Nkurenkuru

ECOLOGY & BIODIVERSITY

PROPOSED EXPANSION OF THE WANSLEY SIYAKHULA QUARRY, EASTERN CAPE PROVINCE

ECOLOGICAL & FRESHWATER RESOURCE STUDY AND ASSESSMENT

Version: 2.1

Date: 18th November 2020

Author: Gerhard Botha

MINING RIGHT AND ENVIRONMENTAL AUTHORISATION APPLICATION FOR THE PROPOSED EXTENDED AREA OF THE EXISTING WANSLEY SIYAKHULA QUARRY

Report Title: Ecological and Freshwater Resource Study and Assessment

Author: Gerhard Botha

Project Name: Proposed expansion of existing Wansley Siyakhula Quarry, Eastern Cape Province

Status of report: Version 2.1

Date: 18th November 2020

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Suggested report citation

Nkurenkuru Ecology and Biodiversity, 2019. Proposed expansion of the existing Wansley Siyakhula Quarry, Eastern Cape Province. *Ecological and Freshwater Resource Study and Assessment Report*. Unpublished report prepared by Nkurenkuru Ecology and Biodiversity for Greenmined Environmental. Version 1.0, 23 March 2020

I. DECLARATION OF CONSULTANT'S INDEPENDENCE

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- have and will not have any vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2014 (specifically in terms of regulation 13 of GN No. R. 326) and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favorable to the applicant or not; and
- am aware that a false declaration is an offense in terms of regulation 48 of GN No. R. 326.

Gerhard Botha Pr.Sci.Nat 400502/14 (Botanical and Ecological Science)
November 2020

Field of expertise:

Wetland ecology, aquatic and wetland fauna & flora, terrestrial biodiversity, aquatic biomonitoring, and wetland habitat evaluations. BSc (Hons) Zoology and Botany, MSc Botany (Phytosociology) from 2011 to present.

II. REQUIREMENTS REGARDING A SPECIALIST ASSESSMENT

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Sections where this is addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page I and Appendix 6 & 7
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page I
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6 (6.2 – 6.4)
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 2
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modeling used;	Section 2 and Appendix 3 and 4
f) details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 2 and Section 5
g) an identification of any areas to be avoided, including buffers;	N/A
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2.8
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Section 5 and 6
k) any mitigation measures for inclusion in the EMPr;	Section 7
l) any conditions for inclusion in the environmental authorisation;	Section 7
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 7
n) a reasoned opinion- i. as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 8
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q) any other information requested by the competent authority.	N/A
2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

MINING RIGHT AND ENVIRONMENTAL AUTHORISATION APPLICATION FOR THE PROPOSED EXTENDED AREA OF THE EXISTING WANSLEY SIYAKHULA QUARRY

ECOLOGICAL AND FRESHWATER RESOURCE STUDY AND ASSESSMENT

1. INTRODUCTION

1.1 Applicant

Greenmined Environmental (Pty) Ltd. on behalf of Wansley Siyakhula (Pty) Ltd.

1.2 Project

The project will be known as Wansley Quarry.

1.3 Proposed Activity

Wansley Siyakhula (Pty) Ltd ("Right Holder"), will submit a Section 102 (S102) amendment application to:

» align the mining documentation with the Section 11 approval,
» comply with the latest departmental and legislative requirements,
» add blasting and processing of material to the EMPR, and
» expand the mining footprint over a portion of Portion 1 of Farm 652, within the East London magisterial district of the Eastern Cape Province. The existing mining right was approved over 5.2149 ha, and the holder now desires to expand the mining area to 37.8575 ha.

Should the S102 and EA applications be approved, the proposed project will entail the extension of the current mining footprint, the addition of blasting to the mining method, and continuance of material processing. The proposed mining method will, therefore, make use of blasting using explosives to loosen the hard rock, the material will then be loaded and hauled out of the excavation to the crushing and screening plant. The gravel will be screened to various sized stockpiles from where it will be transported to clients via trucks and trailers. All activities will be contained within the boundaries of the site.

Additionally, the following aspects about the development should be kept in mind:

- Since existence no permanent infrastructure other than the processing plant was established within the mining footprint.
- Pre-existing workshops and storerooms within the old farmyard are being utilised.
- No additional infrastructure is required for the proposed expansion of the mining area.
- Existing access roads will be utilized
- The proposed extension of the mining area will not require any additional water use as the mining method concerning water needs will remain unchanged.

1.4 Terms of reference

To conduct an ecological and freshwater resource study for a basic assessment of the target area where the expansion of the existing quarry is proposed and provide a professional opinion on ecological and surface hydrological issues about the target area and potential mitigation and measures to aid in future decisions regarding the proposed project and to minimalize the significance of identified impacts.

Please note:

- For the terrestrial ecological assessment emphasis was placed on the proposed new footprint for the expansion of the mine. However, even though some data sampling was conducted outside of the proposed mining footprint (within the affected property), this was not done in such detail, and was for the purpose of obtaining an understanding of the functions and services provided by the habitats and features within the mining footprint.
- For the surface water features assessment emphasis were placed on all features located within the 500m DWS regulated area and which is either located within the mining footprint, are immediately adjacent to the property or have catchment areas that fall within the mining footprint.

1.5 Conditions of this report

Findings, recommendations, and conclusions provided in this report are based on the authors' best scientific and professional knowledge and information available at the time of compilation. No form of this report may be amended or extended without the prior written consent of the author. Any recommendations, statements, or conclusions drawn from or based on this report must clearly cite or refer to this report. Whenever such recommendations, statements or conclusions form part of the main report relating to the current investigation, this report must be included in its entirety.

1.6 Relevant legislation

The following legislation was taken into account whilst compiling this report:

Provincial

» The Eastern Cape Nature and Environmental Conservation Ordinance / ECNECO (Act No 19 of 1974) in its entirety, with special reference to:
  - Schedule 1: Endangered Wild Animals
  - Schedule 2: Protected Wild Animals
  - Schedule 3: Endangered Flora
  - Schedule 4: Protected Flora

The above-mentioned Nature Conservation Ordinance accompanied by all amendments is regarded by the Eastern Cape Economic Development, Environmental Affairs and Tourism (DEDEA) as the legally binding, provincial documents, providing regulations, guidelines and procedures with the aim of protecting game and fish, the conservation of flora and fauna and the destruction of problematic (vermin and invasive) species.

National

» National Environmental Management Act / NEMA (Act No 107 of 1998), and all amendments and supplementary listings and/or regulations
» Environment Conservation Act (ECA) (No 73 of 1989) and amendments
» National Environmental Management Act: Biodiversity Act / NEMA:BA (Act No. 10 of 2004) and amendments
» The National Water Act 36 of 1998
» General Authorisations (GAs): As promulgated under the National Water Act and published under GNR 398 of 26 March 2004.
» National Forest Act 1998 / NFA (No 84 of 1998)
» National Veld and Forest Fire Act (Act No. 101 of 1998)
» Conservation of Agricultural Resources Act / CARA (Act No. 43 of 1983) and amendments

International

» Convention on International Trade in Endangered Species of Fauna and Flora (CITES)
» The Convention on Biological Diversity, 1995
» The Convention on the Conservation of Migratory Species of Wild Animals
» The RAMSAR Convention
» United Nations Convention to Combat Desertification
» The Partnership for Africa’s Development (NEPAD)
» The World Summit on Sustainable Development (WSSD)

2. METHODOLOGY

A detailed description of the methodology that was followed for both the ecology and surface hydrology assessments as well as for the DWS Risk Assessment are contained in the attached Appendixes 3,4, 5, and 6. A summary of the data sources and GIS information consulted during this study are provided in Table 1. Below follows a description of the assessment approach and philosophy that were followed during this study.

Table 1: Information and data coverages used to inform the ecological assessment.

	Data/Coverage Type	Relevance	Source
Biophysical Context	**Colour Aerial Photography**	Desktop mapping of habitat/ecological features as well as drainage network.	National Geo-Spatial Information (NGI)
	Latest Google Earth™ imagery	To supplement available aerial photography	Google Earth™ On-line
	1:50 000 Relief Line (5m Elevation Contours GIS Coverage)	Desktop mapping of terrain and habitat features as well as drainage network.	Client
	1:50 000 River Line (GIS Coverage)	Highlight potential on-site and local rivers and wetlands and map local drainage network.	CSIR (2011)
	National Land-Cover	Shows the land-use and disturbances/transformations within and around the impacted zone.	DEA (2015)
	South African Vegetation Map (GIS Coverage)	Classify vegetation types and determination of reference primary vegetation	Mucina & Rutherford (2012)
	NFEPA: river and wetland inventories (GIS Coverage)	Highlight potential on-site and local rivers and wetlands	CSIR (2011)
Conservation and Distribution Context	**NFEPA: River, wetland and estuarine FEPAs** (GIS Coverage)	Shows location of national aquatic ecosystems conservation priorities	CSIR (2011)
	National Biodiversity Assessment – Threatened Ecosystems (GIS Coverage)	Determination of national threat status of local vegetation types	SANBI (2011)
	Eastern Cape Biodiversity Conservation Plan (GIS Coverage)	Determination of provincial terrestrial/freshwater conservation priorities and biodiversity buffers	SANBI (2016)
	SANBI's PRECIS (National Herbarium Pretoria Computerized Information System) electronic database	Determination of plant species composition within the region as well as potential conservation important plants.	http://posa.sanbi.org 2019-11-14_065833113-BRAHMSOnlineData
	Red Data Books (Red Data Lists of Plants, Mammals, Reptiles, and Amphibians	Determination of endangered and threatened plants, mammals, reptiles and amphibians	Various sources
	Animal Demography Unit	Determination of faunal species composition within the region as well as potential conservation important faunal species	ADU, 2019
	Smither's Mammals of Southern Africa	Compilation of a species list	Apps (ed.) 2012

	The Mammals of the Southern African Subregion	Compilation of a species list	Skinner & Chimimba (2005)
	Field guide to snakes and other reptiles of southern Africa	Compilation of a species list	Branch (1998)
	A Complete Guide to the Frogs of Southern Africa	Compilation of a species list	Du Preez & Carruthers (2009)

2.1 Assessment Approach and Philosophy

2.1.1 Ecology (Biodiversity)

The assessment will be conducted according to the 2014 EIA Regulations, as amended 7 April 2017, as well as within the best-practice guidelines and principles for biodiversity assessment as outlined by Brownlie (2005) and De Villiers et al. (2005).

This includes adherence to the following broad principles:

» That a precautionary and risk-averse approach be adopted towards projects which may result in substantial detrimental impacts on biodiversity and ecosystems, especially the irreversible loss of habitat and ecological functioning in threatened ecosystems or designated sensitive areas: i.e. Critical Biodiversity Areas (as identified by systematic conservation plans, Biodiversity Sector Plans or Bioregional Plans) and Freshwater Ecosystem Priority Areas.

» Demonstrate how the proponent intends complying with the principles contained in section 2 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA), which, amongst other things, indicates that environmental management should, in order of priority aim to:
  - Avoid, minimise or remedy disturbance of ecosystems and loss of biodiversity;
  - Avoid degradation of the environment;
  - Avoid jeopardising ecosystem integrity;
  - Pursue the best practicable environmental option employing integrated environmental management;
  - Protect the environment as the people's common heritage;
  - Control and minimise environmental damage; and
  - Pay specific attention to management and planning procedures pertaining to sensitive, vulnerable, highly dynamic, or stressed ecosystems.

These principles serve as guidelines for all decision-making concerning matters that may affect the environment. As such, it is incumbent upon the proponent to show how proposed activities would comply with these principles and thereby contribute towards the achievement of sustainable development as defined by the NEMA.

To adhere to the above principles and best-practice guidelines, the following approach forms the basis for the study approach and assessment philosophy:

The study will include data searches, desktop studies, site walkovers/field survey of the property and baseline data collection, describing:

» A description of the broad ecological characteristics of the site and its surrounds in terms of any mapped spatial components of ecological processes and/or patchiness, patch size, relative isolation of patches, connectivity, corridors, disturbance regimes, ecotones, buffering, viability, etc.

<u>In terms of pattern, the following will be identified or described:</u>

Community and ecosystem level

» The main vegetation type, its aerial extent, and interaction with neighbouring types, soils or topography;
» Threatened or vulnerable ecosystems (cf. new SA vegetation map/National Spatial Biodiversity Assessment1, fine-scale systematic conservation plans, etc).

Species-level

» Red Data Book (RDB) species (giving location if possible, using GPS)
» The viability of an estimated population size of the RDB species that are present (include the degree of confidence in prediction based on the availability of information and specialist knowledge, i.e. High=70-100% confident, Medium 40-70% confident, low 0-40% confident) The likelihood of other RDB species, or species of conservation concern, occurring in the vicinity (include a degree of confidence).

Other pattern issues

» Any significant landscape features or rare or important vegetation associations such as seasonal wetlands, alluvium, seeps, quartz patches, or salt marshes in the vicinity.
» The extent of alien plant cover of the site, and whether the infestation is the result of prior soil disturbance such as ploughing or quarrying (alien cover resulting from disturbance is generally more difficult to restore than an infestation of undisturbed sites).
» The condition of the site in terms of current or previous land uses.

<u>In terms of process, the following will be identified or described:</u>

» The key ecological “drivers” of ecosystems on the site and in the vicinity, such as fire.
» Any mapped spatial component of an ecological process that may occur at the site or in its vicinity (i.e. corridors such as watercourses, upland-lowland gradients, migration routes, coastal linkages or inland-trending dunes, and vegetation boundaries such as edaphic interfaces, upland-lowland interfaces or biome boundaries)

- Any possible changes in key processes e.g. increased fire frequency or drainage/artificial recharge of aquatic systems.
- Furthermore, any further studies that may be required during or after the EIA process will be outlined.
- All relevant legislation, permits, and standards that would apply to the development will be identified.
- The opportunities and constraints for development will be described and shown graphically on an aerial photograph, satellite image, or map delineated at an appropriate level of spatial accuracy.

2.1.2 Surface Hydrology

The delineation and classification of freshwater resources were conducted using the standards and guidelines produced by the DWS (DWAF, 2005 & 2007) and the South African National Biodiversity Institute (SANBI, 2009). These methods are contained in the attached Appendix 1, which also includes wetland definitions, wetland conservation importance, and Present Ecological State (PES) assessment methods used in this report.

In addition to these guidelines, the general approach to freshwater habitat assessment was furthermore based on the proposed framework for wetland assessment as proposed within the Water Research Commission's (WRC) report titled: "Development of a decision-support framework for wetland assessment in South Africa and a Decision-Support Protocol for the rapid assessment of wetland ecological condition" (Ollis *et.* al., 2014). A schematic illustration of the proposed decision-support framework for wetland assessment in South Africa is provided in Figure 1 below.

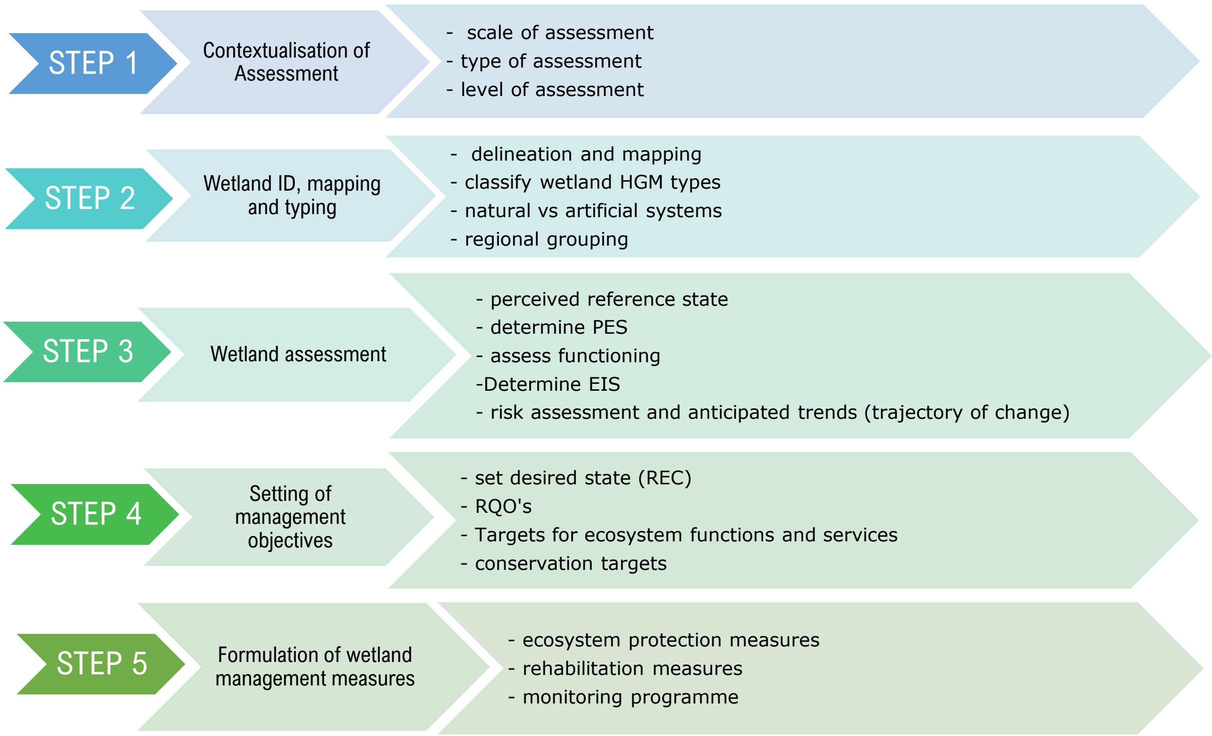


Figure 1: Proposed decision support framework for wetland assessment in South Africa (after Ollis et al., 2014)

2.2 Assumptions, Limitations and Information Gaps

2.2.1 General Assumptions and Limitations

- This report deals exclusively with a defined area and the impacts upon biodiversity and natural ecosystems in that area including all downstream freshwater / aquatic resources that may potentially be impacted and which fall within the Regulated Areas as defined by DWS.
- All relevant project information provided by the applicant and engineering design team to the ecological specialist was correct and valid at the time that it was provided.
- Additional information used to inform the assessment was limited to data and GIS coverage's available for the EC Province at the time of the assessment.

