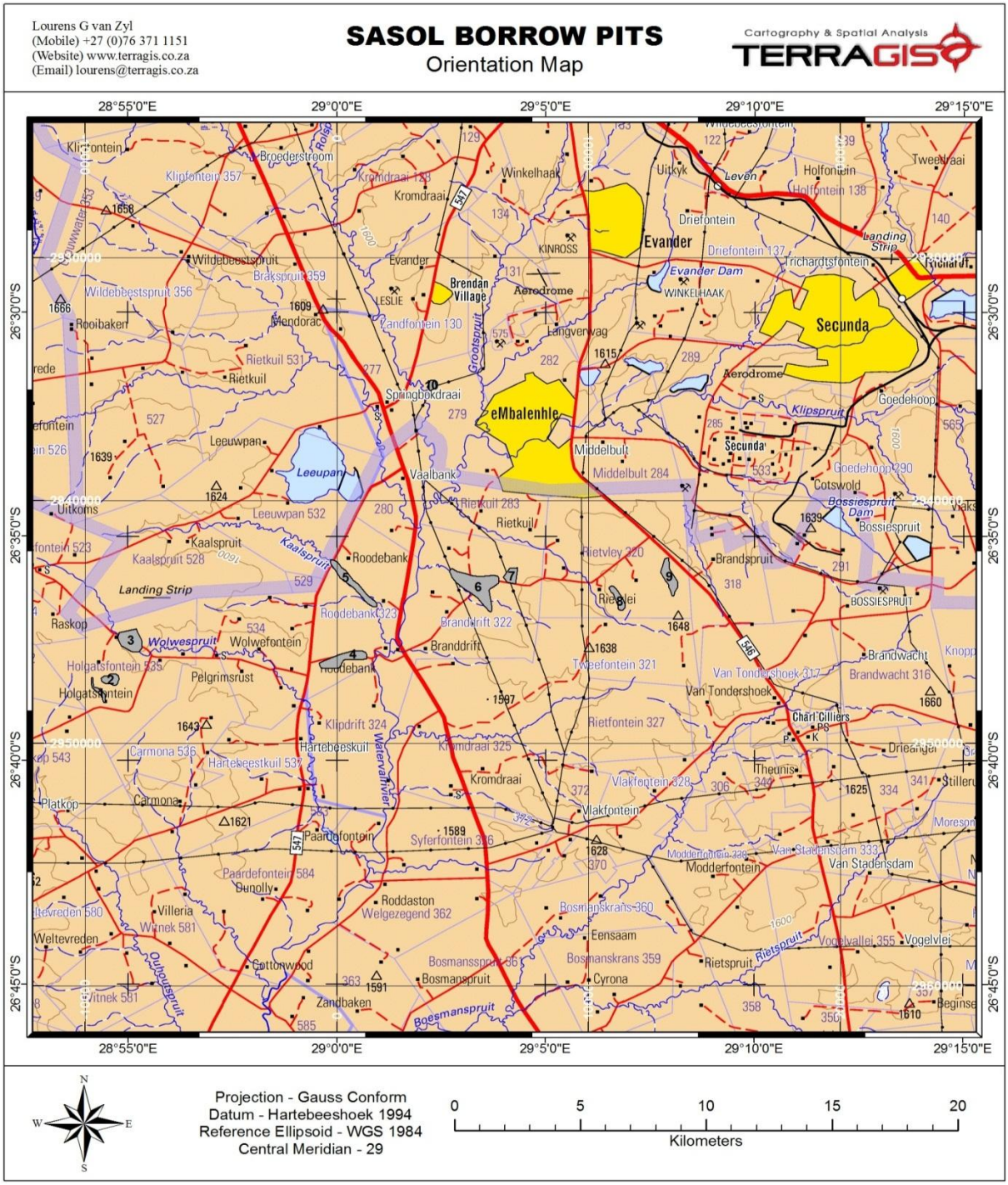


Figure 5.3 (a): Borrow Pit Areas Investigated

New Number Allocation

Original Number	New Allocated Number
Borrow Pit 1	Borrow Pit 1
Borrow Pit 2	Removed by Sasol Mining
Borrow Pit 3	Borrow Pit 2
Borrow Pit 4	Borrow Pit 3
Borrow Pit 5	Borrow Pit 4
Borrow Pit 6	Borrow Pit 5
Borrow Pit 7	Borrow Pit 6
Borrow Pit 8	Borrow Pit 8
Borrow Pit 9	Borrow Pit 9
Borrow Pit 10	Borrow Pit 7

5.3.1 Investigative Methodology

The baseline soil, land capability, land use and agricultural potential surveys were conducted in three phases.

Phase 1: Land (Soil) Type Data/Reconnaissance Soil Survey)

Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC). The land type data is presented at a scale of 1:250 000 and entails the division of land into land types, typical terrain cross sections for the land type and the presentation of dominant soil types for each of the identified terrain units (in the cross section). The soil data is classified according to the Binomial System (MacVicar et al., 1977). The soil data was interpreted and re-classified according to the Taxonomic System (MacVicar, C.N. et al. 1991).

As part of the baseline investigation a reconnaissance soil survey was conducted to confirm the land type data. This survey was conducted through the traversing of the general area with the noting of general soil characteristics as observable in road cuttings, trenches along public roads and ploughed fields.

Phase 2: Aerial Photograph Interpretation and Land Use Mapping

The most up to date aerial photographs of the site were obtained from Google Earth. The images were used to interpret aspects such as land use and land cover as well as historic land uses such as cultivation.

Phase 3: Digital Elevation Model

In order to aid the soil surveys for the sites a digital elevation model (DEM) was generated for the area. This DEM was generated using 5 m contours of the area.

5.3.2 Current Land (Soil) Type

The general area covered by the borrow pits falls into the **Bb3**, **Ea17** and **Ea20** land types (Land Type Survey Staff, 1972 - 2006). (Refer to Figure 5.3.2 (a) for the land type map of the area). A brief summary description of the land types in terms of soils, land capability, land use and agricultural potential is provided in Table 5.3.2 (a).

The results of the reconnaissance survey confirmed to a large degree general aspects of the land type data. In some areas within the **Ea** land types soils were found that should have been classed as falling within the **Bb** land types. This aspect could not be elucidated in detail during the reconnaissance survey and will be investigated in more detail during the EIA phase of the project.

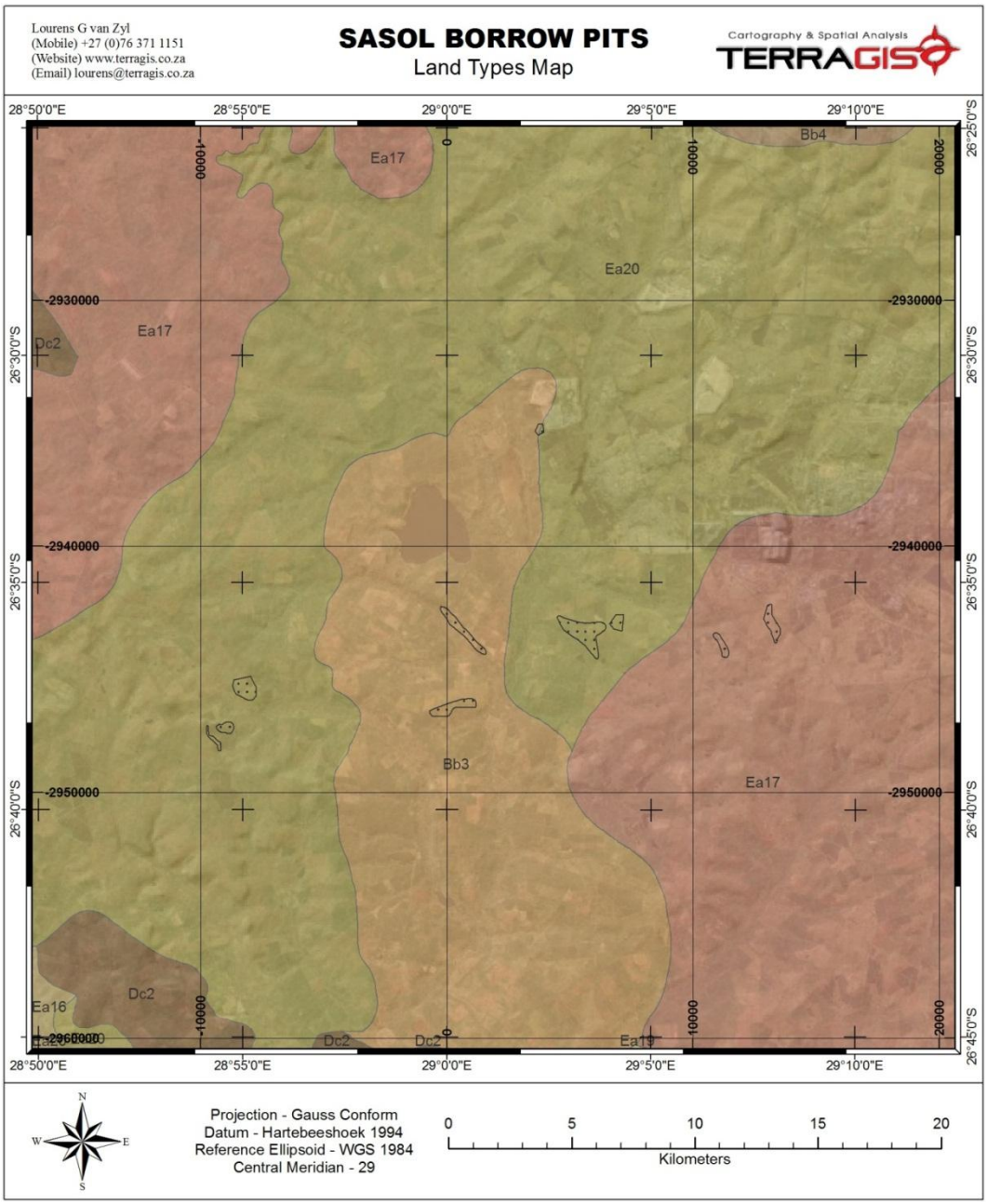


Figure 5.3.2 (a): Land (Soil) Type Map of the Study Area

In general the soils that are currently being used for crop production represent the slightly deeper soils in the area. This is only a general rule and exceptions occur where deeper soils fall into the grazing areas with slightly shallower soils within the cultivated fields. Again, this aspect will be elucidated further with an adequate level of classification during the EIA phase investigation

Table 5.3.2 (a): Summary of Land Types occurring in the Borrow Pits Area

Land Type	Soil Description	Dominant Soil Forms	Land Capability and Land Use	Agricultural Potential
Bb3	Crest: dominated by moderately deep to deep well-drained structureless soils with numerous pans. Mid- and Footslope: dominated by moderately deep to deep well drained structureless to structured soils with limited occurrence of duplex soils. Valley bottom: dominated by poorly drained structured soils.	Avalon, Hutton, Glencoe, Westleigh, Mispah Avalon, Hutton, Glencoe, Westleigh, Mispah, Swartland, Longlands, Arcadia, Estcourt, Kroonstad Rensburg, Katspruit, Willowbrook, Acadia	Mainly dryland agriculture and extensive grazing for the whole land type	Ranging from low to high for the whole land type
Ea17	Crest: dominated by shallow to moderately deep structured soils. Rock outcrops common. Mid- and Footslope: dominated by moderately deep structured soils. Valley bottom: dominated by either poorly drained structured soils (including duplex) or young or recently transported soils.	Mayo, Milkwood, Glenrosa, Arcadia, Valsrivier, Swartland, Avalon, Westleigh Arcadia, Rensburg, Valsrivier, Swartland, Bonheim Arcadia, Rensburg, Streambeds	Mainly dryland agriculture and extensive grazing for the whole land type	Ranging from low to medium for the whole land type
Ea20	Crest: dominated by shallow to moderately deep structured soils. Rock outcrops common. Mid- and Footslope: dominated by moderately deep structured soils with limited occurrence of duplex soils. Valley bottom: dominated by poorly drained structured soils.	Arcadia, Mayo, Milkwood, Swartland, Mispah, Glenrosa, Shortlands, Avalon, Westleigh Arcadia, Mayo, Milkwood, Swartland, Mispah, Glenrosa, Shortlands, Avalon, Valsrivier, Westleigh, Willowbrook, Estcourt, Sterkspruit, Bonheim Rensburg, Willowbrook, Streambeds	Mainly dryland agriculture and extensive grazing for the whole land type	Ranging from low to medium for the whole land type

5.3.3 Current Land Use and Land Capability

The interpretation of the Google Earth images yielded two dominant land uses, namely dryland crop production and extensive grazing. For most of the sites the land capability will mimic the land use in that "dryland crop production" is an "arable" land capability and "extensive grazing" is "grazing". In Figure 5.3.3 (a) below it is clear that **New Borrow Pit 1** (numbered **1** on map) covers mainly extensive grazing areas whereas the Borrow Pit numbered **2** on the **(now removed from project)** covers an area dedicated to crop production.

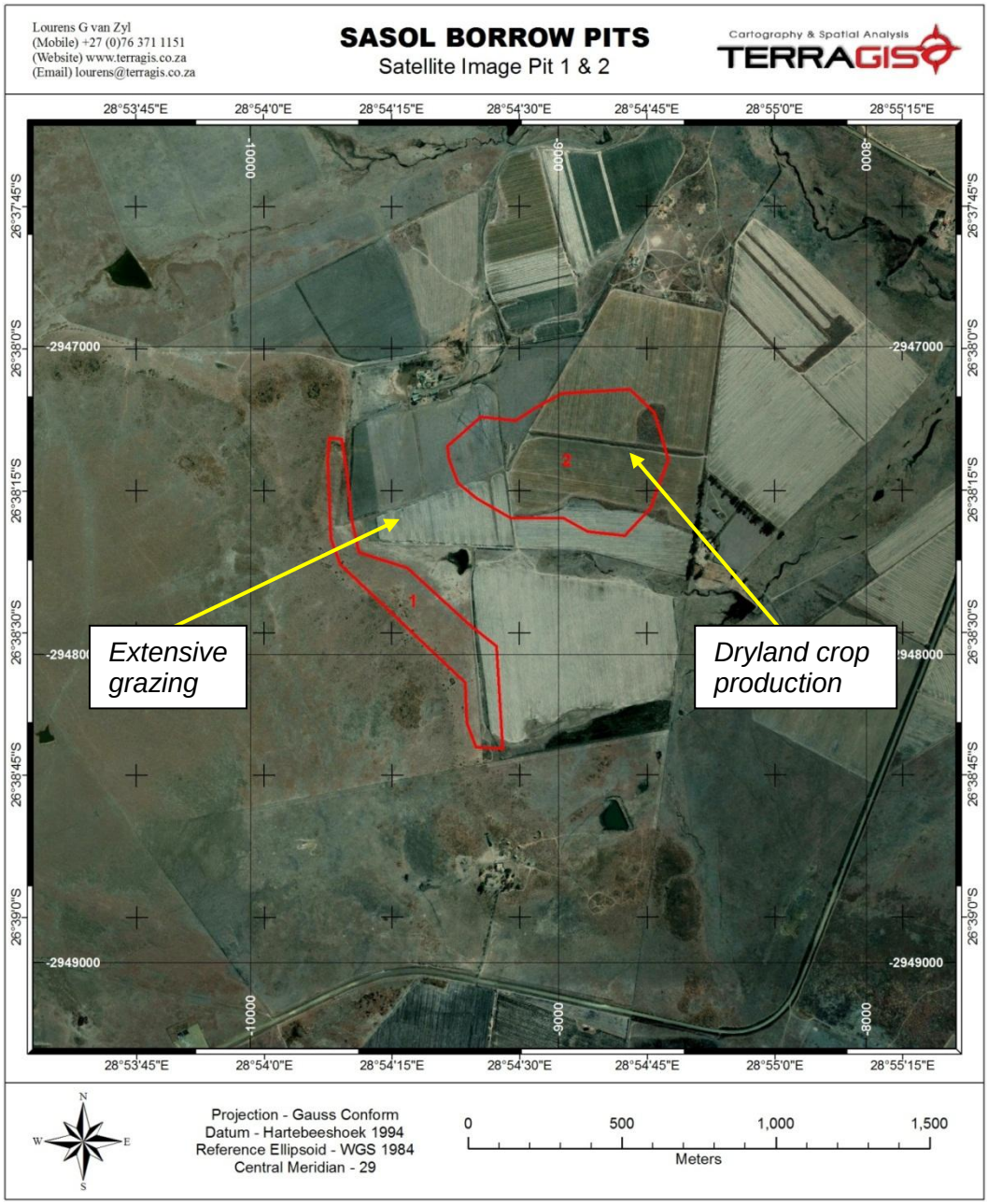


Figure 5.3.3 (a): Land Cover and Use for the Area of Borrow Pit 1 (old number 1 on map)

New **Borrow Pit 2** (numbered 3 on map below) covers both crop production and extensive grazing areas (Figure 5.3.3 (b) below).

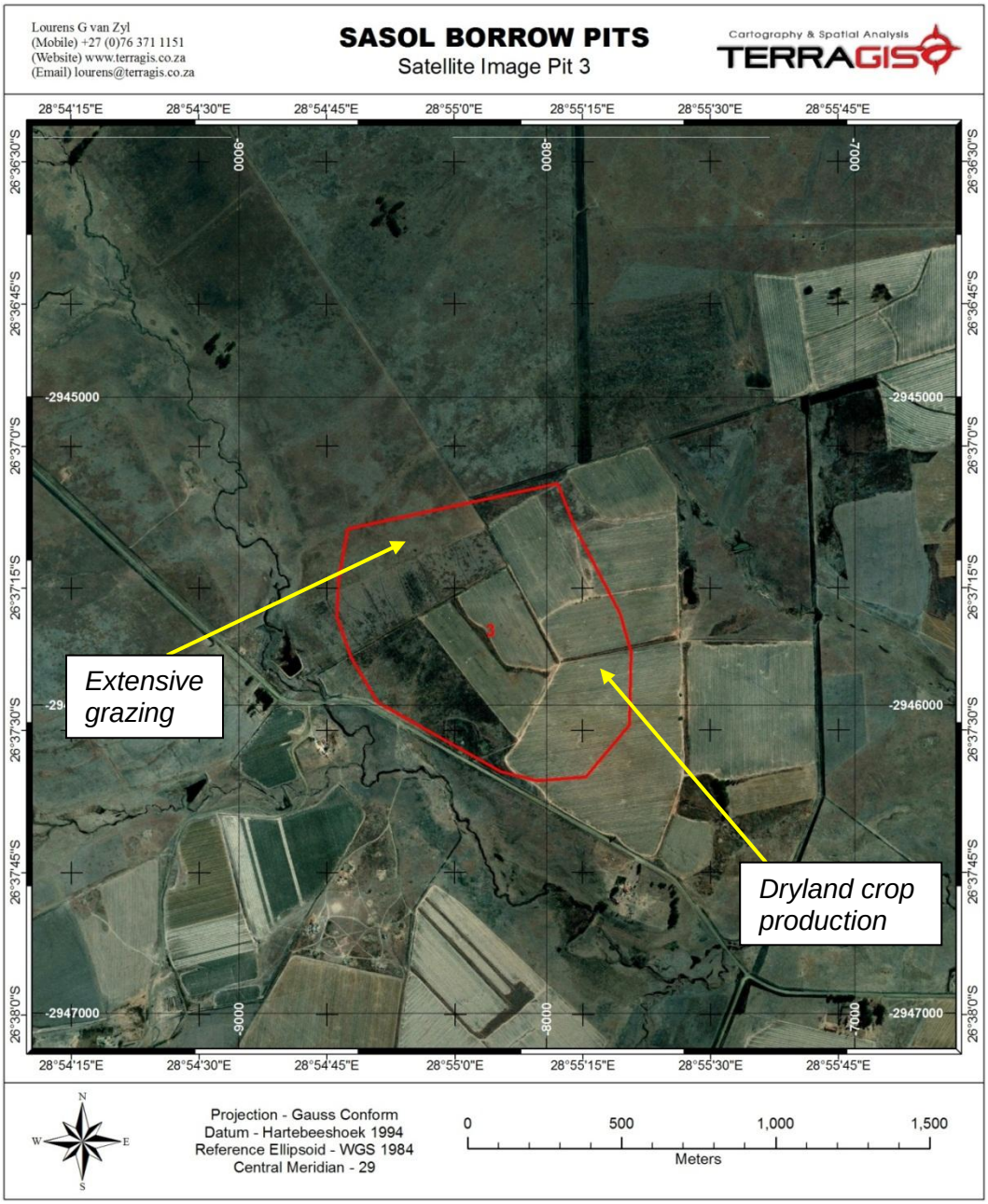


Figure 5.3.3 (b): Land Cover and Use for the Area of Borrow Pit 2 (old number 3 on map)

New **Borrow Pit 3** (numbered **4** on map below) covers mainly crop production areas (Figure 5.3.3 (c) below).

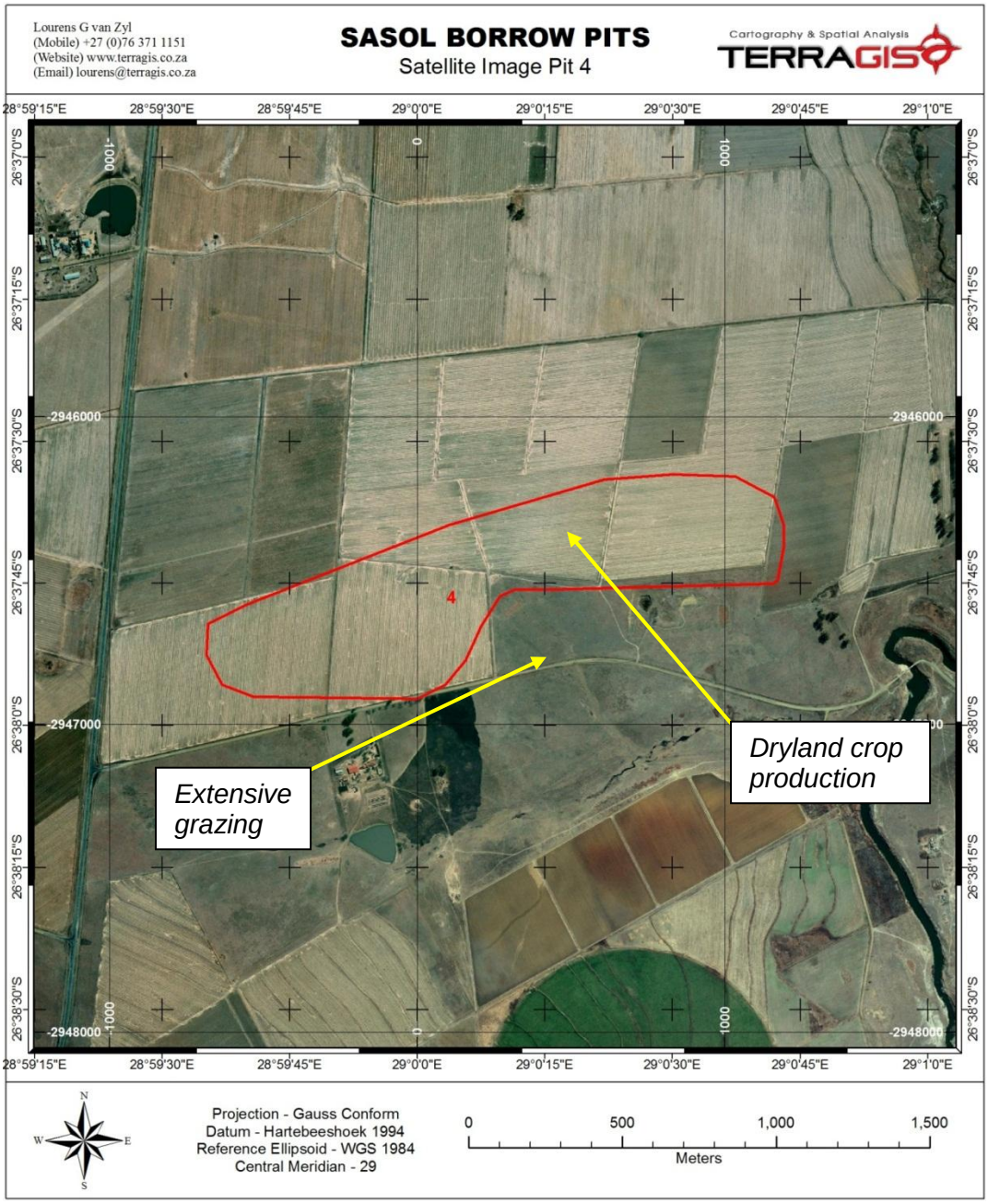


Figure 5.3.3 (c): Land Cover and Use for the Area of Borrow Pit 3 (old number 4 on map)

New **Borrow Pit 4** (numbered 5 on map below) covers predominantly grazing areas with a small inclusion of dryland crop production (Figure 5.3.3 (d) below).

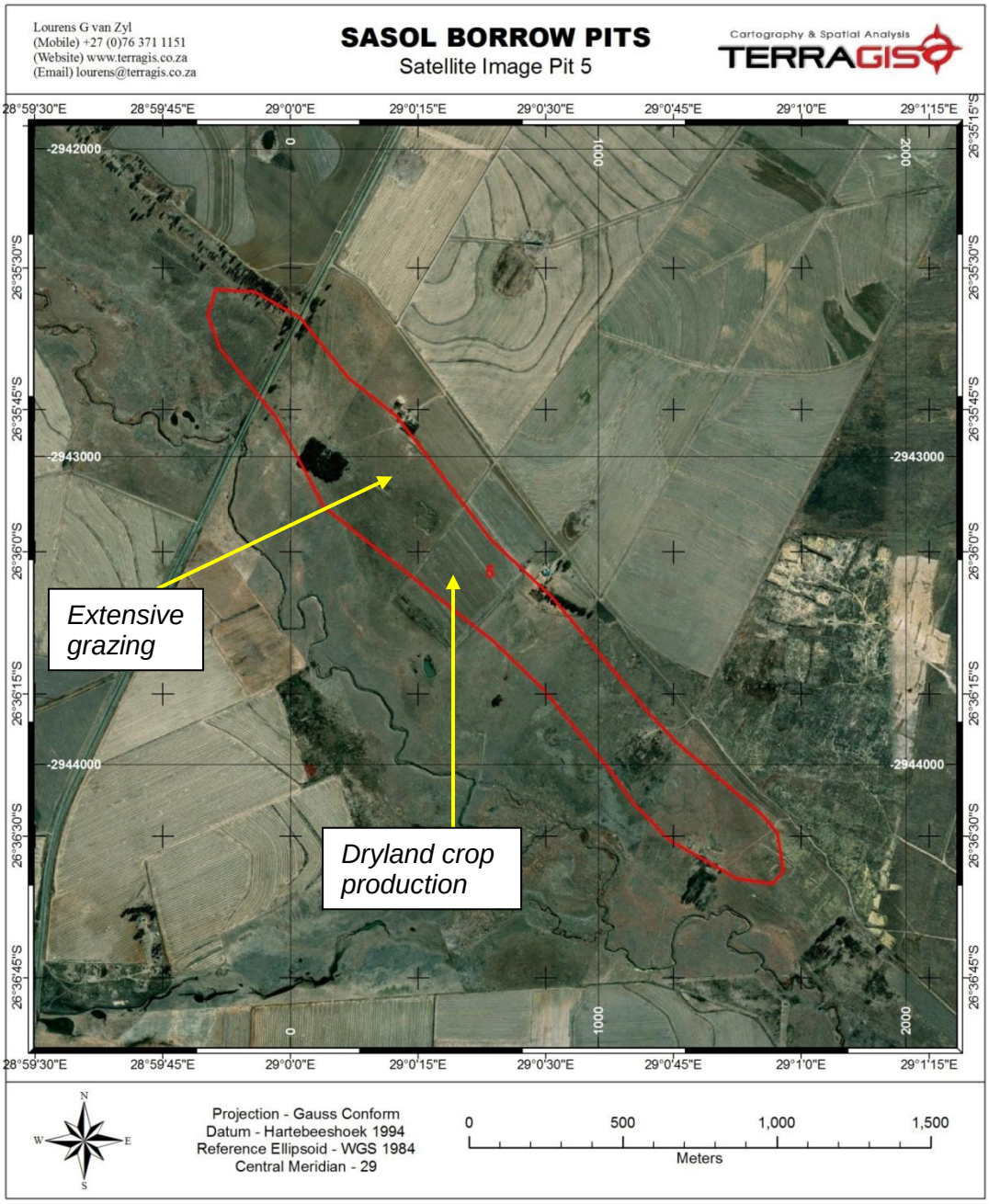


Figure 5.3.3 (d): Land Cover and Use for the Area of Borrow Pit 4 (old number 5 on map)

New **Borrow Pit 5** and new **Borrow Pit 6** (numbered **6** and **7** respectively on map below) cover areas predominantly used for extensive grazing (Figure 5.3.3 (e) below).

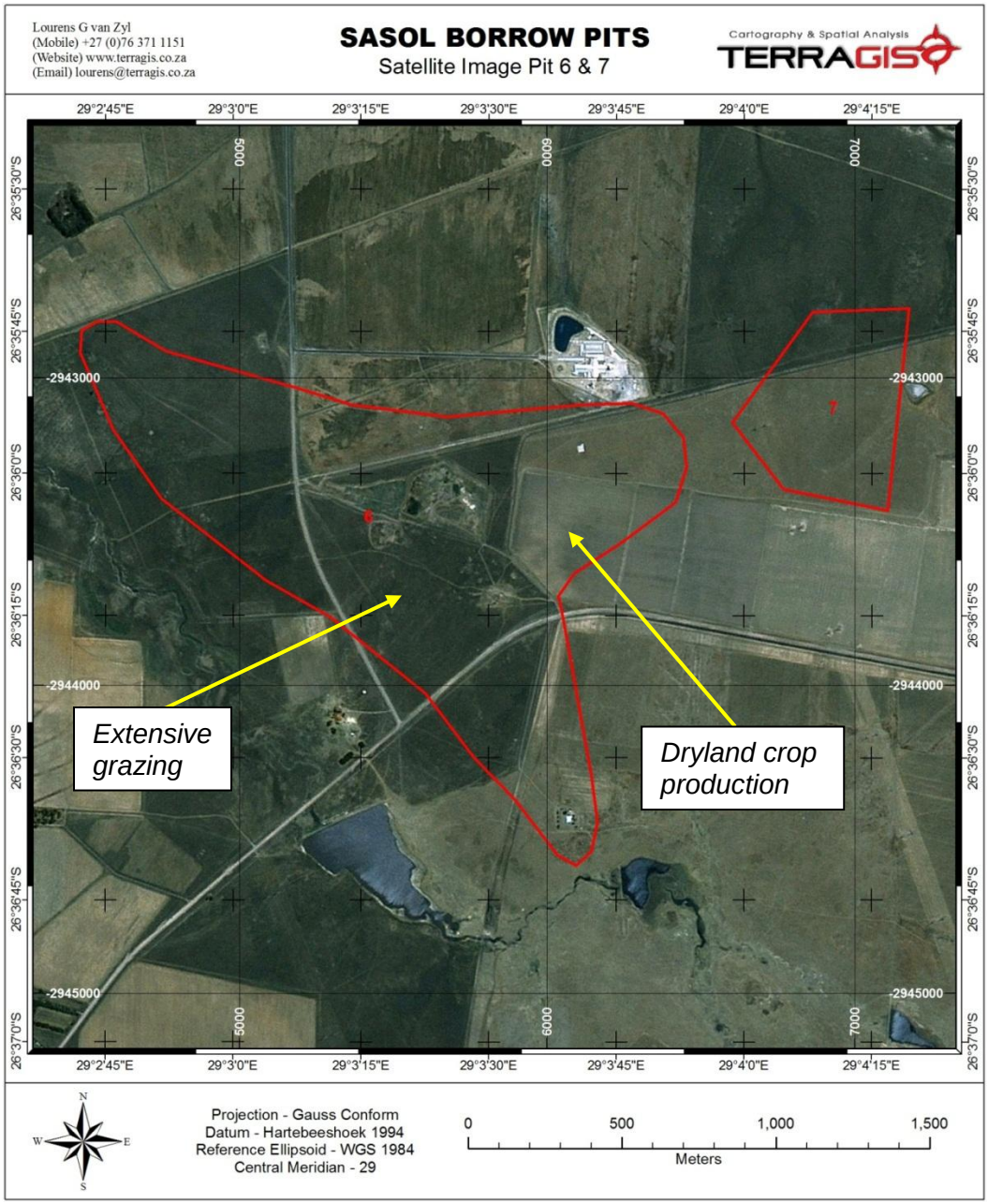


Figure 5.3.3 (e): Land Cover and Use for the Area of Borrow Pit 5 and Borrow Pit 6 (old number 6 and 7 respectively on map)

New **Borrow Pit 7** (numbered **10** on map below) covers an area close to gold tailings dams and as such is assumed to be used for extensive grazing (Figure 5.3.3 (f) below).

Figure 5.3.3 (f): Land Cover and Use for the Area of Borrow Pit 7 (old number 10 on map)

New **Borrow Pit 8** and new **Borrow Pit 9** (numbered **8** and **9** respectively on map below) cover areas predominantly used for extensive grazing (Figure 5.3.3 (g) below).

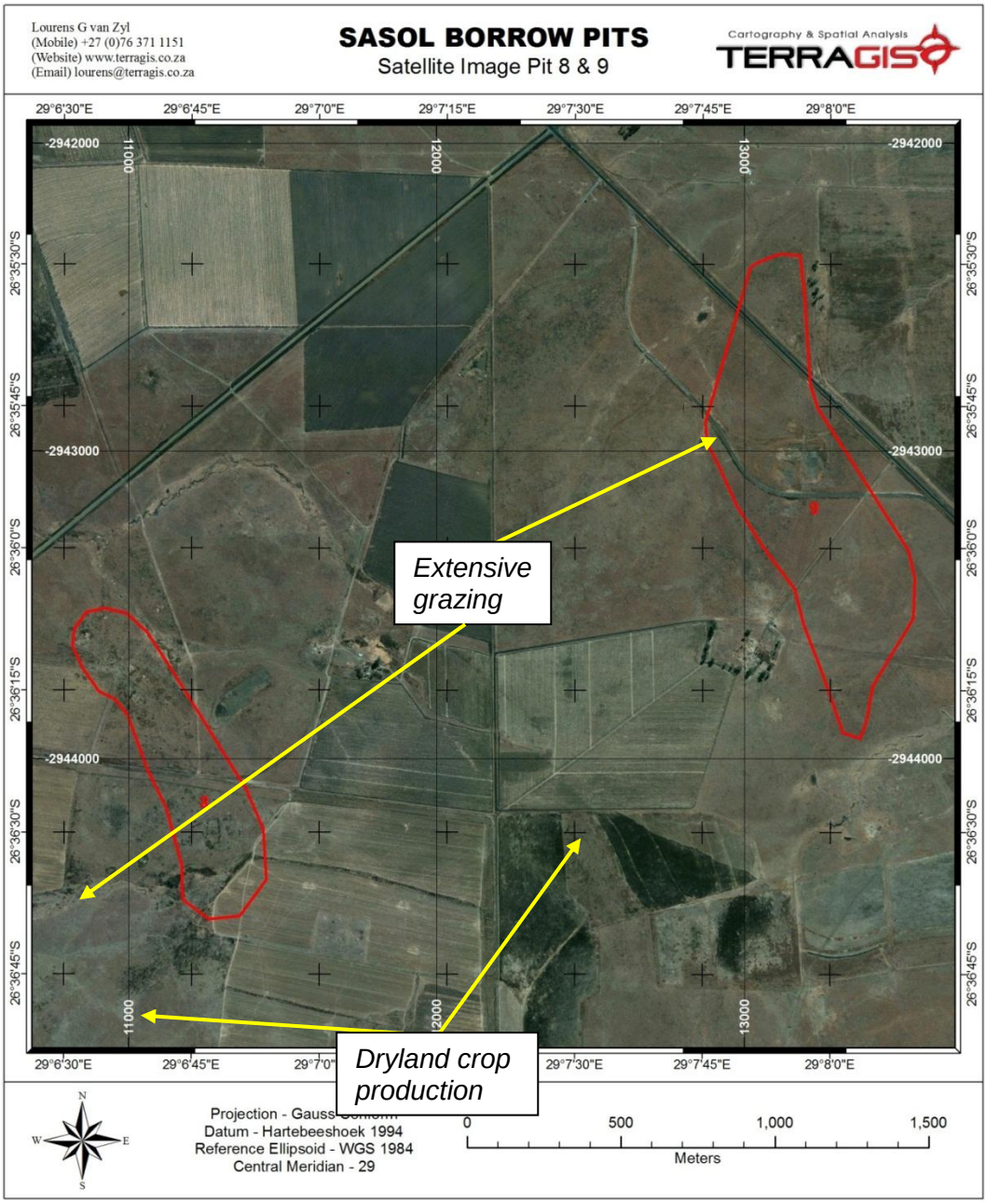


Figure 5.3.3 (g): Land Cover and Use for the Area of Borrow Pit 8 and Borrow Pit 9 (old number 8 and 9 respectively on map)

5.3.4 Digital Elevation Model

The digital elevation model for the site is provided in Figure 5.3.4 (a). The bulk of the borrow pit sites are situated on convex topography. In the specific area convex topography is expected to be associated with shallow soils and rock outcrops. This, however, is a generalisation and has to be confirmed during the EIA level soil survey that will be conducted.

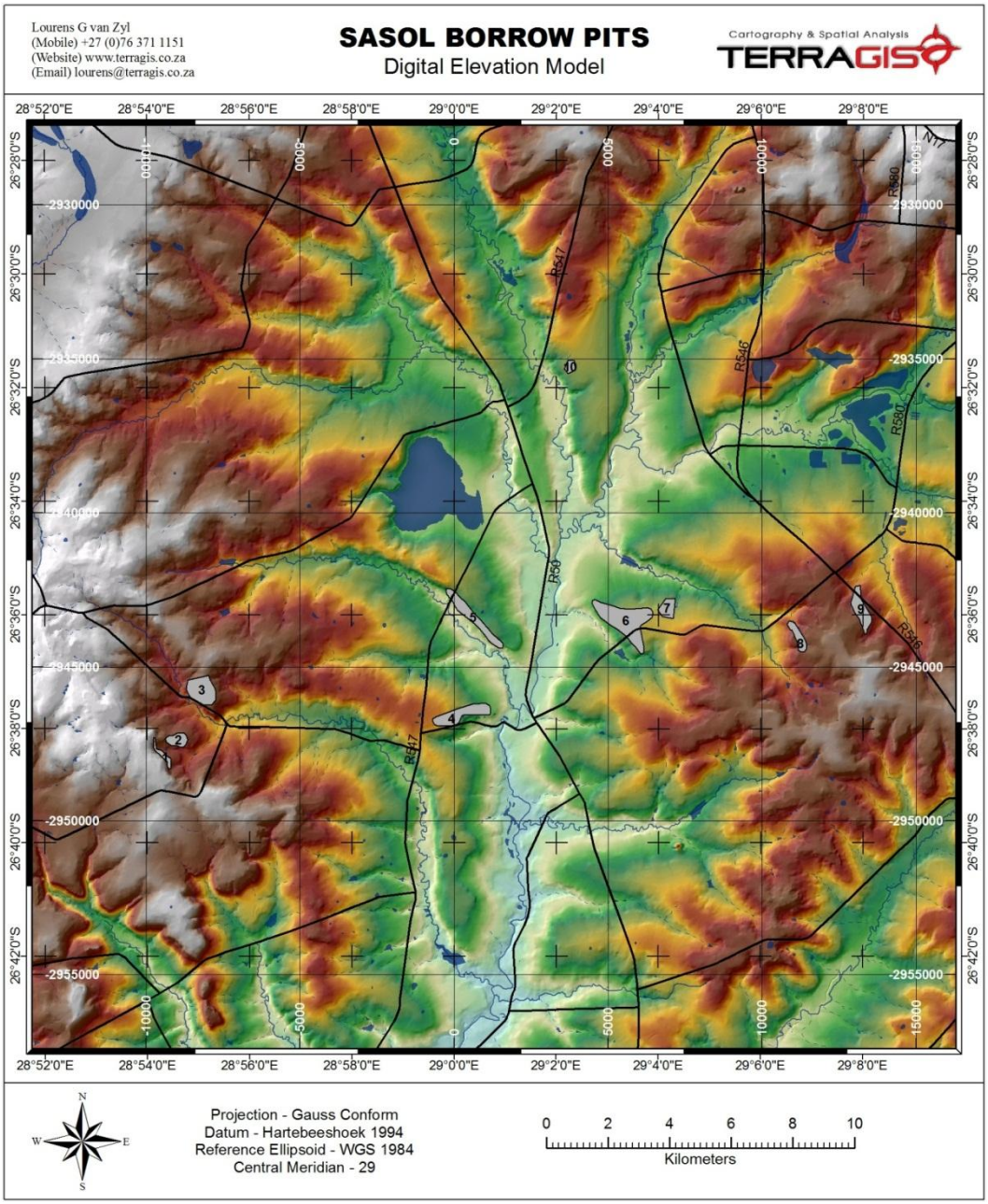


Figure 5.3.4 (a): Digital Elevation Model for the Borrow Pits Study Area

5.3.5 Agricultural Potential

The agricultural potential of the area varies from low to high depending on soil form and soil depth. The crops that are produced are limited to grains with sorghum and maize dominating. The yields vary according to soil depth, rainfall distribution throughout the season (as the soils do not hold large volumes of water like deep apedal profiles) and management inputs in the form of cultivation and fertilizer application rates and nutrient management.

The grazing areas are considered to be of good quality with a relatively high carrying capacity for natural veld. Degradation of grazing land is not encountered widely due to the inherent soil properties that buffer such impacts.

Although irrigated crop production is practiced in the area it has not been identified within the pit areas.

5.3.6 Manner of Potential Environmental Impacts

The following impacts are expected for the proposed mining activities

Physical Soil Disturbance Due To Mining Activities

Nature of Impact: Direct impacts are associated with the soils in the borrow pit areas. Indirect impacts could arise in the form of soil erosion and degradation if storm water management is not planned and managed properly as it is generated on the roads and mining sites. Cumulative impacts are only considered to be problematic if the aforementioned storm water management is not instituted. Otherwise very limited cumulative impacts are expected due to the level terrain.
Extent of Impact: The extent of this impact will be local in terms of the activity and will be associated with the activity only. Slightly larger, but still local in extent, impacts are expected if storm water runoff is not controlled.
Potential Significance of Identified Impacts: The potential significance of the identified impacts varies with the current land use. Impacts on crop production areas will be larger than on grazing areas.
Potentially Significant Impacts to be assessed in EIA Phase: The potentially significant impacts to be assessed in the EIA phase will be limited to the classification of the soils as well as assessment of slopes and storm water impacts. These parameters will provide an indication to the project engineers regarding the erosion risk as well as inform the mitigation and rehabilitation measures to be implemented on the site.

Impacts on Current Land Use Due To Mining Activities

The current land use is limited to dryland crop production and extensive grazing.

Nature of Impact: Direct impacts are associated with the soils in the borrow pit areas. Indirect impacts could arise in the form of soil erosion and degradation if storm water management is not planned and managed properly as it is generated on the roads and mining sites. Cumulative impacts are only considered to be problematic if the aforementioned storm water management is not instituted. Otherwise very limited cumulative impacts are expected due to the level terrain.

Extent of Impact: The extent of this impact will be local in terms of the activity and will be associated with the activity only. Slightly larger, but still local in extent, impacts are expected if storm water runoff is not controlled.
Potential Significance of Identified Impacts: The potential significance of the identified impacts varies with the current land use. Impacts on crop production areas will be larger than on grazing areas.
Potentially Significant Impacts to be assessed in EIA Phase: The potentially significant impacts to be assessed in the EIA phase will be limited to the determination of, in a broad sense, the crop yield potential of the soils as well as the carrying capacity of the sites in general as well as specific sections of the site.

Impacts on Agricultural Potential Due To Mining Activities

The agriculture potential of the sites vary according to soil characteristics as well as other biophysical aspects.

Nature of Impact: Direct impacts vary according to the agricultural potential of specific sites. Significant indirect and/or cumulative impacts are considered to be small due to the limited extent of the mining activities within a broader landscape.
Extent of Impact: The extent of this impact will be local in terms of the activity and will be associated with the activity only. Slightly larger, but still local in extent, impacts are expected if storm water runoff is not controlled. The impacts vary according to site specific characteristics of soils.
Potential Significance of Identified Impacts: The potential significance of the identified impacts varies with the current land use. Impacts on crop production areas will be larger than on grazing areas.
Potentially Significant Impacts to be assessed in EIA Phase: The potentially significant impacts to be assessed in the EIA phase will be limited to the determination of the agricultural potential of the soils as well as the probability that they will be impacted.

5.4 GEOLOGY

The geology of any region forms the basis for the topography, soils, vegetation, ground water and surface water components of the biophysical environments, whilst at the same time determines the setting and delineation of the extensive mining operations within the borrow pit study area.

A fundamental understanding and a site specific quantitative description of the geology within the borrow pit study area is therefore a prerequisite on which to base impact assessments for soils, vegetation, ground water and surface water and from which to design and implement effective environmental management measures related to these environmental components.

The terms of reference for the geological base line and specialist study are as follows:

- Provide the regional geological setting in order to contextualize the ground water and mining environments.
- Provide site specific geological information in support of the soils and ground water base line studies and impact assessments
- Provide an understanding of the environment within which the mining/quarrying of the dolerite occurs.
- Provide an indication and description of the physical properties of the borrow pit material.

5.4.1 Investigative Methodology

The geological investigation comprised a regional and quantitative site specific investigation pertaining to the geology of the study area. The investigation comprised of the following:

- Obtain, review and verify available geological and mining related information. A wealth of geological information has been generated regarding the geology of the study area and will be used. In addition to the geological information generated in the field, geological information has been obtained from the published 1:250 000 Geological Map Series of South Africa.
- Two site specific and detailed geotechnical reports, one by Jones & Wagener and one by Knight Piezold, investigated the site specific dolerite occurrences and conditions at the proposed Borrow Pits.
- Discuss the geological setting based on the information obtained from the published geological maps, field observations, as well the information obtained from previous geological and geotechnical assessments carried out within the study area.

5.4.2 Regional Geology

The regional geology of the study area is addressed with reference to the clipped region of the 1:250 000 Geological Map Series of South Africa – Sheet 2628 EAST RAND, (1986), depicted as Figure 5.4.2 (a). The extent of the 9 Borrow Pits are delineated in blue on Figure 5.4.2 (a) and are numbered 1, 2, 3, 4, 5, 6, 7, 8 and 9 respectively.

The Borrow Pits will serve as quarries from which dolerite will be obtained which will be used during the construction of the Impumelelo and Shondoni conveyor routes. The Borrow Pits are as a result confined by the extent of dolerite outcrops and sub-outcrops. No blasting operations will occur during the removal of the dolerite and the Borrow Pits are expected to extent to a maximum depth of between 1.5 m and 2.0 m below the surface, depending on the physical properties of the dolerite at each of the pits.

The regional geology of the study area is dominated by sedimentary lithologies of the Vryheid Formation (Pv) as well as Jurassic Age Dolerite Intrusives (Jd).

The Vryheid Formation forms part of the Ecca Group of the Karoo Supergroup, and outcrops extensively across the study area. The Vryheid Formation lithological units consist generically of interbedded sandstones and shale layers. Carbonaceous shale and coal layers are generally associated with the Vryheid Formation as well. Deposition of the sediments within the Karoo Supergroup occurred on an erosional, undulating, pre-Karoo surface developed prior to and during the Dwyka glaciation.

The No.2 and No.4 coal seams have been extensively mined within the study area by underground mining operations. The extent of the coal mining is confined to the lithologies of the Ecca Group and typically takes the form of standard board and pillar underground mining operations. Gold (Au), silver (Ag) and coal (C) have been and/or are currently being mined within the study area as well.

The dolerite present within the study area (Jd) is younger than the Vryheid Formation and intruded into and through the sedimentary rocks of the Vryheid Formation. The dolerite intrusives typically occur as laterally extensive sills and dykes and are often responsible for the devolatization of the coal adjacent to the dolerite intrusions.

The river beds across the study area are typically associated with the deposition of tertiary and quaternary sands and sediments.

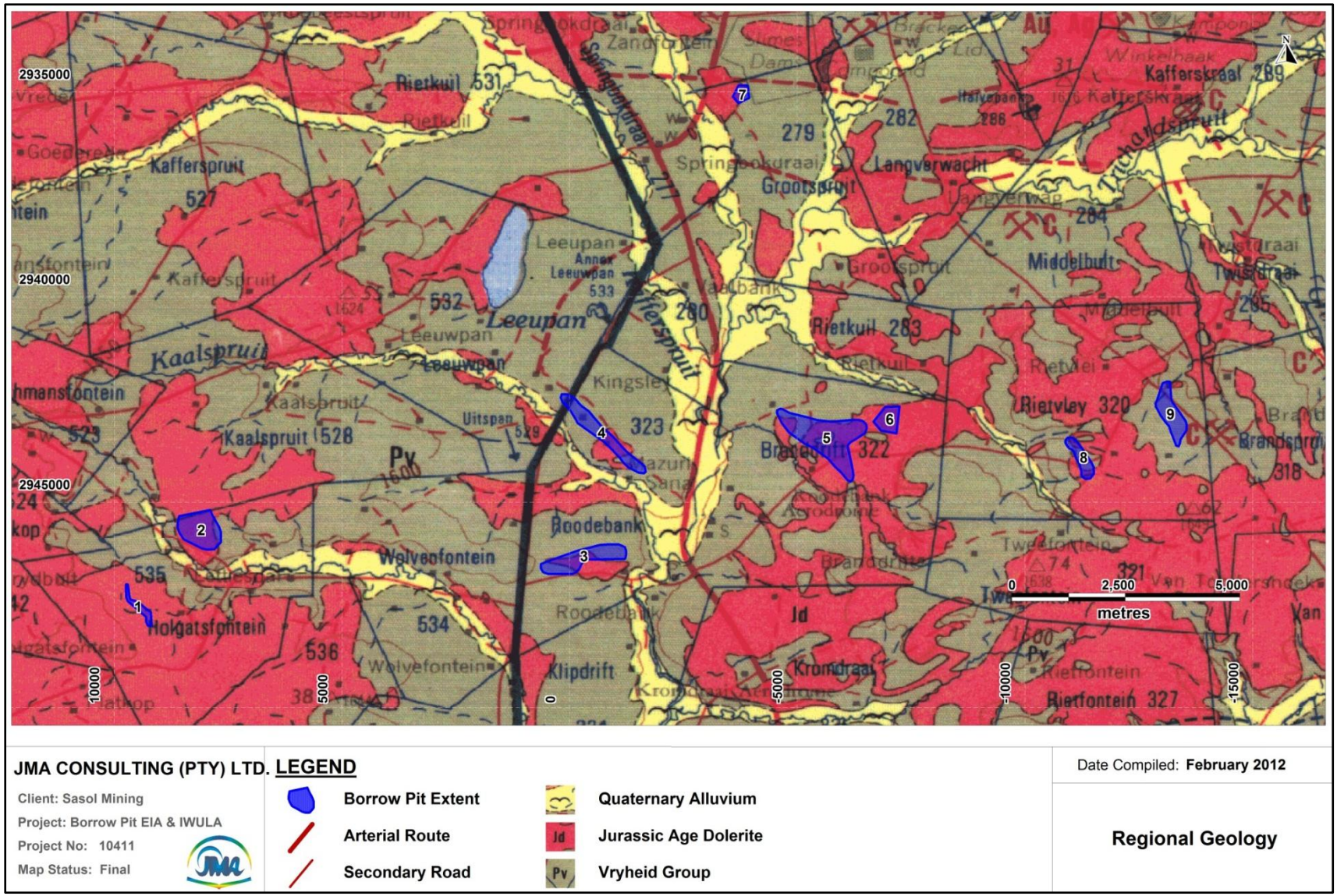


Figure 5.4.2 (a): Regional Geological Map

5.4.3 Local Geology at Borrow Pits

The dolerites in the Mpumalanga Province are highly variable with regard to weathering and composition and are known to exhibit rapid weathering characteristics. This characteristic should be further investigated and tested before the dolerite is considered for use in the structural layers of roads for example.

Tests pits were excavated within the study area during the geotechnical assessment of the dolerite conducted by Jones & Wagener as well as Knight Pièsold and all the profiles were logged by an engineering geologist according to the recognised South African practices.

During the geotechnical assessments several potential dolerite borrow pit sources were investigated in detail and are comprehensively described in the geotechnical reports compiled by Jones & Wagener in July 2010 (Report No.: JW161/09/C293-Rev0) and by Knight Pièsold in September 2011 (Report No.: KHH1887/3110011701).

The geological profile conditions recorded for 9 delineated Borrow Pits as extracted from the two Geotechnical reports are summarised below. In all cases the metre value given refers to a thickness of the relevant horizons. Most test pits were excavated to depths of 2.5 mbgl to 3.0 mbgl.

Borrow Pit 1

Borrow Pit 1 is located immediately downslope of the boulder outcrop that defines the prominent ridge on Portion 19 of Holgatsfontein 357IR. The geological profile encountered in this area comprised:

- 0.8 m thick moist, black, soft, granular-textured, sandy clay and roots with scattered slightly weathered, hard rock, boulders up to 500 mm in size. The thickness of this horizon can extend to 1.4 m, which is underlain by
- 1.7 m thick slightly moist, olive to yellow brown, dense, relict jointed, silty medium and fine doleritic sand. This horizon tends to grade into a coarse and medium grained, silty sand with depth and laterally down slope until, within the lower sideslope, a coarse grained, silty sand derived from a spheroidally weathered, "sugar dolerite" is encountered. The thickness varied between 1.7 m and 2.7 m.

Borrow Pit 2 and Borrow Pit 3

These sources comprise approximately 0.6 m of black clay overlying a residual friable "sugar" dolerite with angular gravels to a depth of approximately 2.0 mbgl. A portion of each of these sources has been excavated probably to supply gravel bearing course material for the district roads in the area. At Borrow Pit 3, the overlying transported material comprises clayey sand and some blending of this hillwash material with the dolerite could be considered.

Borrow Pit 4 and Borrow Pit 5

These sources generally comprise a hillwash horizon of clayey sand to sandy clay that ranges in thickness from 0.1 m to 1.0 m and overlies an angular dolerite gravel in a clayey sand matrix to a depth of approximately 1.5 mbgl.

Borrow Pit 6

Borrow Pit 6 falls within Zone 5 of the Borrow Pit investigation areas investigated by Knight Pièsold. Within this zone sandy clay to silty sand topsoil covers the surface down to a depth of between 0.2 mbgl and 0.3 mbgl. Hillwash generally occurs to a depth less than 1.0 mbgl, although thicker layers (up to a maximum depth of 2.2 mbgl) do occur. Residual dolerite generally occurs from a depth of 0.7 mbgl and increases in gravel content towards the bottom of the layer. The dolerite bedrock comprises of soft rock, which excavates as a gravel for at least 0.5 m depth, where medium hard rock caused TLB refusal.

The average thickness of the usable material (residual dolerite and soft rock dolerite) is 1.5 m. If the medium hard rock (on which refusal of the TLB occurred) is included via heavy ripping, the thickness may increase to 2.0 m.

Borrow Pit B7

Borrow Pit falls within Zone 2 of the Borrow Pit investigation areas investigated by Knight Pièsold. Within this zone the residual dolerite soils comprises of a low to moderate clay content in the upper limits of the soils layer and classifies as G8 or poorer quality material. With an increase in depth the sand and gravel content increases and the material classifies as G6 or G7 quality material. Sandy clay topsoil covers the zone and has an average thickness of between 0.2 m and 0.5 m. The sandy, silty hillwash generally occurs at depths varying between 0.8 mbgl and 1.3 mbgl. The residual dolerite occurs below the transported soil and has a variable particle size distribution. It is generally a finer grained material close to surface, which grades with depth to a more sandy, becoming gravelly towards bedrock.

The average thickness of the residual dolerite at Borrow Pit 7 is 1.6 m and if the medium hard rock (on which the TLB refused excavation) is excavated via heavy ripping, the thickness may increase to 2.0 m.

Borrow Pit 8 and Borrow Pit 9

These sources generally comprise a hillwash horizon of clayey sand to sandy clay that ranges in thickness from 0.1m to 1.0m and overlies an angular dolerite gravel in a clayey sand matrix to a depth of approximately 1.5mbgl.

5.4.4 Engineering Properties of the Dolerite

The properties of the dolerites are highly variable, not only between the individual sources but also within individual sources. Two basic types of weathered dolerite are generally considered preferable materials for construction requirements within the Secunda area. These are namely:

- A friable silty sand to fine gravel ("sugar dolerite"); and a
- Angular medium hard rock gravel and cobbles in a clayey sand matrix.

The in-situ friable dolerite is represented by a spheroidally weathered dolerite that generally excavates as a slightly clayey fine medium and coarse sand with fine gravels and scattered boulders. This material is often irregularly developed as it grades with depth into the angular, blocky dolerite. The friable sources are primarily at Borrow Pits 1, 2 and 3.

The highly weathered, closely jointed, weathered dolerite primarily excavates as angular, medium hard rock, gravel and cobbles in a clayey sand matrix. The gravel : matrix ratio tends to range from about 50 : 50 to 80 : 20. The fines component that would act as a binder may therefore be limited.

Images of the friable "sugar" dolerite and the angular hard rock dolerite gravel are indicated in Figures 5.4.4 (a) and 5.4.4 (b) respectively. The images were obtained from the geotechnical report compiled by Jones & Wagener in July 2010 (Report No.: JW161/09/C239 – Rev 0).

The potential borrow areas are either located on residual friable dolerite or on angular dolerite gravel. The materials are highly variable and classify as G8 to G6. In many instances, the CBR values generally satisfied G6 requirements but the Plasticity Index exceeded the specified limit and this resulted in the G8 classification.

The residual dolerite to refusal depth of the TLB characteristically excavates as an angular gravel in a clayey sand matrix. The dolerite gravels typically range from 20 mm to 150 mm in size, are angular and soft rock to medium hard rock. The larger fragments are likely to break down during handling and compaction. These residual dolerites are non-expansive.

The weathered friable "sugar" dolerite and the angular dolerite provide the most suitable sources of dolerite (borrow) material. However, in all the samples tested, the plasticity index (PI) of the natural material tends to be high. A reduction in the plasticity can be achieved by adding lime. Typically such material responds favourably to lime stabilisation to control the plasticity. The lime stabilisation (2% and 3% by weight) undertaken on representative samples indicated that the plasticity index reduced significantly and resulted a semi-plastic value.

Figure 5.4.4 (a): Images of Friable "Sugar" Dolerite

Figure 5.4.4 (b): Images of Angular Hard Rock Dolerite Gravel

On stabilising with 2% lime, the plasticity index is reduced significantly and the material is improved to G6 and G7 classification requirements. The matrix material is however clayey and therefore good control is required during the addition and blending of lime into the dolerite gravel to ensure uniform mixing and blending.

The high Plasticity values may be due to the release of clay (smectite) on exposure and during handling and therefore locally exhibit rapid weathering characteristics. The addition of lime will have a positive influence by reacting with the available clay and thereby not only improving the durability but also reducing the Plasticity.

5.4.5 Mineralogy and Geochemistry

Dolerite is an inert igneous intrusive rock with predominantly medium sized crystals. The dolerite has a basic composition with a total silica content of less than 55%, with the quartz content usually less than 10%. Dolerite consists of calcium-rich plagioclase feldspar and pyroxene, with olivine and magnetite also sometimes present.

5.4.6 Manner of Potential Environmental Impacts

The geological sequences present at the Borrow Pits represent the actual resource to be mined. The usable dolerite will be excavated and removed down to depths probably not exceeding 2 mbgl. Only the topsoil, as well as the un-usable overburden, will remain on site and will be replaced during rehabilitation.

Apart therefore from the removal of the dolerite, no other geological related impacts are expected to occur.

Due to the fact that all the excavated/disturbed geological materials are inert, the mining will not result in any geochemically controlled impact.

5.5 GROUND WATER

The ground water base line study conducted by JMA Consulting (Pty) Ltd entailed a regional and quantitative site specific investigation pertaining to the geohydrology of the Borrow Pits study area, in accordance with the various guidelines and documents obtained from the regulating authorities as required for EIA's, EMPR's and IWULA's.

5.5.1 Investigative Methodology

The approach and methodology that was followed during the geohydrological investigation is discussed below:

- Obtain, collate, verify and review existing geological, geohydrological and mining information – regional information as well as information contained in old and current EMPR's.
- Verify the existing geological information within the study area. A wealth of information has been obtained from the Sasol Geology Department which will be used. Additional geological investigative boreholes will therefore not be drilled for this study.
- An extensive ground water study was conducted across the north eastern region of the study area. The information obtained from the previous study will therefore be used to describe the ground water baseline environment within the study area.
- Compile base maps for geohydrology.
- Compile a comprehensive ground water base line description including the regional geohydrological setting, physical aquifer description, hydraulic aquifer description, aquifer dynamics, aquifer hydrochemistry, aquifer classification, and ground water use.

5.5.2 Regional Geohydrology

The regional geohydrology of the study area is discussed with reference to the available information relevant to the map extract displayed as Figure 5.5.2 (a). This map extract is a clipped region of the published 1:500 000 Hydrological Map Series of the Republic of South Africa, Sheet 2526 Johannesburg, 1999.

The regional geohydrological attributes of the study area are clearly a function of the geological formation distribution. Two distinctly separate surface stratigraphic sequences (Pe and Jd) occur within the study area, each with their own geohydrological manifestations. Both sequences outcrop extensively and interchangeably across the extent of the study area.

<u>Geohydrological Zone 1: Permian Age Ecca Group Sedimentary Lithologies</u>

The surface geology within the central extent of the study area is predominantly underlain by the argillaceous rocks (shale, mudstone and siltstone) and arenaceous (sandstone) of the Ecca Group – denoted by Pe on Figure 5.5.2 (a).

Figure 5.5.2 (a): Regional Geohydrological Map

The primary ground water occurrences within this zone are in joints and fractures associated with the contact zones, related to the heating and cooling of the country rock, caused by the intrusions of the dolerite dykes and sills. Ground water is also extensively present within the weathered zones of the Ecca Group lithologies.

The borehole yielding potential within this geohydrological zone is classified as d2, which indicates an average yield which varies between 0.1 l/s to 0.5 l/s, although much larger yields are often associated with more localized contact zones.

The aquifer type is classified as intergranular and fractured, and no large scale ground water abstraction is indicated to occur from these aquifers within the bounds of the study area. The ground water potential for the western area is given as between 40 and 60%, which indicates the probability of drilling a successful borehole (yield > 0.1 l/s) whilst the probability of obtaining a yield in excess of 2 l/s is given as between 0% and 20%.

Geohydrological Zone 2: Jurassic Age Dolerite

The surface geology to west, east and discontinually distributed throughout the central parts of the study area consists almost of ultramafic to mafic Jurassic Age Dolerite Intrusives – denoted by Jd on Figure 7.1.5(a).

The primary ground water occurrences within this zone are in joints and fractures associated with the contact zones, related to the heating and cooling of the intrusive bodies as well as in the contact zones with the host rock. The borehole yielding potential within this geohydrological zone is predominantly classified as d2, which indicates an average yield which varies between 0.1 l/s to 0.5 l/s, although much larger yields are often associated with more localized contact zones.

The aquifer type is classified as intergranular and fractured, and no large scale ground water abstraction is indicated to occur from these aquifers within the bounds of the study area. There is however a localized area within the dolerite to the east of the study area, that is classified as d3, indicating that the average yield varies between 0.5 and 2.0 l/s. The aquifer type is still classified as intergranular and fractured.

The mean annual recharge (MAR) to the ground water system within the study area is estimated to be between 25 mm and 50 mm per annum, which relates to about 5% of the mean annual precipitation (MAP). The ground water contribution to surface stream base flow is relatively low, estimated to be less than 25 mm per annum. The aquifer storativity (S) for the fractured aquifers in this part of the study area is estimated to be between 0.001 and 0.01. The saturated interstice types (storage medium) are fractures which are restricted principally to the zone directly below the ground water level. The pristine ground water quality is good with a Total Dissolved Solids (TDS) range of between 300 mg/l to 500 mg/l. The ground water is classified to be of the hydrochemical type B, with dominant cations Ca^{2+} and Mg^{2+} and dominant anion being HCO_3^-.

5.5.3 Regional Historical Mining

It is indicated that coal has been and is currently being extensively mined within the study area by underground mining operations. Gold and silver have been mined to the north of the study area as well. The extent of the coal mining is confined to the lithologies of the Vryheid Formation of the Ecca Group and has taken place predominantly by underground mining operations.

The underground mining operations typically take the form of standard board and pillar operations. The two economically exploitable coal seams within the study area are namely the No. 4 Lower Coal Seam and the No. 2 Coal Seam. The exploitable coal seams occur at average depths of around 190 and 235 meters below the surface respectively. These coal seams are thus located at much greater depths than the shallow weathered zone aquifer.

Dolerite will be mined from the borrow pits at the surface and that the extent thereof is thus limited according to the extent of the dolerite intrusions.

5.5.4 Physical Aquifer Description

During a recent geohydrological investigation, a total of 30 geohydrological investigative and monitoring borehole pairs were drilled to the north-east of the study area. The shallow boreholes (SSW) were drilled to a depth that fully intersected the shallow weathered zone aquifer(s) and the deep boreholes (SDF) were drilled to depths that ranged between 80 mbgl and 150 mbgl. The shallow boreholes were drilled in order to investigate the conditions within the shallow weathered zone aquifers whilst the deep boreholes were drilled to investigate potential deep fractured aquifer(s).

The shallow weathered zone aquifer(s) were sealed off in the deep boreholes (SDF) with 30 m solid steel casing and sealed with cement and bentonite at the surface. The solid casing installed in the shallow boreholes (SSW) ranged in depth between 2 m and 12 m, averaging at 6 m. The borehole logs and site reports as well as multi-parameter profiles for these boreholes were recorded and will be attached as APPENDICES to the Ground Water Specialist Report in support of the EIAR.

In addition to information obtained from these boreholes, geohydrological and hydrochemical information from over 170 external user's boreholes (inclusive of 28 monitoring boreholes used for observation purposes by Kinross, Winkelhaak and Leslie Gold Mines Ltd), 1 dug well and 16 fountains were obtained during the various hydro-census'.

5.5.4.1 Aquifer Matrix (Soil and Geological Matrix)

The surface of the study area consists predominantly of overburden and moderately deep dark brown to black, sandy clay soils formed from the weathering of the underlying lithologies. The soils have an average thickness of around 0.5 m, with a clay content dependant on the host rock material from which the clay formed. The host rock lithologies within the study area consist of Jurassic Age dolerite intrusions as well as sedimentary lithologies of the Vryheid

Formation. Numerous rocky outcrop areas occur within the study area as well, indicating the limited weathering of the more resistant lithologies.

The Vryheid Formation forms part of the Ecca Group of the Karoo Supergroup, and consists of interbedded sandstone, mudstone and shale layers. Carbonaceous shale and coal layers are generally associated with the Vryheid Formation as well. Up to 5 coal seams have been recorded in the Vryheid Formation within the study area, of which the No.2 and the No.4 coal seams are the most economically important. The Ecca Group lithological units lie unconformably on top of the tillites of the late Carboniferous to early Permian Dwyka Group, which forms the base of the Karoo Supergroup.

The dolerite present within the study area is younger than the Vryheid Formation and intruded into and through the sedimentary rocks of the Vryheid Formation. The dolerite intrusions typically occur as dykes and sills and are often responsible for the devolatization of the coal adjacent to the dolerite intrusions. Dolerite is a hard, igneous rock, which due to its physical properties has been largely used a building aggregate material used during the construction of foundations of various infrastructures.

5.5.4.2 Aquifer Types (Primary, Weathered, Fractured, Karst)

There are three major aquifer types present within the extent of the study area, namely:

- isolated shallow weathered zone perched aquifers
- shallow weathered zone aquifers
- deep fractured Karoo aquifers (zone below the weathered zone)

It is a known fact that different piezometric pressures exist both at depth, and for different aquifer units. The perched aquifer usually displays unconfined conditions, whilst the shallow weathered zone aquifer displays unconfined to semi-unconfined conditions, and the deep aquifer predominantly confined conditions. It is typical for Karoo type aquifers (both shallow weathered zone and deep) that the shallow part of an aquifer exists with a higher potential for exploitation, than the deeper aquifers.

The shallow perched aquifers are essentially restricted to the soil (soft overburden) horizon and have a very limited vertical depth. These aquifers are however laterally very extensive and are exposed to unconfined atmospheric conditions.

The host rocks of the other two aquifer types are the Karoo sediments as well as the dolerite intrusions. The nature and physical parameters of these aquifers are dependent on the occurrence, geometry, size, spatial extent as well as the fracturing status (of both the dolerite and Karoo lithologies) associated with the intrusions. For example, dolerite dykes and sills may form aquifer boundaries or act as ground water conduits, depending on their size as well as their weathering and fracturing conditions. In essence, the characteristics of all three aquifer systems may vary depending on the localized conditions.

Ground water flow in all three aquifer types is essentially horizontal, however, interconnection between the aquifer types, can introduce non-horizontal flow components. The ground water flow within the aquifers occurs primarily as a result of advection caused by gravity. Ground water flow in underground sections, which are not fully flooded, is also gravitational and therefore controlled by the mine floor contours, and only become pressure controlled when fully flooded.

5.5.4.3 Aquifer Zones (Unsaturated, Saturated)

With reference to the available geological information from exploration boreholes, supplemented with data obtained during drilling of the geohydrological monitoring boreholes to the north-east of the study area, the physical thicknesses for the three different aquifer types, are summarized in Table 5.5.4.3 (a).

Table 5.5.4.3 (a): Aquifer Zone Thickness

Aquifer Type	Aquifer Depths (mbgl)	Saturated Thickness (m)
Shallow Perched Aquifer	0 m to 6.4 m	-
Shallow Weathered Zone Aquifer	6.4 m to 15.2 m	3.9 m to 15 m
Deep Karoo Aquifer	15.2 m to 165 m	74 m to 108 m

It is evident from Table 5.5.4.3 (a) that the shallow perched aquifer is underlain by the shallow weathered zone aquifer which is further underlain by the deeper Karoo aquifer. The thickness of these aquifers is dependent on the water levels as well as the depth of the interface between the weathered/fractured zones and the fresh host rock lithologies.

The borrow pits will extend to a maximum depth of up to 2.5 m and indicate that the pits will fall within the perched aquifers if present or within the shallow weathered zone aquifer if the perched conditions at the pits are absent. Due to the unconfined to semi-unconfined nature of the isolated perched and more laterally extensive shallow weathered zone aquifers within the study area, these aquifer zones are expected to be the most vulnerable to surface induced impacts associated with borrow pits.

The unsaturated zone thickness of the perched and shallow weathered zone aquifer is defined at the top by the surface and the bottom by the ground water level (water table) if present in each of the two aquifer systems. The saturated thickness of the perched aquifers is defined at the top by the ground water level and the bottom by the depth of the confining clay layers.