2.2.2 Sampling Limitations and Assumptions

- While disturbance and transformation of habitats can lead to shifts in the type and extent of ecosystems, it is important to note that the current extent and classification are reported on here.

- The delineation of the outer boundary of riparian areas is based on several indicators, including topography (macro-channel features), the presence of alluvial deposition and vegetation indicators. The boundaries mapped in this specialist report, therefore, represent the approximate boundary of riparian habitat as evaluated by an assessor familiar and well-practiced in the delineation technique.
- The accuracy of the delineation is based solely on the recording of the relevant onsite indicators using a GPS. GPS accuracy will, therefore, influence the accuracy of the mapped sampling points and therefore resource boundaries and an error of 3 – 5m can be expected. All soil/vegetation/terrain sampling points were recorded using a Garmin etrex Touch 35 Positioning System (GPS) and captured using Geographical Information Systems (GIS) for further processing.
- Infield soil and vegetation sampling were only undertaken within a specific focal area in the vicinity of the proposed development, while the remaining water resource/HGM units were delineated at a desktop level with limited accuracy.
- Any freshwater resources that fall outside of the affected catchment (but still within the 500m DWS regulated area) and are not at risk of being impacted by the specific activity were not delineated or assessed. Such features were flagged during a baseline desktop assessment before the site visit.
- Sampling by its nature, means that generally not all aspects of ecosystems can be assessed and identified.
- With ecology being dynamic and complex, there is the likelihood that some aspects (some of which may be important) may have been overlooked.
- All vegetation information recorded outside of the immediate development footprint was based on the onsite observations of the author and no formal in-depth vegetation sampling was undertaken (apart from a few focal areas/transects within the riparian zones of the downstream water resources that still fall within the regulated area boundary). Furthermore, the vegetation within these areas' information provided for the areas just outside of the development footprint only gives an indication of the dominant and/or indicator species and only provides a general indication of the composition of the vegetation communities. Thus, the vegetation information provided for these areas is somewhat limited in terms of true botanical applications i.e. accurate and detailed species list, phytosociological classification, and rare / Red Data Species identification.
    - This approach for these areas well outside of the development footprint is however regarded as acceptable as the vegetation structure and composition of these areas will not be impacted by the development and vegetation sampling was merely to inform the riparian boundary and transitional zones and to inform the current Ecological Status.
- No formal aquatic faunal survey was undertaken (including macro-invertebrate sampling).
- No water sampling and analysis were undertaken.
- The lists of amphibians, reptiles, and mammals for the study area are based on those observed in the vicinity of the site as well as those likely to occur in the area based on

their distribution and habitat preferences. This represents a sufficiently conservative and cautious approach that takes the study limitations into account.

2.2.3 Sampling Limitations and Assumptions

» Probably the most significant potential limitation associated with such a sampling approach is the narrow temporal window of sampling.
  - Ideally, a site should be visited several times, during different seasons to ensure that the full complement of plant and animal species present is captured.
  - However, this is rarely possible due to time and cost constraints and therefore, the representation of the species sampled at the time of the site visit should be critically evaluated.
  - The site was sampled outside of the wet season.
  - However, the area received a reasonable fair amount of late autumn rain allowing for some geophytes and graminoids to be fairly well represented (distinguishable) during the time of the inspection
  - The proposed mining footprint was covered in detail with the result that the results are considered highly reliable and it is unlikely that there are any significant species or features present that were not recorded.

2.2.4 Baseline Ecological Assessment - Limitations and Assumptions

» All assessment tools utilised within this study were applied only to the resources and habitats located within 'regulated area' and which are at risk of being impacted by the proposed development. Any resource located outside of the impacted catchment and which is not a risk of being impacted was not assessed.

» It should be noted that the most appropriate assessment tools were selected for the analysis of the specific features and resources that may potentially be impacted by the proposed development. The selection was based on the assessment practitioner's knowledge and experience of these tools and their attributes and shortcomings.

» Furthermore, it should be noted that these assessment techniques and tools are currently the most appropriate currently available tools and techniques to undertake assessments of freshwater resources, the area however rapid assessment tools that rely on qualitative information and expert judgment. While these tools have been subjected to peer review processes, the methodology for these tools is ever-evolving and will likely be further refined in the near future. For the purposes of this assessment, the assessments were undertaken at rapid levels with somewhat limited field verification. It, therefore, provides an indication of the PES of the portions of the affected systems rather than providing a definitive measure.

- PES and EIS were only determined for the affected/regulated areas even though upstream and downstream as well as catchment impacts were considered (based on available desktop information).
- The PES and EIS assessments undertaken are largely qualitative assessment tools and thus the results are open to professional opinion and interpretation. We have made an effort to substantiate all claims where applicable and necessary.
- The Ecological Importance and Sensitivity assessment did not specifically address the finer-scale biological aspects of the rivers such as fauna (amphibians and invertebrates).

3. THE IMPORTANCE OF BIODIVERSITY AND CONSERVATION

The term 'Biodiversity' is used to describe the wide variety of plant and animal species occurring in their natural environment or 'habitat'. Biodiversity encompasses not only all living things but also the series of interactions that sustain them, which are termed 'ecological processes. South Africa's biodiversity provides an important basis for economic growth and development; and keeping our biodiversity intact is vital for ensuring the on-going provision of ecosystem services, such as the production of clean water through good catchment management. The role of biodiversity in combating climate change is also well recognised and further emphasises the key role that biodiversity management plays on a global scale (Driver et al., 2012). Typical pressures that natural ecosystems face from human activities include the loss and degradation of natural habitat, invasive alien species, pollution, and waste and climate change (Driver et al.,2012). High levels of infrastructural and agricultural development typically restrict the connectivity of natural ecosystems, and maintaining connectivity is considered critical for the long-term persistence of both ecosystems and species, in the face of human development and global climatic change. Loss of biodiversity puts aspects of our economy and quality of life at risk and reduces socioeconomic options for future generations as well. In essence, then, sustainable development is not possible without it.

4. CONSERVATION AND FUNCTIONAL IMPORTANCE OF AQUATIC ECOSYSTEMS

Water affects every activity and aspiration of human society and sustains all ecosystems. "Freshwater ecosystems" refer to all inland water bodies whether fresh or saline, including rivers, lakes, wetlands, sub-surface waters, and estuaries (Driver et al., 2011). South Africa's freshwater ecosystems are diverse, ranging from sub-tropical in the north-eastern part of the country, to semi-arid and arid in the interior, to the cool and temperate rivers of the fynbos. Wetlands and rivers form a fascinating and essential part of our natural heritage, and are often referred to as the "kidneys" and "arteries" of our living landscapes and this is particularly true in semi-arid countries such as South Africa (Nel et al., 2013). Rivers and their associated riparian zones are vital for supplying freshwater (South Africa's most scarce natural resource) and are important in providing additional biophysical, social, cultural, economic, and aesthetic services (Nel et al., 2013). The health of our rivers and wetlands is measured by the diversity and health of the species we share these resources with. Healthy river ecosystems can increase resilience to the impacts of climate change, by allowing ecosystems and species to adapt as naturally as possible to the changes and by buffering human settlements and activities from the impacts of extreme weather events (Nel et al., 2013). Freshwater ecosystems are likely to be particularly hard hit by rising temperatures and shifting rainfall patterns, and yet healthy, intact freshwater ecosystems are vital for maintaining resilience to climate change and mitigating its impact on human wellbeing by helping to maintain a consistent supply of water and for reducing flood risk and mitigating the impact of flash floods. We, therefore, need to be mindful of the fact that without the integrity of our natural river systems, there will be no sustained long-term economic growth or life (DEA et al., 2013).

Freshwater ecosystems, including rivers and wetlands, are also particularly vulnerable to anthropogenic or human activities, which can often lead to irreversible damage or longer-term, gradual/cumulative changes to freshwater resources and associated aquatic ecosystems. Since channelled systems such as rivers, streams, and drainage lines are generally located at the lowest point in the landscape; they are often the "receivers" of wastes, sediment, and pollutants transported via surface water runoff as well as subsurface water movement (Driver et al., 2011). This combined with the strong connectivity of freshwater ecosystems means that they are highly susceptible to upstream, downstream, and upland impacts, including changes to water quality and quantity as well as changes to aquatic habitat & biota (Driver et al., 2011). South Africa's freshwater ecosystems have been mapped and classified into National Freshwater Ecosystem Priority Areas (NFEPAs). This work shows that 60% of our river ecosystems are threatened and 23% are critically endangered. The situation for wetlands is even worse: 65% of our wetland types are threatened, and 48% are critically endangered (Driver et al., 2011). Recent studies reveal that less than one-third of South Africa's main rivers are considered to be in an ecologically 'natural' state, with the principal threat to freshwater systems being human activities, including river regulation, followed by catchment transformation (Rivers-Moore & Goodman, 2009). South Africa's freshwater fauna also display high levels of threat: at least one-third of freshwater fish indigenous to South Africa are reported as threatened, and a recent southern African study on the conservation status of major freshwater-dependent taxonomic groups (fishes, molluscs, dragonflies, crabs, and vascular plants) reported far higher levels of threat in South Africa than in the rest of the region (Darwall *et al*., 2009). Clearly, urgent attention is required to ensure that representative natural examples of the different ecosystems that make up the natural heritage of this country for current and future generations to come. The degradation of South African rivers and wetlands is a concern now recognized by Government as requiring urgent action and the protection of freshwater resources, including rivers and wetlands, is considered fundamental to the sustainable management of South Africa's water resources in the context of the reconstruction and development of the country.

5. STUDY AREA

4.1 Regional / Local Biophysical Setting

Wansley Siyakhula quarry is located on portion 1 of the Farm 652, within the East London magisterial district (Buffalo City Metropolitan Municipality and Amathole District Municipality), of the Eastern Cape Province (Figure 2). The affected property is approximately 10km north-east of the town of East London. Access to the site can be gained via a gravel district road turning from the N6 national road, opposite the Ducats Township (Figure 1 & 2). The study site falls within the 3227DD quarter degree square (QDGS).

The existing Mining area covers approximately 5.2149 ha and an expansion of a further 32.6426 ha is proposed which will result in a total footprint area of approximately 37.8575 ha (Figure 2). The farm portion has been extensively transformed in the past for cultivation purposes (commercial pineapple crop production) however these activities have been abandoned in the mid-1980s. Mining (quarrying) activities were initiated around 1989 and are now the primary land use activity within this farm portion.

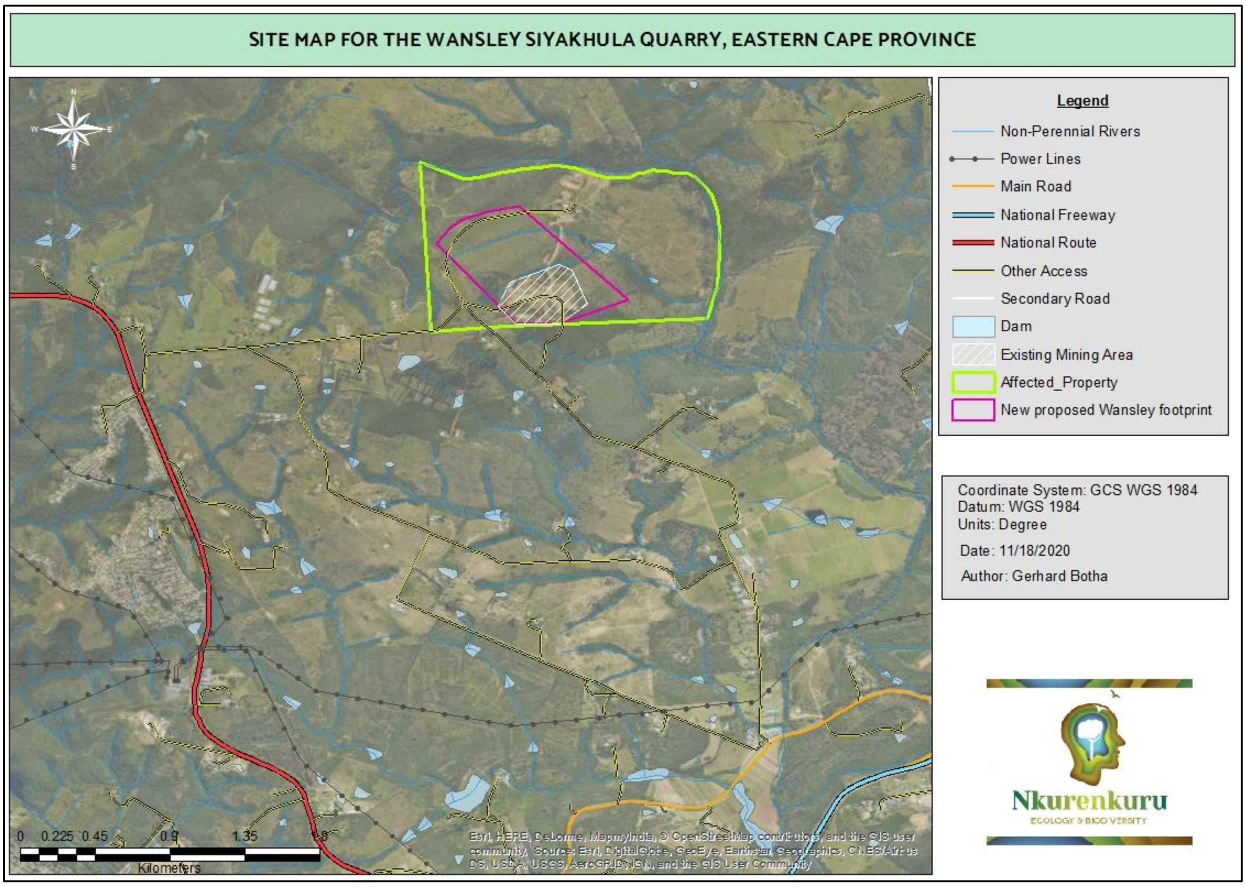


Figure 2: Site map of the Wansley Quarry indicating the extent of the proposed new mining footprint as well as access to the mine from the N6 National Route.

The surrounding landscape is predominantly divided in medium to medium-large sized properties, mostly smallholdings and small farms used for agricultural (subsistence and commercial) purposes with livestock farming being the primary activity. Some properties are also utilized for crop production (mostly perishable crops and some grains) as well as for agri-industrial purposes. Woodlots and plantations are also a relatively common feature within the greater area. Game species have also been introduced in some of the properties, but is likely more for esthetical purposes, however game and wild animals from a more prominent feature of the agricultural landscape further to the east with numerous small game farms and reserves, of which Lombardy Private Nature Reserve is the most prominent within the area. The surrounding landscape can generally be classified as semi-natural dense thickets and shrublands with some patches of grassland and taller woodlands (riparian thickets) which becomes more transformed and disturbed as one move to the west and the south. The closest built-up area is the township of Ducats (Figure 3) situated a little be more than 2km to the west of the study site (refer to Figure 24 for the primary land cover found within the Qinira River sub-quaternary catchment).

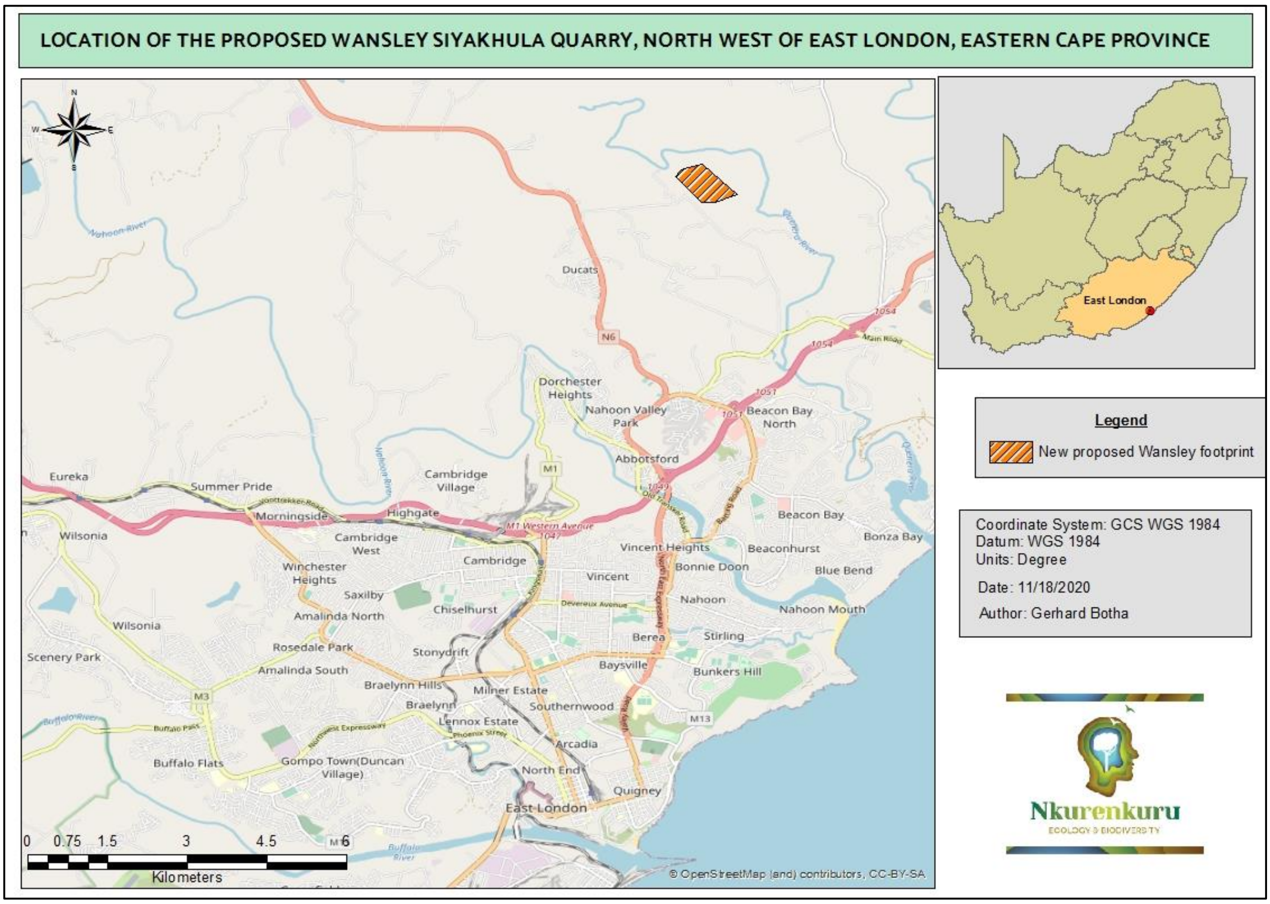


Figure 3: Proposed location of the Wansley Quarry northeast of the city of East London within the Eastern Cape Province.