The saturated thickness of the shallow weathered zone aquifers are defined at the top by the ground water level as well, but are defined at the bottom by the depth of the weathered and weathering related fracturing depth of the host rock lithologies.

5.5.4.4 Lateral Aquifer Boundaries (Physical, Hydraulic, Arbitrary)

The delineation of the lateral aquifer boundaries within the study area define the ground water zone which can potentially be influenced by the borrow pit activities. In the undisturbed environment the ground water zone of influence may be defined and delineated by three principle types of lateral aquifer boundaries, namely physical, hydraulic and arbitrary aquifer boundaries.

- **Physical Aquifer Boundaries** are defined by linear geological intrusions (dykes) or geological contacts between rocks with different geohydrological attributes.
- **Hydraulic Aquifer Boundaries** are defined by dams, rivers and streams, or alternatively by surface water and ground water divides.
- **Arbitrary Aquifer Boundaries** are selected in terms of ground water flow directions and are usually chosen parallel to the ground water flow direction.

Due to the limited depth to which the borrow pits will be excavated as well as the isolated localities of the pits, several smaller lateral aquifer boundaries were delineated for each of the borrow pits as opposed to one large lateral aquifer boundary.

The lateral aquifer boundaries are delineated on Figure 5.5.4.4 (a) and are individually discussed below.

Borrow Pit 1:

The northern, eastern and southern boundaries adjacent to Borrow Pit 1 represent hydraulic aquifer boundaries all of which have been selected along the intermittent and non-perennial streams and rivers. The south-western aquifer boundary represents a hydraulic aquifer boundary as well and has been selected along the ground water divide to the south west of Borrow Pit 1.

Borrow Pit 2:

The western, southern and eastern boundaries adjacent to Borrow Pit 2 represent hydraulic aquifer boundaries all of which have been selected along the intermittent and non-perennial streams including the Wolwespruit (South-Eastern Boundary). The northern aquifer boundary is a hydraulic aquifer boundary as well and has been selected along the ground water divide to the north of Borrow Pit 2.

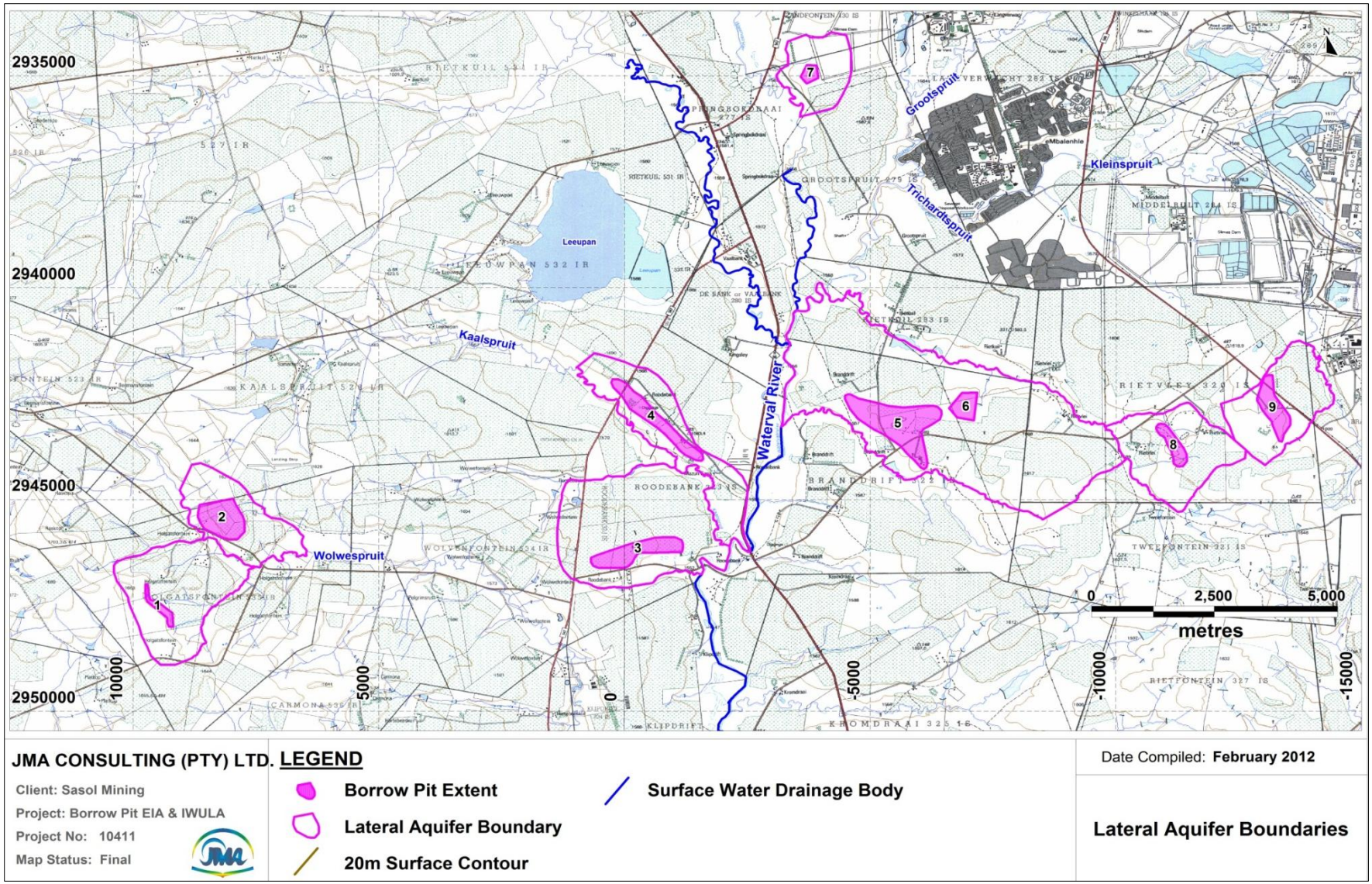


Figure 5.5.4.4. (a): Lateral Aquifer Boundaries

Borrow Pit 3:

The north-western, northern, eastern and southern boundaries adjacent to Borrow Pit 3 represent hydraulic aquifer boundaries all of which have been selected along the intermittent and non-perennial streams including the Kaalspruit (Eastern Boundary). The south-western aquifer boundary represents a hydraulic aquifer boundary as well and has been selected along the ground water divide to the west of Borrow Pit 3.

Borrow Pit 4:

The western to south-western and eastern aquifer boundaries adjacent to Borrow Pit 4 represent hydraulic aquifer boundaries which have been selected along the non-perennial Kaalspruit (Western and South-Western Boundary) and Waterval River (Eastern Boundary). The northern aquifer boundary represents a hydraulic aquifer boundary which been selected along the ground water divide to the north of Borrow Pit 4.

Borrow Pit 5 and Borrow Pit 6:

The northern, western and southern boundaries adjacent to Borrow Pits 5 and 6 represent hydraulic aquifer boundaries all of which have been selected along the non-perennial streams as well as the Waterval River (Western Boundary). The south-eastern aquifer boundary represents a combined hydraulic and arbitrary boundary which has been partially selected two intermittent streams up gradient from Borrow Pits 5 and 6.

Borrow Pit 7:

The eastern boundary represents a hydraulic aquifer boundary which has been selected along the ground water divide to the east of Borrow Pit 7. The southern and western aquifer boundaries are also hydraulic aquifer boundaries and have been selected along ephemeral and non-perennial streams to the south and west of Borrow Pit 7. The north-western aquifer boundary is initially selected along the non-perennial stream along the south western section and further by an intermittent drainage line, both of which represent hydraulic aquifer boundaries.

Borrow Pit 8:

The northern, western and southern boundaries adjacent to Borrow Pit 8 represent hydraulic aquifer boundaries all of which have been selected along the intermittent and non-perennial streams. The eastern aquifer boundary represents a hydraulic aquifer boundary as well and has been selected along the ground water divide to the east of Borrow Pit 8.

Borrow Pit 9:

The northern, eastern and southern boundaries adjacent to Borrow Pit 9 represent hydraulic aquifer boundaries all of which have been selected along the intermittent and non-perennial streams. The western aquifer boundary represents a hydraulic aquifer boundary as well and has been selected along the ground water divide to the west of Borrow Pit 9.

5.5.5 Preferential Ground Water Flow Zones

The presence of the dolerite intrusions as well as the underground mining activities, are expected to affect the ground water flow of the area. During underground mining operations, ground water is removed from the aquifers and ultimately lowers the ground water level of the aquifer. This is known as "dewatering" and may have a significant impact on the ground water flow directions as well as the ground water flow velocities. The degree of impact is related to the volume of ground water extracted, the extent to which as well as the depth at which the dewatering takes place.

Fresh dolerite is impermeable and if the extent thereof is sufficiently continuous, ground water will not be able to pass through the dolerite intrusives may from ground water barriers. The highly permeable zone adjacent to the dolerite intrusions and country rock (Karoo Sediments), known as the contact zone, may be highly fractured. This contact zone generally has a high secondary porosity and may form a preferential ground water flow zone. The degree of fracturing as well as the interconnectivity of the fractures in this zone determines the effect that it may have as a preferential ground water flow zone.

5.5.6 Hydraulic Aquifer Description

The hydraulic aquifer description relates to the parameters which determine the hydraulic ground water properties, such as the occurrence, availability, storage and movement of the ground water within the shallow weathered zone aquifer systems present within the study area. The hydraulic aquifer description will be based on information obtained from previous documents as well as the information generated during the drilling and geohydrological investigation to the north-east of the study area, as well as the information obtained from previous hydrocensus'.

5.5.6.1 Borehole Yields

It is reported that the yields expected from the isolated perched aquifers are low, seasonal and range between 0.01 l/s and 0.3 l/s. The borehole blow yields recorded from the boreholes drilled during the geohydrological investigation to the north-east of the site varied substantially between 0.1 l/s and 6.1 l/s.

Analyses of the water strike information indicate that 81 % of the water strikes occurred at depths between 11 m and 33 m (Shallow Weathered Zone Aquifer), while their reported yields ranged between 0.16 l/s and 6.11 l/s, with an average yield of 1.33 l/s. 19% of the water strikes ranged in depth between 40 m and 80 m (Deep Karroo Aquifer), while their reported yields ranged roughly between 0.25 l/s and 1.66 l/s, with an average blow yield of 0.93 l/s.

The reported blow yields for 96 of the external user's boreholes identified during the hydrocensus' ranged between 0.01 l/s and 8.3 l/s, with an average blow yield of 1.27 l/s. Statistical analyses of all water yielding borehole data - considered to represent the shallow weathered zone aquifer - calculates to an average yield of roughly 1.36 l/s.

Analyses of all the water yielding borehole data considered representing the deep Karoo aquifer calculates to an average yield of roughly 0.62 l/s.

5.5.6.2 Aquifer Permeability/Transmissivity

The hydraulic conductivity or permeability (k) of an aquifer is a measure of the ease with which ground water can pass through the aquifer system. The permeability is defined as the volume of water discharged from a unit area of an aquifer under a unit hydraulic gradient per unit time (expressed as m/day). The permeability of the aquifer was determined by analysing the rate of change in the water level of the shallow weathered zone aquifer during a permeability (slug) test.

Slug tests were performed in 13 of the shallow boreholes (SSW-Group) and 14 of the deep boreholes (SDF-Group), ranging in depth between 80 - 150 m, to determine the hydraulic conductivity representative of the aquifers within the study area. A statistical summary of the permeability's calculated for the Shallow Weathered Zone Aquifers and Deep Karoo Aquifers are listed in Table 5.5.5.2 (a) and Table 5.5.5.2 (b) respectively.

Table 5.5.5.2 (a): Shallow Weathered Zone Aquifers Permeability

Description of statistical analyses	Hydraulic conductivity (m/day)
Minimum value	0.0003 m/day
Maximum value	6.250 m/day (fault zone)
Arithmetic Mean	0.060 m/day
Geometric Mean	0.018 m/day
Harmonic Mean	0.003 m/day
Value for Shallow Weathered Zone Aquifer	**0.015 m/day**

Table 5.5.5.2 (b): Deep Karoo Aquifers Permeability

Description of statistical analyses	Hydraulic conductivity (m/day)
Minimum value	0.001 m/day
Maximum value	5.819 m/day (fault zone)
Arithmetic Mean	0.023 m/day
Geometric Mean	0.007 m/day
Harmonic Mean	0.002 m/day
Value for deeper Fractured Karoo Aquifer	**0.004 m/day**

The calculated permeability results indicate that the permeability of the Shallow Weathered Zone Aquifers vary substantially between 0.0003 m/day and 6.250 m/day, and that the permeability of the Deep Karoo Aquifers were higher and varied between 0.001 m/day and 5.819 m/day. The permeability's assigned to the two aquifer systems were 0.015 m/day and 0.004 m/day for the Shallow Weathered Zone Aquifers and the Deep Karoo Aquifers respectively.

5.5.6.3 Aquifer Storativity

The storativity (S) of an aquifer is defined as the volume of water that an aquifer releases from, or takes into, storage per unit surface area of the aquifer per unit hydraulic gradient.

The storativity of the Karoo Aquifers within the study area was obtained from literature and is taken to be approximately 0.005. The saturated interstice types or storage medium of the aquifer are the interstices and fractures present below the ground water level, as a result of weathering and the weathering related fractures of the host rock and dolerite intrusives.

5.5.6.4 Aquifer Porosity

The porosity of an aquifer is the ratio of the void space to the total volume of the aquifer. The porosity gives is an indication of the amount of water in the subsurface, but does not represent the volume that can be released from or taken into storage. The ratio between the volume of water that can be drained from the aquifer and the total volume of the aquifer is referred to as the effective porosity.

Based on the data obtained from the hydrogeological assessment conducted to the north-east of the study area, an average effective porosity for the shallow weathered zone is calculated as 3.6 %, whilst the average effective porosity for the deep Karoo aquifer zone is calculated as 0.58 %.

5.5.7 Aquifer Dynamics

Attributes described under Aquifer Dynamics relate to transient (time dependent) parameters and include ground water recharge, ground water level fluctuations, ground water flow directions and ground water flow velocities.

5.5.7.1 Rainfall Recharge

The mean annual precipitation (MAP) across the study area as recorded from the Bethal Monitoring Station is 711 mm per annum. The recharge to the shallow weathered zone aquifers within the study area will occur primarily through infiltration of the rain water and surface water bodies.

Surface areas covered by thick soils represent areas with low recharge values, areas covered by alluvium represent areas with medium recharge values and the areas in which rocky outcrops occur and where shallow soils are present represent surface areas with high recharge potentials. The bulk recharge to the aquifer is taken as between 2% and 5% of the MAP, which is calculated to be between 14.2 mm/annum and 35.5 mm/annum.

5.5.7.2 Ground Water Level Fluctuation

Ground water levels were recorded at 151 boreholes to the north-east of the study area. Ground water levels were recorded for the shallow weathered zone aquifers as well as the deep Karoo aquifers.

The depth to water level measured in the boreholes that monitored the shallow weathered zone aquifers, varied between 0.27 m and 26.44 m, with an average depth to the ground water level of 6.49 m. Shallower than average ground water levels are only recorded within the shallow weathered zone aquifers in low lying areas close to surface drainage features or wetlands.

The depth to water level measured in 74 external user's boreholes ranged between 0.05 m and 27.19 m, with an average depth to the ground water level of 6.23 m. It therefore appears that external users' boreholes essentially tap into the shallow weathered zone aquifers.

The depth to water level measured in the boreholes that monitored the deep Karroo Aquifers, varied between 0.24 m and 73.86 m, with an average depth to the ground water level of 14.56 m.

Fluctuations in ground water levels occur as a result of either ground water abstraction (decline in ground water levels) and/or ground water recharge (rising ground water levels). The magnitude of the fluctuations is a function of the aquifer storativity and the amount of abstraction or recharge.

For the Borrow Pits project, due to the shallow nature of the excavations (expected to be above the ground water table) the main interest relates to possible rises in ground water table which would cause ground water seepage into the open pits. Recharge from rainfall has been estimated at a maximum of 5% for the study area, which if applied to the wettest month of the year (average rainfall of 116.24 mm in January), calculates to 5.8 mm.

Using the estimated Storativity value of 0.005 for the area, a maximum ground water level fluctuation of 1.16 m is calculated. Superimposed on the average ground water level depth in the shallow weathered zone aquifers of 6.49 m, it implies the shallowest expected depth to ground water table to be 5.33 m, which is still well below the proposed maximum excavation depth of 2.5 m.

5.5.7.3 Ground Water Flow Velocities

The ground water gradients within the delineated lateral aquifer boundaries for the nine Borrow Pits range between 0.01 and 0.13. The overall average gradient is estimated at 0.02. The Table below indicates the expected ground water seepage velocities for the area:

Table 5.5.7.3 (a): Ground Water Seepage (Flow) Velocities

Gradient	Permeability (m/day)	Effective Porosity	Seepage Velocity (m/day)	Seepage Velocity (m/year)
0.01	**0.015**	**0.036**	**0.004**	**1.52**
0.02	**0.015**	**0.036**	**0.008**	**3.04**
0.13	**0.015**	**0.036**	**0.054**	**19.77**

5.5.7.4 Ground Water Flow Directions

Due to the nature of shallow weathered zone aquifers, the ground water elevation contours within the weathered zone essentially mimic those of the surface topography. It can therefore be stated that the natural regional ground water flow directions (in areas not impacted by underground mining activities), will be perpendicular to the surface topography contour lines and down towards the tributaries and rivers.

Using the 5 m interval surface topography elevation contours obtained from the ortho-photos, ground water flow directions were postulated within the delineated ground water boundaries for the study areas. The ground water flow direction maps are shown in Figure 5.5.7.4 (a) through Figure 5.5.7.4 (e) for the nine Borrow Pits.

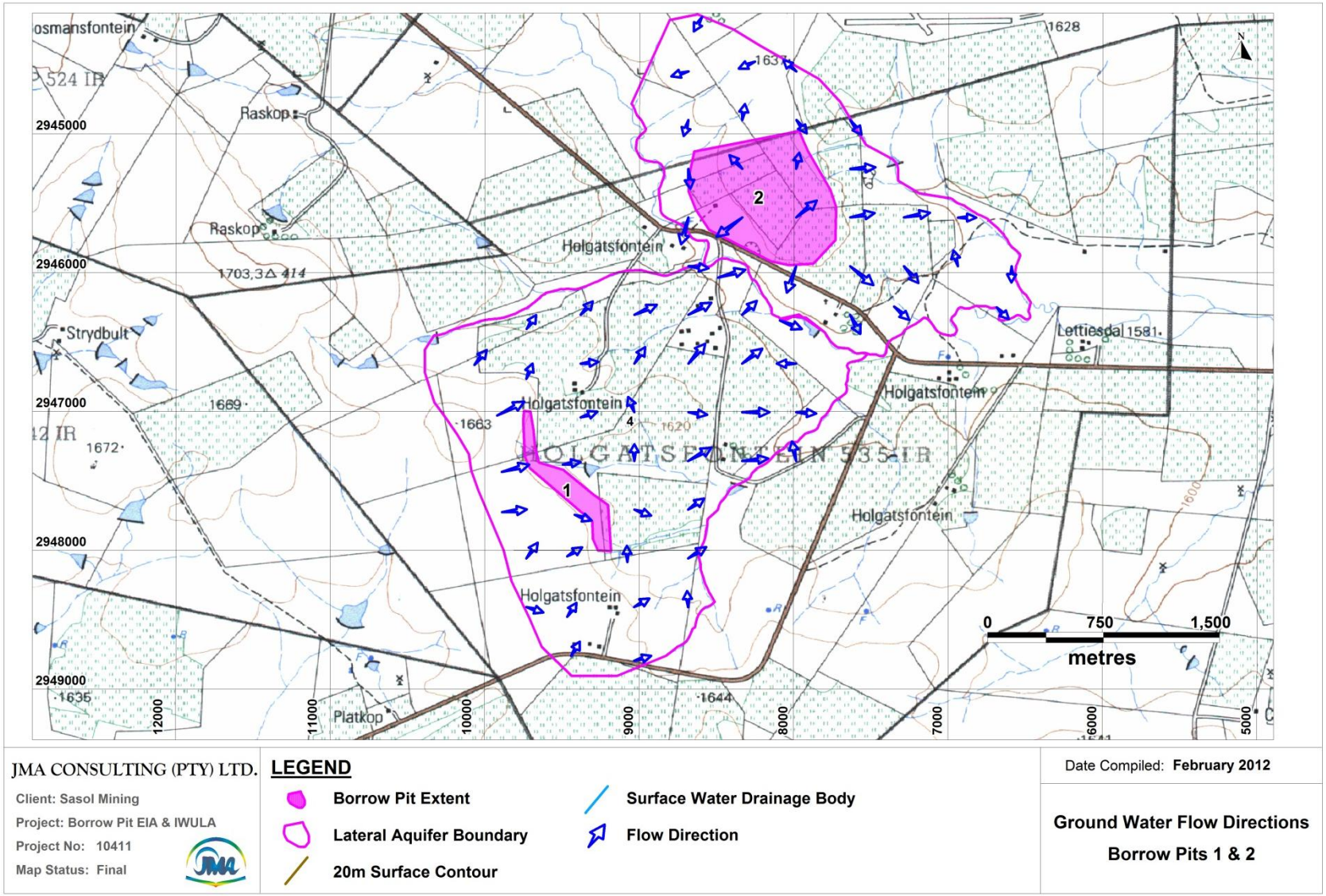


Figure 5.5.7.4 (a): Ground Water Flow Directions for Borrow Pit 1 and Borrow Pit 2

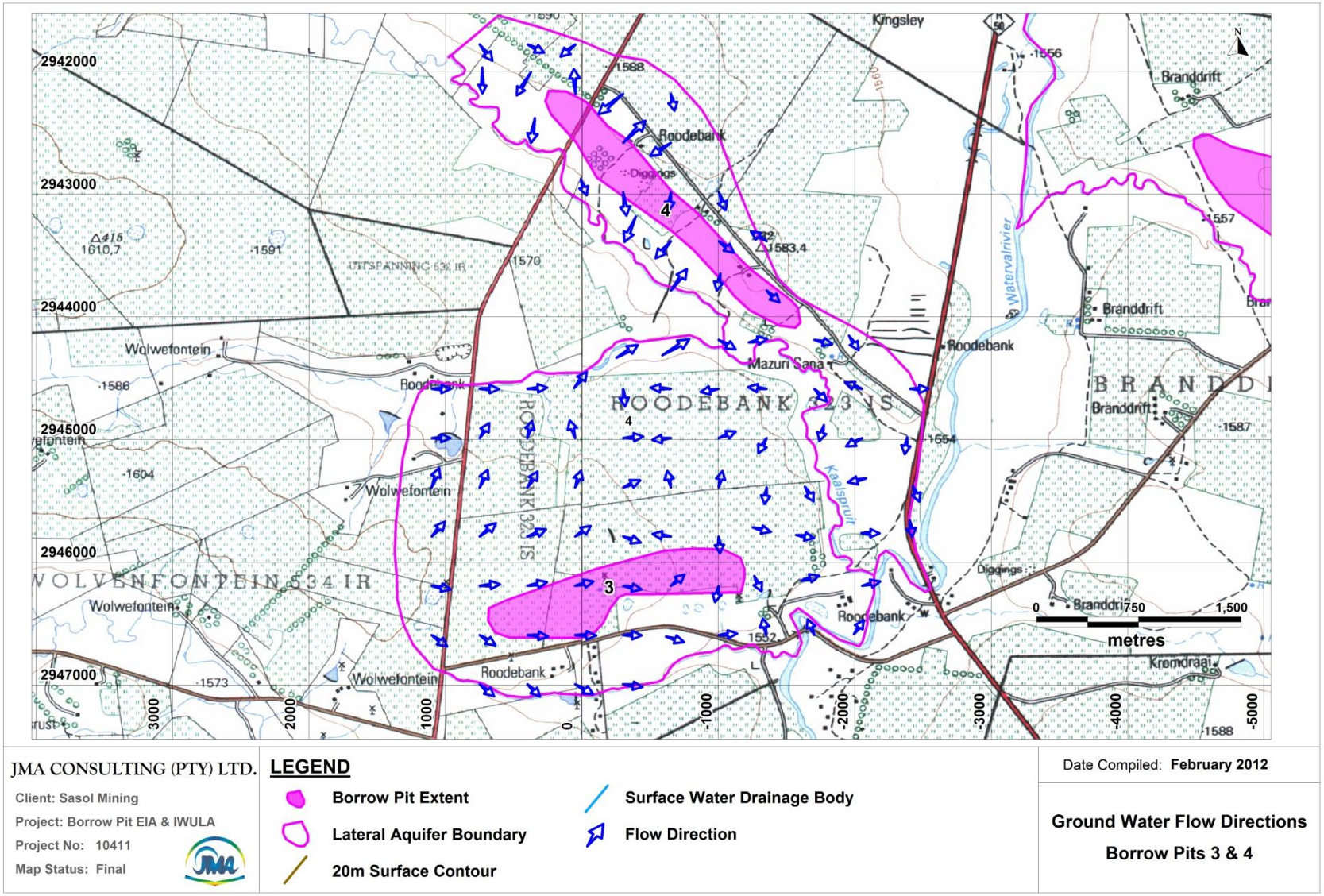


Figure 5.5.7.4 (b): Ground Water Flow Directions for Borrow Pit 3 and Borrow Pit 4

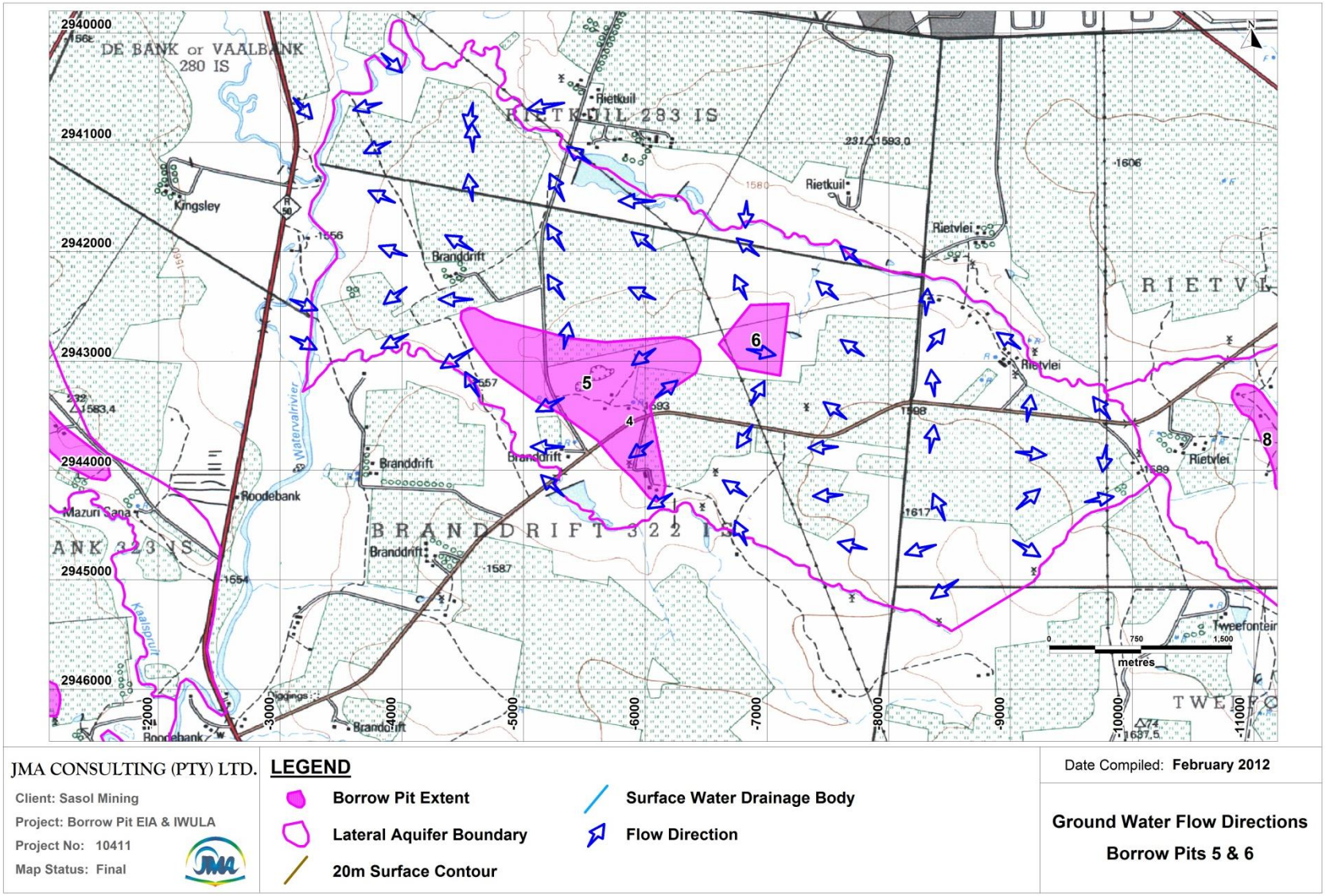


Figure 5.5.7.4 (c): Ground Water Flow Directions for Borrow Pit 5 and Borrow Pit 6

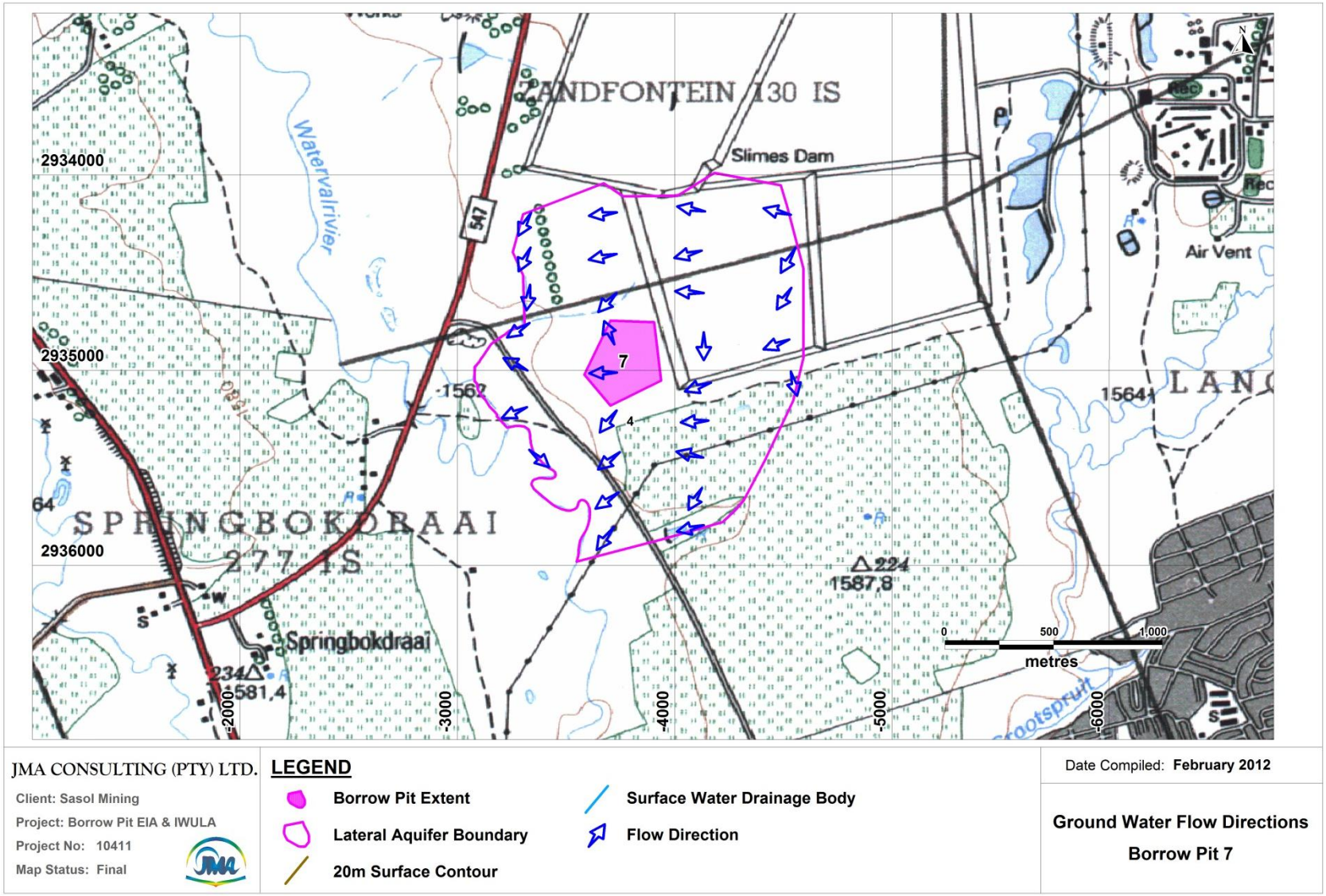


Figure 5.5.7.4 (d): Ground Water Flow Directions for Borrow Pit 7

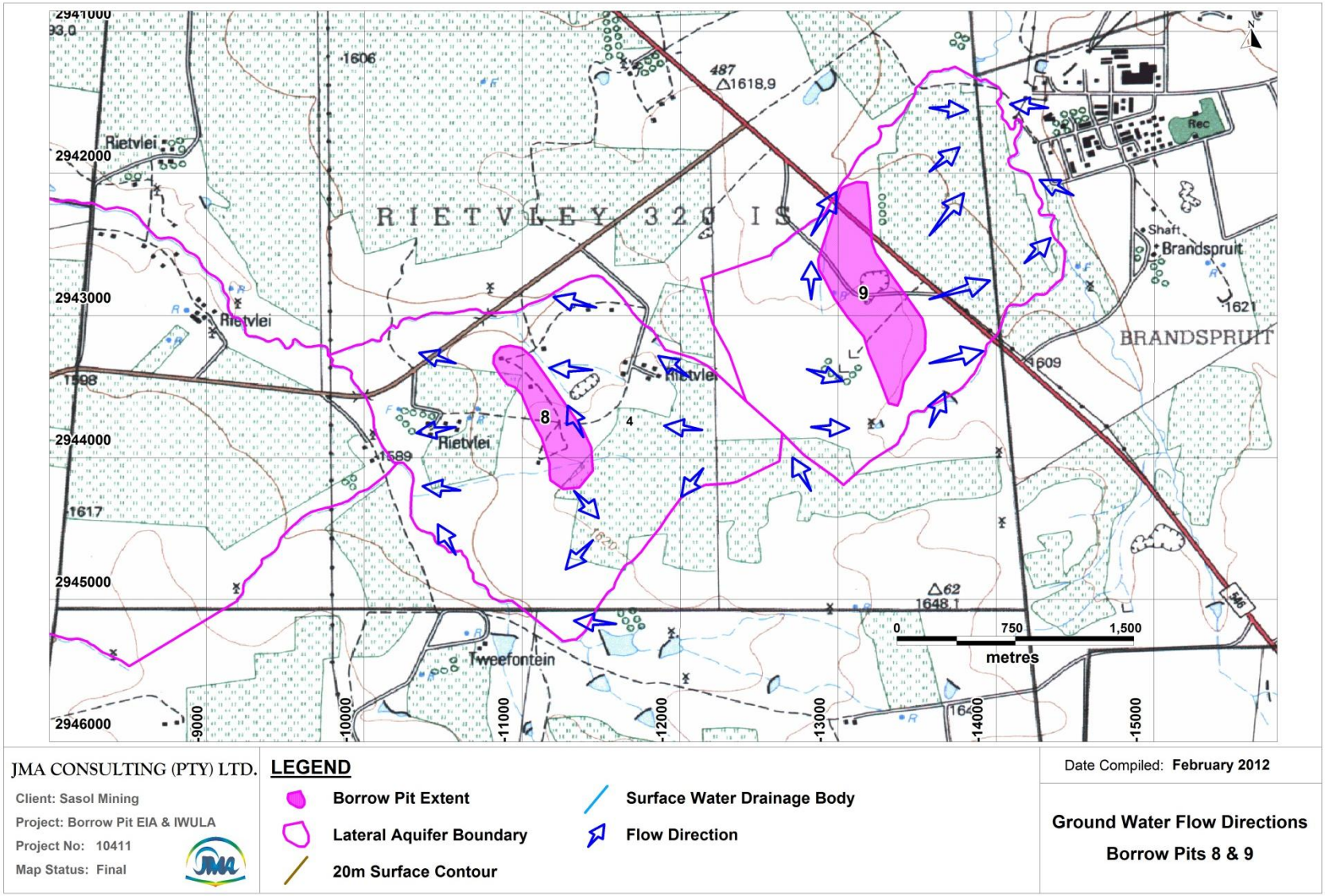


Figure 5.5.7.4 (e): Ground Water Flow Directions for Borrow Pit 8 and Borrow Pit 9

5.5.8 Aquifer Hydrochemistry

The hydrochemistry of the aquifer is discussed with reference to the information obtained from the numerous hydrocensus' conducted to the north-east of the study area.