The study site occurs within the Quaternary Catchment R30F, which is drained by the Qinira River which forms part of the Mzimvubu to Keiskamma Water Management Area (WMA). The proposed project site is situated south-west of the Qinira River (middle reach) within a small catchment area that drains into the Qinira River via two small drainage systems. The Qinira River eventually drains into the Qinira River Estuary.

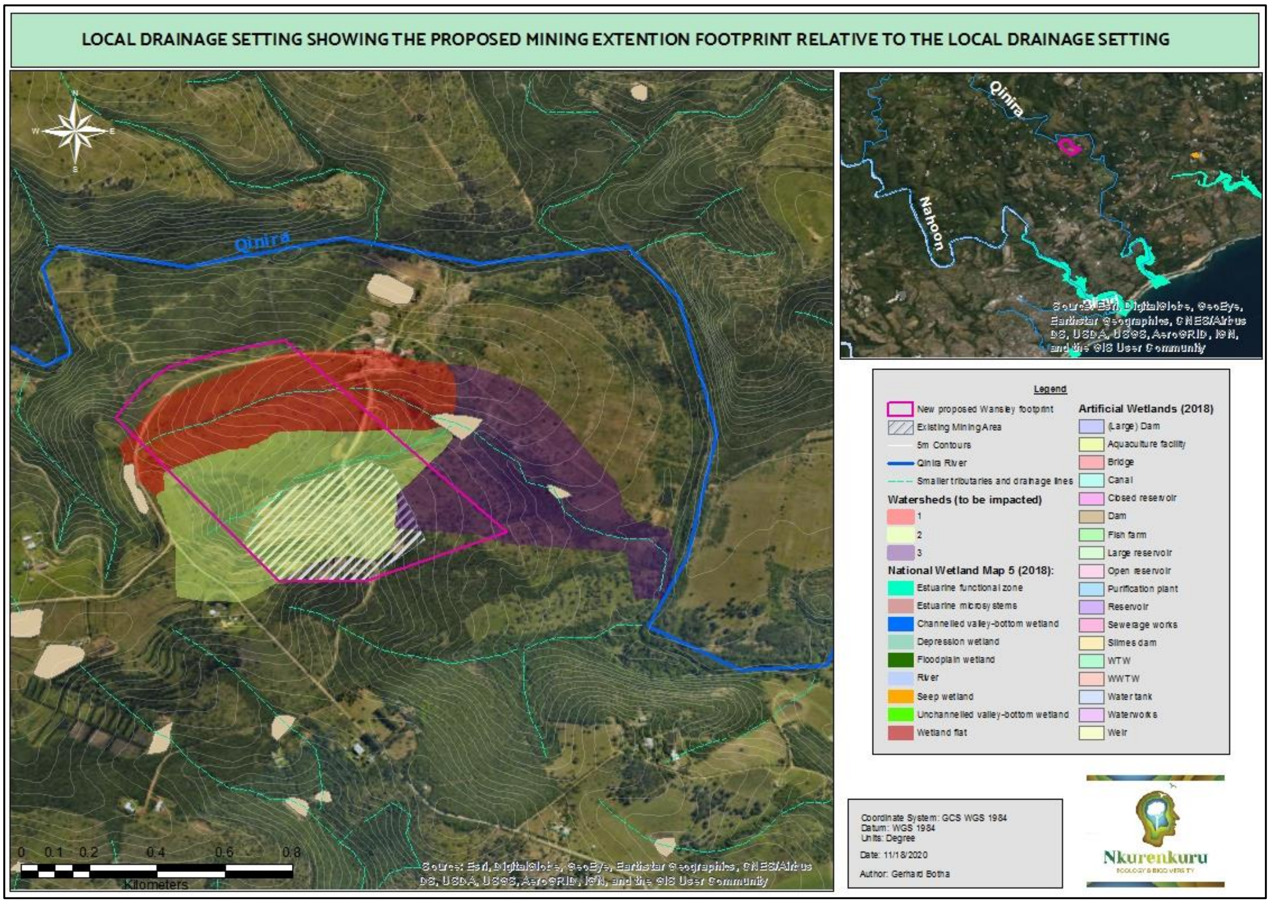


Figure 4: Key hydrological features associated with the Wansley property as well as immediate surroundings. Not the numerous dam structures within the area as well as the number of small ephemeral drainage systems within the larger landscape.

A summary of the biophysical features and the setting of the project site and surroundings are summarised in Table 2 below (also refer to Appendix 7 for a more detailed description of the biophysical setting).

Table 2: Summary of the biophysical setting of the projects site as well as the surroundings

<table>
<tr><th>Biophysical Aspect</th><th colspan="2">Desktop Biophysical Details</th><th>Source</th></tr>
<tr><td colspan="4">Physiography</td></tr>
<tr><td>Av. Elevation a.m.s.l</td><td colspan="2">129m</td><td>Google Earth & ArcGis</td></tr>
<tr><td>Max. Elevation a.m.s.l</td><td colspan="2">170m</td><td>Google Earth & ArcGis</td></tr>
<tr><td>Min. Elevation a.m.s.l</td><td colspan="2">95m</td><td>Google Earth & ArcGis</td></tr>
<tr><td>Av. slope</td><td colspan="2">11.0%; -10.9%</td><td>Google Earth & ArcGis</td></tr>
<tr><td>Maximum slope</td><td colspan="2">22.2%; -34.6%</td><td>Google Earth & ArcGis</td></tr>
<tr><td>Landscape Description</td><td colspan="2">Highly undulating with low hills, ridges, and moderate to steep slopes. Low lying areas contain short drainage systems which drain into the Qinira River (Figure 6). Undulating plains are typically dominated by various grasses and forbs with scattered shrubs and small trees. The steeper slopes, ridges, drainage lines, and valley sections are dominated by dense thicket vegetation comprising of various broad-leaved as well as Vachelia species. Lantana camara is extremely problematic within these thickets with extensive areas having been invaded. Valley sections containing perennial and non-perennial freshwater systems are typically fringed by tall woody species. These areas are extremely prone to the invasion of Cestrum laevigatum</td><td>Google Earth & Mucina and Rutherford, 2006</td></tr>
<tr><td>Land Type Classification</td><td colspan="2">FA415</td><td>ARC</td></tr>
<tr><td rowspan="2">Terrain Type</td><td>Symbol</td><td>Description</td><td rowspan="2">ARC</td></tr>
<tr><td>C3</td><td>Open hills or ridges with 20 – 50% level land.</td></tr>
<tr><td rowspan="4">Terrain Position</td><td>Position No.</td><td>Description</td><td rowspan="4">ARC</td></tr>
<tr><td>1:</td><td>Crest</td></tr>
<tr><td>3:</td><td>Midslope</td></tr>
<tr><td>4:</td><td>Footslope</td></tr>
<tr><td>Geomorphic Province</td><td colspan="2">East London Coastal Hinterland</td><td>Partridge et al., 2010</td></tr>
<tr><td>Geology</td><td colspan="2">Grey mudstone, shale, and sandstone of the Balfour Formation and grey to red mudstones and sandstones of the Middleton formation. Adelaide Subgroup and Beaufort Group. Jurassic Dolerite Suite intrusions in some locations.</td><td>ARC & SA Geological Dataset</td></tr>
<tr><td>Soils (General)</td><td colspan="2">Soils with minimal development, usually shallow, on hard or weathering rock, with or without intermittent diverse soils. Lime rare or absent in the landscape.</td><td>ARC</td></tr>
<tr><td>Soil-forming process</td><td colspan="2">Dominant processes are rock weathering, the formation of orthic topsoil horizons, and commonly clay illuviation.</td><td>ARC</td></tr>
<tr><td>Prominent Soil Forms</td><td colspan="2">Cartref, Glenrosa, Mispah, Estcourt, and Kroonstad</td><td>ARC</td></tr>
<tr><td rowspan="2">Susceptibility to Wind Erosion</td><td>Class</td><td>Description</td><td rowspan="2">ARC</td></tr>
<tr><td>3a</td><td>Moderate susceptibility</td></tr>
<tr><td rowspan="2">Susceptibility to Water Erosion</td><td>Class</td><td>Description</td><td rowspan="2">ARC</td></tr>
<tr><td>4</td><td>Moderate to low susceptibility</td></tr>
<tr><td colspan="4">Climate</td></tr>
<tr><td>Mean annual temperature</td><td colspan="2">18.3°C</td><td>Climate-data.org</td></tr>
<tr><td>Warmest Month & Av. Temp.</td><td colspan="2">February: 21.7°C</td><td>Climate-data.org</td></tr>
</table>

Coldest Month & Av. Temp.	July: 15.1°C			Climate-data.org
Rainfall Seasonality	Late Summer			DWAF, 2007
Mean annual precipitation	782 mm			Schulze, 1997
Mean annual runoff	113.4 mm			Schulze, 1997
Mean annual evaporation	1362 mm			Schulze, 1997
Surface Hydrology				
DWA Ecoregions	Level 1	Level 2		DWA, 2005
	Eastern Coastal Belt	31.02		
Wetland vegetation group	Albany Thicket Valley			CSIR, 2011
Water management area	Mzimvubu to Keiskamma (12)			DWA
Sub water management area	Amatole			DWA
Quaternary catchment	Name (Symbol)	Extent (ha)		DWA
	R30F	20864		
Sub Quaternary Catchment	Name (Symbol)	Extent (ha)		DWA
	8056	8703		
Main collecting river(s) in the catchment	Quaternary catchment	Sub quaternary catchment		CSIR, 2011
	Qinira, Nahoon	Qinira		
Closest river to the project site	Qinira			Google Earth
Geomorphic Class	Symbol	Description	Slope (%)	CSIR, 2011
	D	Upper Foothill	0.01	
Length of river	±26.6 km			CSIR, 2011
Distance (nearest point from development site)	±200m			Google Earth
Vegetation Overview				
Biome	Savanna Biome (Sub-escarpment Savanna Bioregion)			Mucina & Rutherford, 2011
Vegetation Type	South Eastern Coastal Thornveld (Figure 8).			SANBI, 2018
Vegetation & Landscape Feature	Gentle to moderately undulating landscapes and dissected hilltop slopes close to the coast and are dominated by short grasslands punctuated by scattered bush clumps or solitary *Acacia natalitia* trees			Mucina & Rutherford, 2006
BODATSA Data	Regional: Total Species Observed	Immediate area: Total Species Observed		2020-03-22_083018915-BRAHMSOnlineData
	2 481	251		
	Indigenous Flora	Endemic Flora		
	2 309	87		
	Non-indigenous Flora	Red Data (IUCN) Flora		
	172	27		
	Provincially Protected Flora (Schedule 4 and 5)	TOPS		
	313	1		
	National Protected Trees	CITES I & 2		
	5	80		

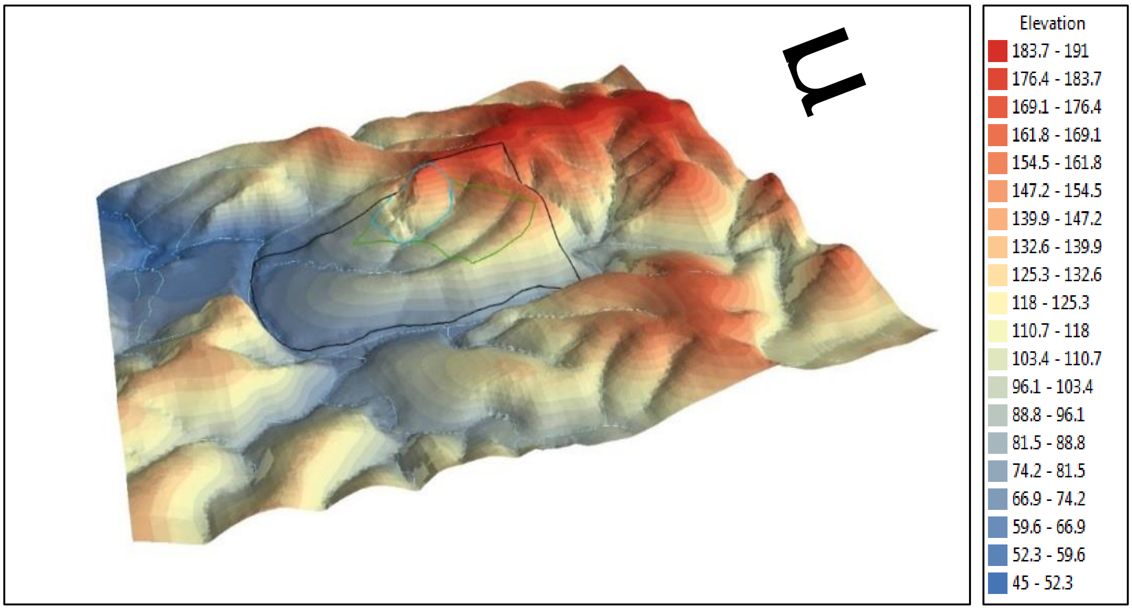


Figure 5: 3D Topographical image of the affected property (black polygon). The green polygon indicates the proposed new Wansley footprint whilst the blue polygon indicates the current mining footprint.

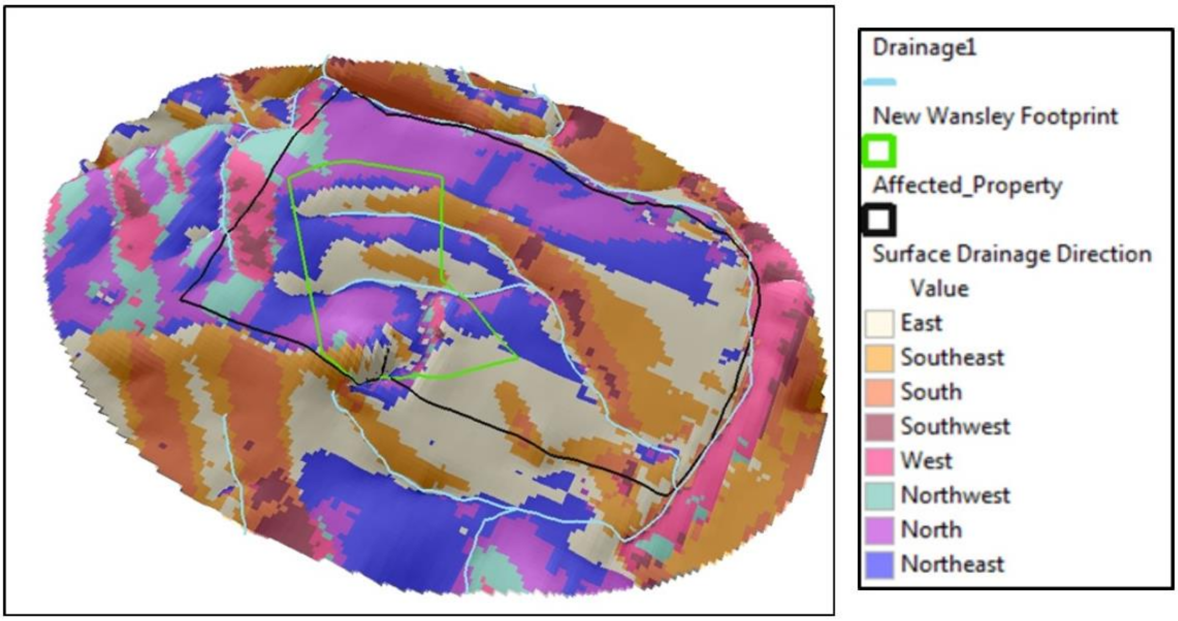


Figure 6: Surface drainage directions within the Wansley property.