5.5.8.1 Background Ground Water Quality

The assessment of the background ground water quality was based on data obtained from the water samples collected during the hydrocensus' and previous geohydrological investigations conducted within the study area.

The ground water samples were submitted to an accredited laboratory and were analysed for the following parameters: pH, EC, TDS, Ca, Mg, Na, K, Si, F, Total Alkalinity, Cl, SO_4, NO_3, Al, Fe and Mn. Due to the nature of the environment adjacent to several of the boreholes, the geochemistry of several boreholes was not used as the ground water quality at these boreholes had been affected by anthropogenic surface activities and do therefore not represent the background ground water quality.

Hydro-chemical imaging was used as a first screening tool, to eliminate boreholes, possibly influenced by any pollution source. This also meant that boreholes close to pollution sources (surface and sub-surface) were carefully scrutinised and discarded from this study group, if deemed necessary. After a statistical evaluation of Electrical Conductivity (EC) values, all boreholes with EC values in excess of 100 mS/m were discarded. Ground water samples that are affected by mining-related pollution have lower pH values, and ground water samples that were classified as having non-compliant or marginally compliant pH values were therefore discarded as well. Elevated SO_4 and Fe concentrations are also indicators of possible mining-related contamination of the ground water.

It should however be noted that the due to the nature of aquifer and associated lithologies (naturally occurring Fe in the Karoo aquifers, as well as the weathering of dolerite dykes and sills), Fe is in fact naturally elevated in the ground water systems within the study area as well. Because of this, only SO_4 was used as a further screening tool, discarding all boreholes with SO_4 values exceeding 20 mg/l. Indicators, including NO_3 and Cl, were used to assess possible agricultural related influences, on external users' boreholes and springs. Some influences from agricultural activities were found, in the form of elevated NO_3 levels.

A summary of the background ground water quality is listed in Table 5.5.8.1 (a). The variable concentrations listed in Table 5.5.8.1 (a) have been assessed with regards to the SANS 241:2006 Drinking Water Standard.

The SANS 241:2006 Drinking Water Standard specifies two compliance classes namely Class I and Class II. The Class I variable concentrations indicate those which are considered to be "acceptable for lifetime consumption" and indicate the recommended compliance limit. The Class II variable concentrations are considered to represent an acceptable drinking water quality if "consumed for a limited period of time" and indicates the maximum allowable limit for a limited duration of time.

This class specifies a water quality range that poses an increasing risk on consumers, dependant on the concentration of the variable within the specified range. Variable concentrations that exceed the Class II concentrations are deemed as unfit for human consumption.

Ground water variable concentrations that fall within the stipulated Class I concentrations are indicated in **green** and are interpreted as having a "Full Compliance" quality with regards to the SANS 241:2006 Drinking Water Standard. Variables concentrations that fall within the stipulated Class II concentrations are indicated in **orange** and are interpreted as having a "Marginal Compliance" quality with regards to the SANS 241:2006 Drinking Water Standard. Variables concentrations that exceed the stipulated Class II concentrations are indicated in **red** and are interpreted as having a "Non-Compliance" quality with regards to the SANS 241:2006 Drinking Water Standard.

Table 5.5.8.1 (a): Background Ground Water Quality Summary

Element / Parameter	Min Value	Mean Value	Max Value	Range
pH	**7.30**	**7.78**	**8.50**	1.20
EC (mS/m)	**24**	**69**	**98**	74
TDS (mg/l)	**138**	**433**	**608**	470
Ca (mg/l)	**4.3**	**34.9**	**72.0**	67.7
Mg (mg/l)	**1.3**	**20.5**	**48.0**	46.7
Na (mg/l)	**14**	**90**	**187**	173
K (mg/l)	**1**	**4**	**27**	26
Cl (mg/l)	**8**	**3**	**80**	72
SO_4 (mg/l)	**1.47**	**10.69**	**19.00**	17.53
NO_3 (mg/l)	**0.20**	**0.75**	**3.30**	3.10
F (mg/l)	**0.08**	**0.49**	**1.40**	1.32
Al (mg/l)	**0.02**	**0.80**	**3.93**	3.91
Fe (mg/l)	**0.03**	**4.26**	**18.00**	17.98
Mn (mg/l)	**0.01**	**0.06**	**0.32**	0.31

The summary of the interpolated background ground water quality listed in Table 5.5.8.1 (a) indicates that average background ground water quality has fully compliant concentrations for the elements pH, E, TDS, Ca, Mg, Na, K, Cl, SO_4, NO_3, F and Mn with regards to the SANS 241:2006 Drinking Water Standard. The average Al and Fe concentrations, however have non-compliant qualities with regards to the same standard. Al and Fe had the most elevated concentrations in the background ground water samples, followed by NO_3 and Mn.

Hydrochemical imaging was performed for the samples that were used to determine the background ground water quality within the study area. Piper and Durov diagrams were compiled using the macro chemistry variables pH, EC, Ca, Mg, Na, K, Total Alkalinity, Cl, SO_4 and NO_3. The resulting Piper and Durov Diagrams depicting the background ground water hydrochemical image are shown in Figure 5.5.8.1 (a) and Figure 5.5.8.1 (b) respectively.

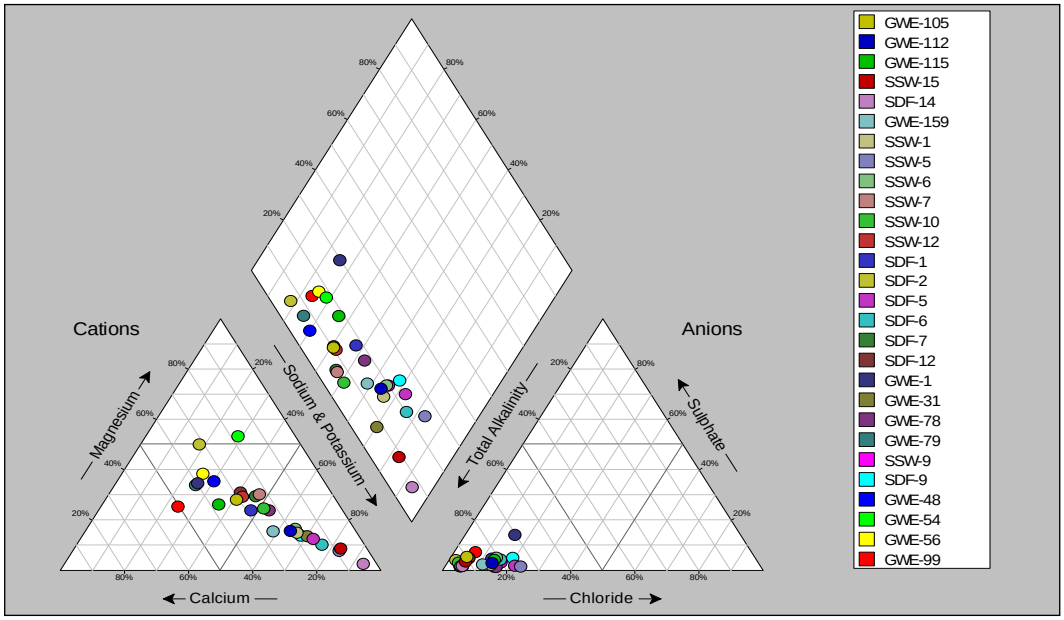


Figure 5.5.8.1 (a): Background Ground Water Piper Diagram

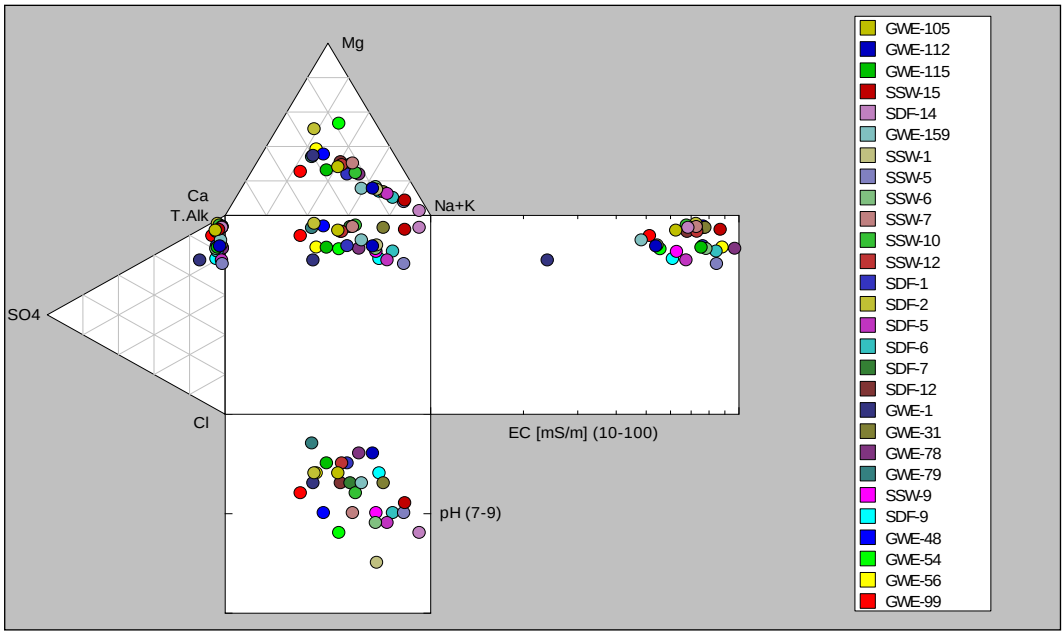


Figure 5.5.8.1 (b): Background Ground Water Durov Diagram

The Piper and Durov Diagrams indicate that the ground water is classified as having a distinctly Type B and Type C hydrochemical facie image. The dominant cations in the background ground water is variable, with most samples being dominant in Na+ K. Interesting to note is that the ratio between the equivalent Ca and Mg concentrations remains constant for most of the background ground water samples collected. The dominant anion in background ground water is distinctly bicarbonate (T.Alk).

Several of the background ground water samples had elevated NO^3 concentrations (not seen on the Piper or Durov Diagrams), indicating sporadic influences as a result of agricultural activities within the study area. Fe and Al values have elevated concentrations as well, which predominantly result from the influence of the adjacent host rocks.

The pH of the background ground water is slightly alkaline and ranges between 7.3 and 8.5 with an average pH of 7.78. The EC of the background ground water samples range between 24 mS/m and 98 mS/m, with an average EC value of 69 mS/m. The majority of the background ground water samples have EC values greater than 70 mS/m.

5.5.9 Aquifer Classification

The aquifer classification is done in accordance with the DWAF protocol "South African Aquifer System Management Classification, December 1995." Special attributes of aquifers related to structural features (such as fracturing along dyke/fault contact zones, or karst development) have been incorporated into the classification through the "Second Variable Classification".

Classification is done in accordance with the following definitions for Aquifer System Management Classes:

Sole Aquifer System:

An aquifer which is used to supply 50 per cent or more of domestic water for a given area, and for which there is no reasonably available alternative sources should the aquifer be impacted upon or depleted. Aquifer yields and natural water quality are immaterial.

Major Aquifer System:

Highly permeable formations, usually with a known, or probable, presence of significant fracturing. They may be highly productive and able to support large abstractions for public supply and other purposes. Water quality is generally very good (less than 150 mS/m Electrical Conductivity).

Minor Aquifer System:

These can be fractured or potentially fractured rocks which do not have a high primary permeability, or other formations of variable permeability. Aquifer extent may be limited and water quality variable. Although these aquifers seldom produce large quantities of water, they are important for local supplies and in supplying base flow for rivers.

Non-Aquifer System:

These are formations with negligible permeability that are regarded as not containing ground water in exploitable quantities. Water quality may also be such that it renders the aquifer unusable. However, ground water flow through such rocks, although imperceptible, does take place, and needs to be considered when assessing the risk associated with persistent pollutants.

Aquifer System Management and Second Variable Classifications

Aquifer System Management Classification		
Class	**Points**	**Shallow Weathered Zone Aquifers**
Sole Source Aquifer System:	6	-
Major Aquifer System:	4	-
Minor Aquifer System:	2	2
Non-Aquifer System:	0	-
Special Aquifer System:	0 – 6	-
Second Variable Classification – Mining Related Dewatering		
Class	**Points**	**Shallow Weathered Zone Aquifers**
High:	3	-
Medium:	2	-
Low:	1	-

The Karoo Aquifers present within the study area appear to have been locally impacted by underground mining operations as a result of dewatering. This is observed by the localized drop in the water levels across the study area.

Aquifer System Management Classification Points = **2**

Ground Water Quality Management Classification

Aquifer System Management Classification		
Class	**Points**	**Shallow Weathered Zone Aquifers**
Sole Source Aquifer System:	6	-
Major Aquifer System:	4	-
Minor Aquifer System:	2	2
Non-Aquifer System:	0	-
Special Aquifer System:	0 – 6	-
Aquifer Vulnerability Classification		
Class	**Points**	**Shallow Weathered Zone Aquifers**
High:	3	-
Medium:	2	-
Low:	1	-

Aquifer System Management Classification Points = **2**

The indicated level of ground water protection is derived from the Ground Water Quality Management Index (GQM Index).

GQM Index = Aquifer System Management Classification x Aquifer Vulnerability Classification

= 2 x 2

= **4**

Indicated Level of Ground Water Protection

GQM Index	Level of Protection	Karoo Aquifers
<1	Limited	-
1 - 3	Low Level	-
3 - 6	Medium Level	4
6 - 10	High Level	-
>10	Strictly Non-Degradation	-

Aquifer Protection Classification

The ratings for the Aquifer System Management Classification and Aquifer Vulnerability Classification yield a Ground Water Quality Management Index of 4 for the Shallow Weathered Zone Aquifers within the study area, indicating that **Medium Level** of ground water protection is required.

5.5.10 Ground Water Use

It is evident from previous ground water hydrocensus' conducted that a significant number of privately owned boreholes are present within the larger study area. Ground water abstracted within the study area is predominantly used for livestock watering and domestic purposes. The ground water within the study area supplies the necessary base flow for the rivers and springs within the study area.

5.5.11 Ground Water Reserve

The Ground Water Reserve is defined in the National Water Act (Act No. 36 of 1998) as "the quantity and quality of water required to satisfy the basic human needs by securing a basic water supply, as prescribed under the Water Services Act (Act 108 of 1997) for people to be supplied with water from that resource, and to protect aquatic ecosystems in order to secure ecologically sustainable development and use of water resources".

The Borrow Pit study area falls within the C12D and C12F quaternary catchment areas within the Upper Vaal Water Management Area of the Vaal Primary Catchment. In order to manage the ground water resources within South Africa a ground water quality and quantity reserve is required to be determined for each of the individual quaternary catchments. These reserves are issued upon the application of any new water use license application within the reserve and are therefore required to be continually updated as new applications are lodged.

The ground water reserve is obtained from the Department of Water Affairs (DWA) and includes ground water quality and quantity requirements that are to be complied with for each quaternary catchment. It was indicated upon request for the ground water reserves for the quaternary catchments C12D and C12F that there is no ground water reserve available for the quaternary catchment C12F. An approved ground water reserve has however been determined for the C12D quaternary catchment (Ref: 26/8/3/3/82).

5.5.11.1 Ground Water Quantity Reserve

Quaternary Catchment C12F

No Ground Water Quantity Reserve has been determined for the C12F quaternary catchment.

Quaternary Catchment C12D

The ground water reserve determined for quaternary catchment C12D (Ref: 26/8/3/3/82) stipulates that the quaternary catchment receives an estimated average annual ground water recharge of 27.7 million m^3 (Mm^3), of which 2.73 Mm^3/annum (9.85%) is required for the Reserve. It is further noted that the Reserve consists largely of the BHN (Basic Human Needs) component (63.74%) whereas the ecological component is relatively low (36.26%).

A summary of the Reserve determination (Ref: 26/8/3/3/82) is given in theTable below:

Table 5.5.11.1 (a): Ground Water Quantity Reserve

Catchment	Area (km^2)	Recharge (Mm^3/a)	Population	Baseflow (Mm^3/a)	EWR (Mm^3/a)	BHN Reserve (Mm^3/a)	Reserve as % of Recharge
C12D	898.3	27.7*	191 160	4.24**	0.99	1.74	9.85

***** **Estimated from GRAII Data**
****** **Estimated using the Herold Method (GRDM Version 3.3)**

5.5.11.2 Ground Water Quality Reserve

Quaternary Catchment C12F

No Ground Water Quality Reserve has been determined for the C12F quaternary catchment.

Quaternary Catchment C12D

The ground water quality component of the Reserve listed (Ref: 26/8/3/3/82) for the C12D quaternary catchment was determined from the statistical analysis between 27 and 32 data sets from the catchment and indicates that the reference ground water quality in quaternary catchment (C12D) falls within Class I of the DWA Water Quality Classification. It is indicated that Class I represents the water quality that suitable for domestic use.

It is noted that the ground water quality at specific sites may occasionally exceed the broader and generic ground water quality reserve determined for the catchment, due to the natural spatial quality variations dictated by the geology in which the water occurs. Under these circumstances, site specific data should be obtained and used to determine more representative local ambient ground water quality conditions for the site. This directorate should be notified of such incidence, so as to revise the Reserve accordingly.

The DWA Target Water Quality Classes are indicated in Table 5.5.11.2 (a) and was obtained from: Quality of Domestic Water Suuplies, Volume 1: Assessment Guide, 2nd Edition. 1998. Water Research Commission Report No: TT 101/98. Pretoria, South Africa.

Table 5.5.11.2 (a): Target Water Quality Classes

Chemical Parameter	Unit	Target Water Quality Range		
		Class 0	Class I	Class II
pH	-	6 - 9	5 - 6 & 9 - 9.5	4 - 5 & > 9.5 - 10
EC	mS/m	< 70	70 – 150	150 – 370
Ca	mg/l	< 80	80 – 150	150 – 300
Mg	mg/l	< 70	70 – 100	100 – 200
Na	mg/l	< 100	100 – 200	200 – 400
Cl	mg/l	< 100	100 – 200	200 – 600
SO_4	mg/l	< 200	200 – 400	400 – 600
NO_3 as N	mg/l	< 6	6 – 10	10 – 20
F	mg/l	< 0.7	0.7 – 1.0	1.0 – 1.5

The ground water reserve determined for the quaternary catchment C12D (Ref: 26/8/3/3/82) stipulates that no ground water abstraction may take place within 100 m of a river, spring or wetland. This distance may be further increased by the Regional Office if deemed necessary. Future license applications in this area should be referred to the Chief Director: Resource Directed Measures to verify the applicability of the level of Reserve determination in relation to the specific license application.

5.5.12 Manner of Potential Environmental Impacts

The proposed Borrow Pit quarrying can potentially impact on both the availability and quality of ground water.

Due to the fact that the Borrow Pits will only between 1.5 m and 2.5 m deep, none of them are expected to penetrated the ground water table of the shallow weathered zone aquifers. At worst they may intercept some perched aquifers, although no significant ground water seepages have been reported in the geotechnical reports. Based on this, the only impact that these Borrow Pits could have on the ground water availability, relates to influences on ground water recharge to the underlying aquifers.

From a ground water quality perspective the only possible impacts would be if spillages of diesel and oil occur within the Borrow Pits during the operational phase, which if not cleared up immediately, could cause ground water pollution.

5.6 SURFACE WATER

5.6.1 Scope of Work and Investigative Methodology

Sasol Mining wishes to operate 9 Dolerite Borrow Pits in support of construction activities related to their Impumelelo and Shondoni expansion projects. Jones & Wagener Consulting Engineers was appointed by JMA Consulting requested to conduct a Surface Water Specialist Assessment in support of the technical information requirements for the NEMA and MPRDA EIA processes as well as the NWA IWULA process.

The scope of work in terms of the surface water base line assessment is outlined below:

The objective of the baseline study is to characterise the surface water regime at the proposed development site and the catchments in which it resides, in terms of surface water quality and quantity. The surface water quality and quantity are assessed as follows:

- The water quality upstream and downstream of the proposed development area is characterised prior to the onset of any potential impacts from the activities.
- The water quantity baseline assessment defines the flows in the streams (mean annual runoff and dry weather flows), flood magnitudes and floodlines.

The Sasol Mining Borrow Pits Project consists of a number of dolerite Borrow Pit quarries situated to the south west of Secunda, in the Mpumalanga Province. The locality plan can be seen in Figure 5.6.1 (a).

At the onset of the project, the proposed number of Borrow Pits was 10, but subsequent to the finalization of the Figures and Maps for this base line report, Sasol Mining has indicated that 1 of the proposed Borrow Pits will no longer be included in the application. The original Borrow Pit 2 was removed from the application and some of the remaining Borrow Pits were re-numbered. The Table below indicates the old and new numbers. Although the Figures in this base line description still carries the old numbers, the text has been adapted to reflect the new numbers as will be used in the application. The Figures will be updated for the EIA phase of this project.

Table 5.6.1 (a): New Number Allocation for 9 Borrow Pits

Original Number	New Allocated Number
Borrow Pit 1	Borrow Pit 1
Borrow Pit 2	Removed by Sasol Mining
Borrow Pit 3	Borrow Pit 2
Borrow Pit 4	Borrow Pit 3
Borrow Pit 5	Borrow Pit 4
Borrow Pit 6	Borrow Pit 5
Borrow Pit 7	Borrow Pit 6
Borrow Pit 8	Borrow Pit 8
Borrow Pit 9	Borrow Pit 9
Borrow Pit 10	Borrow Pit 7

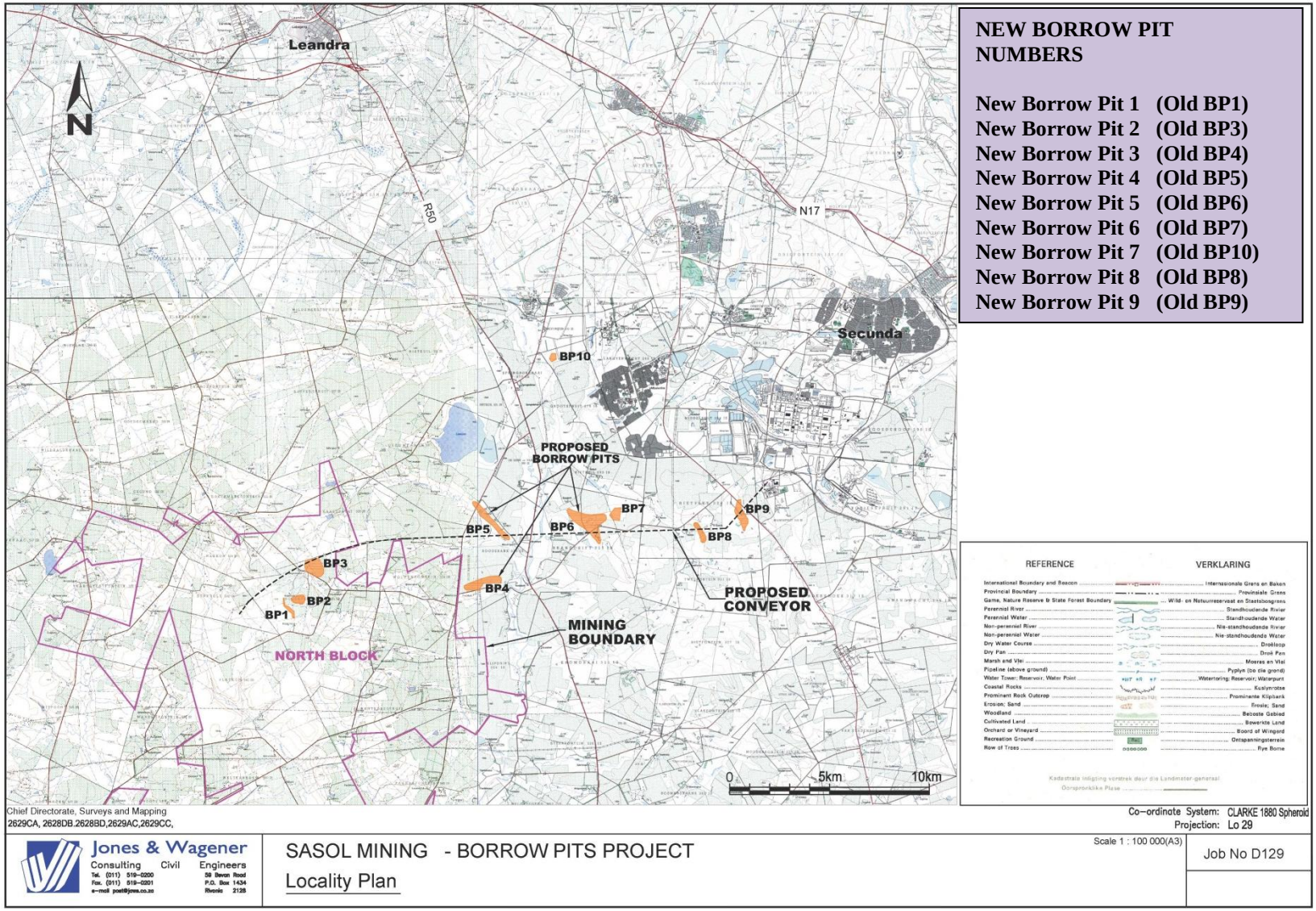


Figure 5.6.1 (a): Locality Plan (Old Borrow Pit Numbers)

The surface water specialist study entails an assessment of the baseline surface water environment in the vicinity of the proposed Borrow Pit locations. This is to characterise the surface water regime at the proposed development site and the catchment in which it resides, in terms of surface water quality and quantity.

The methodology used to assess the surface water quality and quantity is outlined below:

Water Quality

- Water quality data for the majority of the watercourses potentially affected by the Borrow Pits was taken directly from recent EIAR's compiled in the area.
- Where additional water quality data was required, grab sampling was carried out as part of the current study. Additional sampling was undertaken at two locations.
- The grab samples were delivered to an accredited laboratory for analysis.
- The analysis results were then collated and interpreted in relation to the expected potential impacts and current water quality guidelines/ standards.

Water Quantity

- Data from local rainfall stations were obtained and analysed for input into the peak flow calculations, as well as the runoff modelling.
- Catchments were delineated using the 1:50000 series topographical maps, as well as survey data provided by the client. Catchment characteristics were determined from the maps, site visits and aerial photography.
- Peak flood flows were estimated using relevant methodologies.
- Digital terrain mapping (dtm) data were obtained from the client and were used, together with the peak flow values to determine the 1:50 year and 1:100 year floodlines for streams running adjacent to the proposed Borrow Pit locations.
- The mean annual runoff and dry weather flows for the tributaries of the Waterval River that lie adjacent to or in close proximity to the proposed Borrow Pit locations were modelled and compared with published values for the receiving water body, being the Vaal River for this site.

The baseline information is important for several reasons. These include assessment of possible impacts and setting of objectives for closure. However, for surface water it is also important that the mine is able to identify other point sources that may be impacting on surface water so that the origin of any future impacts can be identified.

AREA	DEFINITION
Sasol Mining Borrow Pit Areas	This area includes the Borrow Pits located within the Impumelelo North Block and Shondoni mine boundaries as well as along the Impumelelo conveyor route. There are 9 Borrow Pit areas in total which amount to 313 ha collectively.
Study Area	In terms of surface water, the study area covers the Borrow Pits themselves, as well as the watercourses adjacent to or in close proximity to the proposed Borrow Pits.

AREA	DEFINITION
Impumelelo and Shondoni Land Use Areas	The Impumelelo land use area includes the designated borrow pit areas within the mining boundary as well as along the conveyor route.
Area of Surface Disturbance	This refers to the area where the soil and vegetation will be physically disturbed due to proposed activities, i.e. the excavation in areas where borrow material will be obtained including associated infrastructure and access routes.
Dirty Water Management Area	The surface area where surface water will probably be impacted upon by excavation activities and thus will be contained in order to prevent spillage to the catchment.

5.6.2 Assumptions, Limitations and Exclusions

- The surface water assessment was carried out using survey data received from Sasol Mining, both during the original surface water study (2009) and the current study.
- The outlines of the proposed borrow pits, as indicated in Figure 5.6.1 (a) were also received from Sasol Mining.
- Existing floodlines determined from the original Impumelelo EMP were used. Additional floodlines were computed near Borrow Pit 6 as well as near Borrow Pit 3. These are not certified floodlines.

5.6.3 Climate

In terms of surface water, key aspects are the rainfall, evaporation, runoff and infiltration. In terms of the water balance, the rainfall and associated infiltration are important drivers to determine the overall water balance.

5.6.3.1 Mean Monthly and Annual Rainfall

The Daily Rainfall Extraction Utility, developed by the Institute for Commercial Forestry Research (ICFR) in conjunction with the School of Bio-resources Engineering and Environmental Hydrology (BEEH) at the University of KwaZulu-Natal, Pietermaritzburg, was used to obtain summary data for all rainfall stations within the vicinity of the proposed borrow pit areas. These data were assessed in terms of length of record, completeness of the data set, mean annual precipitation (MAP) and location with respect to the site and the catchment.

Key data extracted from the database for the three most reliable stations are shown in Table 5.6.3.1 (a). The ICFR database contains daily patched rainfall data for all official South African Weather Service (SAWS) stations, and includes data up to August 2000.

Table 5.6.3.1 (a): Key data for selected rainfall stations (ICFR database)

Station Number	Station Name	MAP (mm)	Length of Record
0440 885	Sandbaken	653*	1909-2000 (92 years)
0441 104	Bosmanspruit	630	1914-1975 (62 years)
0440 767	Val (SAR)	623	1905-1988 (84 years)

* This MAP value differs from that given in Table 7.1.2(b) as it is based on a different record length.

Mass plots were produced for each station. A mass plot is a graph showing the cumulative rainfall depth vs. time for the full rainfall record, and is a good indication of the reliability of the data set. A good mass plot should produce a straight line (with slight oscillations for seasonality). Any changes in slope indicate a potential problem in the data set. The mass plot for the Sandbaken station is shown in Figure 5.6.3.1 (a).

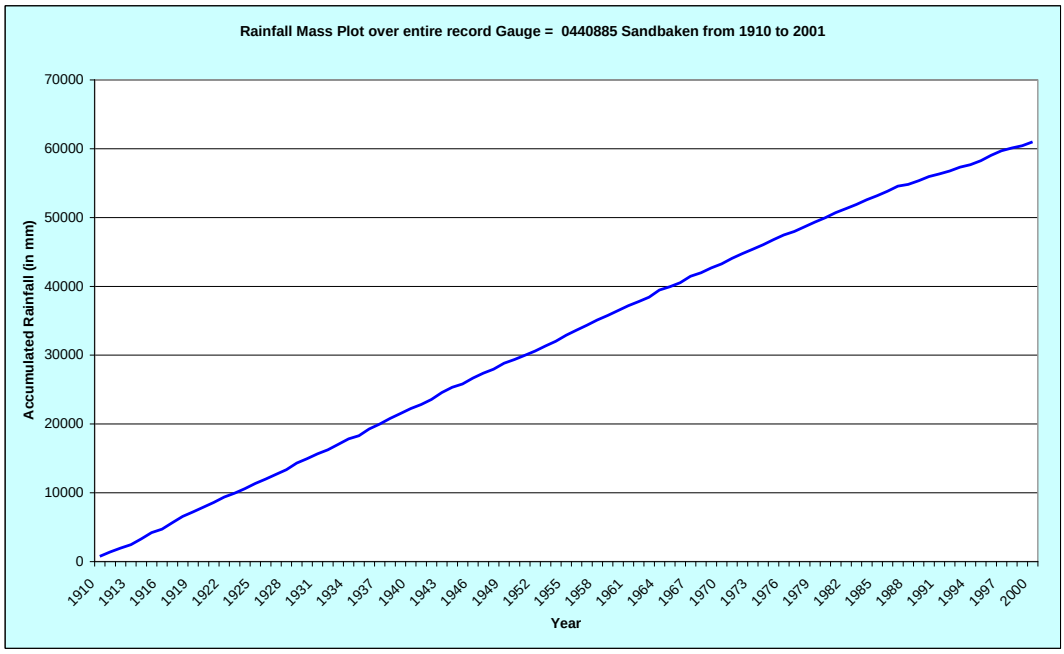


Figure 5.6.3.1 (a): Mass plot for Station 0440885 Sandbaken

Based on its proximity to the site (approximately 8 km from the centre of the Mine boundary as shown in Figure 5.6.3.1 (b) and its reasonable length of reliable record, station number 0440885 Sandbaken was selected as the representative rainfall data set for the site and was used for the floodline computations. Average monthly rainfall depths are presented in Table 5.6.3.1 (b).

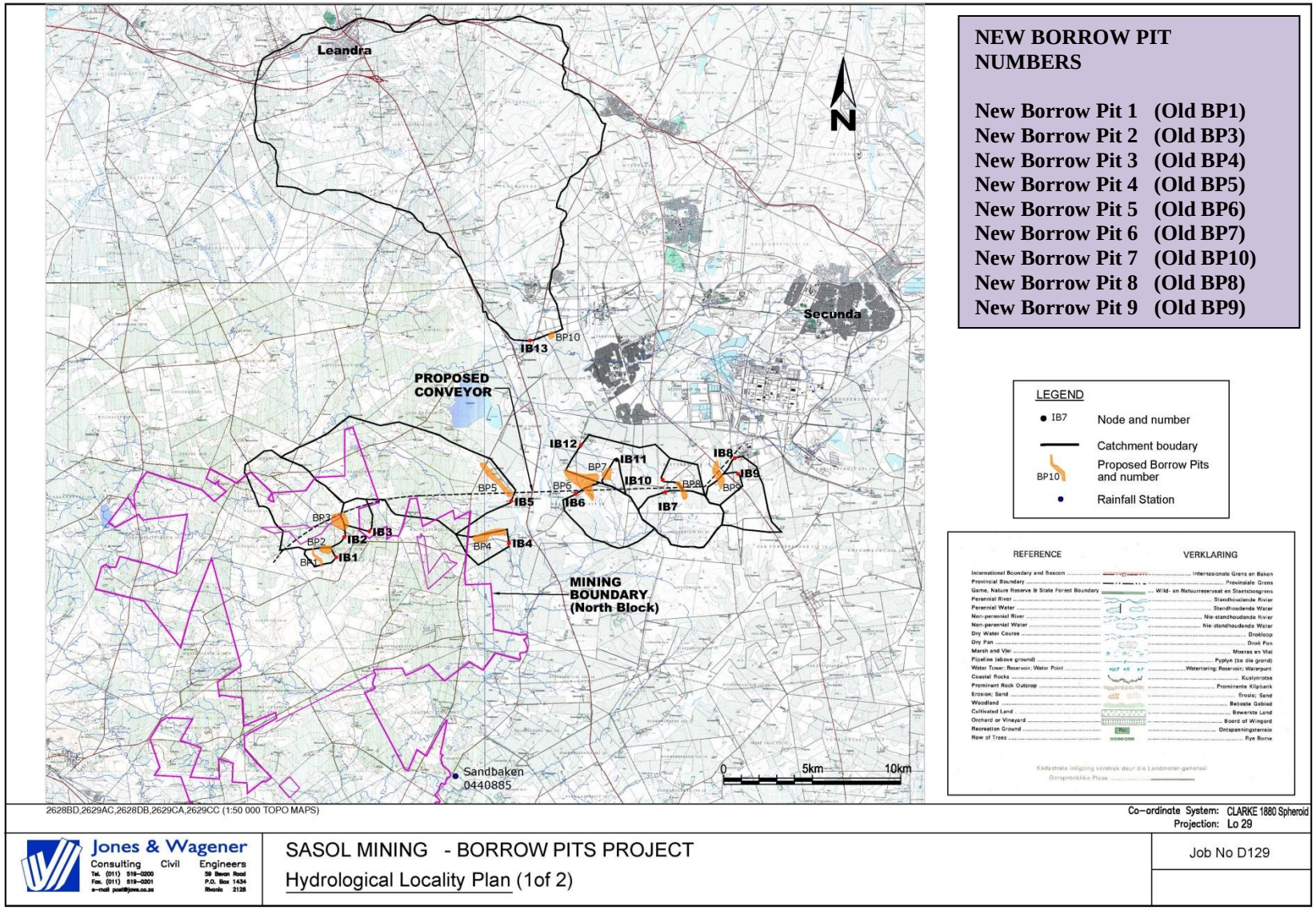


Figure 5.6.3.1 (b): Hydrological Locality Plan (1 of 2)

Table 5.6.3.1 (b): Average monthly rainfall depths for SAWS station 0440885 Sandbaken (based on the period 1910 to 2000)

Month	Average Rainfall (mm)
October	75.1
November	105.7
December	104.7
January	117.9
February	90.8
March	80.2
April	36.6
May	17.1
June	6.8
July	7.6
August	8.3
September	22.8
Mean Annual Precipitation	**673.6***

* This MAP value differs from that given in Table 7.1.2(a) as it is based on a different record length.

5.6.4 Surface Water Quantity

This section details the baseline surface water information related to water quantity, being rainfall, flood events and stream flow, in essence, the hydrology. The quantity of water under average and extreme rainfall conditions (wet and dry) is given below.

5.6.4.1 Hydrological Setting

The proposed Impumelelo and Shondoni Mines are situated some 37 km south west of Secunda. The designated borrow pit areas are located within the mine boundaries with the nearest Borrow Pit to Secunda Town located being 11 km to the south west. This can be seen in Figure 5.6.3.1 (b).

The designated Borrow Pit locations are situated adjacent to several tributaries of the Waterval River, Wolwespruit, Kaalspruit and Trichardtspruit. Each of these streams ultimately drains into the Waterval River, located on the eastern boundary of the proposed mining area. This is shown in Figure 5.6.3.1 (b) and Figure 5.6.4.1 (a).

The proposed Borrow Pits are located within quaternary sub-catchments C12D and C12F of the Vaal primary drainage region (Figure 5.6.4.1 (b)) taken from *"Surface Water Resources of South Africa – 1990"* Vol II (*Midgley, Pitman & Middleton, 1995*) (WR90)).

The proposed Borrow Pits (please take note of the new numbers) are indicated on Figure 5.6.3.1 (b) and 5.6.4.1(a) and are located on the farms Rietvley 320IS, Branddrift 322 IS, Roodebank 323 IS, Wolvenfontien 534 IR, Holgatsfontien 535 IR, Kaalspruit 528 IR, Zandfontien 130 IS and Grootspruit 279 IS.

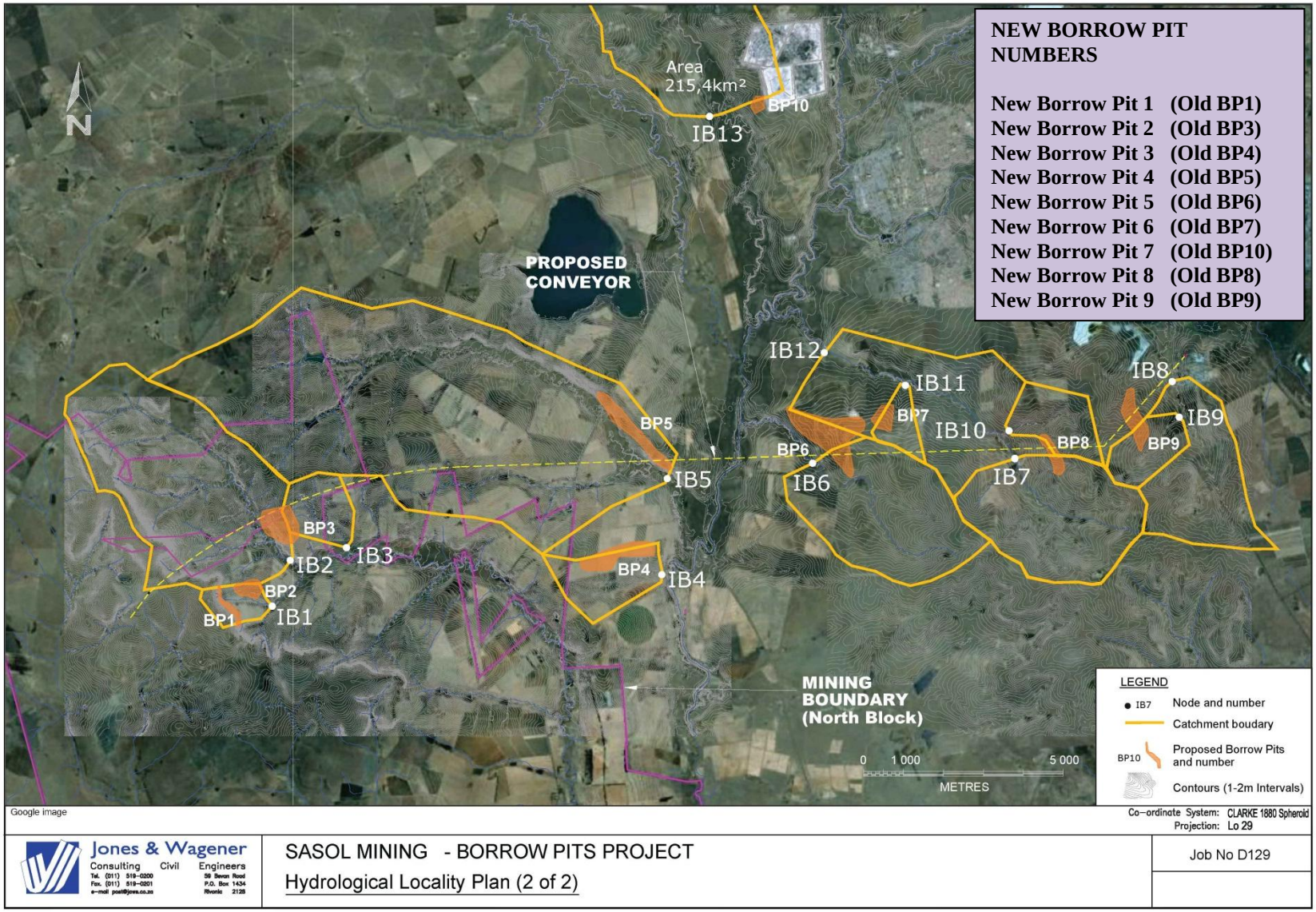


Figure 5.6.4.1 (a): Hydrological Locality Plan (2 of 2)

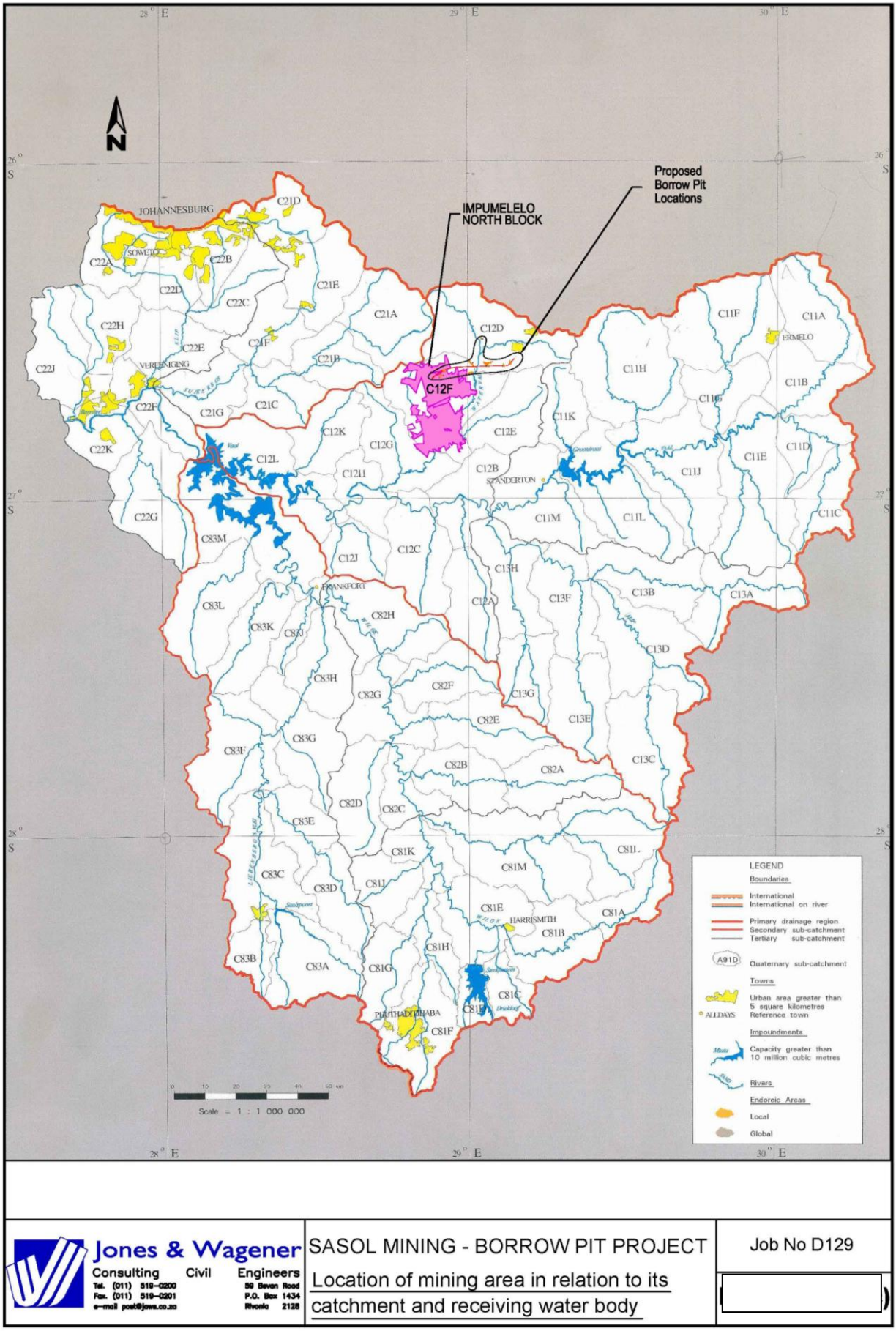


Figure 5.6.4.1 (b): Quaternary Catchments C12D and C12F

The borrow pit areas all drain ultimately to the Waterval River, which is a tributary of the Vaal River, which runs through the Vaal Dam, later converging with the Orange River, which finally discharges into the Atlantic Ocean on the west coast of South Africa.

The topography of the region comprises rolling grasslands and agricultural land, typical of the eastern Highveld. The average catchment slope is 3 to 10%. The watercourses are gently sloped (average slope of 1%) and mostly ephemeral, with wide valleys. The major streams, namely the Waterval River and Wolwespruit, are perennial.

5.6.4.2 Receiving Water Body

In terms of the catchment description, the receiving water body is an important concept. The receiving water body is the point below which the borrow pits impact on the catchment is considered to be negligible. This implies that aspects such as surface water users need only be defined down to the receiving water body.

The receiving water body for the assessment of potential surface water quality impacts of the proposed borrow pits, is taken as the Vaal River at the confluence with the Waterval River.

The use of this location is motivated on the basis that:

- By implication, potential impacts on the Vaal River will also be included in the impact assessment.
- Further, by the time the water reaches the Vaal River, it is required to be suitable for use for all of the expected uses (drinking water, agricultural, industrial and aquatic ecosystems). Thus, by achieving compliance in terms of these, no additional impacts are expected downstream on the Vaal River. The receiving water body is relevant only in so far as it defines the aerial extent of the catchment to be considered in the impact assessment, and described in the baseline study.
- Beyond the confluence with the Vaal River, the potential impact of the borrow pits become extremely small due to the water volumes in the catchment and dilution effects.
- In terms of impact assessment, the total borrow pit areas are small compared to the Vaal River catchment. The proposed borrow pit areas cover some 3.13 km^2, compared to a catchment of approximately 18 406 km^2 for the Vaal River to the confluence with the Waterval River (or some 0.03% of the area).

The MAR for the Vaal River at the Waterval River confluence is 1 055.5 x 10^6 m^3, while the MAR for the borrow areas is estimated at 0.28 x 10^6 m^3.

5.6.4.3 Mean Annual Runoff (MAR)

The MAR for the various sub-catchments was computed using the WRSM2000 synthetic streamflow generation model. This software utilises rainfall and evaporation data, together with a number of parameters that characterise the catchment, to compute synthetic monthly streamflow data from monthly rainfall data. The catchment parameters, as published in WR90 were used in the computations.

The results of the modelling are shown in Table 5.6.4.3 (a). The catchments and nodes are shown in Figure 5.6.4.1 (a).

Table 5.6.4.3(a): Mean Annual Runoff (MAR) for the Borrow Pit Areas

Node	Catchment Area (km^2)	MAR ($x10^6m^3$)	% of MAR at Vaal River
IB1	1.35	0.09	0.01
IB2	19.80	1.39	0.13
IB3	2.53	0.18	0.02
IB4	3.43	0.24	0.02
IB5	47.96	3.36	0.32
IB6	11.60	0.81	0.08
IB7	11.10	0.78	0.07
IB8	10.30	0.72	0.07
IB9	2.38	0.17	0.02
IB10	3.00	0.21	0.02
IB11	1.32	0.09	0.01
IB12	28.30	1.98	0.19
IB13	215.40	12.62	1.20

Note:The MAR for the Vaal River at the Waterval River confluence is 1 055.5 x 10^6 m^3.

5.6.4.4 Dry Weather Flow

In the absence of any streamflow monitoring, the conventional approach to compute the dry weather flow (also often termed "normal flow") is to analyse the long term synthetic monthly streamflow time series in order to develop a flow-duration relationship. An accepted definition of the dry weather flow in a stream is that flow in the stream that is equalled or exceeded for 70% of the time, a value which can readily be ascertained from an analysis of the flow-duration relationship.

The dry weather flows (DWF) for the proposed mining areas were determined using the WRSM2000 synthetic streamflow generation model. Where possible, the DWF from WRSM2000 was correlated to the MAR and the values extrapolated to other catchments. The computed dry weather flows (DWF) for the various sub-catchments (Refer to Figure 5.6.4.1 (a)), are shown in Table 5.6.4.4(a).

Table 5.6.4.4(a): Computed dry weather flows for the affected rivers at the Borrow Pit Areas

Node	Catchment Area (km^2)	Computed DWF ($x10^6 m^3$ per month average)	Computed DWF (l/s average over month)
IB1	1.35	0.00	0.05
IB2	19.80	0.00	0.77
IB3	2.53	0.00	0.10
IB4	3.43	0.00	0.13
IB5	47.96	0.00	1.85
IB6	11.60	0.00	0.45
IB7	11.10	0.00	0.43
IB8	10.30	0.00	0.40
IB9	2.38	0.00	0.09
IB10	3.00	0.00	0.12
IB11	1.32	0.00	0.05
IB12	28.30	0.00	1.09
IB13	215.4	1.94	748.46

Note: A flow of less than 0,01 x 10^6 m^3 per month probably implies that the river in question dries out completely during the winter months. This correlates to a flow of less than 10l/s

5.6.4.5 Flood Peaks and Volumes

Thirteen points of interest, or nodes, were identified for peak flow calculations. These were located in streams adjacent to or in close proximity to the proposed borrow pit areas, and are indicated on Figure 5.6.3.1 (b) and Figure 5.6.4.1 (a).

Catchment areas and slopes were determined from the contour plan provided by the client, as well as the 1:50 000 series topographical maps (2628DB Willemsdal, 2628DD Val, 2629CA Secunda and 2629CC Standerton).

There are a multitude of methods for the determination of peak flows. Several methods were used, but it was generally found that the values from the Standard Design Flood (SDF) (Alexander, 2002) Method gave consistent results for catchments. The 1:50, 1:100 year and Regional Maximum Flood (RMF) for each node, together with catchment areas, are given in Table 5.6.4.5(a).

The flood volumes shown in Table 5.6.4.5(a) were based on the simplified hydrograph proposed by Kovács (1988), and the relationship between the RMF and Mean Annual Runoff as derived from the measurement of various extreme flood events across South Africa, documented in various Department of Water Affairs (DWA) publications.

Table 5.6.4.5(a): Flood peaks and flood volumes for the Borrow Pit Areas

Node	Catchment area (km^2)	Recurrence Interval	Flood Peak (m^3/s)	Flood Volume (m^3x10^6)
IB 1	1.35	1:50 year 1:100 year RMF	26 33 112	0.06 0.08 0.27
IB 2	19.80	1:50 year 1:100 year RMF	155 197 311	2.08 2.64 4.17
IB 3	2.53	1:50 year 1:100 year RMF	47 59 142	0.18 0.22 0.54
IB 4	3.43	1:50 year 1:100 year RMF	48 60 160	0.22 0.27 0.72
IB 5	47.96	1:50 year 1:100 year RMF	184 233 435	4.26 5.40 10.08
IB 6	11.60	1:50 year 1:100 year RMF	84 106 254	0.80 1.01 2.43
IB7	11.10	1:50 year 1:100 year RMF	74 94 250	0.69 0.88 2.34
IB8	10.30	1:50 year 1:100 year RMF	72 91 243	0.64 0.81 2.16
IB 9	2.38	1:50 year 1:100 year RMF	39 49 139	0.14 0.18 0.51
IB 10	3.00	1:50 year 1:100 year RMF	48 61 152	0.20 0.25 0.63
IB11	1.32	1:50 year 1:100 year RMF	23 29 111	0.06 0.07 0.27
IB12	28.30	1:50 year 1:100 year RMF	145 183 356	2.42 3.05 5.94
IB 13	215.40	1:50 year 1:100 year RMF	256 357 871	11.13 15.52 37.86

5.6.4.6 Floodlines

Floodlines were determined based on the calculated flood peaks at each node. A steady flow, backwater analysis was performed for each stream using the HEC-RAS river modelling system. HEC-RAS was developed by the United States Army Corps of Engineers, and is considered industry standard software for floodline determination in many countries, including the United States, the United Kingdom, Europe, Australia and South Africa.

The relevant floodlines were taken from the original Impumelelo surface water specialist reports (Jones and Wagener report No. JW68/09/B475 and JW166/11/B475) and were determined by InterCiv (InterCiv report No. 81004_2). InterCiv is now part of Jones and Wagener.

The floodline for streams relevant to the borrow pits that were not covered in the original study were determined by Jones and Wagener as part of the current study.

In the original study an electronic digital terrain model (dtm), in the form of a three dimensional DGN file with contours at 1 m intervals was used, covering the area. For areas where additional floodlines were required a DXF with 2 m and 1 m contour interval was used.

When determining floodlines, each stream is defined by inputting a number of cross sections along the length of the stream. The cross sections are determined from the dtm data. Cross sections were measured at approximately 50 m to 70 m intervals on average, as well as at significant features which may act as flow controls.

The floodlines are shown in Figure 5.6.4.6 (a). It should be noted that the accuracy of the floodlines produced in this study is commensurate with the accuracy of the dtm data provided. With a contour interval of 1 m, the accuracy of the floodlines can be considered to be within 1 m vertically. Similarly, where the contour interval is 2 m the accuracy of the floodlines can be considered to be within 2 m vertically. The floodlines given here are considered suitable for planning purposes only. Where infrastructure is to be located adjacent to streams, the floodlines should be determined more accurately using a digital terrain model (dtm) developed from a field survey at the area of concern.

5.6.4.7 Watercourse Alterations

No physical watercourse alterations have been planned.

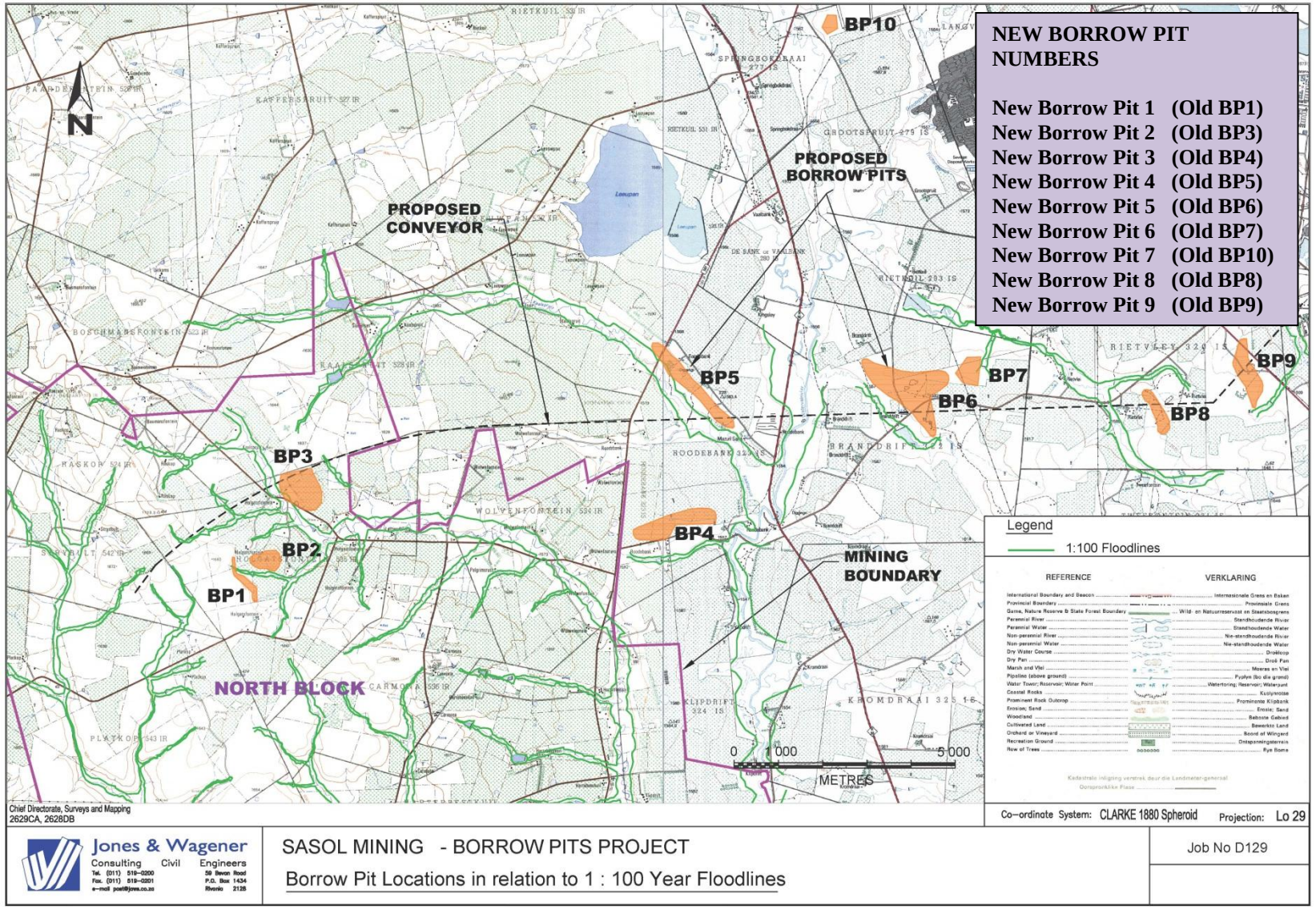


Figure 5.6.4.6 (a): Borrow Pit Locations in relation to 1:100 year Floodlines

5.6.5 Surface Water Quality

The water quality and sampling locations are given in this section.

5.6.5.1 Sampling Locations

As mentioned previously, the water quality sampling for the original Impumelelo EMP was carried out by Clean-Stream. This water quality data covered new Borrow Pits 1, 2, 3, 4, 5, 8 and 9. Water quality sampling for these areas was undertaken at the locations indicated in Figure 5.6.5.1 (a) on 26 March 2008, 23 June 2008, 24 September 2008 and 17 November 2008.

The water quality data from the original EMP does not cover new Borrow Pits 6 and 7. Therefore, additional water quality sampling was carried out at locations indicated in Figure 5.6.5.1 (a) on 7 December 2011.

The description for each sampling position, along with flow conditions and comments on each of the sites (from the original EMP) and the additional sampling locations, are included in Table 5.6.5.1(a) and Table 5.6.5.1(b).

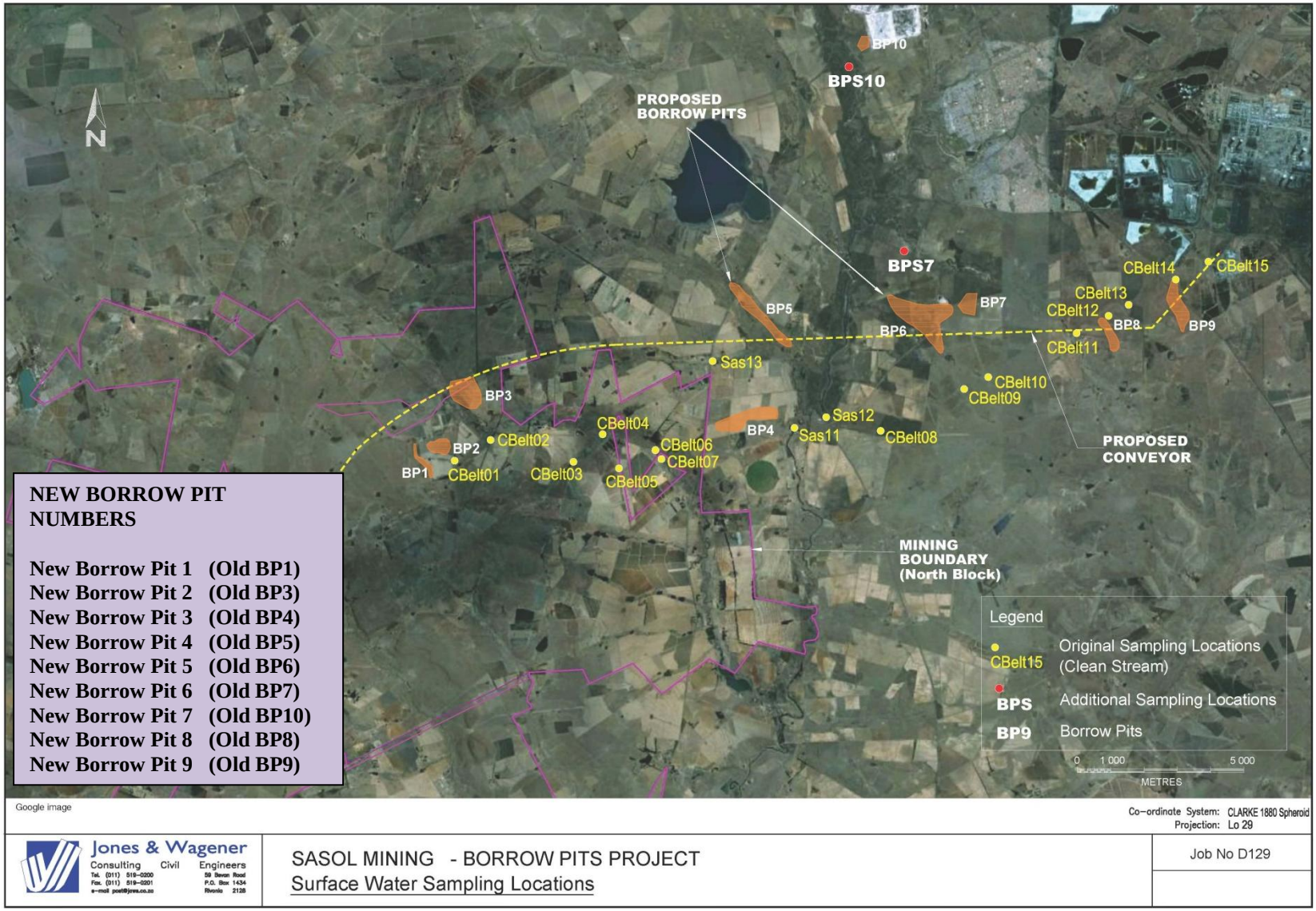


Figure 5.6.5.1 (a): Surface Water Sampling Locations

Table 5.6.5.1(a): Summary of the River Characteristics at each Sampling Location

Date of Sampling				26-Mar-08			23-Jun-08		
Locality	**Description**	**Channel Dimensions (m)**	**Active Channel (m)**	**Sampled**	**Flow Estimation (m/s)**	**Comments**	**Sampled**	**Flow Conditions**	**Comments**
Original EMP - surface water drainage monitoring									
SAS11	Waterval River after confluence with Kaal Spruit	50 x 10	15 x 0.5	Yes	0.15	Flooding signs above active channel	Yes	Medium	Clear
SAS12	Waterval River before confluence with Kaal Spruit	50 x 2.5	3 x 1	Yes	0.15	Flooding signs above active channel	Yes	Medium	Clear
SAS13	Kaal Spruit before confluence with Waterval River	No Defined Channel	Dry	Yes	-	Sampled dam	Yes	Medium	Clear
CBelt01	Conveyor Belt monitoring locality	2 x 1.5	1 x 0.3	Yes	0.1	Small channel underneath road surface	Yes	Very Low	Clear
CBelt02	Conveyor Belt monitoring locality	2 x 1.0	Dry	No	0.1	Small culvert underneath road	Yes	Very Low	Clear
CBelt03	Conveyor Belt monitoring locality	2 x 1.0	1.0 x 0.1	Yes	0.1	Small culvert underneath road	Yes	Very Low	Clear
CBelt04	Conveyor Belt monitoring locality	2 x 1.0	1.0 x 0.2	Yes	0.1	Small culvert underneath road	No	Dry	Not Sampled
CBelt05	Conveyor Belt monitoring locality	No Defined Channel	Dry	No	0.1	Insignificant channel	No	Dry	Not Sampled
CBelt06	Conveyor Belt monitoring locality	5 x 1.5	Dry	No	0.1	Dry	No	Dry	Not Sampled
CBelt07	Conveyor Belt monitoring locality	3 x 2	1.0 x 0.3	Yes	0.1	Very low flow velocity	Yes	Medium	Clear
CBelt08	Conveyor Belt monitoring locality	3.5 x 1	0.5 x 0.1	Yes	0.1	Very low flow velocity	Yes	Very Low	Clear
CBelt09	Conveyor Belt monitoring locality	5 x 1.5	1.0 x 0.5	Yes	0.1	Very low flow velocity	No	Dry	Not Sampled
CBelt10	Conveyor Belt monitoring locality	5 x 1.5	3 x 0.5	Yes	0.1	Very low flow velocity	No	Dry	Not Sampled
CBelt11	Conveyor Belt monitoring locality	4 x 1.5	2 x 1	Yes	0.1	Very low flow velocity	No	Dry	Not Sampled
CBelt12	Conveyor Belt monitoring locality	3 x 1	0.5 x 0.1	Yes	0.1	Very low flow velocity	Yes	Very Low	Clear
CBelt13	Conveyor Belt monitoring locality	2 x 1	0.3 x 0.1	Yes	0.1	Very low flow velocity	No	Dry	Not Sampled
CBelt14	Conveyor Belt monitoring locality	5 x 1.5	1.0 x 0.1	Yes	0.1	Very low flow velocity	No	Dry	Not Sampled
CBelt15	Conveyor Belt monitoring locality	3 x 1	1.0 x 0.1	Yes	0.1	Very low flow velocity	Yes	Low	Clear
Additional surface water drainage monitoring									
BPS7	Tributary of the Waterval River adjacent to Borrow pit 6 and 7	-	-	Yes	-	-	-	-	-
BPS10	Tributary of the Waterval River adjacent to Borrow pit 10	-	-	Yes	-	-	-	-	-

Table 5.6.5.1(b): Summary of the River Characteristics at each Sampling Location

Date of Sampling				24-Sep-08			17-Nov-08			07-Dec-08		
Locality	**Description**	**Channel Dimensions (m)**	**Active Channel (m)**	**Sampled**	**Flow Conditions**	**Comments**	**Sampled**	**Flow Conditions**	**Comments**	**Sampled**	**Flow Conditions**	**Comments**
Original EMP - surface water drainage monitoring												
SAS11	Waterval River after confluence with Kaal Spruit	50 x 10	15 x 0.5	Yes	Medium	Clear	Yes	Medium	Clear	-	-	-
SAS12	Waterval River before confluence with Kaal Spruit	50 x 2.5	3 x 1	Yes	Medium	Clear	Yes	Medium	Clear	-	-	-
SAS13	Kaal Spruit before confluence with Waterval River	No Defined Channel	Dry	No	Dry	Not Sampled	No	Dry	Not Sampled	-	-	-
CBelt01	Conveyor Belt monitoring locality	2 x 1.5	1 x 0.3	Yes	Very Low	Clear	-	-	-	-	-	-
CBelt02	Conveyor Belt monitoring locality	2 x 1.0	Dry	No	Dry	Not Sampled	-	-	-	-	-	-
CBelt03	Conveyor Belt monitoring locality	2 x 1.0	1.0 x 0.1	No	Dry	Not Sampled	-	-	-	-	-	-
CBelt04	Conveyor Belt monitoring locality	2 x 1.0	1.0 x 0.2	No	Dry	Not Sampled	-	-	-	-	-	-
CBelt05	Conveyor Belt monitoring locality	No Defined Channel	Dry	No	Dry	Not Sampled	-	-	-	-	-	-
CBelt06	Conveyor Belt monitoring locality	5 x 1.5	Dry	Yes	Very Low	Clear	-	-	-	-	-	-
CBelt07	Conveyor Belt monitoring locality	3 x 2	1.0 x 0.3	Yes	Very Low	Clear	-	-	-	-	-	-
CBelt08	Conveyor Belt monitoring locality	3.5 x 1	0.5 x 0.1	No	Dry	Not Sampled	-	-	-	-	-	-
CBelt09	Conveyor Belt monitoring locality	5 x 1.5	1.0 x 0.5	No	Dry	Not Sampled	-	-	-	-	-	-
CBelt10	Conveyor Belt monitoring locality	5 x 1.5	3 x 0.5	No	Dry	Not Sampled	-	-	-	-	-	-
CBelt11	Conveyor Belt monitoring locality	4 x 1.5	2 x 1	No	Dry	Not Sampled	-	-	-	-	-	-
CBelt12	Conveyor Belt monitoring locality	3 x 1	0.5 x 0.1	No	Dry	Not Sampled	-	-	-	-	-	-
CBelt13	Conveyor Belt monitoring locality	2 x 1	0.3 x 0.1	No	Dry	Not Sampled	-	-	-	-	-	-
CBelt14	Conveyor Belt monitoring locality	5 x 1.5	1.0 x 0.1	No	Dry	Not Sampled	-	-	-	-	-	-
CBelt15	Conveyor Belt monitoring locality	3 x 1	1.0 x 0.1	Yes	Medium	Clear	-	-	-	-	-	-
Additional surface water drainage monitoring												
BPS7	Tributary of the Waterval River adjacent to Borrow pit 6 and 7	-	-	-	-	-	-	-	-	Yes	Very Low	Clear
BPS10	Tributary of the Waterval River adjacent to Borrow pit 10	-	-	-	-	-	-	-	-	Yes	Very Low	Clear

5.6.5.2 Surface Water Monitoring Results

The results of the water quality analyses from the original Impumelelo EMP are provided in Table 5.6.5.2(a) and Table 5.6.5.2(b) and the results of the water quality analyses for the additional water quality sampling in Table 5.6.5.2(c). These results indicate the pre-mining background water quality, and are compared to the South African Water Quality Guidelines and catchment objectives (DWAF, 1996a) as presented in Table 5.6.5.2(d).