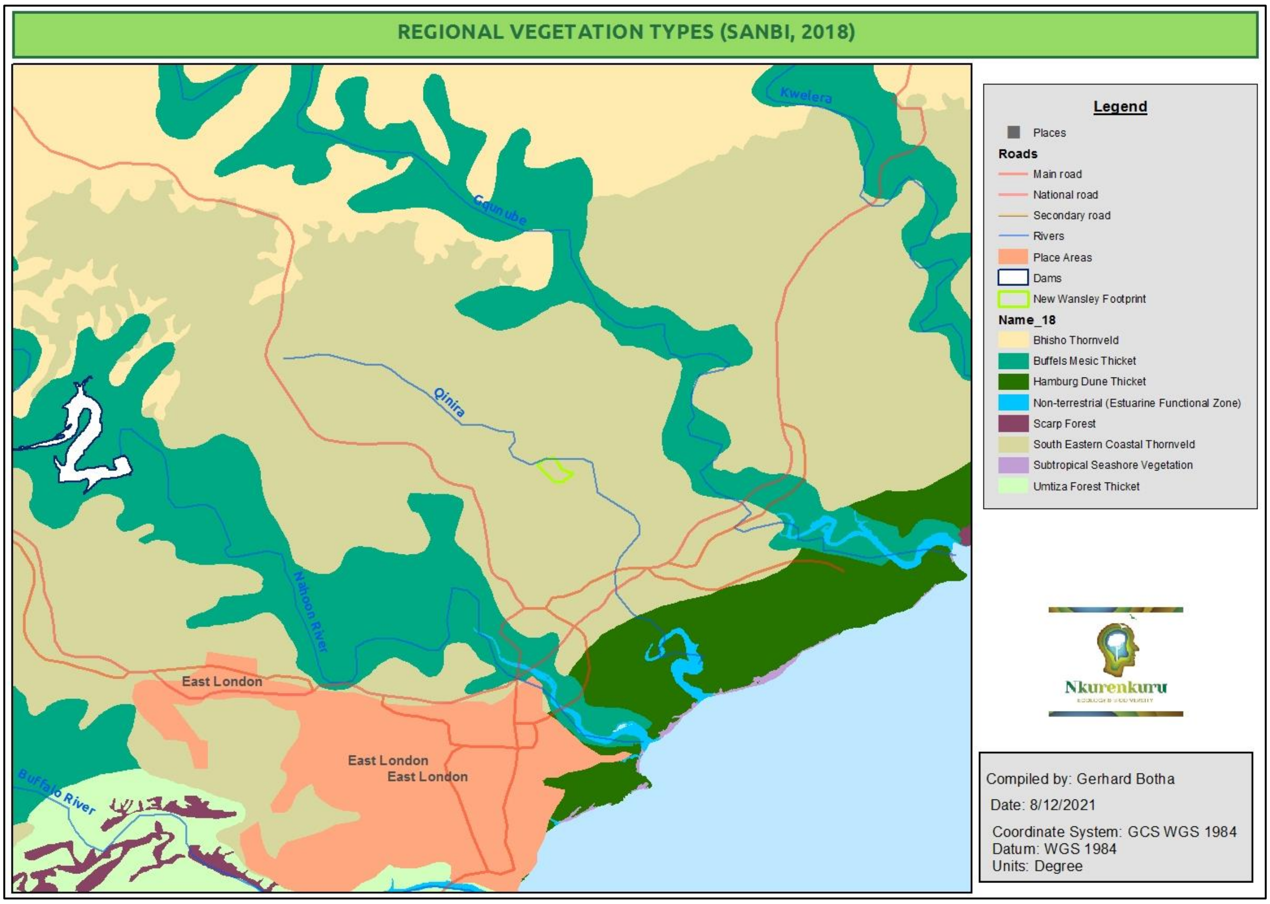


Figure 7: Map indicating the vegetation type located within the proposed new Wansley mining footprint.

4.2 Conservation Planning / Context

Understanding the conservation context and importance of the study area and surroundings is important to inform decision making regarding the management of the aquatic resources in the area. In this regard, national, provincial, and regional conservation planning information available and was used to obtain an overview of the study site (Table 3) (Also refer to Appendix 7 for a more detailed description of the conservation planning context).

Table 3: Summary of the conservation context details for the study area.

Conservation Planning Dataset		Relevant Conservation Feature	Location in Relationship to Project Site	Conservation Planning Status
NATIONAL LEVEL CONSERVATION PLANNING CONTEXT	National Protected Areas Expansion Strategy	Focus Area	Outside Focus Area: ± 14.34km south-east of Bisho Kei Focus Area	Not Classified
		Informal Protected Area	Outside IPA: ± 1.96km west of Lombardy Private Nature Reserve	Not Classified
		Formal Protected Area	Outside FPA: ± 7.85km north-west of the Nahoon Point to Gonubie Point MPA	Not Classified
	Vegetation Types	South Eastern Coastal Thornveld	Vegetation of Study Area	Least Threatened
	Threatened Ecosystems	Not Classified	Ecosystems of Study Area	Not Classified
	National Freshwater Ecosystem Priority Area	River FEPA	Qinira River	Not Classified
		Wetland FEPA	Small artificial water bodies (Dams and reservoirs)	Not Classified
PROVINCIAL AND REGIONAL LEVEL CONSERVATION PLANNING CONTEXT	ECBCP: Terrestrial CBA	Ecological Corridor	Study area and adjacent landscape	T_CBA2
	ECBCP: Aquatic CBA	Important sub-catchments, Primary catchment management areas for E2 estuaries.	Study area and adjacent landscape located within Qinira primary catchment area	A_CBA3: A3b

4.2.1 National Protected Areas Expansion Strategy

According to the NPAES spatial data (Holness, 2010), the proposed development footprint is located well outside of any Focus Area (Figure 8) with the closest focus area located approximately 14.34km to the north-west (Bisho Kei Focus Area). The nearest Informal Protected Area is located approximately 1.96km to the east (Lombardy Private Nature Reserve. Subsequently no NPAES Focus Areas will be impacted by the borrow pit. The closest Formal Protected Area is the Nahoon Point to Gonubie Point Marine Protected Area (MPA) which is located 7.85km south-east of the proposed Wansley footprint.

Subsequently the proposed new Wansley mining footprint is located well outside of any protected or potentially protected area and will have no impact on such areas.

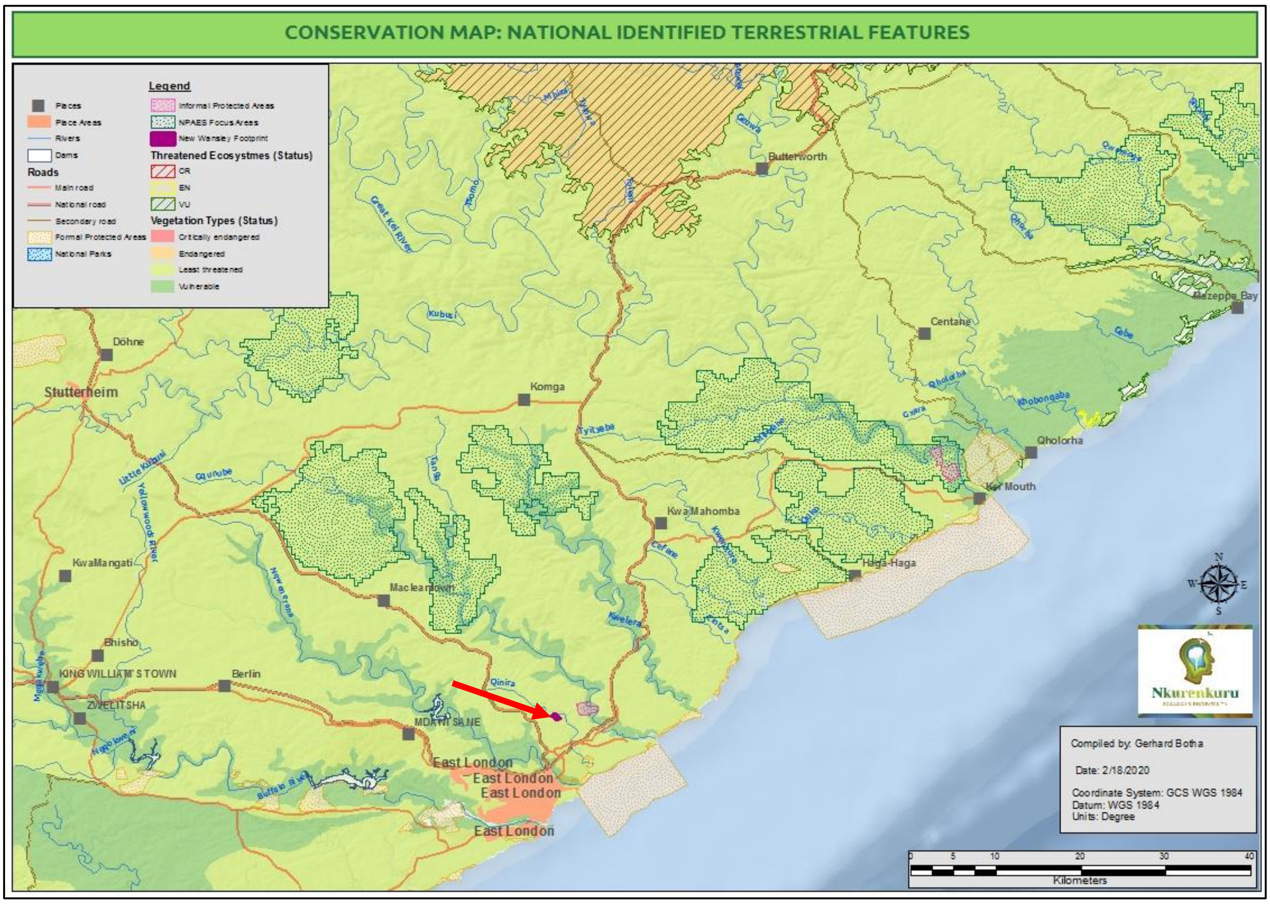


Figure 8: Map showing the location of the proposed new Wansley mining footprint in relationship to the identified National Conservation Context, Vegetation Types, and Threatened Ecosystems.

4.2.2 National Level of Conservation Priorities (Threatened Ecosystems)

According to Mucina and Rutherford (2006), this vegetation type is classified as Least Threatened and is furthermore not listed within the Threatened Ecosystem List (NEMA:BA) (Figure 9). It is highly unlikely that this development will have an impact on the status of the Ecosystem as well as Vegetation Type Status due to the extent of the development as well as the presence of already disturbed areas within the footprint (almost the entire proposed footprint is located on secondary vegetation that has established on old cultivated lands).

4.2.3 NFEPA (National Freshwater Ecosystem Priority Areas

No wetlands have been identified within the 500m radius of the proposed new mining footprint, with the nearest wetland FEPA (a channelled valley-bottom wetland) located approximately 1.35 km north-west of the site (Figure 9).
Furthermore, the non-perennial Qinira River is not classified as a river FEPA and has been categorised as category D (Largely Modified) River according to its Present Ecological Status (PES), with a moderate (C) Ecological Importance and Sensitivity.

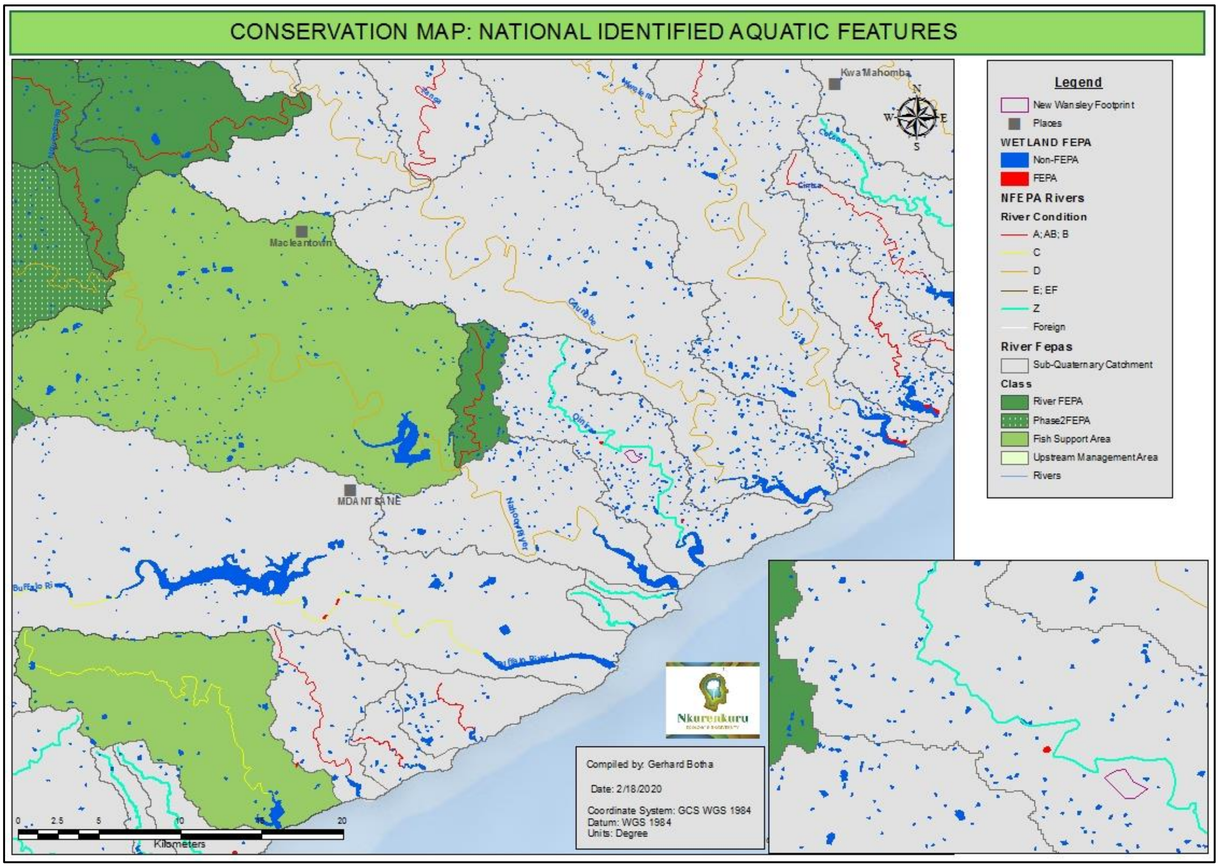


Figure 9: Map showing the location of the proposed new Wansley mining footprint to the identified river and wetland Freshwater Ecosystem Priority Areas or FEPAs.

4.2.4 Critical Biodiversity Areas and Broad Scale Ecological Processes

» Terrestrial Critical Biodiversity Areas (Figure 10):

The Eastern Cape Biodiversity Conservation Plan (2007) was compiled to address the urgent need to identify and map critical biodiversity areas and priority areas for conservation in the Province. It also provides land use planning guidelines and recommendations. Although several landscape-scale conservation planning projects had been undertaken in the Eastern Cape (including SKEP) before the development of the ECBCP, there were large areas of the Province that were excluded.

Across the province, some areas have a general higher level of biodiversity than others. These higher levels may include large numbers of species or ecosystems, large numbers of threatened species, or ecological processes that are crucial for the long-term persistence of biodiversity. A spatial biodiversity conservation plan takes this variability into account by collating and mapping information about:

- Biodiversity features (species, ecosystems, ecological processes);
- Existing protected areas;
- Current patterns of land use;
- Potential and conflicting patterns of land use.

The ECBCP developed two maps, one showing terrestrial (land-based) CBAs, and the other showing aquatic (freshwater) CBAs. The map of terrestrial CBAs was compiled by undertaking a systematic biodiversity planning analysis and adding all biodiversity priority areas identified by other systematic biodiversity planning projects (including STEP) in the Province.

Due to the fact that the ECBCP has incorporated updated spatial data obtained from various biodiversity and land use planning projects, including spatial data from the Subtropical Thicket Ecosystem Planning project (STEP), and provides more updated land use and management objectives for these features, these older planning projects are not specifically referred to anymore, as the ECBCP is now regarded as the single principal planning project.

Furthermore, the various planning units within STEP have been reorganized/integrated within the planning units of the ECBCP, with each planning unit, contained within the ECBCP, having its own set of management/conservation objectives and land-use guidelines.

For example:

1. Features used to define Terrestrial CBA 1 includes critically endangered vegetation types as identified within STEP, amongst other identified critically sensitive features.
2. The Terrestrial CBA 2 (T2) unit includes endangered vegetation types from STEP, along with other endangered features, etc.

The entire project site is located within a CBA2 since this area forms part of an extensive ecological corridor as identified by the ECBCP (also previously included as a STEP corridor).

Furthermore, this CBA 2 area is regarded as a near-natural landscape that falls within the BLMC 2.

However, during the site visit it was found that a large portion of the Wansley property as well as some of the surrounding landscape do not meet the criteria that justify the area as a CBA2. A portion of the property has already been severely transformed due to current mining activities and meets the criteria for Transformed Land Classification. Furthermore, the bulk of the property is covered by a secondary (degraded) vegetation cover which has established on old cultivated areas (old ploughing contours are still visible). These areas should rather be regarded as Other Natural Areas.

The Qinira River and its riparian fringe however was found to be in a near-natural state and do indeed function as an important corridor for species movement. The functionality of a corridor is however, largely dependent on the connectivity of the landscape. This section of the Qinira River has a mostly unbroken longitudinal connectivity and will allow for species movement up and down this section of the Qinira River. However, lateral connectivity along the Qinira River (including the Wansley property) have been largely impacted. Numerous fences, roads, infrastructure, and cultivation have fractured the area influencing lateral connectivity. Within the Wansley property the disturbed nature of the bulk of the vegetation cover, fencing around the property, as well as current anthropogenic activities (including current mining activities) have significantly reduced the area outside of the riparian fringe’s capability of functioning as an important corridor.

Subsequently it can be concluded that the Qinira River and its associated riparian fringe as well as the abutting natural thicket meet the criteria set out for a CBA2 Corridor. However, the remainder of the property does not meet the criteria and from field observations should rather be regarded as an Other Natural Areas with some Transformed Land (as described above).

The maintenance of the riparian fringes is critically important for the sustainable functioning of this river as an ecological corridor. As such the Qinira River as well as the delineated riparian fringe and adjacent remaining natural thicket has been classified as High Sensitive Areas and are regarded as No-Go Areas for the proposed development.

Furthermore, to ensure that this area's functionality (as an ecological corridor) is preserved, and to allow some lateral movement to and from the Qinira River, a Buffer Area of 100m has been recommended and should also be regarded as a No-Go Area for the proposed development. The current layout of the new mining footprint is situated outside of these High Sensitive (No-Go Areas) and will not contribute to a further reduction in landscape connectivity.