Ordinarily, results would be compared to the South African Water Quality Guidelines (DWAF, 1996a) as given in Table 5.6.5.2(d) as well as the catchment specific guidelines. However, for the Waterval River objectives have not yet been set, and the water quality guidelines have been used.

The majority of concentrations of all constituents tested fall within the Water Quality Guideline values with a few exceptions.

The concentrations of several constituents exceeded their recommended limit for water quality, based on Water Quality Guidelines (DWAF, 1996).

Generally there are marginally elevated concentrations of Ca and Mg, which are not attributed to industrial, mining or farming activities and could reflect background concentrations. Then there are marginally elevated concentrations of Fe, Mn and Na, which could be attributed to mining and farming activities in the area.

These locations are scatted throughout the mining area.

Other sampling points that indicate elevated values:

- At SASCBelt15 along the conveyor route elevated Na, SO_4 and TDS values were noted from a sampling run in September 2008. This sampling point is upstream of the Sasol Synfuels area but downstream of the Brandspruit shaft. The most likely origin (unconfirmed) is an incident at Brandspruit.
- At BPS 10 marginally elevated concentrations of TDS, Ca, Mg, Fe and Mn were noted. Results from only one sampling run were available at the time of writing.
- At BPS 7 marginally elevated concentrations of Mg, Fe and Mn were noted. Results from only one sampling run were available at the time of writing.

Table 5.6.5.2(a): Pre-mining quality in rivers associated with the proposed Borrow Pits 1, 2, 3, 4, 5, 8 and 9 covered in the Original Impumelelo EMP

Parameter		Sample									
		SAS CBelt 01	SAS Cbelt 02	SAS Cbelt 03	SAS Cbelt 04	SAS Cbelt 06	SAS Cbelt 07	SAS Cbelt 08	SAS Cbelt 09	SAS Cbelt 10	SAS Cbelt 11
No.of Samples		2	1	2	1	1	3	2	1	1	1
pH	Ave	8.31	8.34	8.46	8.16	8.5	8.32	8.28	7.77	8.97	8.53
	Min-Max	8.12-8.50		8-8.91			8.08-8.75	8.25-8.31			
	Coeff of Var. (%)	3.20		7.6			4.4	0.51			
EC (mS/m)	Ave	126.45	111.9	79.15	46.7	101.2	58.83	116.2	31.1	14.5	33.1
	Min-Max	125.90-127		50.8-107.50			45.4-67.5	95.5-136.9			
	Coeff of Var. (%)	0.61		50.6			20	25.1			
TDS (mg/l)	Ave	763.00	602	435	246	564	318.67	595	42	16	160
	Min-Max	706-820		308-562			234-388	514-676			
	Coeff of Var. (%)	10.50		41.2			24.5	19.2			
T hardness (mg/l)	Ave	606.65	406.2	311.78	170.43	348.31	228.08	396.55	99.3	50.2	132.9
	Min-Max	604.54-608.75		214.09-409.47			181.51-261.57	343.81-449.30			
	Coeff of Var. (%)	0.49		44.3			18.2	18.8			
Ca (mg/l)	Ave	65.54	62	48.45	34	37	37.04	69.15	18	9	25
	Min-Max	63.51-67.57		36.01-60.89			28.47-47.94	64.63-73.66			
	Coeff of Var. (%)	4.30		36.3			26.8	9.2			
Mg (mg/l)	Ave	107.57	61	46.33	21	62	32.92	54.37	13	7	17
	Min-Max	105.83-109.32		30.15-62.51			23.03-41.30	44.30-64.44			
	Coeff of Var. (%)	2.28		49.3			28	26.1			
Na (mg/l)	Ave	63.3	52	55.36	21	74	31.18	126.68	27	10	18
	Min-Max	49.98-76.67		28.12-82.61			20.77-39	97.72-155.64			
	Coeff of Var. (%)	29.7		69.5			30.1	32.3			
K (mg/l)	Ave	4.33	10	3.65	4	11	6.2	12.09	7	4	6
	Min-Max	2.84-5.81		3.46-3.83			4.27-8.21	10.95-13.23			
	Coeff of Var. (%)	48.4		7.1			31.7	13.3			
M alk (mg/l)	Ave	472.92	262	291.9	199	380	211.85	417.8	140	61	125
	Min-Max	372.10-573.74		260.49-323.31			200.26-228.53	405.1-430.49			
	Coeff of Var. (%)	30.1		15.2			6.9	4.29			
Cl (mg/l)	Ave	29.28	41	21.31	9	75	23.27	59.89	18	3	17
	Min-Max	18.05-40.50		10.83-31.80			12.29-34.04	56.85-62.92			
	Coeff of Var. (%)	54.2		69.5			46.7	7.2			
SO^4 (mg/l)	Ave	135.43	114	63.03	17	16	51.32	58.74	15	13	31
	Min-Max	76.35-194.52		18.74-63.03			27.62-89.66	53.46-64.03			
	Coeff of Var. (%)	61.6		99.3			65.3	12.7			
F (mg/l)	Ave	<0.48	0.616	<0.48	<0.48	0.625	<0.48	<0.48	<0.48	<0.49	<0.50
	Min-Max										
	Coeff of Var. (%)										

Parameter		Sample									
		SAS CBelt 01	SAS Cbelt 02	SAS Cbelt 03	SAS Cbelt 04	SAS Cbelt 06	SAS Cbelt 07	SAS Cbelt 08	SAS Cbelt 09	SAS Cbelt 10	SAS Cbelt 11
No.of Samples		2	1	2	1	1	3	2	1	1	1
Al (mg/l)	Ave	<0.01	<0.01	<0.01	0.029	0.436	0.21	<0.01	0.291	0.419	0.175
	Min-Max						0.04-0.39				
	Coeff of Var. (%)						113.4				
Fe (mg/l)	Ave	0.03	<0.01	0.02	0.065	0.032	0.11	0.09	0.837	1.046	0.174
	Min-Max	0.01-0.05		0.022-0.023			0.03-0.19	0.06-0.13			
	Coeff of Var. (%)	76.7		1.8			109	46.9			
Mn (mg/l)	Ave	0.1	<0.01	<0.01	<0.01	0.026	<0.01	<0.01	0.017	0.093	<0.01
	Min-Max	0.08-0.12									
	Coeff of Var. (%)	28.7									
NO^3 (mg/l)	Ave	<0.1	5.13	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.39
	Min-Max										
	Coeff of Var. (%)										
NH^3 (mg/l)	Ave	<0.1	<0.1	<0.1	<0.1	0.29	<0.1	<0.1	0.37	0.41	0.33
	Min-Max										
	Coeff of Var. (%)										
PO^4 (mg/l)	Ave	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Min-Max										
	Coeff of Var. (%)										
Cr (mg/l)	Ave	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Min-Max										
	Coeff of Var. (%)										
Cu (mg/l)	Ave	<0.01	<0.01	<0.01	0.013	0.055	0.01	<0.01	0.018	0.012	0.013
	Min-Max						0.01-0.02				
	Coeff of Var. (%)						19.2				
Ni (mg/l)	Ave	<0.01	<0.01	<0.01	<0.01	0.018	<0.01	<0.01	<0.01	<0.01	<0.01
	Min-Max										
	Coeff of Var. (%)										
SAR (ratio)	Ave	1.12	1.11	1.31	0.71	1.73	0.89	2.74	1.2	0.6	0.66
	Min-Max	0.88-1.35		0.84-1.78			0.67-1.09	2.29-3.20			
	Coeff of Var. (%)	29.5		50.8			23.7	23.2			

Table 5.6.5.2(b): Pre-mining quality in rivers associated with the proposed Borrow Pits 1, 2, 3, 4, 5, 8 and 9 covered in the Original Impumelelo EMP

Parameter		Sample						
		SAS Cbelt 12	SAS Cbelt 13	SAS Cbelt 14	SAS Cbelt 15	SAS11	SAS12	SAS13
No.of Samples		2	1	1	2	4	4	2
pH	Ave	8.62	8.04	7.12	7.91	7.71	7.67	8.18
	Min-Max	8.33-8.91			7.73-8.09	7.36-8.15	7.41-8	7.99-8.37
	Coeff of Var. (%)	4.7			3.2	4.5	3.95	3.28
EC (mS/m)	Ave	80	137.1	18.22	395.1	68.28	68.68	50.15
	Min-Max	53.60-106.40			48.20-742	51.60-81.40	53.10-83.10	45.30-55
	Coeff of Var. (%)	46.6			124.1	19.9	18.6	13.6
TDS (mg/l)	Ave	414	872	118	3163	320	337.5	266
	Min-Max	292-536			218-6108	266-412	252-418	242-290
	Coeff of Var. (%)	41.6			131.6	20.2	20.1	12.7
T hardness (mg/l)	Ave	328.09	549.9	45.84	1229.7	184.09	186.68	155.15
	Min-Max	213.55-442.62			151.45-2307.95	158.15-230.07	161.55-228.71	144.46-165.84
	Coeff of Var. (%)	49.3			124	17.8	16.5	9.7
Ca (mg/l)	Ave	60.08	82	9	201	38.72	39.23	28.81
	Min-Max	36.97-83.18			28.71-373.3	35.25-47.46	35.21-47.61	28.39-29.22
	Coeff of Var. (%)	54.3			121.2	15.1	14.4	2
Mg (mg/l)	Ave	43.24	84	6	176.74	21.23	21.54	20.21
	Min-Max	29.44-57.05			19.37-334.10	17.03-27.09	17.88-26.67	17.36-23.06
	Coeff of Var. (%)	45.1			125.9	21.7	20.3	19.9
Na (mg/l)	Ave	54.93	98	11	559.75	55.46	57.11	33.43
	Min-Max	39.74-70.12			34.49-1085	34.74-77.25	34.65-80.89	25.04-41.82
	Coeff of Var. (%)	39.1			132.7	33	34.2	35.5
K (mg/l)	Ave	5.52	5	11	23.28	8.74	9.17	10.64
	Min-Max	3.84-7.17			5.12-41.43	5.41-11.71	5.53-12.13	10.48-10.81
	Coeff of Var. (%)	42.2			110.2	29.5	30.4	2.2
M alk (mg/l)	Ave	259.97	484	37	101.8	154.96	160.23	144.39
	Min-Max	190.74-329.21			79.30-124.3	141.97-165.76	151.63-172.05	128.57-160.21
	Coeff of Var. (%)	37.6			31.2	6.7	5.4	15.4

Parameter		Sample						
		SAS Cbelt 12	SAS Cbelt 13	SAS Cbelt 14	SAS Cbelt 15	SAS11	SAS12	SAS13
No.of Samples		2	1	1	2	4	4	2
Cl (mg/l)	Ave	20.7	53	12	209.24	46.2	46.06	32.74
	Min-Max	19.27-22.13			12.17-406.31	31.56-56.18	31.16-54.29	29.96-35.53
	Coeff of Var. (%)	9.7			133	22.5	22.1	12
SO^4 (mg/l)	Ave	112.95	231	32	1738.74	79.06	72.01	26.22
	Min-Max	111.68-114.23			112.38-3365.11	37.92-103.30	36.77-101.27	20.89-31.55
	Coeff of Var. (%)	1.59			132.2	38.2	37	28.7
F (mg/l)	Ave	0.5	<0.48	<0.48	<0.48	0.58	0.64	<0.48
	Min-Max	0.49-0.50				0.54-0.64	0.53-0.89	
	Coeff of Var. (%)	1.8				9	25.6	
Al (mg/l)	Ave	<0.01	<0.01	0.073	1.36	0.25	0.21	0.18
	Min-Max				0.31-2.40	0.24-0.26	0.04-0.37	0.13-0.22
	Coeff of Var. (%)				108.8	3.39	115	39.7
Fe (mg/l)	Ave	0.05	<0.01	0.451	<0.01	0.1	0.05	0.18
	Min-Max	0.02-0.08				0.02-0.29	0.02-0.09	0.13-0.22
	Coeff of Var. (%)	84				125.5	72.4	35.3
Mn (mg/l)	Ave	<0.01	<0.01	0.064	<0.01	0.24	0.18	0.06
	Min-Max					0.04-0.45	0.11-0.25	0.06-0.07
	Coeff of Var. (%)					116	53	9.8
NO^3 (mg/l)	Ave	<0.1	<0.1	<0.1	<0.1	4.39	3.41	<0.1
	Min-Max					3.27-5.43	2.53-4.47	
	Coeff of Var. (%)					24.6	28.8	
NH^3 (mg/l)	Ave	<0.1	0.25	0.66	0.69	3.39	4.39	<0.1
	Min-Max				0.21-1.16	0.62-7.08	1.66-6.26	
	Coeff of Var. (%)				97.8	68	48.9	
PO^4 (mg/l)	Ave	<0.1	<0.1	<0.1	<0.1	2.27	2.34	<0.1
	Min-Max					0.77-3.32	0.99-3.17	
	Coeff of Var. (%)					47.4	44.3	

Parameter		Sample						
		SAS Cbelt 12	SAS Cbelt 13	SAS Cbelt 14	SAS Cbelt 15	SAS11	SAS12	SAS13
No.of Samples		2	1	1	2	4	4	2
Cr (mg/l)	Ave	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Min-Max							
	Coeff of Var. (%)							
Cu (mg/l)	Ave	<0.01	0.01	0.011	<0.01	<0.01	<0.01	0.01
	Min-Max							0.011-0.012
	Coeff of Var. (%)							8.7
Ni (mg/l)	Ave	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Min-Max							
	Coeff of Var. (%)							
SAR (ratio)	Ave	1.32	1.83	0.74	5.52	1.77	1.81	1.16
	Min-Max	1.18-1.45			1.22-9.83	1.19-2.47	1.19-2.55	0.91-1.41
	Coeff of Var. (%)	14.33			110	29.9	31	31

Table 5.6.5.2(c): Pre-mining quality in rivers associated with the proposed Borrow Pits 6 and 7

Parameter	December 2011 Sample	
	BPS 10: Borrow Pit 10	BPS 7 : Borrow Pit 6 and 7
Sample Run and Number	1	1
pH	8.20	8.30
EC (mS/m)	87.20	65.20
TDS (mg/l)	540.00	406.00
SS (mg/l)	21.00	10.00
Ca (mg/l)	49.00	29.00
Mg (mg/l)	43.00	33.00
Na (mg/l)	83.00	61.00
K (mg/l)	5.00	5.10
Total Alkalinity (mg/l)	360.00	272.00
Cl (mg/l)	52.00	41.00
SO_4 (mg/l)	47.00	25.00
F (mg/l)	0.50	0.50
Al (mg/l)	0.37	0.11
Fe (mg/l)	0.48	0.28
Mn (mg/l)	0.55	0.58
NO_3 (mg/l)	0.50	0.50
NH_3 (mg/l)	<0.2	<0.2
SAR (ratio)	2.10	1.80

Table 5.6.5.2(d): South African Water Quality Guidelines (DWAF, 1996)

Constituent	Water Quality Guideline value for:					
	Aquatic Ecosystems	Domestic	Recreation (Full Contact)	Industry (cat. 3)	Agriculture	
					Livestock	Irrigation
pH	within 5% or 0.5 units of background	6 - 9	6.5 - 8.5	6.5 - 8.0	NA	6.5 - 8.4
EC (mS/m)**	-	-	-	-	-	-
SO_4	NA	0 - 200	NA	0 - 200	0 - 1000	NA
TDS	within 15% of background	0 - 450	NA	0 - 450	0 – 1000 *	< 40
V	NA	0 - 0.1	NA	NA	0 - 1	0 - 0.10
Cl	NA	0 - 100	NA	0 - 100	0 – 1500 *	0 - 1.00
Alkalinity	NA	NA	NA	0 - 300	NA	NA
Ca	NA	0 - 32	NA	NA	0 - 1000	NA
Mg	NA	0 - 30	NA	NA	0 - 500	NA
Na	NA	0 - 100	Na	NA	0 - 2000	< 70
Fe	NA	0 - 0.1	NA	0 - 0.3	0 - 10	0 – 5
F	< 0.75	0 - 1	NA	NA	0 - 2	0 – 2
Mn	< 0.18	0 - 0.05	NA	0 - 0.2	0 - 10	0 - 0.02
K	NA	0 - 50	NA	NA	NA	NA

NA - Not Available

*** Most stringent guideline taken (dairy, pigs and poultry)**

****The potable water standard for EC is 70mS/m (Quality of Domestic Water Supplies, 1998)**

5.6.6 Surface Water Use

Surface water is used primarily for Domestic, Livestock and Irrigation watering purposes. Water users within and surrounding the proposed mining areas are shown and detailed in **Table 5.6.6(a)**.

Table 5.6.6(a): Surface Water Users

Name of owner	Farm Name	Farm Portion	Usage		
			Irrigation	Livestock	Domestic
Klopper, Lucas	Wolvenfontein 534 IR	9	✓	✓	✓
	Wolvenfontein 534 IR	18	✓	✓	✓
	Wolvenfontein 534 IR	7	✓	✓	✓
	Wolvenfontein 534 IR	16	✓	✓	✓
Kotze JH	Holgatsfontein 535 IR	16		✓	✓
	Holgatsfontein 535 IR	18		✓	✓
	Holgatsfontein 535 IR	19		✓	✓
	Holgatsfontein 535 IR	20		✓	✓
	Holgatsfontein 535 IR	22		✓	✓
Kriek JJ	Holgatsfontein 535 IR	14			
Lanser, EA	Holgatsfontein 535 IR	2			
Lanser, JJ	Holgatsfontein 535 IR	1			
Louwrens, Koos	Kaalspruit 528 IR	0		✓	✓
	Kaalspruit 528 IR	2		✓	✓
Pistorius, Tinus	Kaalspruit 528 IR	13		✓	✓
Smith, Hardus	Holgatsfontein 535 IR	11		✓	✓
Smith JWJ (Christo)	Holgatsfontein 535 IR	7		✓	✓
	Holgatsfontein 535 IR	10		✓	✓
	Holgatsfontein 535 IR	12		✓	✓
	Holgatsfontein 535 IR	13		✓	✓
Botha, Moses (contact p: Riaan Snyman)	Holgatsfontein 535 IR	6		✓	✓
Botha, Moses	Holgatsfontein 535 IR	15		✓	✓
Urquhart, AA	Kaalspruit 528 IR	9	✓	✓	✓
	Roodebank 323 IS	1	✓	✓	✓
	Roodebank 323 IS	13	✓	✓	✓
	Roodebank 323 IS	20	✓	✓	✓
	Wolvenfontein 534 IR	1	✓	✓	✓
	Wolvenfontein 534 IR	3	✓	✓	✓
	Wolvenfontein 534 IR	4	✓	✓	✓
	Wolvenfontein 534 IR	6	✓	✓	✓
	Wolvenfontein 534 IR	8	✓	✓	✓
	Wolvenfontein 534 IR	14	✓	✓	✓
	Wolvenfontein 534 IR	15	✓	✓	✓
	Wolvenfontein 534 IR	17	✓	✓	✓
	Wolvenfontein 534 IR	19	✓	✓	✓
	Wolvenfontein 534 IR	20	✓	✓	✓
Urquhart, AA	Wolvenfontein 534 IR	21	✓	✓	✓
	Wolvenfontein 534 IR	22	✓	✓	✓

Name of owner	Farm Name	Farm Portion	Usage		
			Irrigation	Livestock	Domestic
Wessels, AH	Roodebank 323 IS	6		✓	✓
	Roodebank 323 IS	7		✓	✓
	Roodebank 323 IS	9		✓	✓
	Roodebank 323 IS	10		✓	✓
	Roodebank 323 IS	11		✓	✓
	Roodebank 323 IS	12		✓	✓
	Roodebank 323 IS	18		✓	✓
	Roodebank 323 IS	19		✓	✓
	Wolvenfontein 534 IR			✓	✓
Terblanche, CJ	Roodebank 323 IS	24			
Jordaan, Daan	Wolvefontein				

5.6.7 Bio-monitoring

Bio-monitoring will be addressed by the relevant specialists.

5.6.8 Water Authority

The mine falls within the Department of Water Affairs Gauteng Region.

5.6.9 Wetlands

The wetlands have been addressed in a separate report by the wetland specialist.

5.6.10 Interested and Affected Parties

Will be addressed as part of the Public Participation Program.

5.6.11 Manner of Potential Environmental Impacts

The proposed dolerite quarrying can potentially impact on both the availability and quality of surface water. Impacts on surface water can occur through all the life cycles of a quarrying operation.

The moment that soils stripping starts, the run-off characteristics of the surface water catchment will start to change, with potential impacts on both the availability and quality of surface water. During the operational phase, the borrow pits will capture all rainwater, whilst a buffer zone around the pit perimeter will also become potentially contaminated with solids in suspension. If the operational pit water balance is not managed properly, contaminated surface water can spill from containment facilities and enter the surrounding surface streams and dams as contaminated run-off. Post closure the surface water impact will become very small provided that rehabilitation is optimized to ensure free draining run-off of good quality and that any closure surface water discharge from the pits onto surface is managed effectively.

5.7 TERRESTRIAL ECOLOGY (PLANT LIFE)

This baseline vegetation description of the study area was compiled by JMA Consulting using studies of both CleanStream Environmental Consultants done for the Impumelelo Project, and that done for the Sasol Shondoni Project, as well as by expanding on an existing study that was undertaken for a smaller part of the study area.

5.7.1 Regional Plant Life Description

5.7.1.1 Climate and Morphology

The study area is located South-west of Secunda and South to Southwest of the town of eMbalenhle in the Vaal River Catchment in the Mpumalanga province. The area is characterised by slightly undulating plains and pans.

The study area is situated in the Soweto Highveld Grassland (Gm8) vegetation unit, which forms part of the Mesic Highveld Grassland Bioregion (Mucina & Rutherford, 2006). This area characteristically consists of tufted grassland with only small, scattered wetlands and alluvia in undisturbed places. From a conservation perspective this grassland habitat is endangered as it has been largely transformed by cultivation, mining and infrastructure (Mucina & Rutherford, 2006).

The rainfall in the study area is approximately 700 mm per annum and occurs mainly in the summer (Dent et al. 1989).

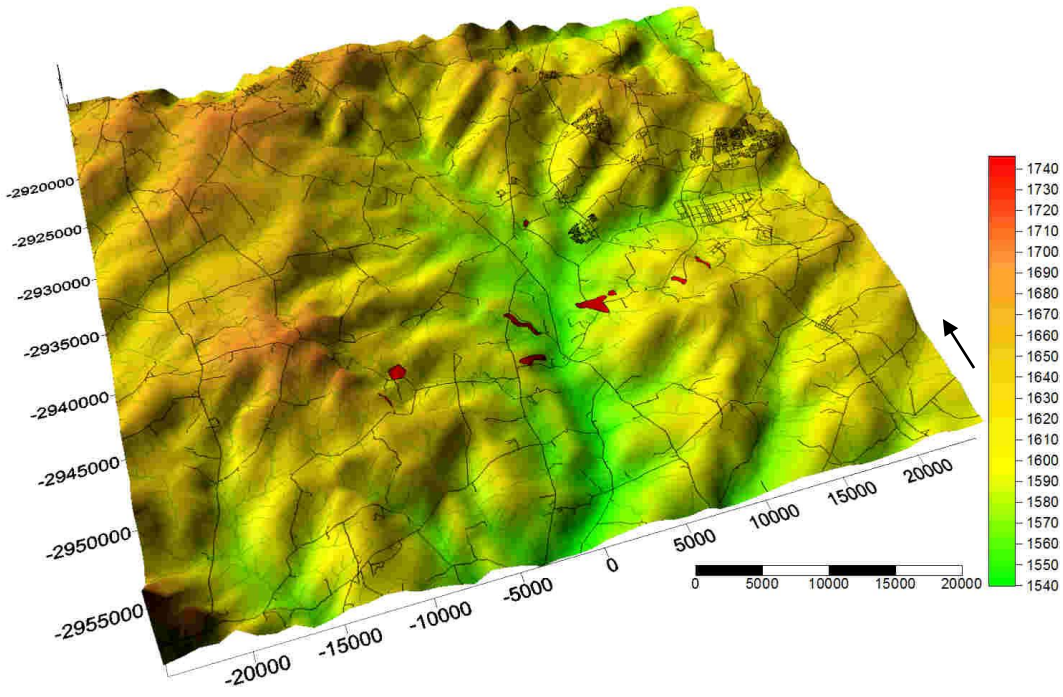


Figure 5.7.1 (a): Tilted 3-D Image of the Study Area

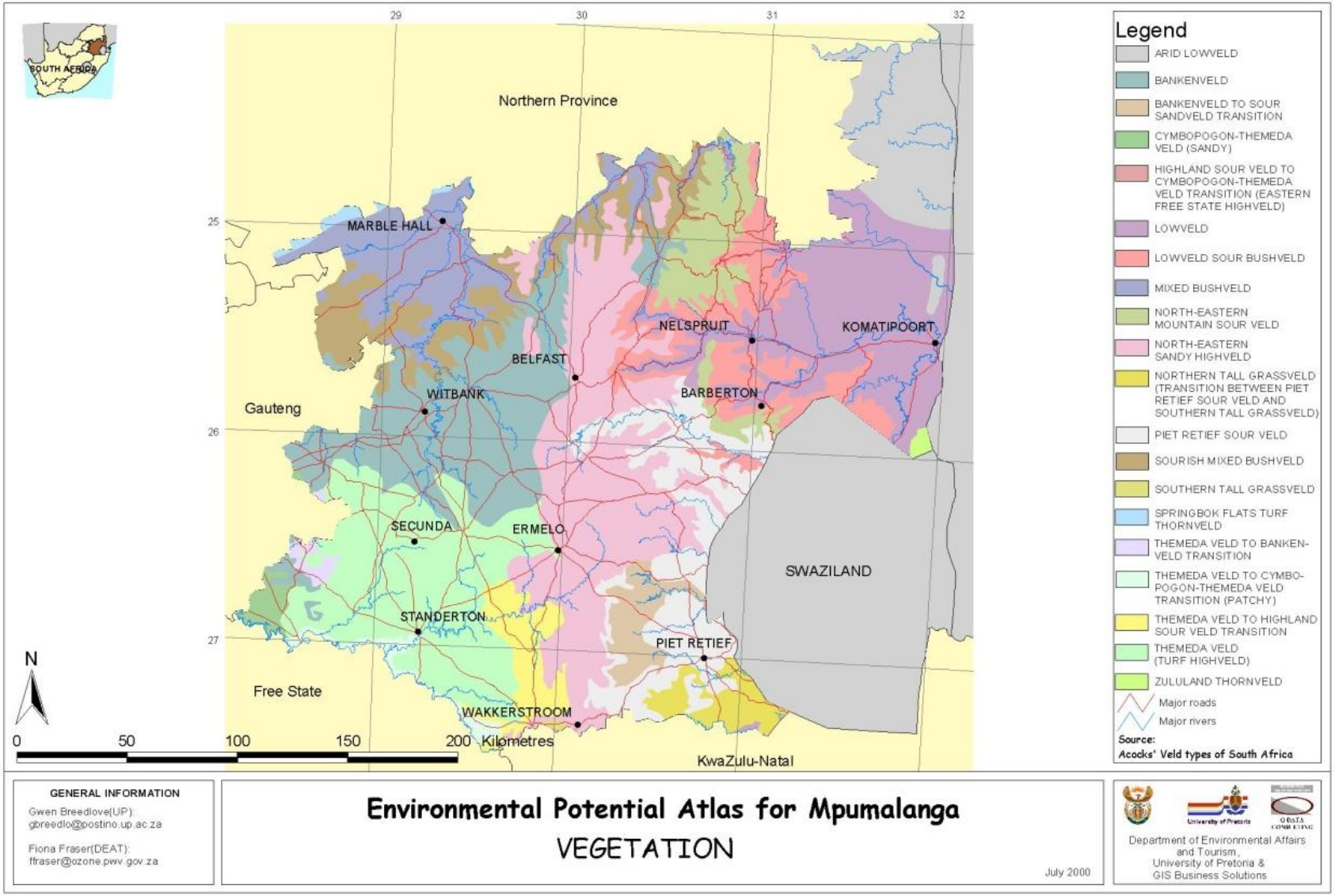


Figure 5.7.1 (b): ENPAT Vegetation Map for Mpumalanga Province

The study areas fall within the quarter degree squares 2628BD, 2628DB, 2629AC and 2629CA. A land cover map of the study area (Fairbanks *et al*. 2000) indicates that the study area is within a grassland area that has been heavily impacted upon by cultivation. Mapped areas of cultivation are widespread on site as can be seen on the Surveyor-General's 1:50000 topocadastral map of the area. Mining and urbanisation have also led to significant amounts of transformation of natural vegetation. There are also various man-made and natural water-bodies on site and a few stands of alien trees. Figure 5.7.1 (c) indicates the larger study area, also showing the proposed Borrow Pit areas.

5.7.1.2 Vegetation, Biogeography and Conservation Value

According to (Mucina et al., 2006), Soweto Highveld Grassland occurs on gently to moderately undulating landscapes. There is a continuous grassland cover that is only occasionally interrupted by small wetlands, narrow stream alluvia, pans and ridges or rocky outcrops. Soweto Highveld Grassland occurs on shale, sandstone or mudstone of the Madzarawinge Formation or the intrusive Karoo Suite dolerites. Soils are deep, reddish on flat plains and are typically Ea, Ba and Bb landtypes.

The vegetation is described as a short to medium-high, dense, tufted grassland dominated almost entirely by *Themeda triandra* accompanied by other grasses such as *Elionurus muticus*, *Eragrostis racemosa*, *Heteropogon contortus* and *Tristachya leucothrix*. A more complete list of expected species in undisturbed Soweto Highveld Grassland include the following:

Graminoids (dominant): *Andropogon appendiculatus*, *Brachiaria serrata*, *Cymbopogon pospischilii*, *Cynodon dactylon*, *Elionurus muticus*, *Eragrostis capensis*, *Eragrostis chloromelas*, *Eragrostis curvula*, *Eragrostis plana*, *Eragrostis planiculmis*, *Eragrostis racemosa*, *Heteropogon contortus*, *Hyparrhenia hirta*, *Setaria nigrirostris*, *Setaria sphacelata*, *Themeda triandra*, *Tristachya leucothrix*.

Graminoids (accompanying): *Andropogon schirensis*, *Aristida adscensionis*, *Aristida bipartita*, *Aristida congesta*, *Aristida junciformis*, *Cymbopogon caesius*, *Digitaria diagonalis*, *Diheteropogon amplectens*, *Eragrostis micrantha*, *Eragrostis superba*, *Harpochloa falx*, *Michrochloa caffra*, *Paspalum dilatatum*.
Herbs: *Hermannia depressa* (d), *Acalypha angustata*, *Berkheya setifera*, *Dicoma anomala*, *Euryops gilfillanii*, *Geigeria aspera*, *Graderia subintegra*, *Haplocarpha scaposa*, *Helichrysum miciniifolium*, *Helichrysum nudifolium*, *Helichrysum rugulosum*, *Hibiscus pusillus*, *Justicia anagalloides*, *Lippia scaberrima*, *Rhynchosia effusa*, *Schistostephium crataegifolium*, *Selago densiflora*, *Senecio coronatus*, *Vernonia oligocephala*, *Wahlenbergia undulata*

Geophytes: *Haemanthus humilis*, *Haemanthus montanus*

Herbaceous climbers: *Rhynchosia totta*

Low shrubs: *Anthospermum hispidulum*, *Anthospermum rigidum* subsp. *pumilum*, *Berkheya annectens*, *Felicia muricata*, *Ziziphus zeyheriana*.

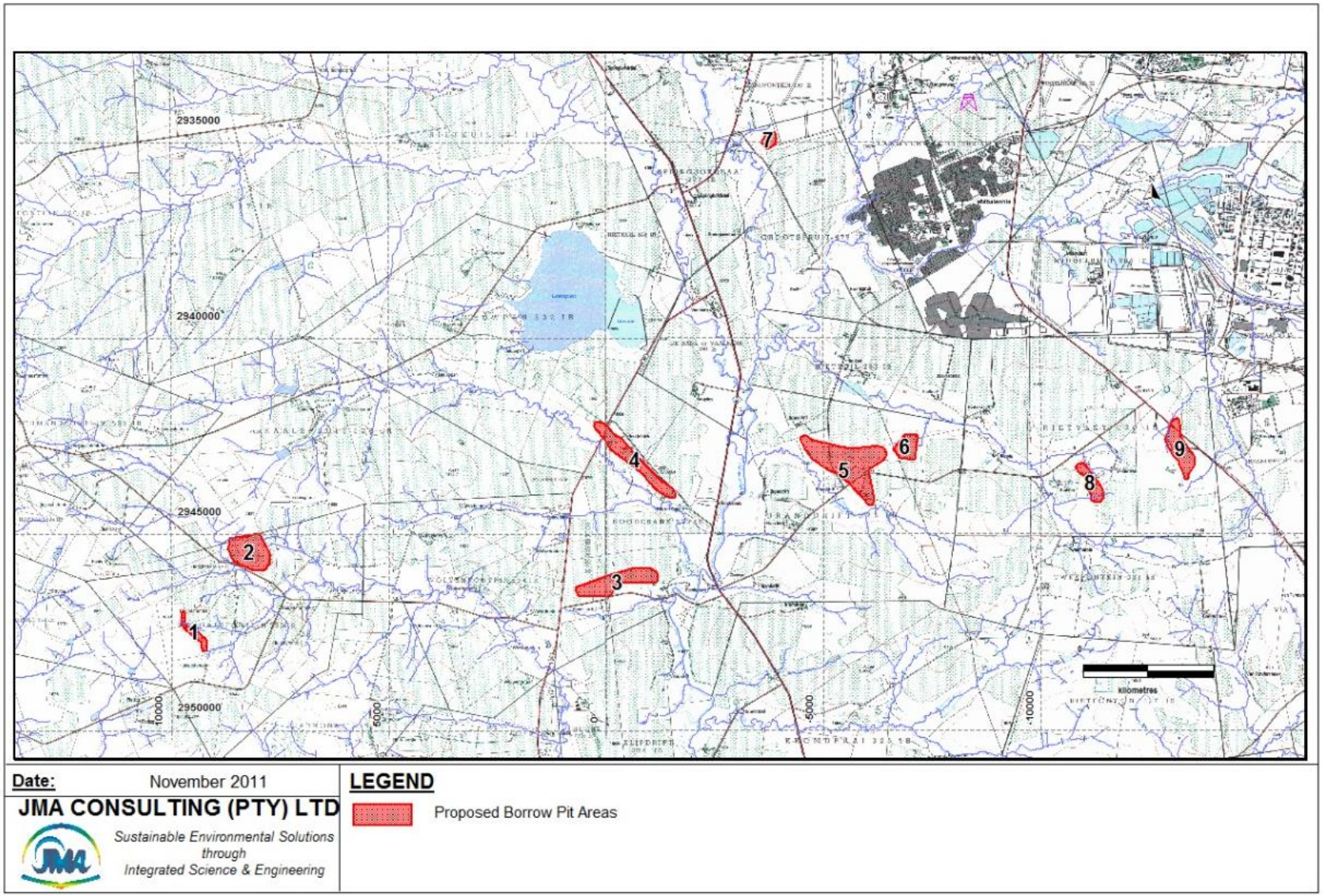


Figure 5.7.1 (c): Study Area with 9 Proposed Borrow Pits on 1:50 000 Topographical Maps 2628BD, 2628DB, 2629AC and 2629CA.