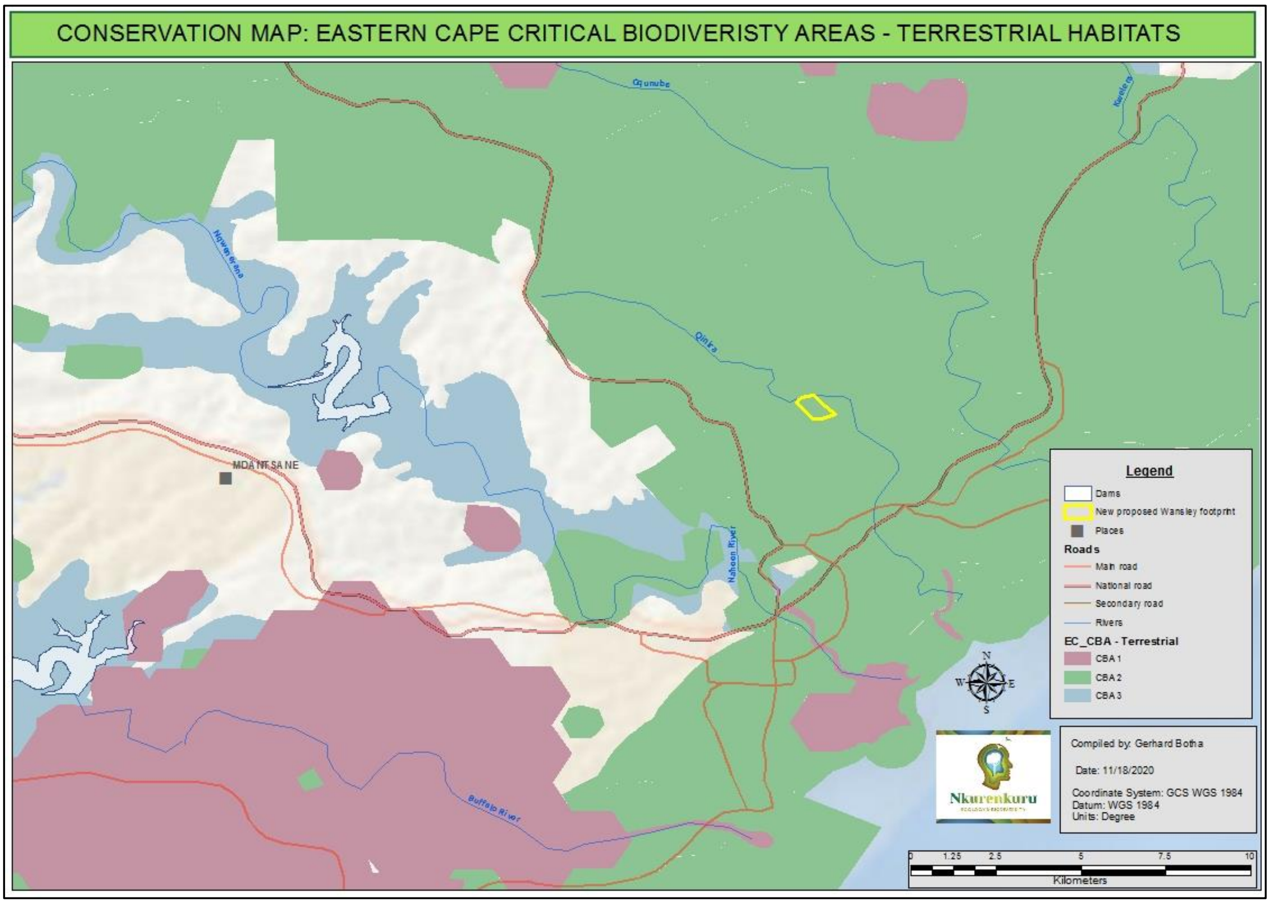


Figure 10: Map showing the location and extent of Terrestrial CBAs in relationship to the proposed new Wansley mining footprint identified according to the Eastern Cape Biodiversity Conservation Plan.

» <u>Aquatic Critical Biodiversity Areas (Figure 11):</u>

The entire project site is located within an Aquatic CBA3_A3b because this area falls within a hydrological primary catchment management area for an Aquatic CBA2_E2 Estuary.

The proposed new Wansley mining footprint is located outside of the primary hydrological features of this catchment area, namely the Qinira River. As already mentioned, the Qinira River as well as its riparian fringe and the abutting natural thicket has been classified as a No-Go Area (High Sensitive) and includes a 100m No-Go Buffer Area around these features. This area has been classified as a No-Go Area to preserve the integrity and functionality of this aquatic resource.

The proposed new Wansley mining footprint is located predominantly within two micro-catchments (Refer to Figure 12). Surface drainage within these micro-catchments as well as other micro-catchments within the Wansley property have already been largely modified with numerous gravel dams located within the catchment areas as well directly within drainage systems. Furthermore, these micro-catchments have been largely transformed by existing mining activities, roads, building infrastructure, and historical cultivation practices. Even though, two drainage systems will be impacted by the proposed expansion of the mining footprint, it is highly unlikely that this expansion will significantly impact the hydrological nature of the important downstream aquatic resources maintaining the Qinira Estuary. Furthermore, with the implementation of mitigation measures impacts such as pollution and sedimentation will be avoided within this downstream aquatic resource.

As such it can be concluded that the proposed development will not impact the functioning of the CBA_A3b primary catchment area and subsequently not the Qinira Estuary (CBA2_E2).

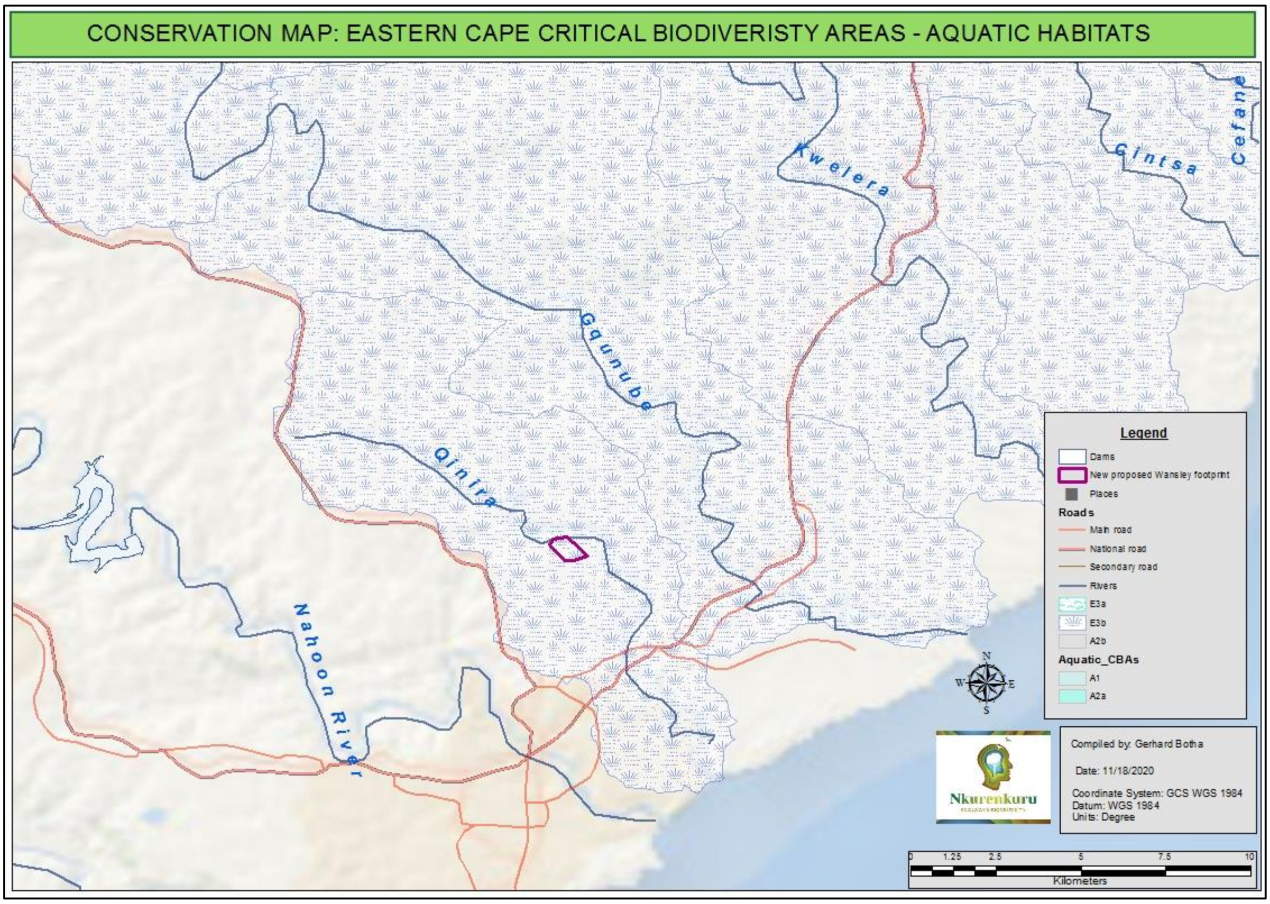


Figure 11: Map showing the location and extent of Aquatic CBAs in relationship to the proposed new Wansley mining footprint identified according to the Eastern Cape Biodiversity Conservation Plan.

6. FINDINGS OF THE FRESHWATER RESOURCE ASSESSMENT

6.1 Delineation and Classification of Watercourses

The study site can be described as highly undulating comprising of low hills with moderate to gentle slopes (Figures 5 and 6) vegetated with secondary wooded grassland to dense thicket vegetation. This rolling hilly landscape is dissected by lower gradient drainage lines as well as relative steep valleys and ravines hosting dense, moderate to tall riverine forests and thickets which are drained by seasonal streams/rivers and ephemeral drainage lines. The topography does not lend itself to the formation of the persistence of wetland features, which are notably absent from the study site. Watercourses are therefore channelled bedrock streams characterised by mostly straight channel patterns to slightly wandering in some isolated sections. The study site generally slopes in an eastern to southeastern direction and is drained by two ephemeral drainage lines (Figures 4 and 12) which join up to the east of the proposed new mining footprint to form a small intermittent watercourse, flowing in a southeastern direction over a short distance to finally terminate into the seasonal Qinira River.

The Qinira River is the main collecting non-perennial river system of the region and flows in a south-easterly direction along the northern and eastern boundary of the Wansley Property. Riparian vegetation within the area is typically an expression of the hydrological nature of watercourse with the stronger seasonal systems such as the Qinira River fringed by a well-developed, tall woody riparian fringe whilst the smaller intermittent stream comprising of narrower woody riparian fringe. The ephemeral drainage lines mostly lack riparian vegetation cover apart from the lower points where some riparian vegetation is present and have extended from the intermittent stream into these portions of the drainage lines. Another prominent feature of this property as well as the surrounding landscape are the numerous small gravel dams. Most of which have been constructed within drainage lines, in an attempt to store water runoff for longer periods. The Wansley Property can be divided into five drainage regions or micro-catchments. The proposed new Wansley mining footprint will mostly impact two of these micro-catchments, which are drained by the two ephemeral drainage lines.

The extent of 'riparian habitat' (defined as 'the physical structure and associated vegetation within a zone or area adjacent to and affected by surface and subsurface hydrologic features such as rivers, streams, lakes or drainage ways and are commonly associated with alluvial soils') was delineated according to the methods contained in the Department of Water Affairs delineation guideline document for wetlands and riparian areas (DWAF, 2005) and are shown indicated/shaded in "tourmaline green" on the map in Figure 12. Riparian habitat was delineated using a combination of topographic/morphological features such as the edge of channel bank and according to the apparent transition from riparian to terrestrial vegetation along transects from the channel centre line laterally outwards, which can be observed through changes in the structure and composition of the vegetation from taller, more robust vegetation and species typical of "wet" environments to more sparse, low vegetation dominated by terrestrial or dryland species that are typically intolerant of saturated soil or waterlogged conditions.

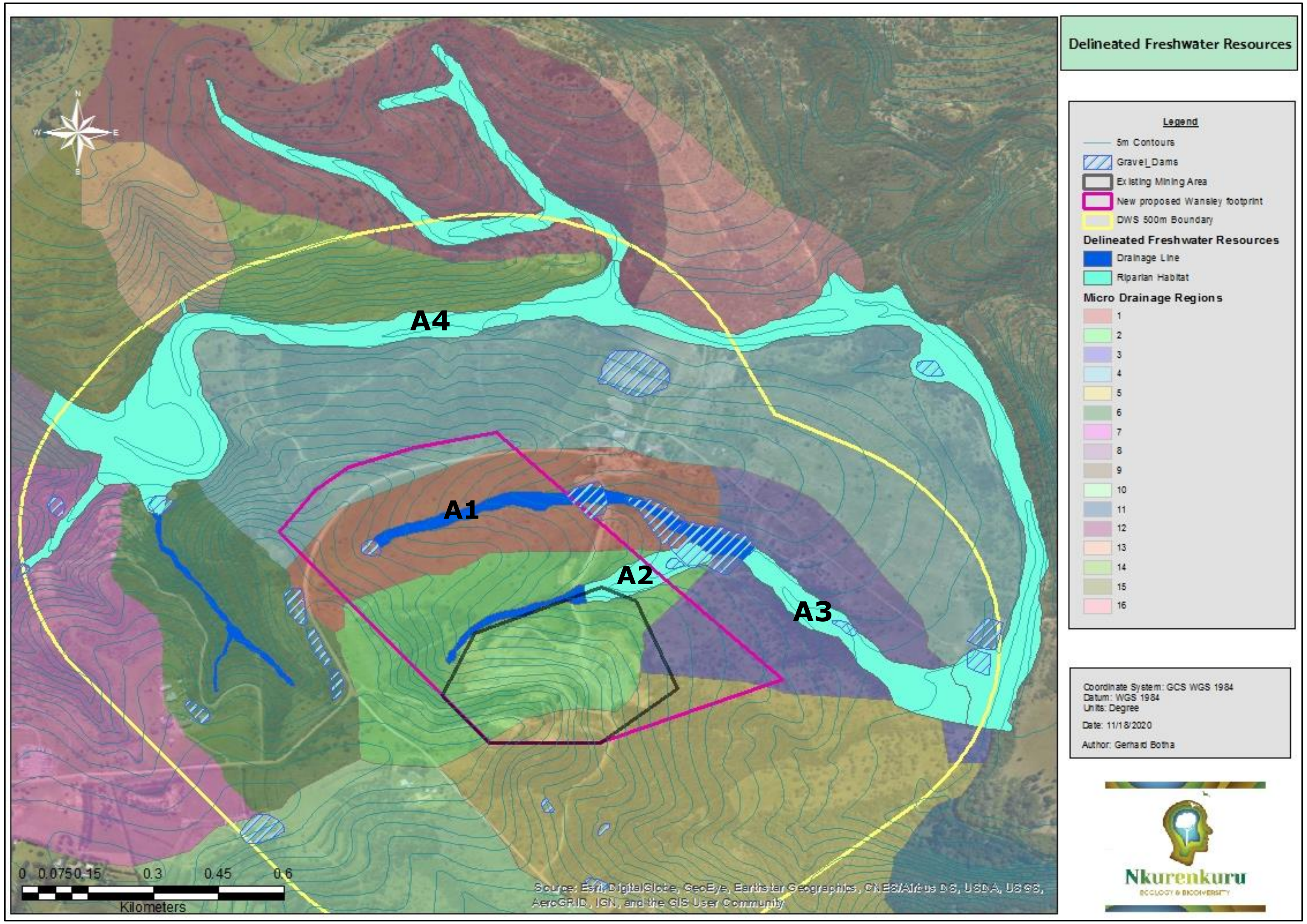


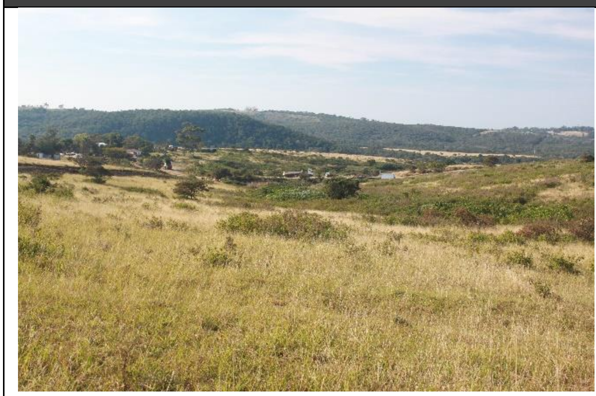
Figure 12: Map showing the classified watercourses (streams rivers and drainage lines) within a radius of 500m meters (DWS Regulated Area) around the proposed new mining footprint.

6.2 Fresh Water Resource Descriptions

6.2.1 Drainage Line A1

Table 4: Hydrological and geomorphological summary for Drainage Line A1.

ASSESSMENT UNIT SUMMARY				
Recorder	Gerhard Botha	**Upper Latitude**	-32.913°	
River System	Drainage Line	**Upper Longitude**	27.923°	
River Name	No Name	**Upper Altitude**	142m	
Site Name	Wansley Siyakhula Quarry	**Lower Latitude**	-32.912304°	
Sub-Quaternary Catchment	R30F-8056	**Lower Longitude**	27.930754°	
Catchment Area (ha)	8703	**Lower Altitude**	90m	
Micro-catchment Area	18	**Tributary**	Tributary of Qinira River	
Size of Freshwater Resource (ha)	3.42ha	**Reach length**	735m	
Reach gradient (Average slope)	7.1%	**Geomorph Zone**	N/A	
Maximum slope	16.1%	**Valley Confinement**	V-shaped valley (V6)	
Hydrological Regime	Ephemeral	**Channel Type**	Drainage Channel with no exposed bedrock.	
Drainage Direction	West to east	**Dominant reach types**	RUN	
Channel Pattern	Straight	**Riparian area present**	YES	NO
Dominant Sediment	Clay Loam Soils with low % rock fragments (>15%) within the first 10cm. Combination of Bonheim and Mayo Soil forms	**Vegetation Structure**	Open thicket/shrubland	
PHOTOGRAPHS				



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This is a fairly short ephemeral drainage line and will only contain flowing water for a very short period after precipitation events in a typical year. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water and permanent pools do not occur. Surface run-off from the hillslopes is the primary source of water for streamflow.

Soils are typically dark coloured and well-structured clay-loam (Melanic A) and may either cover an enriched clay layer (Pedocutanic B) or lay directly over weathering rock which in turn may grade into unaffected and eventually, fresh rock. Melanic A and Pedocutanic B horizons are usually an indication of downward and lateral movement of fine materials by, and deposition from water. This drainage line does not contain a riparian fringe and is characterised by a moderately dense, low growing shrubland dominated by *Lantana camara, Acacia natalitia* (now *Vachelia natalitia*), *Solanum mauritianum, Solanum chrysotrichum, Brachylaena elliptica, Justicia protracta, Argemone spp., Helichrysum rosum, Plantago major* and *Melenis repens, Sporobolus africanus, Eragrostis plana, Paspalum urvillei,* and P. *scrobiculatum*. The vegetation composition is indicative of a highly disturbed environment dominated by invasive alien shrubs and forbs/herbs. Earth rubble have been stockpiled within this drainage line. The lower-lying grave dams comprise of *Typha capensis, Ficinia* spp. and *Juncus kraussii.*

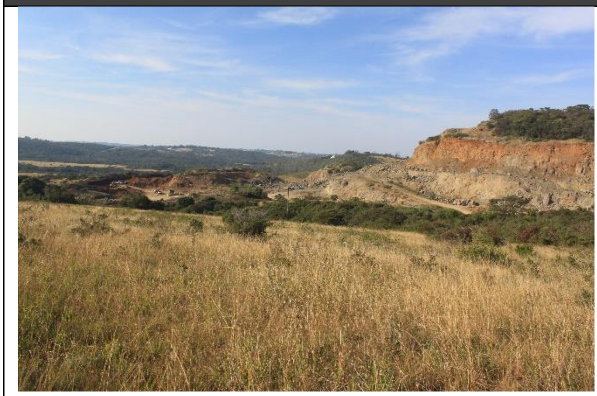
This drainage line has a shallow V-shape confinement. In an attempt to store this surface runoff small gravel dam/reservoirs have been constructed within this channel and have significantly impacted longitudinal connectivity. One such dam has been constructed at the point of origin (headwater) of this drainage channel whilst two dam structures have been constructed are present within the lower half of this channel. These farm dams/reservoirs have impacted the nature of flooding downstream (magnitude and frequency), especially into the semi-ephemeral watercourse

6.2.2 Drainage Line A2

Table 5: Hydrological and geomorphological summary for Drainage Line A2 and associated Riparian Zone.

ASSESSMENT UNIT SUMMARY			
Recorder	Gerhard Botha	**Upper Latitude**	-32.914741°
River System	Drainage Line	**Upper Longitude**	27.95216°
River Name	No Name	**Upper Altitude**	143m
Site Name	Wansley Siyakhula Quarry	**Lower Latitude**	-32.912275°
Sub-Quaternary Catchment	R30F-8056	**Lower Longitude**	27.930705°
Catchment Area (ha)	8703	**Lower Altitude**	90m
Micro-catchment Area	24ha	**Tributary**	Tributary of Qinira River
Size of Freshwater Resource (ha)	2.86ha	**Reach length**	616m
Reach gradient (Average slope)	8.7%	**Geomorph Zone**	N/A
Maximum slope	23.5%	**Valley Confinement**	V-shaped valley (V6)
Hydrological Regime	Ephemeral	**Channel Type**	Drainage Channel with some exposed bedrock within the lower reaches.
Drainage Direction	West to east	**Dominant reach types**	RUN
Channel Pattern	Straight	**Riparian area present**	YES / NO
Dominant Sediment	Clay Loam Soils with low % rock fragments (>15%) within the first 10cm. Combination of Bonheim and Mayo Soil forms. Some exposure of bedrock within the lower portions of the channel	**Vegetation Structure**	Upper half: Open thicket/shrubland Lower half: Dense, moderate tall woody riparian fringe

PHOTOGRAPHS



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This is a fairly short ephemeral drainage line and will only contain flowing water for a very short period after precipitation events in a typical year. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water and permanent pools do not occur. Surface run-off from the hillslopes is the primary source of water for streamflow.

This drainage line has a shallow V-shape confinement and comprises of an upper half dominated by a woody, moderately dense thicket, whilst the lower portion comprise of a moderately tall woody riparian fringe. This drainage line terminates into a moderately sized gravel dam dominated by *Typha capensis*. The soil form and structure are similar to that of Drainage Line 1 apart from a small locality along this drainage line where some bedrock is exposed. More than half of this drainage line has been completely transformed by mining activities and has lost most of its functionality. The upper portion of the drainage line that has not been transformed through mining activities comprises of *Lantana camara*, *Acacia natalitia, Solanum mauritianum*, Solanum chrysotrichum *Brachylaena elliptica, Trachonanthus parvicapitulatus, Helichrysum rosum, Plantago major, Eragrostis plana, Sporobolus africanus* and *Paspalum scrobiculatum*. The riparian section of this drainage system is located between the access road to the quarry and the moderately sized gravel dam and comprise of *Lantana camara*, *Brachylaena elliptica, Maytenus spp., Rhoicissus tomentosa, Acalypha glabrata, Schotia brachypetala, Harpephyllum caffrum, Zanthoxylon capensis and Vepris lanceolata*.

Mining activities, vegetation clearance, alien invasive plants, access roads and small farm dams have significantly impacted all aspects of this drainage line.

6.2.3 Watercourse A3 with Riparian Vegetation

Table 6: Hydrological and geomorphological summary for Watercourse A3 and associated Riparian Zone.

ASSESSMENT UNIT SUMMARY				
Recorder	Gerhard Botha	**Upper Latitude**	-32.912275°	
River System	Intermittent stream	**Upper Longitude**	27.930705°	
River Name	No Name	**Upper Altitude**	90m	
Site Name	Wansley Siyakhula Quarry	**Lower Latitude**	-32.915898°	
Sub-Quaternary Catchment	R30F-8056	**Lower Longitude**	27.936535°	
Catchment Area (ha)	8703	**Lower Altitude**	66m	
Micro-catchment Area	21ha	**Tributary**	Tributary of Qinira River. The two drainage lines drain into this stream	
Size of Freshwater Resource (ha)	5.06ha	**Reach length**	746m	
Reach gradient (Average slope)	3.9%	**Geomorph Zone**	Upper Foothills	
Maximum slope	8.4%	**Valley Confinement**	V-shaped valley (V6)	
Hydrological Regime	Semi-Ephemeral	**Channel Type**	Eroded mixed bedrock-cobble channel	
Drainage Direction	North-west to south-east	**Dominant reach types**	Plan-bed	
Channel Pattern	Straight	**Riparian area present**	YES	NO
Dominant Sediment	Mixed-bedrock-cobble Minimal alluvial sediments within the channel. Alluvial sediments within the stream banks	**Vegetation Structure**	Channel: Bare Bank: Dense, tall woody riparian fringe with sparse ground cover.	
PHOTOGRAPHS				

This watercourse is regarded as semi-ephemeral and will experience water flow only during, and for a short duration after precipitation events in a typical year. Semi-ephemeral stream beds are located above the water table year-round along with the majority of the stream length. Groundwater is, therefore, a source of surface water to a very limited extent and results in the presence of permanent but isolated static pools. Run-off from rainfall is the primary source of water for streamflow. The contribution of the drainage lines to surface flow has been significantly impacted by the farm dams located within their channels.

The channel bed has experienced some geomorphological modification due to anthropogenic activities within the catchment as well as within the upstream drainage lines. Typically, the channel type can be described as predominantly bedrock channels however some areas within the channel exist where alluvium is collected. However, some of these alluvium sections have been exposed to channel erosion, mainly as a result of an increase in surface flow from the historically cultivated slopes. The channel is furthermore typographically largely uniform (plan-bed) and devoid of vegetation whilst the channel bank comprises of a dense woody riparian fringe. This reach is not associated with a floodplain or any other wetland.

Longitudinal connectivity has been influenced mainly by gravel roads and farm dams, especially within the upstream tributary junction. This has resulted in a reduction in the magnitude and frequency of floods, thus reducing the energy for geomorphic work, and secondly to trap sediment and reduce the supply of sediment to downstream reaches. Especially the smaller, most frequent floods are affected by this impact. Hillslope connectivity has somewhat returned to its original near-natural state due to the establishment of secondary vegetation within the historically cultivated slopes. However, the historical impacts of cultivation along these slopes have left its mark in the form of local incised channels. Due to historical channel erosion, lateral connectivity has been slightly influenced. This impact along with the upstream farm dams have resulted in a reduction in elevated floods and subsequently a reduction in the flooding of the different riparian zones.

As mentioned, the channel itself is devoid of vegetation whilst the banks are characterised by dense, tall woody riparian vegetation, most notably *Sideroxylon inerme, Trachonanthus* *ilicifolia, Maytenus* spp. *Acalypha glabrata, Scotia brachypetala, Erythrina lysistemon* and *Vepris lanceolata, Harpephyllum caffrum, Carrisa bispinosa, Zanthoxylon capensis* and *Cestrum laevigatum*. The outer fringes of the riparian zone have been extensively invaded with *Lantana camara.*

6.2.4 Impacted Reach of Qinira River and Associated Riparian Vegetation

Table 7: Hydrological and geomorphological summary for the Qinira River (A4) and associated Riparian Zone.

ASSESSMENT UNIT SUMMARY				
Recorder	Gerhard Botha	**Upper Latitude**	-32.909366°	
River System	Intermittent stream	**Upper Longitude**	27.917002 °	
River Name	No Name	**Upper Altitude**	109m	
Site Name	Wansley Siyakhula Quarry	**Lower Latitude**	-32.916194°	
Sub-Quaternary Catchment	R30F-8056	**Lower Longitude**	27.936539°	
Catchment Area (ha)	8703	**Lower Altitude**	66m	
Micro-catchment Area	643ha	**Tributary**	Main collecting river within the sub-quaternary catchment. Fed by numerous ephemeral and semi-seasonal drainage systems.	
Size of Freshwater Resource (ha)	31.2ha	**Reach length**	3 263m	
Reach gradient (Average slope)	2.9%	**Geomorph Zone**	Upper Foothills	
Maximum slope	14.5%	**Valley Confinement**	Partly ravine (V7) and partly v-shaped valley (V6)	
Hydrological Regime	Semi-Seasonal River	**Channel Type**	Bedrock Channel	
Drainage Direction	West to East and then North to South (Bend in the river)	**Dominant reach types**	Pool-Rapid (Rapids, Bedrock pools, Bedrock pavements and Bedrock runs)	
Channel Pattern	Mostly straight with areas becoming slightly wandering	**Riparian area present**	YES	NO
Dominant Sediment	Mostly bedrock with boulders and fine sediment and leaf litter within bedrock pools.	**Vegetation Structure**	Channel: Bare Bank: Dense, tall woody riparian fringe with sparse ground cover.	
PHOTOGRAPHS				




This watercourse is regarded as semi-seasonal and has flowing water during certain times of the year (>25% of the time) when groundwater provides for streamflow. It ceases to flow regularly and seasonally because bed seepage and evapotranspiration exceed the available water supply. During dry periods, this river is unlikely to have flowing water. However, permanent but isolated and static pools may be present in sections of this river reach. Runoff from rainfall is a supplemental source of water for streamflow.

The channel bed has experienced some geomorphological modification due to anthropogenic activities within the catchment, upstream reaches as well as within its tributaries. Typically, the channel type can be described as a bedrock channel comprising of runs, pools and bedrock pavements as well as a few small rapids.

Longitudinal connectivity within the assessed section of this river is largely unmodified and continuous however longitudinal connectivity within the entire system has been influenced by anthropogenic activities and include instream dams, causeways and bridges. These dams are mostly relatively small in terms of capacity and will likely have a moderate influence on flood intensity and frequency within this assessed portion of the river. Due to the distant location of causeways and bridges, these infrastructures do not have a significant impact on local flooding and sediment characteristics. Hillslope connectivity within this portion of the river plays a more important role in water input and flooding characteristics of this section of the river. Low order tributaries within this section are regarded as important hydrological features. Most of these low order tributaries area low to moderately impacted with minimal barriers (dams and roads) within their reaches as well as within the junction points between these tributaries and the Qinira river. However, the hillslopes fringing these low order tributaries (including the tributary within the Wansley property have been significantly impacted by agricultural activities (historical cultivation and livestock grazing) and have resulted in a reduction in roughage (vegetation cover). Subsequently, most of these lower-order tributaries have experienced an increase in flooding magnitude and frequency, contributing to a very slight increase in flooding magnitude and frequency within this portion of the Qinira River. The low order tributary, as well as the associated drainage lines within the Wansley footprint, are however an exception to this, due to the presence of several instream farm dams as well as farm dams within the catchment area. These reservoirs have resulted in a reduction in the contribution this tributary makes to the Qinira River. Furthermore, the more frequent and smaller flooding events have been altered within this region (reduction in magnitude and frequency). Most of these farm dams have been constructed a long time ago when the area was predominantly under pineapple cultivation. The mining activities that followed also contributed to a change in water inputs and flooding characteristics within this area. However, due to the relatively small extent of this impacted micro-catchment, these modifications have a moderately small impact on the local hydrological character of this section of the Qinira River.

The channel bed is mostly devoid of vegetation. The marginal zone is also known as the active feature or wet bank (the area from the water level at low flow to those features that are hydrologically activated for the greater part of the year) comprise mostly of moisture-loving graminoids and herbs such as *Miscanthus capensis, Echinochloa* spp., *Ranunculus baurii*. The lower (seasonal) and upper (ephemeral) zones are characterised by a tall dense woody forest, with a near closed canopy. The lower zone consists of geomorphic features that area hydrologically activated on a seasonal basis (yearly during high flow, or every 2 to 3 years) and is characterised *by Ilex mites, Olinia emerginata, Sesbania punicea, Phoenix reclinata, Acacia dealbata, Impatens spp. Cestrum laevigatum, Asparagus macowanii, Podocarpus latifolius* and *Sideroxylon inermis.* The upper zone is also known as the dry bank and extends from the end of the lower zone to the end of the riparian corridor. The upper zone consists of geomorphic features that are hydrologically activated on an ephemeral base (less than every 3 years. Furthermore, this zone is characterised by steeper slopes and the presence of both riparian and terrestrial species such as; *Podocarpus latifolius, Sideroxylon inermis, Dracaena aletriformis, Acalypha glabrata, Scotia brachypetala, Zanthoxylon capensis, Harpephyllum caffrum, Carissa bispinosa, Vepris lanceolata, Canthium inerme, Clorophytum bowkeri, C. comosum* and *Isoglossa* spp. Almost the entire outer fringe of this zone has been invaded with *Lantana camara* with the exception where natural thicket has persisted.

6.3 Rivers/Drainage Lines: PES and EIS Assessment

6.3.1 Present Ecological State of Freshwater Resources

The Present Ecological State (PES) refers to the health or integrity of an ecosystem defined as a measure of deviation from the reference state. The 'habitat integrity' of a river refers to the "maintenance of a balanced composition of physic-chemical and habitat characteristics on a temporal and spatial scale that is comparable to the characteristics of natural habitats of the region" (Kleynhans, 1996). It is seen as a surrogate for the assessment of biological responses to driver changes. The Index of habitat Integrity (IHI) is a measure of the Present Ecological State (PES) which infers the health or integrity of a river system and includes both in-stream habitats as well as riparian habitat adjacent to the main channel.

Habitat integrity for instream and riparian habitats was assessed separately based on the following indicators of habitat integrity:

- Water abstraction
- Flow modification
- Inundation
- Bed modification
- Bank erosion
- Channel modification
- Water quality
- Solid waste disposal
- Vegetation removal
- Exotic vegetation

The results of the IHI assessment are summarised in Table 8 below and shown graphically in Figures 14 - 17 below. The results of the IHI assessment undertaken generally reveal the following:

- The drainage channel A2 has seen the highest level of habitat transformation and disturbance with more than half of the drainage system being lost due to current mining activities. Furthermore, the vegetation composition and structure of especially the upper portion have been significantly modified with *Lantana camara* having extensively invaded this system. Other invasive alien plants (IAPs) that have invaded the area include *Solanum mauritianum* and *S. chrysotrichum*. The herbaceous layer also comprises many weedy and alien plants. The lower portion of this drainage line is in a less transformed and degraded condition and comprise of a well-developed, tall, woody riparian fringe. *Cestrum laevigatum* have invaded portions of this zone with the out edges comprising of a fairly dense barrier of *Lantana camara*. All of the mentioned IAPs are listed Category 1b Invasives. Furthermore, longitudinal and hillslope connectivity has been significantly influenced through the small farm dams, access roads, and the mine itself resulting in an alteration in water inputs, outputs as well as the magnitude and extent of flooding.

» Similarly, drainage line A2 have also be subjected to significant modified, especially the vegetation cover which is severely invaded with Lantana camara, *Solanum mauritianum,* S. *chrysotrichum, Argemone ochroleuca* and *Xanthium spinosum.* Longitudinal connectivity has also been significantly influenced through the construction of various farm dams, altering the nature of flooding downstream (magnitude and frequency), especially into the semi-ephemeral watercourse.
» The semi-ephemeral watercourse A3 has also been subjected to habitat modification and alteration, and especially the channel bed has experienced significant geomorphological modification due to historical anthropogenic activities (within catchment as well as tributaries). This, in turn, has influenced water input, output, flood magnitude, and extent. Upstream dams within the drainage lines have resulted in a reduction in the magnitude and frequency of floods, thus reducing the energy for geomorphic work, and secondly to trap sediment and reduce the supply of sediment to downstream reaches. Especially the smaller, most frequent floods are affected by this impact. Hillslope connectivity has somewhat returned to its original near-natural state due to the establishment of secondary vegetation within the historically cultivated slopes. However, the historical impacts of cultivation along these slopes have left its mark in the form of local incised channels. Due to historical channel erosion, lateral connectivity has been slightly influenced. This impact along with the upstream farm dams have resulted in a reduction in elevated floods and subsequently a reduction in the flooding of the different riparian zones. Significant impacts within the riparian zone include, as mentioned a reduction in flooding extent and magnitude, but also the invasion of IAPs such as *Cestrum laevigatum* within the lower riparian zone and *Lantana camara* within the outer boundary of the upper zone.
» Habitats within this reach of the Qinira River has been moderately modified. Most of the upstream impacts such as dams, causeways and bridges, do not have a significant bearing on the local habitats within this portion of the Qinira River due to the distance of these impacts. Local impacts from the catchment such as a reduction in vegetation cover, an increase in water input from some tributaries and the reduction of water inputs from others have somewhat modified the flow character within this section. Reservoirs/dams within the tributary and its associated drainage lines, located within the project area, have resulted in a slight alteration in the hydrological contribution this tributary provides towards the total water input and flooding nature of the Qinira River.