Soweto Highveld Grassland is considered to be Endangered, with none conserved and at least 45% transformed, mostly by cultivation (36%) and urbanization (8%), which is spreading rapidly (Mucina & Rutherford, 2006). The Draft National List of Threatened Ecosystems (GN1477 of 2009), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004), lists this vegetation type as Vulnerable.

5.7.2 Local Plant Life Baseline Description

The Borrow Pit areas lie widespread across mostly disturbed grassland as well as land transformed by agricultural activities. Figure 5.7.2 (a) – Figure 5.7.2 (i) indicate the proposed Borrow Pit localities overlain on the 2009/2010 81cm ortho-photos.

Table 5.7.2(a): Current Vegetation Disturbance Percentages

Borrow Pit Number	Total Area (m^2)	Transformed Land %	Disturbed Grassland %
1	127140	33%	67%
2	675650	91%	9%
3	678760	97%	3%
4	660440	26%	74%
5	1421420	41%	59%
6	261000	10%	90%
7	106960	100%	0%
8	257670	18%	82%
9	487630	27%	73%

The Table above indicates the approximate percentage of the proposed Borrow Pit areas that have been transformed by agricultural and other activities and the percentage that still have grassland present as seen on the ortho-photos.

Two plant communities and four variations were identified during the original vegetation survey within the study area (EkoInfo 2004). These communities are:

1. *Themeda triandra – Berkheya carlinopsis* Grassland Community on clayey soils
   a. *Themeda triandra – Berkheya carlinopsis – Cirsium vulgare* Low lying variation
   b. *Themeda triandra – Berkheya carlinopsis – Elionurus muticus* High lying variation

2. *Hyparrhenia hirta – Helichrysum nudifolium* Grassland Community on sandy soils
   a. *Hyparrhenia hirta – Helichrysum nudifolium – Trichoneura grandiglumus* Over utilised variation
   b. *Hyparrhenia hirta – Helichrysum nudifolium – Commelina africana* Disturbed variation

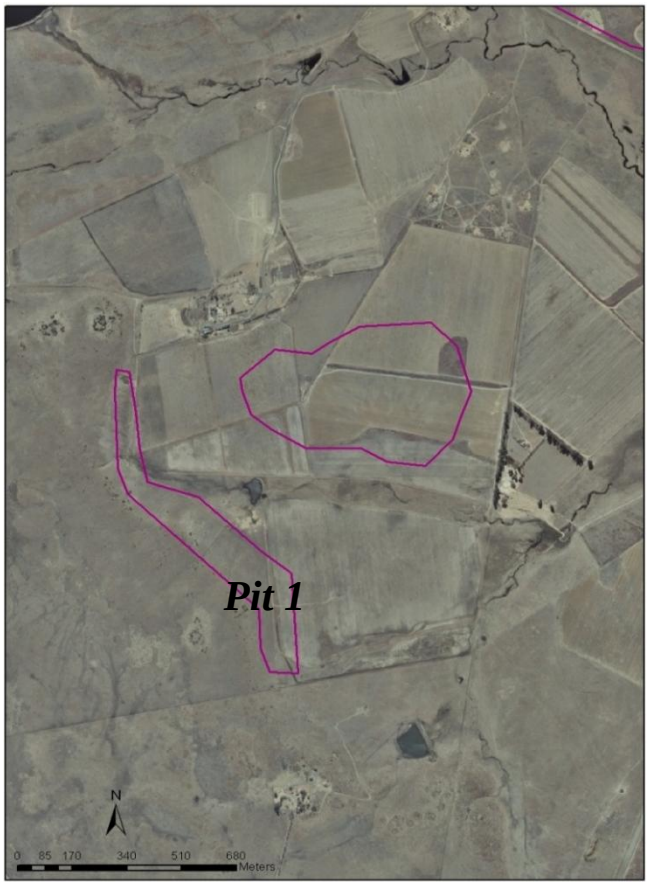


Figure 5.7.2(a) Orthophoto showing Pit 1

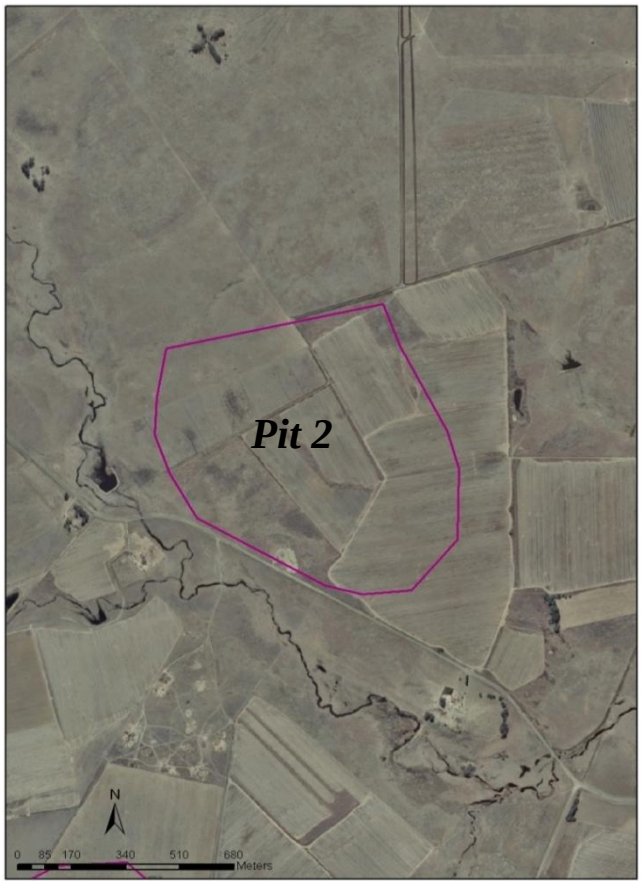


Figure 5.7.2(b) Orthophoto showing Pit 2

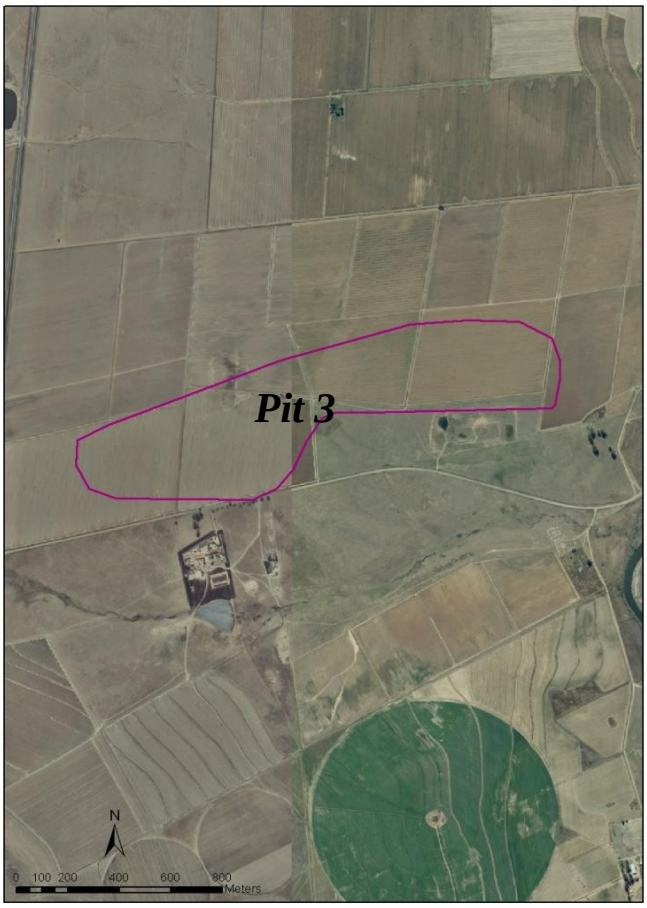


Figure 5.7.2(c) Orthophoto showing Pit 3

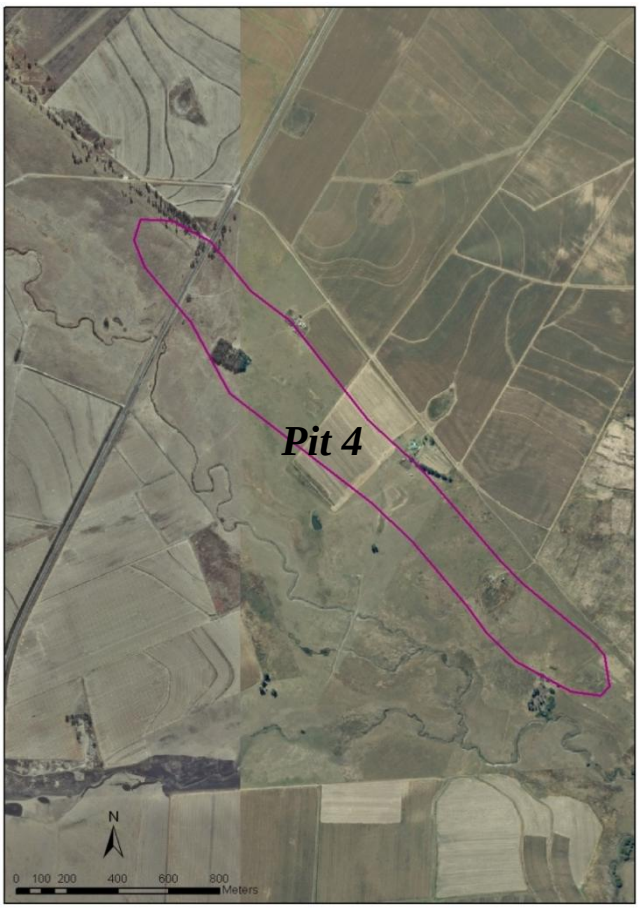


Figure 5.7.2(d) Orthophoto showing Pit 4

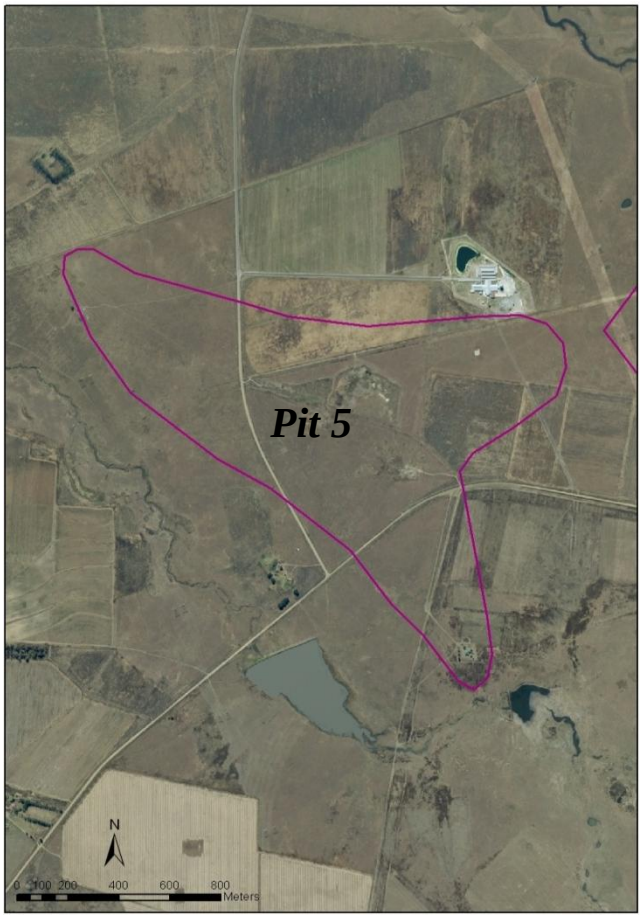


Figure 5.7.2(e) Orthophoto showing Pit 5

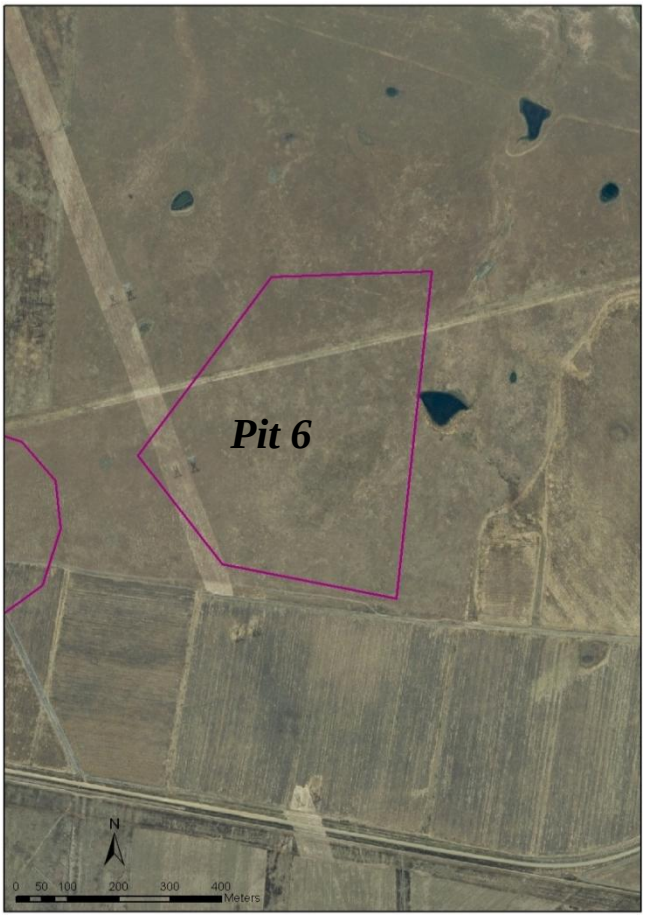


Figure 5.7.2(f) Orthophoto showing Pit 6

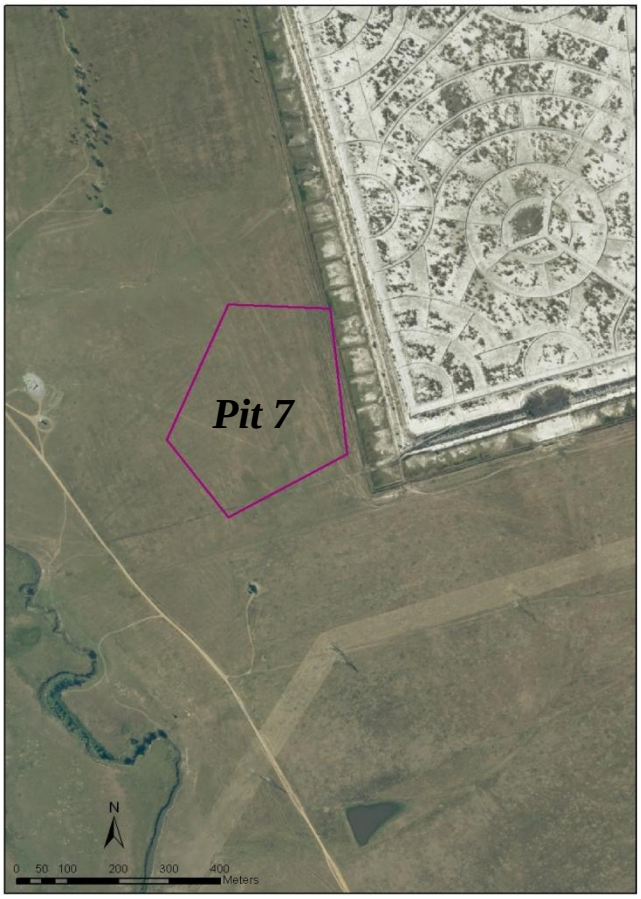


Figure 5.7.2(g) Orthophoto showing Pit 7

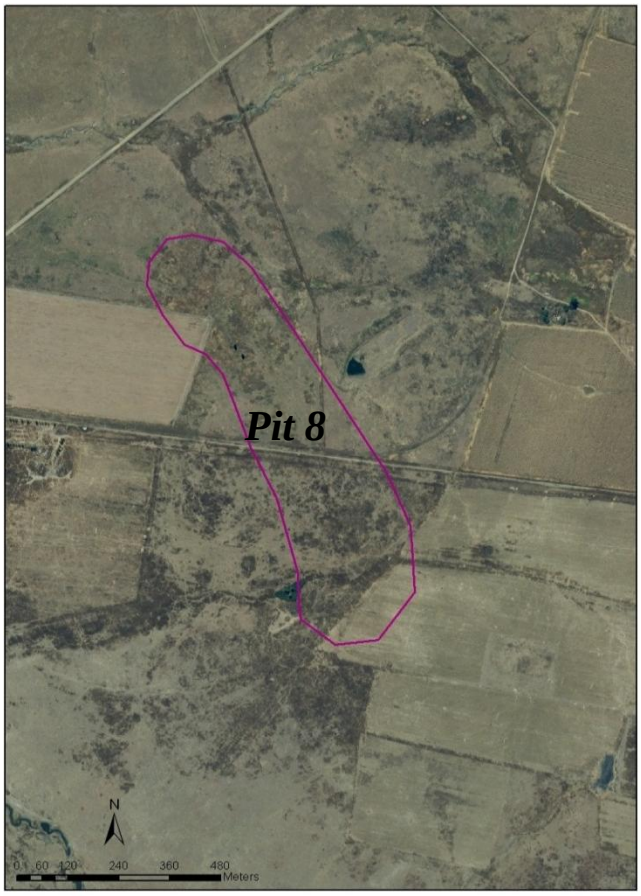


Figure 5.7.2(h) Orthophoto showing Pit 8

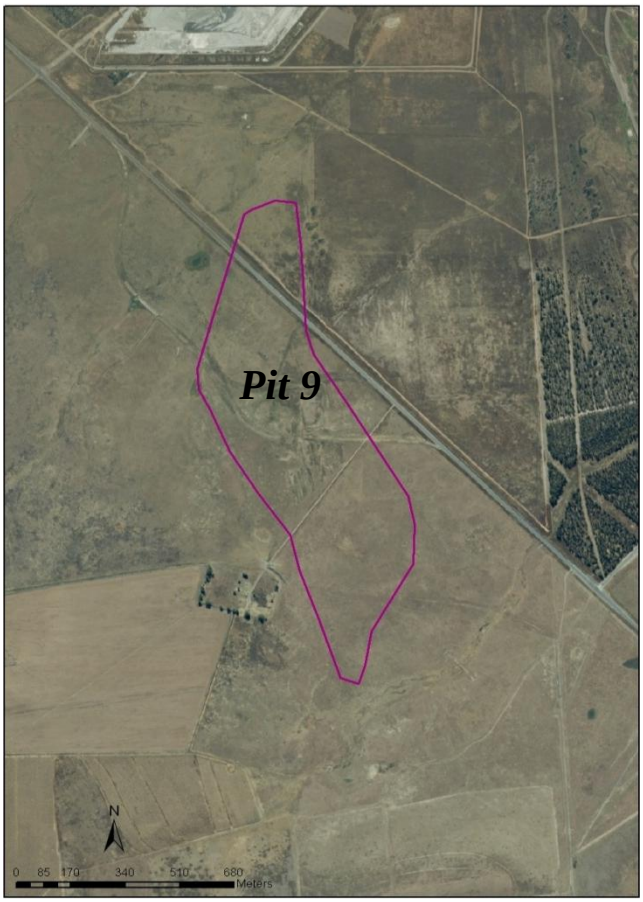


Figure 5.7.2(i) Orthophoto showing Pit 9

Summarised descriptions of the two major plant communities are provided below. For a more detailed description, refer to the original report by EkoInfo (2004).

5.7.2.1 Themeda triandra – Berkheya carlinopsis Grassland Community on clayey soils

The *Themeda triandra – Berkheya carlinopsis* Grassland Community on clayey soils represents approximately 83% of the natural vegetation. It is associated with clayey soils of which the average estimated clay content is 48%. Common, dominant and characteristic species are provided in Appendix 1. Two variations were identified within this community during the survey of which the *Themeda triandra – Berkheya carlinopsis – Cirsium vulgare* Low lying variation is associated with the valley bottoms and low-lying areas within the study area. This community is over utilised by livestock because it is en route to water and is higher in nutrients and soil moisture and therefore more palatable to livestock than the surrounding high-lying areas.

The *Themeda triandra – Berkheya carlinopsis – Elionurus muticus* High lying variation is associated with the areas above the valley bottom to the crests. It has the most extensive distribution of the two variations and reflects both natural and human influences ranging from over utilisation to high species diversity.

5.7.2.2 Hyparrhenia hirta – Helichrysum nudifolium Grassland Community on sandy soils

The *Hyparrhenia hirta – Helichrysum nudifolium* Grassland Community on sandy soils occurs as islands or stands within the larger *Themeda triandra – Berkheya carlinopsis* Grassland Community on clayey soils. It is associated with sandy soils of which the average estimated clay content is 14%. This community represents approximately 17% of the natural vegetation. This does not reflect the true distribution of the sandy soils nor the vegetation associated with the soils, as large areas of the sandy soils have been transformed for cultivation.

The two variations identified during the survey, reflect this trend. The *Hyparrhenia hirta – Helichrysum nudifolium – Trichoneura grandiglumus* over utilised variation represents a community which has not been mechanically disturbed, but is used for grazing and whose condition can be improved through management. The *Hyparrhenia hirta – Helichrysum nudifolium – Commelina africana* disturbed variation represents old fields or areas on the border of cultivated fields which had been abandoned due to water logging or change in land use.

5.7.2.3 Riparian Wetlands

The riparian wetlands found within this area are representative of floodplain/vlei's. The reed, *Phragmites australis*, and bulrush, *Typha capensis*, are characteristic of the floodplain/vlei's. The species composition of the riparian fringes is similar to terrestrial vegetation up to where the streambed starts or open water is found, but may include a high number of facultative wetland species that would not ordinarily be found in terrestrial grassland. On the storage floodplains the location of the oxbow lakes are indicated by a change in vegetation from mesophytic species to hydrophytic species, especially sedges. The levees along the riparian wetland are eroded in most places and are degraded through trampling and over-utilization by livestock. Aesthetically appealing species found in the vicinity of the riparian wetlands include the shrub, *Erythrina zeyheri*, and the geophytes, *Nerine krigei* and *Haemanthus montanus*.

5.7.3 Red List Plant Species

The objective of this section was to compile a list of plant species for which there is conservation concern that may be affected by the proposed infrastructure. This includes threatened, rare, declining and protected plant species.

Lists of plant species previously recorded in the quarter degree grids in which the study area is situated were obtained from SANBI. This list contains 10 species, listed in Table 5.7.3(b) together with their conservation status categories according to the IUCN Version 3.1 criteria (IUCN, 2001).

Relevant information, such as habitat, flowering time, etc., is given for all species listed. Five of these species are listed as Near Threatened and five as Declining (see Table 5.7.3(a) for explanation of IUCN categories).

Table 5.7.3(a): Explanation of IUCN Ver. 3.1 categories (IUCN, 2001), and Orange List categories (Victor & Keith, 2004)

IUCN category	Definition	Class
EX	Extinct	Extinct
CR	Critically Endangered	Threatened
EN	Endangered	Threatened
VU	Vulnerable	Threatened
NT	Near Threatened	Orange List
Declining	Least Concern, declining taxa	Orange List
Rare	Least Concern, rare	Orange List
Critically Rare	Least Concern, rare: only one subpopulation	Orange List
LC (Rare-Sparse)	Least Concern, rare: widely distributed but rare	Orange List
DDD	Data Deficient: well-known but not enough information for assessment	Orange List
DDT	Data Deficient: taxonomic problems	Data Deficient
DDX	Data Deficient: unknown species	Data Deficient
LC	Least Concern	Least Concern

Of the 10 potential red data species, three Declining species were recorded during a previous survey. They were *Boophane disticha*, *Eucomis autumnalis* subsp. *clavata* and *Hypoxis hemerocallidea*. On the basis of information, six of the remaining seven species were considered to have a high chance of occurring in the type of habitats available on site.

5.7.4 Protected Plant Species

All of the species from the genus *Gladiolus* and all the species from the family Orchidacea are protected in terms of the Mpumalanga Conservation Act's list of protected flora. Species previously recorded in surveys on site and within the quarter degree grid in which the study area is found are the following:

- *Bonatea speciosa*
- *Eulophia welwitschii*
- *Gladiolus crassifolius*
- *Gladiolus robertsoniae*
- *Gladiolus sericeovillosus* subsp. *calvatus*
- *Gladiolus elliotii*

Taxon	Latest (IUCN version 3.1) Conservation Status**	Habitat	Flowering Time	Probability of occurrence*
Boophane disticha	Declining	Dry grassland and rocky areas	October-January	**DEFINITE** found on site
Crinum bulbispermum	Declining	Along rivers and streams or in damp depressions in black clay or sandy soil.	September-November	**HIGH** suitable habitat on site
Eucomis autumnalis subsp. *clavata*	Declining	Open grassland, marshes.	November-April	**DEFINITE** found on site
Gladiolus robertsoniae	Near Threatened (NT)	Moist highveld grasslands, found in rocky sites, mostly dolerite outcrops. Corms are wedged in rock crevices. Restricted to seeps and stream banks where moisture is available at the end of the dry season.	October-December	**HIGH** suitable habitat on site
Hypoxis hemerocallidea	Declining	Grassland and mixed woodland.	January-March	**DEFINITE** found on site
Kniphofia typhoides	Near Threatened (NT)	Low-lying wetlands and seasonally wet areas in climax Themeda triandra grasslands on heavy black clay soils, tends to disappear from degraded grasslands.	February-March	**HIGH** suitable habitat on site
Nerine gracilis	Near Threatened (NT)	Undulating grasslands in damp, moist areas; the plants grow in full sun in damp depressions, near pans or on the edges of streams; grassland, riverbanks, vleis.	February – March	**HIGH** suitable habitat on site
Pelargonium sidoides	Declining	Open grassland, often on shallow soils.	February – March	**MEDIUM** marginal habitat on site
Stenostelma umbelluliferum	Near Threatened (NT)	Deep black turf soil in open woodland mainly in the vicinity of drainage lines.	September – March	**MEDIUM** marginal habitat on site
Trachyandra erythrorrhiza	Near Threatened (NT)	Marshy areas, grassland, usually in black turf marshes.	September – November	**HIGH** suitable habitat on site

** Conservation Status Category assessment according to IUCN Ver. 3.1 (IUCN, 2001), as indicated on SANBI website (http://sibis.sanbi.org/, accessed on 28/07/2010).

*Probability of occurrence, as follows: LOW – no suitable habitats occur on site / habitats on site do not match habitat description for species, MEDIUM – habitats on site match general habitat description for species (e.g. grassland), but microhabitat requirements are absent (e.g. rocky grassland on shallow soils overlying dolomite), HIGH – habitats on site match very strongly the general and microhabitat description for the species, DEFINITE – species found on site.

Table 5.7.3(b): Red Data Plant Species Recorded in the Region during the 2010 Survey

5.7.5 Sensitivity Assessment

The sensitivity assessment is an attempt to identify those parts of the study area that may have high conservation value or that may be sensitive to disturbance. Areas containing untransformed natural vegetation, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to have low sensitivity.

According to the Mpumalanga C-plan version there are some sensitive features in and around the study area, as follows (Figure 5.7.5 (a)):

- Pit 1 and Pit 4 lie within areas classified as highly significant.
- Pit 3 lie within an area classified as important and necessary.

Additional requirements, as per other environmental legislation are as follows:

- All remaining untransformed grasslands in South Africa are considered to have high sensitivity and conservation value.

The site is situated within an area that contains patches of primary grassland that occurs within the Endangered vegetation type, Soweto Highveld Grassland. There are various parts of the site that contain grassland with good species composition that is considered to be reasonably good quality Soweto Highveld Grassland.

Table 5.7.5 (a): Factors Contributing to Sensitivity Classification of Habitats

Vegetation Habitat Type	Sensitivity	Reason
Grassland	High	• representative of an endangered vegetation type (Soweto Highveld Grassland) • protected under National Environmental Management: Biodiversity Act (draft ecosystem list)
Wetlands	High	• habitat in main drainage lines classified as wetlands (National Water Act).

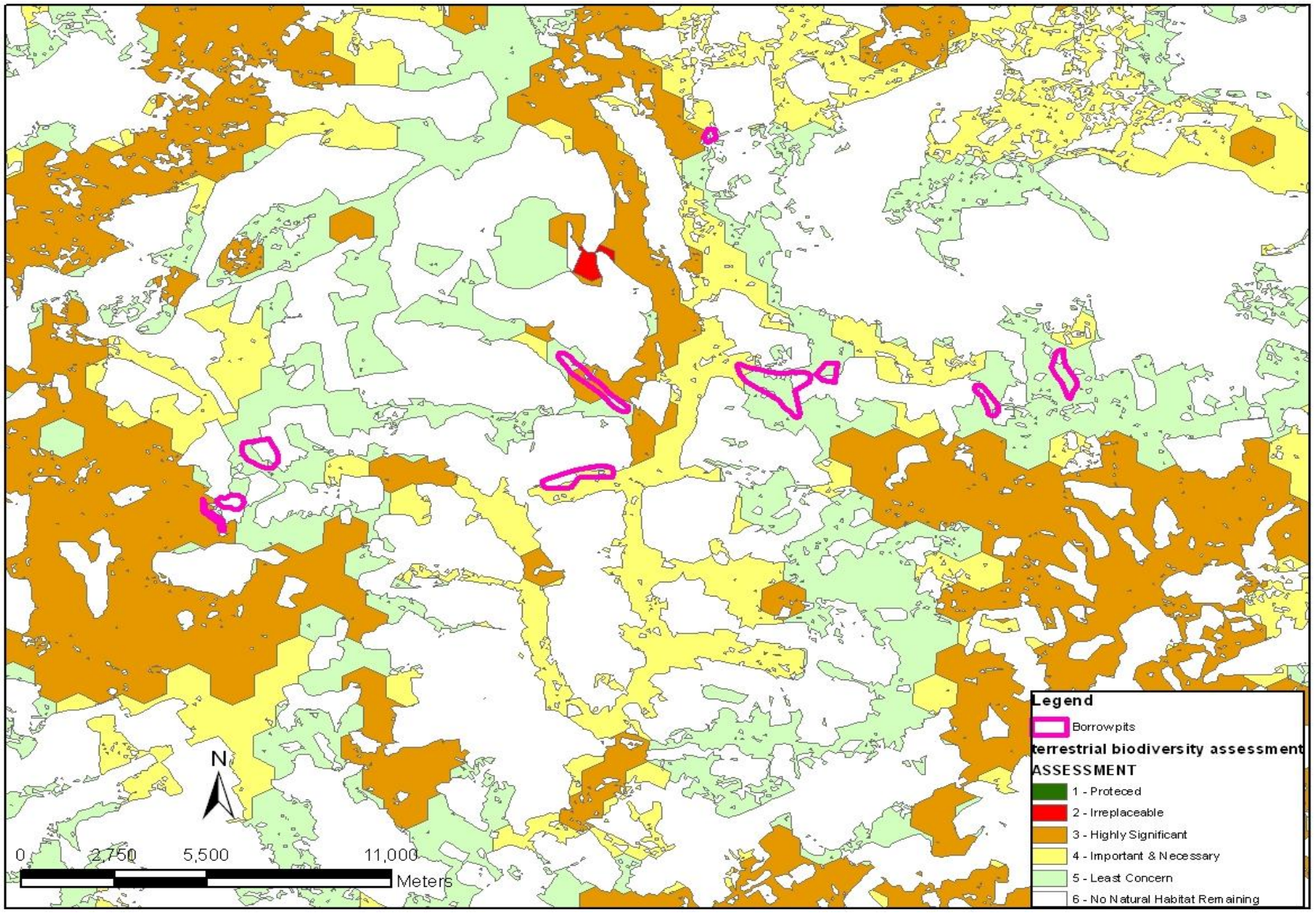


Figure 5.7.5 (a): Sensitive Areas as classified by the Mpumalanga C-Plan

5.7.6 Conclusions

The baseline vegetation description of the study area was performed using studies of both CleanStream Environmental Consultants done for the Impumelelo project and that done for the Sasol Shondoni project as well as by expanding on an existing study that was undertaken for a smaller part of the study area. Since the original study was completed, the study area has been expanded.

The requirements of this study were to undertake a specialist study to describe the base line vegetation and flora in the borrow pits study areas. The vegetation studies described above identified two major grassland plant communities as well as wetland vegetation in drainage lines.

The grassland is within a grassland vegetation type called Soweto Highveld Grassland, which is classified as Endangered and listed in the Draft List of protected ecosystems (National Environmental Management: Biodiversity Act). It is a high conservation priority nationally.

All remaining areas of natural grassland are therefore considered to have high conservation value and ecological sensitivity. All wetlands are considered to be ecologically sensitive. Where natural wetland vegetation still occurs, this is considered to be an important biodiversity resource and is therefore also classified as having elevated sensitivity and conservation value. Remaining natural grasslands and all areas of wetland vegetation should be considered to have HIGH sensitivity. Remaining areas have LOW sensitivity.

5.7.7 Manner of Potential Environmental Impacts

The vegetation within the footprints of the actual open pits will of course be fully destroyed during mining, whilst a further buffer zone around the pits could be subjected to trampling by vehicles, dust deposition and in certain instances depletion in water supply due to the possible depletion in shallow hill slope seepages feeding wetland type vegetation. The possibility for an impact on the vegetation due to spillages of contaminated water should also be considered.

Although the mining area will be fully rehabilitated and re-vegetated after closure, the increase in weeds and invader species during the re-establishment period is a given if they are not monitored and controlled effectively.

Depending on the success of the re-vegetation program, the post rehabilitation vegetative potential could be affected indefinitely.

5.8 TERRESTRIAL ECOLOGY (ANIMAL LIFE)

The baseline animal life description of the study area was performed using studies of both CleanStream Environmental Consultants done for the Impumelelo Project and that done for the Sasol Shondoni Project as well as by expanding on an existing study that was undertaken for a smaller part of the study area. Since the original study was completed, the study area has been expanded.

A detailed investigation of the fauna (birds and mammals) within the study area was undertaken by CleanStream for the larger Sasol Block 8 study area. The aim of this investigation was to determine the faunal communities likely to occur in the study area and the relative sensitivities of the vegetation habitats which support these communities.

5.8.1 Regional Description of Relevant Faunal Attributes

5.8.1.1 Location

The study area is located South-west of Secunda and South to Southwest of the town of eMbalenhle in the Vaal River Catchment in the Mpumalanga province. The area is characterised by slightly undulating plains and pans.

Figure 5.8.1.1 (a) indicates the larger study area, also showing the proposed Borrow Pit areas.

5.8.1.2 Habitat Types

Habitat selection by an animal takes into account a number of biotic and abiotic factors including: plant species present, vegetation structure, topography, pedology, climate, distance to water, presence of rocky outcrops, trees, predators and sufficient food. The level of human disturbance is also an important factor influencing habitat selection.

Approximately 45% of the borrow pit study areas are already transformed by mostly agricultural activities. The grasslands still occurring in the study area are disturbed by human presence and associated impacts.

Within the study area the main habitat types available are short and tall mesic grasslands and to a lesser extent riparian and wetland habitat, including floodplains, valley bottom wetlands, and hillslope seepage wetlands. Therefore the species most likely to occur are grassland specialists, species linked to wet habitats and those with wide habitat tolerances.