Table 8: Summary results of the river IHI (Index of Habitat Integrity) assessment.

WATERCOURSE UNIT	HABITAT COMPONENT		
	Instream PES Category with % Intact	Riparian PES Category with % Intact	Overall PES (weighted 60:40)
Drainage Line A1	E: Seriously Modified (39% intact)	N/A	E: Seriously Modified (39% intact)
Drainage Line A2 with Riparian Fringe	F: Critically Modified (14.38% intact)	E: Seriously Modified (31% intact)	E: Seriously Modified (38% intact)
Stream A3 with Riparian Fringe	D: Largely Modified (58% intact)	C: Moderately Modified (60% intact)	D: Largely Modified (59% intact)
Qinira River A4 with Riparian Fringe	B: Largely Natural (83% intact)	C: Moderately Modified (73% intact)	C: Moderately Modified (79% intact)

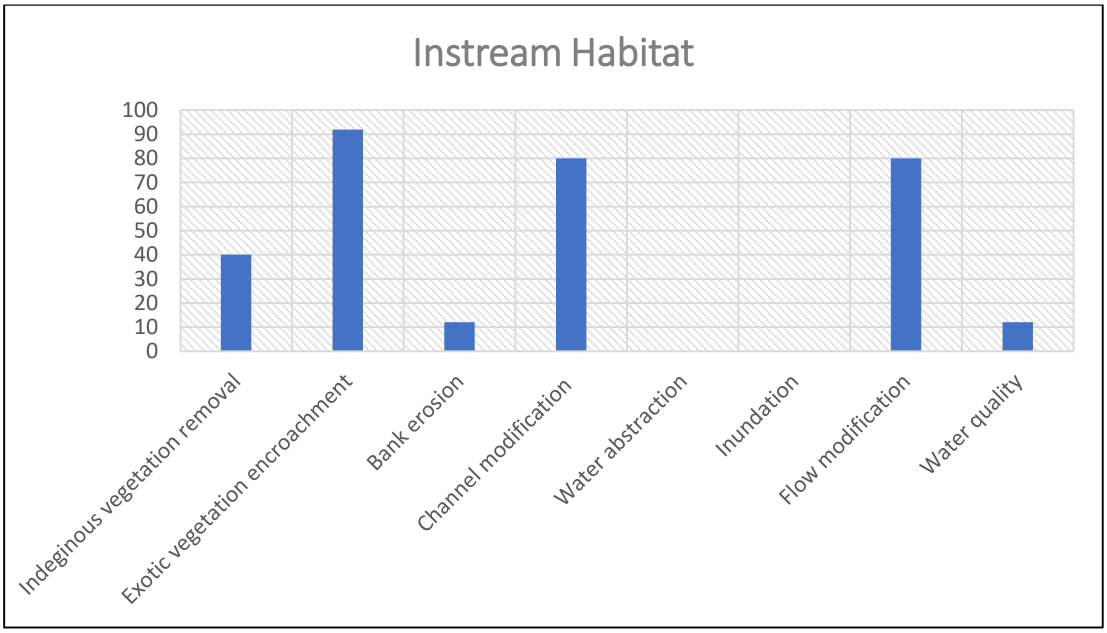

Figure 13: Graph comparing the level of instream habitat modification expressed as a percentage as a result of several modifying determinants for drainage line A1 assessed using the IHI method.

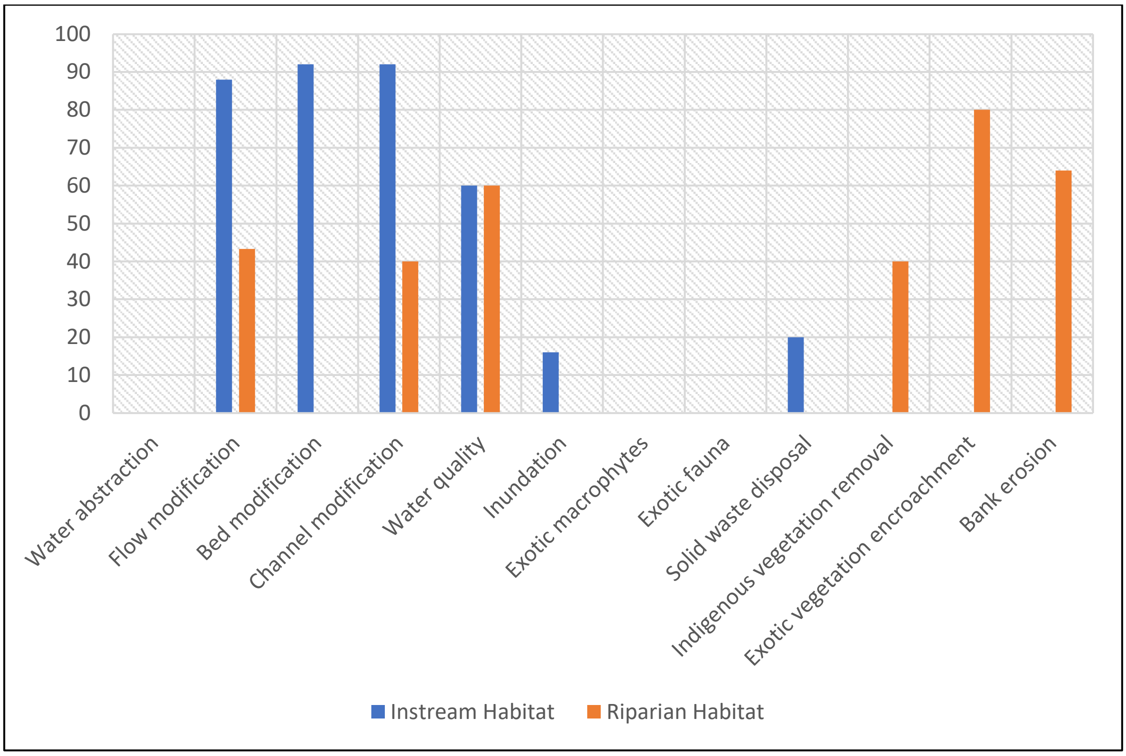

Figure 14: Graph comparing the level of instream habitat modification expressed as a percentage as a result of several modifying determinants for drainage line A2 assessed using the IHI method.

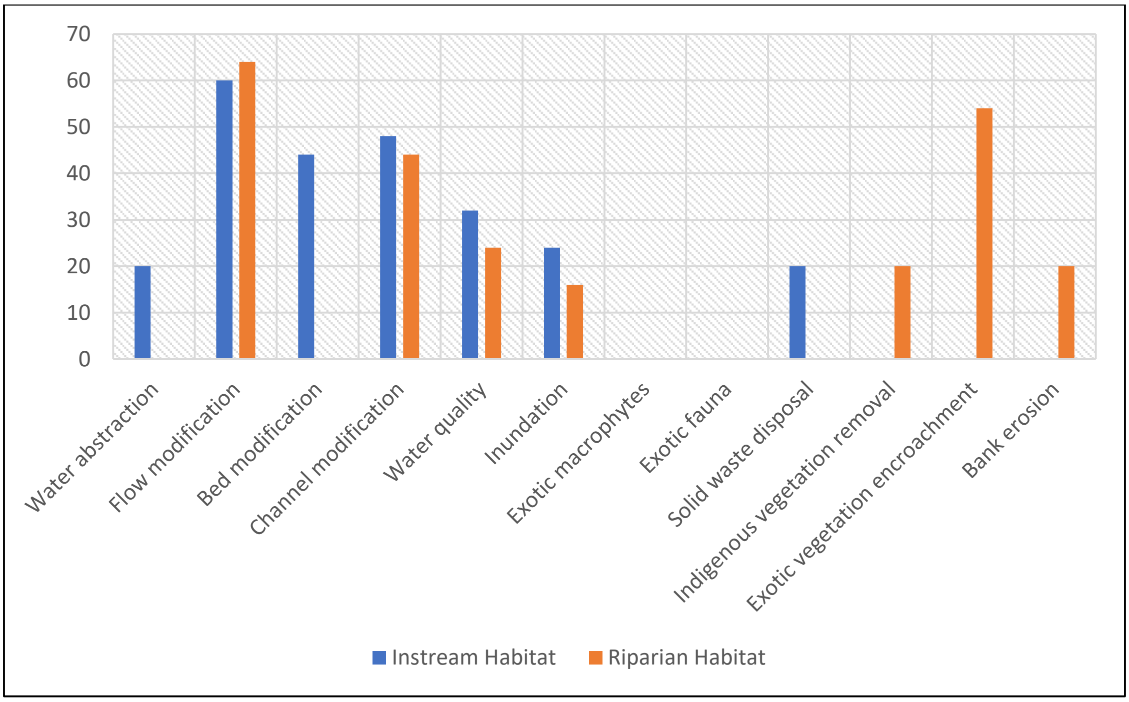

Figure 15: Graph comparing the level of instream habitat modification expressed as a percentage as a result of several modifying determinants for drainage line A3 assessed using the IHI method.

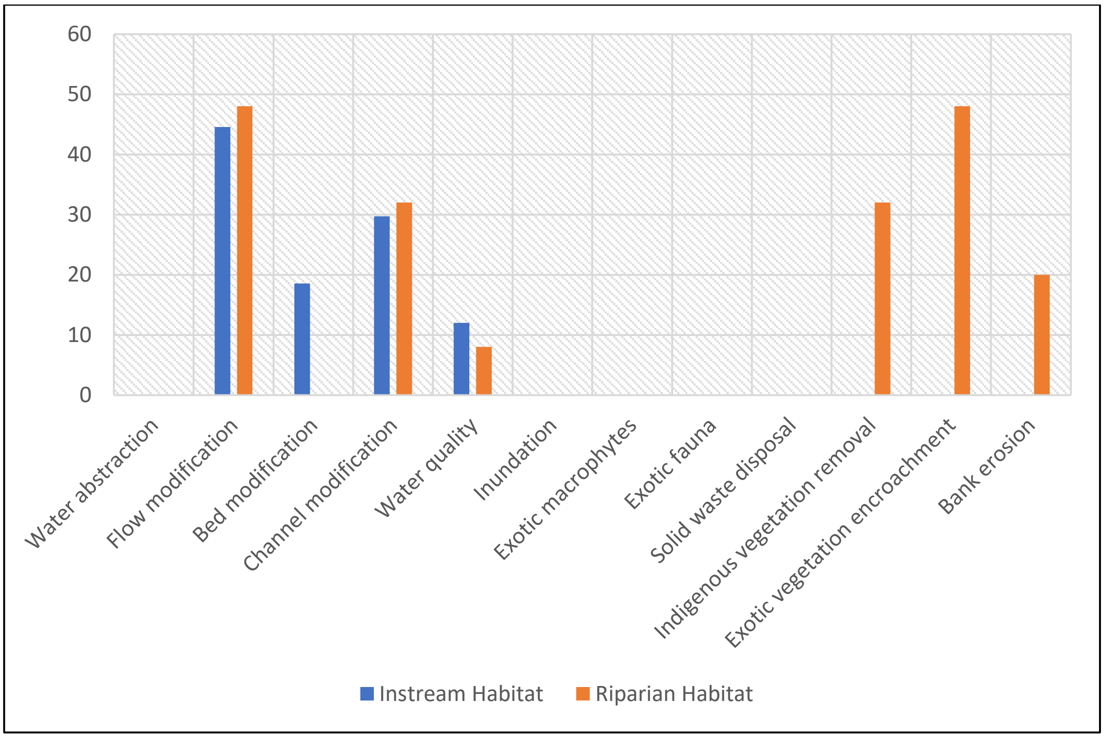

Figure 16: Graph comparing the level of instream habitat modification expressed as a percentage as a result of several modifying determinants for drainage line A4 assessed using the IHI method.

6.3.2 Ecological Importance and Sensitivity of the Freshwater Resources

The Ecological Importance and Sensitivity (EIS) of the river and riparian areas is an expression of the importance of the aquatic resource for the maintenance of biological diversity and ecological functioning on local and wider scales; whilst Ecological Sensitivity (or fragility) refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans & Louw, 2007).

The outcomes of a rapid instream and riparian habitat ecological importance and sensitivity assessment (using the DWAF EIS tool for rivers) is summarised below in Table 9 with an ecological sensitivity map for aquatic and terrestrial habitats of the project site included as Figure 19.

Table 9: Summary of the EIS assessment results.

UNIT	RATING FOR BIOTIC DETERMINANTS OF EIS	RATING FOR PHYSICAL HABITAT DETERMINANTS OF EIS	OVERALL EIS RATING	RATIONALE / OBSERVATIONS
A1	Low (0.5)	Moderate (1.5)	Low (1)	» High level of habitat modification due to alien plants, farm dams and dumping of earthen rubble » Lacks riparian habitat

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				» Low habitat diversity » Low species diversity » No flora/fauna species of conservation concern noted and unlikely to be present. » Non-functional wildlife corridor. » Low sensitivity due to the existing level of flow and water quality. » Located within A_CBA2 (E3b)
A2	Low (1)	Moderate (2)	Low (1)	» High level of habitat modification due to mining activities, access roads, alien plants and farm dams » Lacks riparian habitat within the upper portion » Low habitat diversity » Low species diversity » Three provincially protected tree species observed. » Non-functional wildlife corridor. » Low sensitivity due to the existing level of flow and water quality. » Located within A_CBA2 (E3b)
A3	High (2.5)	Moderate (2)	Moderate (2)	» Moderate level of habitat modification due to farm dams, alien plants channel modification » Relative intact riparian fringe » Low habitat diversity » Moderate species diversity » Three provincially protected tree species observed. » Non-functional wildlife corridor. » Low sensitivity due to the existing level of flow and water quality. » Located within A_CBA2 (E3b).
A4	High (2.5)	High (3)	High (3)	» Moderate to a low level of habitat modification due to alien plants and limited alteration in flooding extent and regime. » Well developed, dense riparian zone » High habitat diversity » Moderate species diversity » Four provincially protected tree species observed. » Important wildlife corridor. » Experience seasonal flow with relatively high aquatic diversity. » Located within A_CBA2 (E3b). » Feeds into the CBA2 (E2) Qinira Estuary.

7. FINDINGS OF THE BOTANICAL ASSESSMENT

7.1 Site-Specific Vegetation Description - Fine-Scale Vegetation Patterns

In this section, the different habitats and vegetation patterns observed within the newly mining footprint is described with some mention of the surrounding habitats within the affected property. As these are field-based observations taken directly from the site, they are of greater reliability and pertinence than the results of the National Vegetation Map which is at a coarse scale and does not represent the detail of the site adequately. The habitat map derived for the study site is provided in Figure 18 and their sensitivity ratings are provided in Figure 19.

The bulk of the vegetation within of the study site resembles a severely modified and transformed form of South Eastern Coastal Thornveld. These areas have been subjected to historical cultivation (pineapple cultivation) and can be described as secondary vegetation that has established within these areas. The more natural areas are associated with the riparian zones and small pockets of near-natural to natural pockets of thickets. Other disturbances within the property include severe invasion of IAPs (especially *Lantana camara, Solanum mauritianum, Solanum chrysotrichum,* and *Cestrum laevigatum* within the riparian areas), mining activities, building infrastructure, gravel roads, bush clearing, and farm dams.

The secondary vegetation can be divided into two distinguishable thicket types according to their dominant structure and species composition. The more gradual plateaus and slopes of the rolling hills comprise of a more open wooded grassland whilst the steeper north-facing slope is characterized by a much denser woodland thicket with a less prominent grass and herb/forb cover. Furthermore, this denser thicket contains a lower diversity of plants in comparison with the open wooded grassland.

Key species found within the open wooded grassland include;

> *Searsia pallens, Arctotis arctotoides, Brachylaena elliptica, Cineraria lobate, Gerbera pilosellides, Osteospermum grandidentatum, Diospyros dichrophylla, Eragrostis chloromelas, Melinis repens, Koeleria capensis, Solanum mauritianum, Lantana camara* and *Acacia natalitia.*

Key species of the densely wooded thicket (encroaching thicket) include;

> *Brachylaena elliptica, Diospyros dichrophylla, Olea exasperata, Cymbopogon excavates, Hyparrhenia hirta, Melinis repens, Solanum mauritianum and Lantana camara*

Pockets and remnants of the original thicket vegetation have survived within less arable lands as well as narrow strips along portions of the riparian zone. Unfortunately, these patches have not remained unscathed and have been subjected to the invasion of *Lantana camara*. Fortunately, the dense natural stands of woody species have prohibited the "penetration" of these invasives and they mostly persist as a dense, almost impenetrable band around these patches and only establish where natural tree species have been removed.

Key species of the densely wooded thicket (encroaching thicket) include;

> *Mystroxylon aethiopicum, Diospyros dichrophylla, Acacia natalitia, Olea exasperata, Pittosporum viridiflorum and Hyppobromus pauciflorus*

As already discussed within the previous section, hydrological features within the property comprise of two drainage lines feeding into a semi-ephemeral tributary which feed into the seasonal Qinira River. The drainage lines have been severely transformed and disturbed and comprise of highly altered vegetation cover dominated by IAPs. Probably the most significant ecological features within the Wansley property are the riparian zones associated with the short tributary and the Qinira River. These riparian zones comprise of a tall, dense tree layer and a relative well-developed shrub layer. In some areas, the tree canopy may become closed, almost forest-like. Even though some disturbances have occurred within these zones, these riparian fringes have largely maintained their functionality and are regarded as important biological features within the property as well as within the larger area. Of some concern is the establishment of the highly invasive IAP, *Cestrum laevigatum* along the channels of especially the short tributary. The potential of this species, spreading and invading downstream habitats are extremely high.