Some of the habitat types observed during the field survey is shown in the photographs below (Figure 5.8.1.2(a)). Some of the disturbances in the larger study area include urban settlements, roads, cultivated and cattle-grazed land and a large coal mining operation. A number of slimes dams and water impoundments are also present.

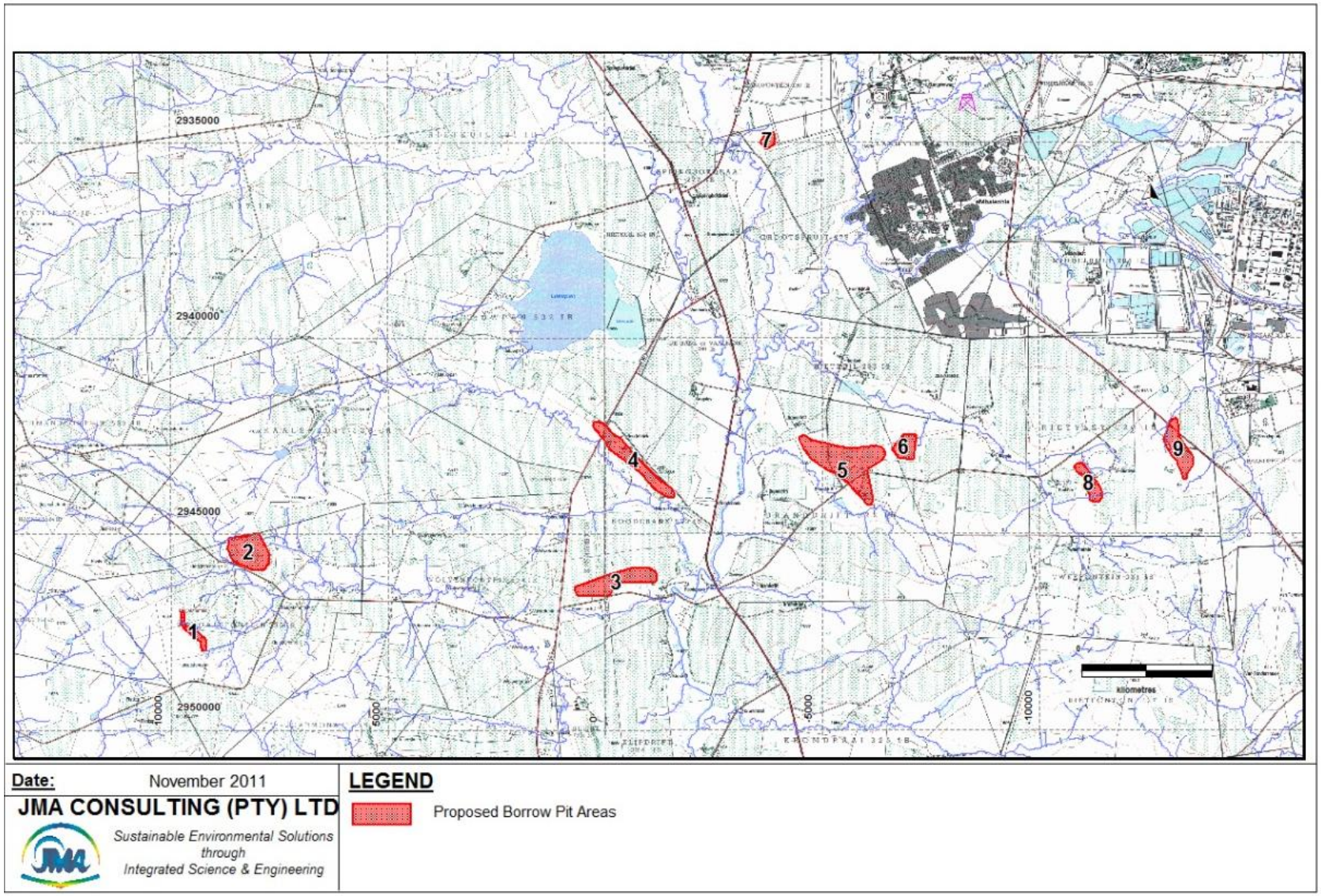


Figure 5.8.1.1 (a): Study Area on 1:50 000 Topographical Maps 2628BD, 2628DB, 2629AC and 2629CA.

Figure 5.8.1.2(a): Series of Photographs showing Various Habitats Present

5.8.2 Fauna of the Study Area

5.8.2.1 Mammals

The results of the literature review done by CleanStream suggest that 84 mammals species potentially occur within the larger study area based on their distribution ranges alone, 23 of these species being of conservation concern (Endangered, Near-threatened, Vulnerable) or Data Deficient.

Agricultural, mining, human settlement and other similar activities have negatively impacted the occurrence of large mammal species, in particular ungulates and predators.

No Red Data List mammal species were observed during the field survey. A list of all Red Data List mammal species recorded for the study is provided below, including their likelihood of occurrence based upon habitat suitability within the study area (Table 5.8.2.1(a)). Both the Spotted-necked Otter and the Water Rat (both listed as Near Threatened) are likely to occur in the study area based on their habitat requirements, the presence of suitable habitat and the levels of human disturbance.

This does not preclude the possibility of other Red Data List species occurring in the study area, they are merely less likely to occur. A list of mammal species observed in the Study Area is also included in Table 5.8.2.1(b). A complete list of all mammal species potentially occurring in the area is shown in Table 5.8.2.1(c) in Appendix I.

Table 5.8.2.1(a): Red Data List mammal species potentially occurring within QDS 2629AC, 2629CA, 2628BD and 2628DB and their likelihood of occurrence within the study area (DD = Data Deficient, EN = Endangered, NT = Near Threatened, VU = Vulnerable and (E) = Endemic)

SPECIES	COMMON NAME	CONSERVATION STATUS	LIKELYHOOD OF OCCURRENCE
Amblysomus hottentotus	Hottentot's golden mole	DD (E)	Unlikely
Crocidura cyanea	Reddish-grey musk shrew	DD	May Occur
Crocidura mariquensis	Swamp musk shrew	DD	Unlikely
Crocidura silacea	Lesser grey-brown musk shrew	DD	May Occur
Graphiurua platyops	Rock dormouse	DD	May Occur
Lemniscomys rosalia	Single-striped mouse	DD	Likely
Myosorex varius	Forest shrew	DD (E)	May Occur
Poecilogale albinucha	Striped weasel	DD	May Occur
Suncus infinitesimus	Least dwarf shrew	DD (E)	May Occur
Suncus varilla	Lesser dwarf shrew	DD	May Occur
Tatera leucogaster	Bushveld gerbil	DD	Unlikely
Mystromys albicaudatus	White-tailed mouse	EN (E)	May Occur
Ourebia ourebi	Oribi	EN	Unlikely
Amblysomus septentrionalis	Highveld golden mole	NT	May Occur
Atelerix frontalis	South African hedgehog	NT	May Occur
Dasymys incomtus	Water rat	NT	Likely
Lutra maculicollis	Spotted-necked otter	NT	Likely

SPECIES	COMMON NAME	CONSERVATION STATUS	LIKELYHOOD OF OCCURRENCE
Miniopterus schreibersii	Schreibers' long-fingered bat	NT	Unlikely
Myotis tricolor	Temminck's hairy bat	NT	Unlikely
Parahyaena brunnea	Brown hyaena	NT	Unlikely
Rhinolophus clivosus	Geoffrey's horseshoe bat	NT	Unlikely
Manis temminckii	Pangolin	VU	Unlikely
Rhinolophus blasii	Peak-saddle horseshoe bat	VU	Unlikely

Table 5.8.2.1(b): List of mammal species observed during field surveys within the study area

ORDER	SPECIES	COMMON NAME
Carnivora	*Canis mesomelas*	Black-backed jackal
Rodentia	*Otomys irroratus*	Vlei rat
Ruminantia	*Raphicerus campestris*	Steenbok
Ruminantia	*Sylvicarpa grimmia*	Grey Duiker
Carnivora	*Aonyx capensis*	Cape clawless otter
Carnivora	*Atilax paludinosus*	Water/Marsh mongoose
Lagomorpha	*Lepus saxatillus*	Scub hare/Savannah hare
Rodentia	*Hystrix africaeaustralis*	Porcupine
Carnivora	*Cynictis penicillata*	Yellow mongoose
Chiroptera	*Neoromicia capensis*	Cape serotine bat
Lagomorpha	*Lepus capensis*	Cape hare/Desert hare
Rodentia	*Rhabdomys pumilio*	Striped mouse

Table 5.8.2.1(c): List of mammal species potentially occurring within the Larger study area

ORDER	SPECIES	COMMON NAME
Afrosoricida	***Amblysomus hottentotus***	**Hottentot's golden mole**
Afrosoricida	***Amblysomus septentrionalis***	**Highveld golden mole**
Carnivora	*Aonyx capensis*	Cape clawless otter
Carnivora	*Atilax paludinosus*	Water/Marsh mongoose
Carnivora	*Canis mesomelas*	Black-backed jackal
Carnivora	*Caracal caracal*	Caracal
Carnivora	*Cynictis penicillata*	Yellow mongoose
Carnivora	*Felis nigripes*	Black-footed cat
Carnivora	*Felis silvestris*	African wild cat
Carnivora	*Galerella sanguinea*	Slender mongoose
Carnivora	*Genetta genetta*	Small-spotted genet
Carnivora	*Genetta tigrina*	Large-spotted genet
Carnivora	*Ichneumia albicauda*	White-tailed mongoose
Carnivora	*Ictonyx striatus*	Striped polecat
Carnivora	***Lutra maculicollis***	**Spotted-necked otter**
Carnivora	*Mungos mungo*	Banded mongoose
Carnivora	***Parahyaena brunnea***	**Brown hyaena**
Carnivora	***Poecilogale albinucha***	**Striped weasel**
Carnivora	*Proteles cristatus*	Aardwolf
Carnivora	*Suricata suricatta*	Suricate
Carnivora	*Vulpes chama*	Cape fox
Chiroptera	*Eidolon helvum*	Straw-coloured fruit bat
Chiroptera	***Miniopterus schreibersii***	**Schreibers' long-fingered bat**
Chiroptera	***Myotis tricolor***	**Temminck's hairy bat**
Chiroptera	*Neoromicia capensis*	Cape serotine bat
Chiroptera	*Nycteris thebaica*	Egyptian slit-faced bat

ORDER	SPECIES	COMMON NAME
Chiroptera	***Rhinolophus blasii***	**Peak-saddle horseshoe bat**
Chiroptera	***Rhinolophus clivosus***	**Geoffrey's horseshoe bat**
Chiroptera	*Sauromys petrophilus*	Flat-headed free-tailed bat
Chiroptera	*Tadarida aegyptiaca*	Egyptian free-tailed bat
Chiroptera	*Taphozous mauritianus*	Tomb bat
Eulipotyphla	***Atelerix frontalis***	**South African hedgehog**
Eulipotyphla	***Crocidura cyanea***	**Reddish-grey musk shrew**
Eulipotyphla	***Crocidura mariquensis***	**Swamp musk shrew**
Eulipotyphla	***Crocidura silacea***	**Lesser grey-brown musk shrew**
Eulipotyphla	***Myosorex varius***	**Forest shrew**
Eulipotyphla	***Suncus infinitesimus***	**Least dwarf shrew**
Eulipotyphla	***Suncus varilla***	**Lesser dwarf shrew**
Hyracoidea	*Procavia capensis*	Rock Hyrax
Lagomorpha	*Lepus capensis*	Cape hare/Desert hare
Lagomorpha	*Lepus saxatillus*	Scub hare/Savannah hare
Lagomorpha	*Pronolagus randensis*	Jameson's red rock rabbit
Lagomorpha	*Pronolagus rupestris*	Smith's red rock rabbit
Macroscelidea	*Elephantulus myurus*	Rock elephant-shrew
Pholidota	***Manis temminckii***	**Pangolin**
Primata	*Galago moholi*	Lesser bushbaby
Primata	*Papio ursinus*	Chacma baboon
Rodentia	*Aethomys chrysophilus*	Red veld rat
Rodentia	*Aethomys ineptus*	Tete veld rat
Rodentia	*Cryptomys hottentotus*	Common mole-rat
Rodentia	***Dasymys incomtus***	**Water rat**
Rodentia	*Dendromus melanotis*	Grey climbing mouse
Rodentia	*Dendromus mesomelas*	Brant's climbing mouse
Rodentia	*Dendromus mystacalis*	Chestnut climbing mouse
Rodentia	***Graphiurua platyops***	**Rock dormouse**
Rodentia	*Graphiurus murinus*	Woodland dormouse
Rodentia	*Hystrix africaeaustralis*	Porcupine
Rodentia	***Lemniscomys rosalia***	**Single-striped mouse**
Rodentia	*Mastomys coucha*	Multimammate mouse
Rodentia	*Mastomys natalensis*	Natal multimammate mouse
Rodentia	*Micaelamys namaquensis*	Namaqua rock mouse
Rodentia	*Mus indutus*	Desert pygmy mouse
Rodentia	*Mus minutoides*	Pygmy mouse
Rodentia	***Mystromys albicaudatus***	**White-tailed mouse**
Rodentia	*Otomys angoniensis*	Angoni vlei rat
Rodentia	*Otomys irroratus*	Vlei rat
Rodentia	*Pedetes capensis*	Springhare
Rodentia	*Rhabdomys pumilio*	Striped mouse
Rodentia	*Saccostomus campestris*	Pouched mouse
Rodentia	*Tatera bransii*	Highveld gerbil
Rodentia	***Tatera leucogaster***	**Bushveld gerbil**
Rodentia	*Thallomys nigricauda*	Black-tailed tree mouse
Rodentia	*Thallomys paedulcus*	Tree mouse
Rodentia	*Xerus inauris*	Cape Ground squirrel
Ruminantia	*Antidorcas marsupialis*	Springbok
Ruminantia	*Connochaetes gnou*	Black wildebeest
Ruminantia	*Damaliscus pygargus phillipsi*	Blesbok
Ruminantia	***Ourebia ourebi***	**Oribi**
Ruminantia	*Pelea capreolus*	Grey rhebok
Ruminantia	*Raphicerus campestris*	Steenbok
Ruminantia	*Sylvicapra grimmia*	Common duiker
Ruminantia	*Tragelaphus oryx*	Eland
Suiformes	*Phacochoerus africanus*	Common warthog
Tubulidentata	*Orycteropus afer*	Aardvark

5.8.2.2 Birds

The list of bird species extracted from SABAP 1 for the four QDS's are actual recent sightings of those species by individuals and therefore constitute the actual bird species assemblage within the area (although it is recognised that it may not be a complete list). The bird species list includes 255 bird species, 25 of which are of conservation concern (Table 5.8.2.2(a)).

Four Red Data List bird species were observed during the field survey, including the Martial Eagle (*Polemaetus bellicosus*) which had not previously been recorded from this area during the SABAP 1 bird counts. Greater and Lesser Flamingo were both observed on Leeupan, a South African grass-owl was flushed from a stand of *I. cylindrica* grass along one of the watercourses in the Springbokdraai reserve, and the Martial eagle was seen just outside and to the west of the Springbokdraai area boundary.

The bulk of the species diversity is made up of grassland birds and water birds. A complete list of all bird species occurring in the area can be found in Table 5.8.2.2(b).

Table 5.8.2.2(a): Red Data List bird species occurring within QDS 2629CA and 2628DB

Common Name	Afrikaans Name	Scientific Name	Status
African Marsh-Harrier	Afrikaanse Vleivalk	*Circus ranivorus*	VU
African Openbill	Oopbekooievaar	*Anastomus lamelligerus*	NT
Black Harrier	Witkruisvleivalk	*Circus maurus*	NT
Black-winged Pratincole	Swartvlerksprinkaanvoel	*Glareola nordmanni*	NT
Blue Crane	Bloukraanvoel	*Anthropoides paradiseus*	VU
Blue Korhaan	Bloukorhaan	*Eupodotis caerulescens*	NT
Caspian Tern	Reusesterretjie	*Sterna caspia*	NT
Greater Flamingo	Grootflamink	*Phoenicopterus ruber*	NT
Lanner Falcon	Edelvalk	*Falco biarmicus*	NT
Lesser Flamingo	Kleinflamink	*Phoenicopterus minor*	NT
Lesser Kestrel	Kleinrooivalk	*Falco naumanni*	VU
Melodious Lark	Spotlewerik	*Mirafra cheniana*	NT
Pallid Harrier	Witborsvleivalk	*Circus macrourus*	NT
Secretarybird	Sekretarisvoel	*Sagittarius serpentarius*	NT
White-bellied Korhaan	Witpenskorhaan	*Eupodotis senegalensis*	VU

(CR= Critically Endangered, EN= Endangered, NT= Near Threatened, VU= Vulnerable)

Table 5.8.2.2(b): List of bird species potentially occurring within the study area

Common Name	Scientific Name
Acacia Pied Barbet	*Tricholaema leucomelas*
African Black Duck	*Anas sparsa*
African Black Swift	*Apus barbatus*
African Darter	*Anhinga rufa*
African Hoopoe	*Upupa africana*
African Marsh-Harrier	*Circus ranivorus*
African Openbill	*Anastomus lamelligerus*
African Palm-Swift	*Cypsiurus parvus*
African Paradise-Flycatcher	*Terpsiphone viridis*
African Pipit	*Anthus cinnamomeus*
African Purple Swamphen	*Porphyrio madagascariensis*
African Quailfinch	*Ortygospiza atricollis*
African Quailfinch	*Ortygospiza atricollis*
African Red-eyed Bulbul	*Pycnonotus nigricans*
African Reed-Warbler	*Acrocephalus baeticatus*
African Rock Pipit	*Anthus crenatus*
African Sacred Ibis	*Threskiornis aethiopicus*
African Snipe	*Gallinago nigripennis*
African Spoonbill	*Platalea alba*
African Stonechat	*Saxicola torquatus*
African Wattled Lapwing	*Vanellus senegallus*
Alpine Swift	*Tachymarptis melba*
Amethyst Sunbird	*Chalcomitra amethystina*
Amur Falcon	*Falco amurensis*
Anteating Chat	*Myrmecocichla formicivora*
Banded Martin	*Riparia cincta*
Barn Owl	*Tyto alba*
Barn Swallow	*Hirundo rustica*
Bar-throated Apalis	*Apalis thoracica*
Black Harrier	*Circus maurus*
Black Sparrowhawk	*Accipiter melanoleucus*
Black-chested Prinia	*Prinia flavicans*
Black-chested Snake-Eagle	*Circaetus pectoralis*
Black-collared Barbet	*Lybius torquatus*
Black-crowned Night-Heron	*Nycticorax nycticorax*
Black-headed Heron	*Ardea melanocephala*
Black-necked Grebe	*Podiceps nigricollis*
Black-shouldered Kite	*Elanus caeruleus*
Blacksmith Lapwing	*Vanellus armatus*
Black-throated Canary	*Crithagra atrogularis*
Black-winged Pratincole	*Glareola nordmanni*
Black-winged Stilt	*Himantopus himantopus*
Blue Crane	*Anthropoides paradiseus*

Common Name	Scientific Name
Blue Korhaan	*Eupodotis caerulescens*
Blue Waxbill	*Uraeginthus angolensis*
Bokmakierie Bokmakierie	*Telophorus zeylonus*
Brown-backed Honeybird	*Prodotiscus regulus*
Brown-crowned Tchagra	*Tchagra australis*
Brown-throated Martin	*Riparia paludicola*
Brubru Brubru	*Nilaus afer*
Cape Bunting	*Emberiza capensis*
Cape Canary	*Serinus canicollis*
Cape Crow	*Corvus capensis*
Cape Glossy Starling	*Lamprotornis nitens*
Cape Longclaw	*Macronyx capensis*
Cape Robin-Chat	*Cossypha caffra*
Cape Shoveler	*Anas smithii*
Cape Sparrow	*Passer melanurus*
Cape Teal	*Anas capensis*
Cape Turtle-Dove	*Streptopelia capicola*
Cape Wagtail	*Motacilla capensis*
Cape Weaver	*Ploceus capensis*
Cape White-eye	*Zosterops virens*
Capped Wheatear	*Oenanthe pileata*
Cardinal Woodpecker	*Dendropicos fuscescens*
Caspian Tern	*Sterna caspia*
Cattle Egret	*Bubulcus ibis*
Chestnut-backed Sparrowlark	*Eremopterix leucotis*
Cinnamon-breasted Bunting	*Emberiza tahapisi*
Cloud Cisticola	*Cisticola textrix*
Comb Duck	*Sarkidiornis melanotos*
Common Fiscal	*Lanius collaris*
Common Greenshank	*Tringa nebularia*
Common House-Martin	*Delichon urbicum*
Common Moorhen	*Gallinula chloropus*
Common Myna	*Acridotheres tristis*
Common Ostrich	*Struthio camelus*
Common Quail	*Coturnix coturnix*
Common Ringed Plover	*Charadrius hiaticula*
Common Sandpiper	*Actitis hypoleucos*
Common Swift	*Apus apus*
Common Waxbill	*Estrilda astrild*
Crested Barbet	*Trachyphonus vaillantii*
Crowned Lapwing	*Vanellus coronatus*
Cuckoo Finch	*Anomalospiza imberbis*
Curlew Sandpiper	*Calidris ferruginea*
Dark-capped Bulbul	*Pycnonotus tricolor*
Desert Cisticola	*Cisticola aridulus*

Common Name	Scientific Name
Diderick Cuckoo	*Chrysococcyx caprius*
Eastern Clapper Lark	*Mirafra fasciolata*
Eastern Long-billed Lark	*Certhilauda semitorquata*
Egyptian Goose	*Alopochen aegyptiacus*
European Bee-eater	*Merops apiaster*
European Honey-Buzzard	*Pernis apivorus*
European Roller	*Coracias garrulus*
Fairy Flycatcher	*Stenostira scita*
Familiar Chat	*Cercomela familiaris*
Fan-tailed Widowbird	*Euplectes axillaris*
Fiscal Flycatcher	*Sigelus silens*
Fulvous Duck	*Dendrocygna bicolor*
Giant Kingfisher	*Megaceryle maximus*
Glossy Ibis	*Plegadis falcinellus*
Goliath Heron	*Ardea goliath*
Great Crested Grebe	*Podiceps cristatus*
Great Egret	*Egretta alba*
Great Reed-Warbler	*Acrocephalus arundinaceus*
Greater Flamingo	*Phoenicopterus ruber*
Greater Honeyguide	*Indicator indicator*
Greater Kestrel	*Falco rupicoloides*
Greater Striped Swallow	*Hirundo cucullata*
Green Wood-Hoopoe	*Phoeniculus purpureus*
Green-winged Pytilia	*Pytilia melba*
Grey Heron	*Ardea cinerea*
Grey-headed Gull	*Larus cirrocephalus*
Grey-winged Francolin	*Scleroptila africanus*
Hadeda Ibis	*Bostrychia hagedash*
Hamerkop Hamerkop	*Scopus umbretta*
Helmeted Guineafowl	*Numida meleagris*
Horus Swift	*Apus horus*
Hottentot Teal	*Anas hottentota*
House Sparrow	*Passer domesticus*
Icterine Warbler	*Hippolais icterina*
Jackal Buzzard	*Buteo rufofuscus*
Jacobin Cuckoo	*Clamator jacobinus*
Karoo Thrush	*Turdus smithi*
Kittlitz's Plover	*Charadrius pecuarius*
Kurrichane Buttonquail	*Turnix sylvaticus*
Lanner Falcon	*Falco biarmicus*
Laughing Dove	*Streptopelia senegalensis*
Lesser Flamingo	*Phoenicopterus minor*
Lesser Grey Shrike	*Lanius minor*
Lesser Honeyguide	*Indicator minor*
Lesser Kestrel	*Falco naumanni*

Common Name	Scientific Name
Lesser Swamp-Warbler	*Acrocephalus gracilirostris*
Levaillant's Cisticola	*Cisticola tinniens*
Lilac-breasted Roller	*Coracias caudatus*
Little Bittern	*Ixobrychus minutus*
Little Egret	*Egretta garzetta*
Little Grebe	*Tachybaptus ruficollis*
Little Rush-Warbler	*Bradypterus baboecala*
Little Stint	*Calidris minuta*
Little Swift	*Apus affinis*
Long-billed Pipit	*Anthus similis*
Long-tailed Paradise-Whydah	*Vidua paradisaea*
Long-tailed Widowbird	*Euplectes progne*
Maccoa Duck	*Oxyura maccoa*
Malachite Kingfisher	*Alcedo cristata*
Malachite Sunbird	*Nectarinia famosa*
Mallard Duck	*Anas platyrhynchos*
Marsh Owl	*Asio capensis*
Marsh Sandpiper	*Tringa stagnatilis*
Marsh Warbler	*Acrocephalus palustris*
Melodious Lark	*Mirafra cheniana*
Montagu's Harrier	*Circus pygargus*
Mountain Wheatear	*Oenanthe monticola*
Namaqua Dove	*Oena capensis*
Neddicky Neddicky	*Cisticola fulvicapilla*
Northern Black Korhaan	*Afrotis afraoides*
Olive Thrush	*Turdus olivaceus*
Orange River Francolin	*Scleroptila levaillantoides*
Orange-breasted Waxbill	*Amandava subflava*
Pale-crowned Cisticola	*Cisticola cinnamomeus*
Pallid Harrier	*Circus macrourus*
Pied Avocet	*Recurvirostra avosetta*
Pied Crow	*Corvus albus*
Pied Kingfisher	*Ceryle rudis*
Pied Starling	*Spreo bicolor*
Pink-billed Lark	*Spizocorys conirostris*
Pin-tailed Whydah	*Vidua macroura*
Plain-backed Pipit	*Anthus leucophrys*
Purple Heron	*Ardea purpurea*
Red-backed Shrike	*Lanius collurio*
Red-billed Firefinch	*Lagonosticta senegala*
Red-billed Quelea	*Quelea quelea*
Red-billed Teal	*Anas erythrorhyncha*
Red-capped Lark	*Calandrella cinerea*
Red-chested Cuckoo	*Cuculus solitarius*
Red-collared Widowbird	*Euplectes ardens*

Common Name	Scientific Name
Red-eyed Dove	*Streptopelia semitorquata*
Red-faced Mousebird	*Urocolius indicus*
Red-headed Finch	*Amadina erythrocephala*
Red-knobbed Coot	*Fulica cristata*
Red-throated Wryneck	*Jynx ruficollis*
Red-throated Wryneck	*Jynx ruficollis*
Red-winged Starling	*Onychognathus morio*
Reed Cormorant	*Phalacrocorax africanus*
Rock Dove	*Columba livia*
Rock Kestrel	*Falco rupicolus*
Rock Martin	*Hirundo fuligula*
Ruddy Turnstone	*Arenaria interpres*
Ruff Ruff	*Philomachus pugnax*
Rufous-naped Lark	*Mirafra africana*
Secretarybird Secretarybird	*Sagittarius serpentarius*
Sentinel Rock-Thrush	*Monticola explorator*
Sickle-winged Chat	*Cercomela sinuata*
South African Cliff-Swallow	*Hirundo spilodera*
South African Shelduck	*Tadorna cana*
Southern Black Korhaan	*Afrotis afra*
Southern Boubou	*Laniarius ferrugineus*
Southern Grey-headed Sparrow	*Passer diffusus*
Southern Masked-Weaver	*Ploceus velatus*
Southern Pochard	*Netta erythrophthalma*
Southern Red Bishop	*Euplectes orix*
Speckled Mousebird	*Colius striatus*
Speckled Pigeon	*Columba guinea*
Spike-heeled Lark	*Chersomanes albofasciata*
Spotted Eagle-Owl	*Bubo africanus*
Spotted Flycatcher	*Muscicapa striata*
Spotted Thick-knee	*Burhinus capensis*
Spur-winged Goose	*Plectropterus gambensis*
Squacco Heron	*Ardeola ralloides*
Steppe Buzzard	*Buteo vulpinus*
Streaky-headed Seedeater	*Crithagra gularis*
Swainson's Spurfowl	*Pternistis swainsonii*
Tawny-flanked Prinia	*Prinia subflava*
Three-banded Plover	*Charadrius tricollaris*
Violet-backed Starling	*Cinnyricinclus leucogaster*
Wailing Cisticola	*Cisticola lais*
Wattled Starling	*Creatophora cinerea*
Whiskered Tern	*Chlidonias hybrida*
White Stork	*Ciconia ciconia*
White-backed Duck	*Thalassornis leuconotus*
White-backed Mousebird	*Colius colius*

Common Name	Scientific Name
White-bellied Korhaan	*Eupodotis senegalensis*
White-bellied Sunbird	*Cinnyris talatala*
White-breasted Cormorant	*Phalacrocorax carbo*
White-browed Sparrow-Weaver	*Plocepasser mahali*
White-faced Duck	*Dendrocygna viduata*
White-rumped Swift	*Apus caffer*
White-throated Swallow	*Hirundo albigularis*
White-winged Tern	*Chlidonias leucopterus*
White-winged Widowbird	*Euplectes albonotatus*
Willow Warbler	*Phylloscopus trochilus*
Wing-snapping Cisticola	*Cisticola ayresii*
Wood Sandpiper	*Tringa glareola*
Yellow Canary	*Crithagra flaviventris*
Yellow-billed Duck	*Anas undulata*
Yellow-billed Egret	*Egretta intermedia*
Yellow-billed Kite	*Milvus aegyptius*
Yellow-crowned Bishop	*Euplectes afer*
Yellow-fronted Canary	*Crithagra mozambicus*
Zitting Cisticola	*Cisticola juncidis*

5.8.2.3 Reptiles and Amphibians

Though the study focused primarily on bird and mammal species distribution, a list of reptile and amphibian species potentially occurring in the area has been included as Table 5.8.2.3(a). A total of 41 herpetofauna species have been reported for the study area. These results likely reflect a general lack of herpetofaunal sampling rather than low species diversity.

The distribution range of the Giant bullfrog (*Pyxicephalus adspersus*; Near Threatened) includes the study area (Du Preez & Carruthers 2009), although, according to Minter *et al.* (2004), no individuals had been recorded in the area before 2002.

Table 5.8.2.3(a): List of Reptile and Amphibian species potentially occurring within the study area

FAMILY	SPECIES	COMMON NAME	CONS STATUS
Reptiles			
Gekkonidae	*Pachydactylus c. capensis*	Cape thick-toed gecko	
Gekkonidae	*Pachydactylus vansoni*	Van Son's thick-toed gecko	
Gekkonidae	*Pachydactylus affinis*	Transvaal thick-toed gecko	
Agamidae	*Agama atra*	Southern rock agama	
Agamidae	*Agama a. distanti*	Spiny agama	
Scincidae	*Mabuya capensis*	Cape skink	
Scincidae	*Mabuya varia*	Variable skink	
Scincidae	*Mabuya striata punctatissimus*	Striped skink	
Scincidae	*Acontias g. gracilicauda*	Slendertail lance skink	
Scincidae	*Acontias breviceps*	Shorthead lance skink	
Lacertidae	*Pedioplanis burchellii*	Burchell's sand lizard	
Gerrhosauridae	*Gerrhosaurus flavigularis*	Yellow-throated plated lizard	
Cordylidae	*Chamaesaura aenea*	Transvaal grass lizard	
Cordylidae	*Pseudocordylus m. melanotus*	Drakensberg crag lizard	
Typhlopidae	*Typhlops bibronii*	South African blind snake	
Leptotyphlopidae	*Leptotyphlops c. conjunctus*	Cape thread snake	
Colubridae	*Pseudaspis cana*	Mole snake	
Colubridae	*Lycodonomorphus rufulus*	Brown water snake	
Colubridae	*Lamprophis aurora*	Aurora house snake	
Colubridae	*Lamprophis fuliginosis*	Brown house snake	
Colubridae	*Duberria l. lutrix*	Common slug-eater	
Colubridae	*Psammophylax r. rhombeatus*	Rhombic skaapsteker	
Colubridae	*Psammophis s. brevirostris*	Short-snouted grass snake	
Colubridae	*Psammophis crucifer*	Cross-marked grass snake	
Colubridae	*Aparallactus capensis*	Black-headed centipede-eater	
Colubridae	*Homoreselaps lacteus*	Spotted harlequin snake	
Colubridae	*Crotaphopeltis hotamboeia*	Herald snake	
Colubridae	*Dasypeltis scabra*	Common egg-eater	
Elapidae	*Hemachatus hemachaetus*	Rinkhals	
Amphibians			
Bufonidae	Amietophrynus gutturalis	Guttural toad	
Bufonidae	Amietophrynus maculatus	Flat-backed toad	
Bufonidae	Amietophrynus rangeri	Raucous toad	
Hyperolidae	Kassina senegalensis	Bubbling kassina	
Hyperolidae	Kassina wealii	Rattling kassina	

Phrynobatrachidae	Phrynobatrachus natalensis	Snoring puddle frog	
Pipidae	Xenopus laevis	Common platanna	
Pyxicephalidae	Amietia angolensis	Common river frog	
Pyxicephalidae	Amietia fuscigula	Cape river frog	
Pyxicephalidae	Cacosternum boettgeri	Boettger's Caco	
Pyxicephalidae	**Pyxicephalus adspersus**	**Giant bullfrog**	**NT**
Pyxicephalidae	Strongylopus fasciatus	Striped stream frog	
Pyxicephalidae	Strongylopus grayii	Clicking stream frog	
Pyxicephalidae	Tomopterna cryptotis	Tremolo sand frog	
Pyxicephalidae	Tomopterna natalensis	Natal sand frog	
Pyxicephalidae	Tomopterna tandyi	Tandy's sand frog	

5.8.3 Habitats of Conservation Importance

Within the study areas the following habitats are considered to be sensitive and of conservation importance:

- Natural vegetation which has not been cultivated recently or heavily grazed;
- Wetlands and rivers; and
- Any other areas known to support Red Data List species or which have the potential to do so.

Wetlands and rivers are considered sensitive habitat as they support a different range of species than the surrounding terrestrial landscape, they are an important water and food resource for many species, the transition zone (ecotone) between aquatic and terrestrial habitats is typically species-rich, and rivers form a network of (relatively) natural vegetation along which species can migrate and disperse.

Many of the Red Data List species (birds and mammals) occurring or potentially occurring in the area are linked to water or wetland habitats, e.g.: African grass-owl, Greater flamingo, Lesser flamingo, water rat and Spotted-necked otter.

Areas of undisturbed grassland are also of significance as they support a diverse granivore and insectivore community (both birds and mammals) which forms an essential food resource for many of the small to medium-sized carnivores, omnivores and birds of prey.

5.8.4 Significance of Observations

The study area comprises of Soweto Highveld Grassland, rivers and wetlands. This diversity of habitats helps to support a variety of faunal communities including a number of Red Data List species. A total of 84 mammal, 242 bird, 28 reptile and 13 amphibian species potentially occur within the study area. Of these, 29 Red Data List species could occur four of which were observed (all birds).

The presence of many of the species recorded is dependent on the presence of water - either in the form of large, open water bodies, streams or wetlands – and natural grassland. Therefore the continued existence of these species in and around the study area relies upon the maintenance of these habitats in a condition and to an extent sufficient to meet their habitat requirements.

5.8.5 Manner of Potential Environmental Impacts

The mining area will be fenced in for security purposes and the majority of the surface vegetation within this area will be destroyed or disturbed by mining and associated activities. Furthermore excavation activities will occur on a daily basis which will cause noise and dust impacts and high volumes of vehicular traffic will be present on a 10 hour/day basis.

Al these activities will of course influence the availability and nature of habitat for the faunal life of the area. The fencing will restrict the migration routes for larger animals and vehicles could run over animals venturing onto roads in the area.

Post closure, the situation will improve depending of course on the efficiency of rehabilitation and re-vegetation.