Key species of the drainage lines include;

> *Justicia protracta, Cineraria lobate, Cirsium vulgare, Helichrysum rosum, Senecio serratuloides, Plantago major, Paspalum urvillei, Sporobolus africanus, Lantana camara, Solanum chrysotrichum and Solanum mauritianum*

Key species of the riparian fringes include;

> *Harpephyllum caffrum, Buxus macowanii, Elaeodendron croceum, Dracaena aletriformis, Acalypha glabrata, Schotia brachypetala, Erythrina lysistemon, Pittosporum viridiflorum, Olinia emerginata, Podocarpus latifolius, Vepris lanceolata Zanthoxylon capense, Sideroxylon inerme and Cestrum laevigatum.*

From the layout map provided by the client, it is clear that all streams and rivers will be avoided as well as their riparian zones. Furthermore, only a portion of the natural thicket will be impacted by the proposed new mining footprint.

It is highly unlikely that this development will have any impact on the status of the South Eastern Coastal Thornveld. Furthermore, not sensitive and important biodiversity features will be impacted by the proposed development.

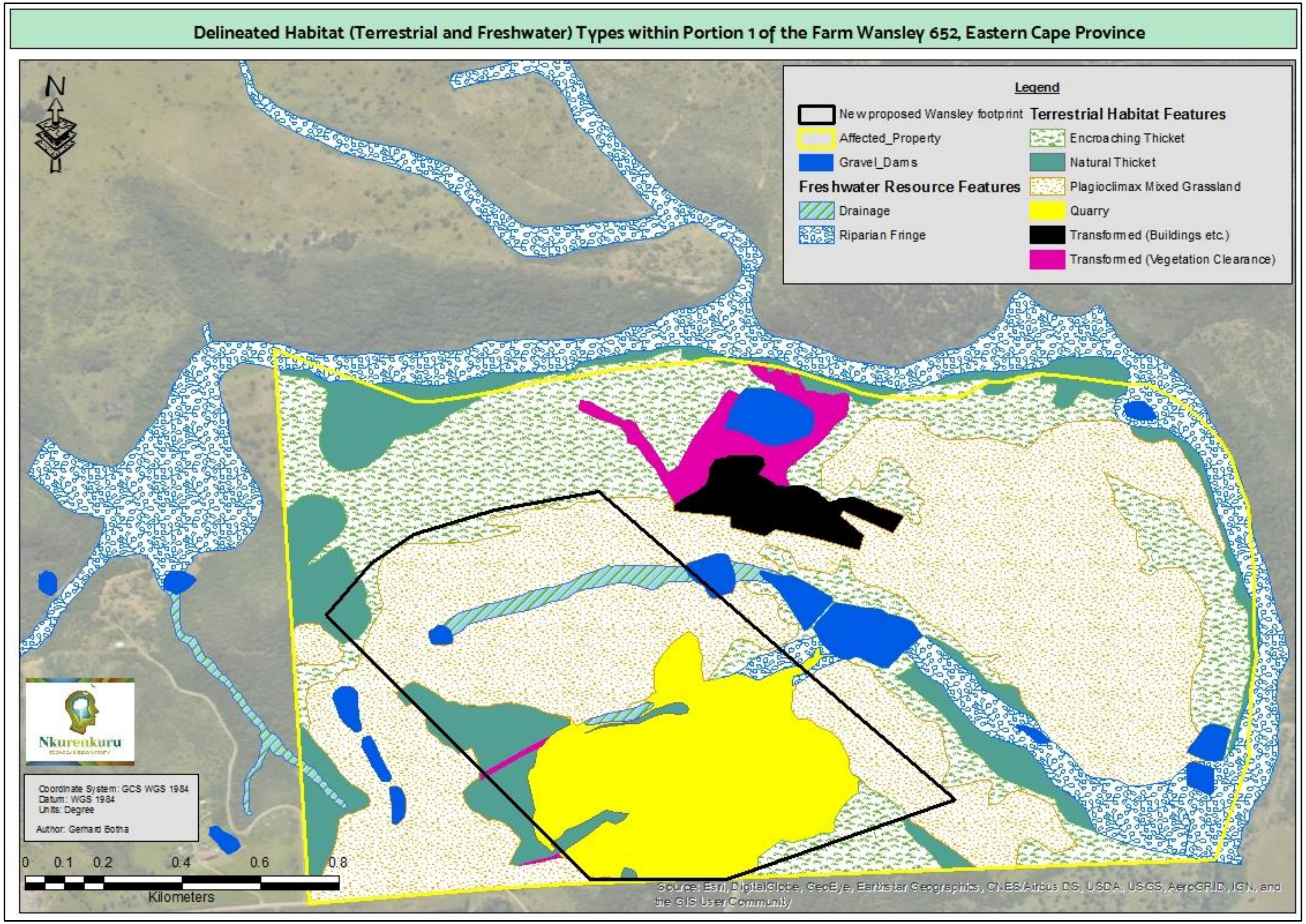

Figure 17: Map showing the identified habitat features within the affected property.

Table 10: Summary of results for the Study Site.

Open wooded grassland (Plagioclimatic grassland)	**Habitat Sensitivity**	**Low:** Bulk of the development is proposed within this area	**<u>Photographs:</u>**      
	No-Go Areas	None identified	
	Present Ecological Status (PES)	**D: Largely Modified**	
Substrate	» Plateaus and gentle slopes of the rolling hills » Sandy-loam soils » Disturbed soils (historical ploughing) » Soil depth highly variable » An abundance of small rock fragments		
Species richness	**Moderate-High: 139** species of which 17 species are weeds and alien species		
Alien Invasive Plants	**5 Species:** *Xanthium spinosum, Melia azedarach, Solanum chrysotrichum, S. mauritianum, Lantana camara*		
Conservation Important Plants	*Aristia abyssinica & Moraea spp.*		
Disturbance	» Secondary vegetation on old cultivated land » Numerous Invasive Alien Plants » Roads » Dams » Trampled game paths	**Naturalness:**	» Secondary vegetation with numerous Invasive Alien plants

<table>
<tr><td>Habitat Integrity:</td><td>Medium - Low
» Even though this is a secondary open wooded grassland, this vegetation cover is relatively high in species diversity creating a niche for some fauna and providing stability.</td><td>Biotic integrity</td><td>Low
» Significant habitat transformation due to historical mining activities
» During the operation of the mine, disturbance and human movement within this area may periodically affect the faunal component, especially in terms of ‘shy’ and sensitive species that will move away during the operational phase.</td></tr>
<tr><td>Anthropogenic importance and potential</td><td>Agricultural Potential: Low</td><td rowspan="3">Conclusion and Mitigation Requirements</td><td rowspan="3">» This area is of low ecological sensitivity.
» Development activities within this area are allowed.
» Development activities within this area are unlikely to have a significant impact on regional ecological functionality.
» Operational activities should be restricted to the development footprint as indicated within this study.
» Pre-construction/operation Botanical walk-through should occur in order to GPS tag all conservation important species that may be at risk of being disturbed/destroyed by the mining activities.
» No conservation important species may be re-located / disturbed or destroyed without the necessary Permits in place (obtained from the relevant nature conservation authorities)
» A vegetation rehabilitation and management plan are also vital for the stabilisation of soils and the prevention of potential erosion from occurring or becoming exacerbated.
» An invasive alien plant management plan should be compiled to address the mitigation and management of such species throughout the operational phase as well as the post-operational phase.
» Rehabilitation progress, erosion, and IAP monitoring can occur simultaneously post-operational phase and should occur bi-annual for a minimum of two years.</td></tr>
<tr><td>Conservation value</td><td>Moderate
» Area is disturbed
» Situated outside of any NPAEs
» Transformed habitat.
» No Red Data Species
» Low level of protected species.</td></tr>
<tr><td>Ecosystem Functions</td><td>Highly limited functions and services
» Potential niche habitats for fauna
» Nich habitat for specific flora species
» Secondary vegetation cover provide stability and resilience against severe weather events</td></tr>
</table>

<table>
<tr><td rowspan="3">Dense, woody thicket

(Encroaching Thicket)</td><td>Habitat Sensitivity</td><td>Low:</td><td colspan="3" rowspan="7"><u>Photographs:</u>
</td></tr>
<tr><td>No-Go Areas</td><td>None identified</td></tr>
<tr><td>Present Ecological Status (PES)</td><td>D: Extremely Modified</td></tr>
<tr><td>Substrate</td><td colspan="2">» Steeper gradients of rolling hills
» Sandy-loam soils
» Disturbed soils (historical ploughing)
» Soil depth highly variable
» An abundance of small rock fragments</td></tr>
<tr><td>Species richness</td><td colspan="2">Moderate-High: 26 species of which 7 species are weeds and alien species</td></tr>
<tr><td>Alien Invasive Plants</td><td colspan="2">3 Species: Solanum mauritianum, Lantana camara and Psidium guajava</td></tr>
<tr><td>Conservation Important Plants</td><td colspan="2">No Conservation Important Species</td></tr>
<tr><td>Disturbance</td><td colspan="3">» Secondary vegetation on old cultivated land
» Dominated by the Invasive Alien Lantana camara
» Roads</td><td>Naturalness:</td><td>» Low Naturalness
» This thicket is dominated by Lantana camara preventing the establishment of a dominant natural vegetation cover.</td></tr>
<tr><td>Habitat Integrity:</td><td colspan="3">Low</td><td>Biotic integrity</td><td>Low
» The dense, impenetrable barrier of Lantana camara provides little forage and habitat for faunal species.</td></tr>
</table>

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	» Dense, almost mono stands of *Lanta camara* have significantly reduced the areas habitat integrity and have almost formed an impenetrable barrier.		
Anthropogenic importance and potential	**Agricultural Potential: Low**	**Conclusion and Mitigation Requirements**	» This area is of low ecological sensitivity. » Development activities within this area are allowed. » Development activities within this area are unlikely to have a significant impact on regional ecological functionality. » Operational activities should be restricted to the development footprint as indicated within this study. » An invasive alien plant management plan should be compiled to address the mitigation and management of such species throughout the operational phase as well as the post-operational phase. » Rehabilitation progress, erosion, and IAP monitoring can occur simultaneously post-operational phase and should occur bi-annual for a minimum of two years.
Conservation value	**Low** » The area is highly disturbed » Situated outside of any NPAEs » Transformed habitat. » No Red Data Species » No Protected Species.		
Ecosystem Functions	**Highly limited functions and services** » Potential niche habitats for some of the smaller mammal species		

Natural Thicket	**Habitat Sensitivty**	**Medium**	**Photographs:** 
	No-Go Areas	All natural thicket areas fringing riparian habitat	
	Present Ecological Status (PES)	**B: Largely Natural**	
Substrate	» Sandy-loam soils » Due to the low agricultural potential these areas have not been cultivated. Subsequently, no soil disturbance has occurred » Soil depth highly variable » An abundance of small rock fragments		
Species richness	**Moderate-High: 37** species of which 4 species are weeds and alien species		
Alien Invasive Plants	**2 Species:** *Solanum mauritianum, Lantana camara*		
Conservation Important Plants	*Zanthoxylon capense and Pittosporum viridiflorum, Encephalartos villosus, Delaeodendron croceum*		
Disturbance	» Highly fractured vegetation unit » Invasive Alien Plant, *Lantana camara* is located within the outer boundaries of this vegetation unit. » Any disturbance of the natural vegetation will allow for the penetration and establishment of this species within this vegetation unit.	**Naturalness:**	» Apart from the outer boundaries of this vegetation unit which has been invaded with *L. camara*, the majority of this vegetation unit is in a natural condition.

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Habitat Integrity:	» Intermediate integrity for isolated (fractured) patches. » High for portions fringing riparian zones as these areas contribute to lateral landscape connectivity allowing for species movement to and from the Qinira valley.	**Biotic integrity**	» Intermediate integrity for isolated (fractured) patches. » High for portions fringing riparian zones: Important biological corridor
Anthropogenic importance and potential	**Agricultural Potential: Low**	**Conclusion and Mitigation Requirements**	» Where this vegetation unit fringes riparian zones, these vegetation units are regarded as high sensitive. » These areas should furthermore be regarded as no-go areas. » Fortunately, such areas are excluded from the proposed mining footprint » The isolated patches of this vegetation type that do not fringe the riparian zone are regarded as medium sensitive and are acceptable to be included in the mining footprint. » Development activities within this area are unlikely to have a significant impact on regional ecological functionality. » Operational activities should be restricted to the development footprint as indicated within this study. » Pre-construction/operation Botanical walk-through should occur in order to GPS tag all conservation important species that may be at risk of being disturbed/destroyed by the mining activities. » No conservation important species may be re-located / disturbed or destroyed without the necessary Permits in place (obtained from the relevant nature conservation authorities) » A vegetation rehabilitation and management plan are also vital for the stabilisation of soils and the prevention of potential erosion from occurring or becoming exacerbated. » An invasive alien plant management plan should be compiled to address the mitigation and management of such species throughout the operational phase as well as the post-operational phase. » Rehabilitation progress, erosion, and IAP monitoring can occur simultaneously post-operational phase and should occur bi-annual for a minimum of two years.
Conservation value	» Low-medium for isolated patches » High for patches that fringe the natural riparian habitat		
Ecosystem Functions	» Important corridor for abiotic and biotic material transfer, as well as wildlife. » Potential niche habitats for fauna » Nich habitat for specific flora species		

<table>
<tr><td rowspan="3">Drainage channels</td><td>Habitat Sensitivity</td><td>Low: Bulk of the development is proposed within this area</td><td rowspan="7"><u>Photographs:</u>
</td></tr>
<tr><td>No-Go Areas</td><td>None identified</td></tr>
<tr><td>Present Ecological Status (PES)</td><td>Serious (E) to Critically (F) Modified</td></tr>
<tr><td>Substrate</td><td colspan="2">» Soils typically dark coloured and well-structured clay-loam.
» Topsoil may be located on a clay enriched Pedocutanic B horizon or weathered rock.
» Some locations erosion may exposed bedrock</td></tr>
<tr><td>Species richness</td><td colspan="2">Low: 47 species of which 24 species are weeds and alien species</td></tr>
<tr><td>Alien Invasive Plants</td><td colspan="2">8 Species: Xanthium spinosum, Melia azedarach, Solanum chrysotrichum, S. mauritianum, Lantana camara, Cirsium vulgare, Ricinus communis, Argemone ochroleuca</td></tr>
<tr><td>Conservation Important Plants</td><td colspan="2">No Conservation Important Species recorded.</td></tr>
</table>

Disturbance	» Mining activities » Access roads » Numerous Invasive Alien Plants » Dams » Trampled game paths	**Naturalness:**	» Secondary vegetation with numerous Invasive Alien plants
Habitat Integrity:	**Low**	**Biotic integrity**	**Low** » Small farm dams provide a water source for the game present within the property
Anthropogenic importance and potential	**Agricultural Potential: Low**	**Conclusion and Mitigation Requirements**	» This area is of moderate ecological sensitivity. » Development activities within this area are allowed. » Development activities within this area are unlikely to have a significant impact on regional ecological functionality including the downstream Qinira river. » Operational activities should be restricted to the development footprint as indicated within this study. » A vegetation rehabilitation and management plan are vital for the stabilisation of soils and the prevention of potential erosion from occurring or becoming exacerbated. » An invasive alien plant management plan should be compiled to address the mitigation and management of such species throughout the operational phase as well as the post-operational phase. » Rehabilitation progress, erosion, and IAP monitoring can occur simultaneously post-operational phase and should occur bi-annual for a minimum of two years.
Conservation value	**Moderate** » Area is disturbed » Situated outside of any NPAEs » Transformed habitat. » No Red Data Species » Low level of protected species.		
Ecosystem Functions	**Highly limited functions and services** » Potential niche habitats for fauna » Vegetation cover provides stability and resilience against severe weather events » Absorption and reduction of occasional flash floods. » Dense herbaceous vegetation helps slow down floods and retain nutrients. » Vegetation filters out possible pollutants to prevent their discharge into the Qinira River.		

Watercourses and Riparian fringes	**Habitat Sensitivty**	**High**
	No-Go Areas	All riparian fringes should be regarded as No-Go Areas, including a recommended buffer.
	Present Ecological Status (PES)	**C: Moderately Modified**
Substrate	Channels: Mostly bedrock with boulders and fine sediment and leaf litter within bedrock pools. Riparian fringe: Alluvial sediment.	
Species richness	**Moderate-High: 56** species of which 4 species are weeds and alien species	
Alien Invasive Plants	**4 Species:** *Solanum chrysotrichum, Lantana camara, Cestrum laevigatum, Acacia dealbata*	

Photographs:





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Conservation Important Plants	*Crocosmia spp., Dietes grandiflora, Pittosporum viridiflorum, Podocarpus latifolius, Vepris lanceolata, Zanthoxylon capensis, Sideroxylon inerme*		
Disturbance	» Habitats within this reach of the Qinira River has been moderately modified. Most of the upstream impacts such as dams, causeways and bridges, do not have a significant bearing on the local habitats within this portion of the Qinira River due to the distance of these impacts. Local impacts from the catchment such as a reduction in vegetation cover, an increase in water input from some tributaries and the reduction of water inputs from others have somewhat modified the flow character within this section. Reservoirs/dams within the tributary and its associated drainage lines, located within the project area, have resulted in a slight alteration in the hydrological contribution this tributary provides towards the total water input and flooding nature of the Qinira River.	**Naturalness:**	» Apart from the outer boundaries of this vegetation unit which has been invaded with *L. camara*, the majority of this vegetation unit is in a near-natural condition. » Some portions of the channel bank have been invaded with *Cestrum laevigatum*
Habitat Integrity:	» High habitat integrity. » Various micro-habitats created	**Biotic integrity**	» An important biological corridor
Anthropogenic importance and potential	**Agricultural Potential: Low**	**Conclusion and Mitigation Requirements**	» All riparian habitats should be regarded as no-go areas. » A 100m buffer should be placed around these habitats as well as any natural terrestrial thicket vegetation. » This buffer area should also be regarded as a no-go area. » The current layout excludes these habitats as well as the 100m buffer area.
Conservation value	» High		
Ecosystem Functions	» Important biological corridor » Various conservation important flora located within this habitat. » Various micro-habitats for a wide variety of faunal and floral species. » Absorption and reduction of occasional flash floods.		

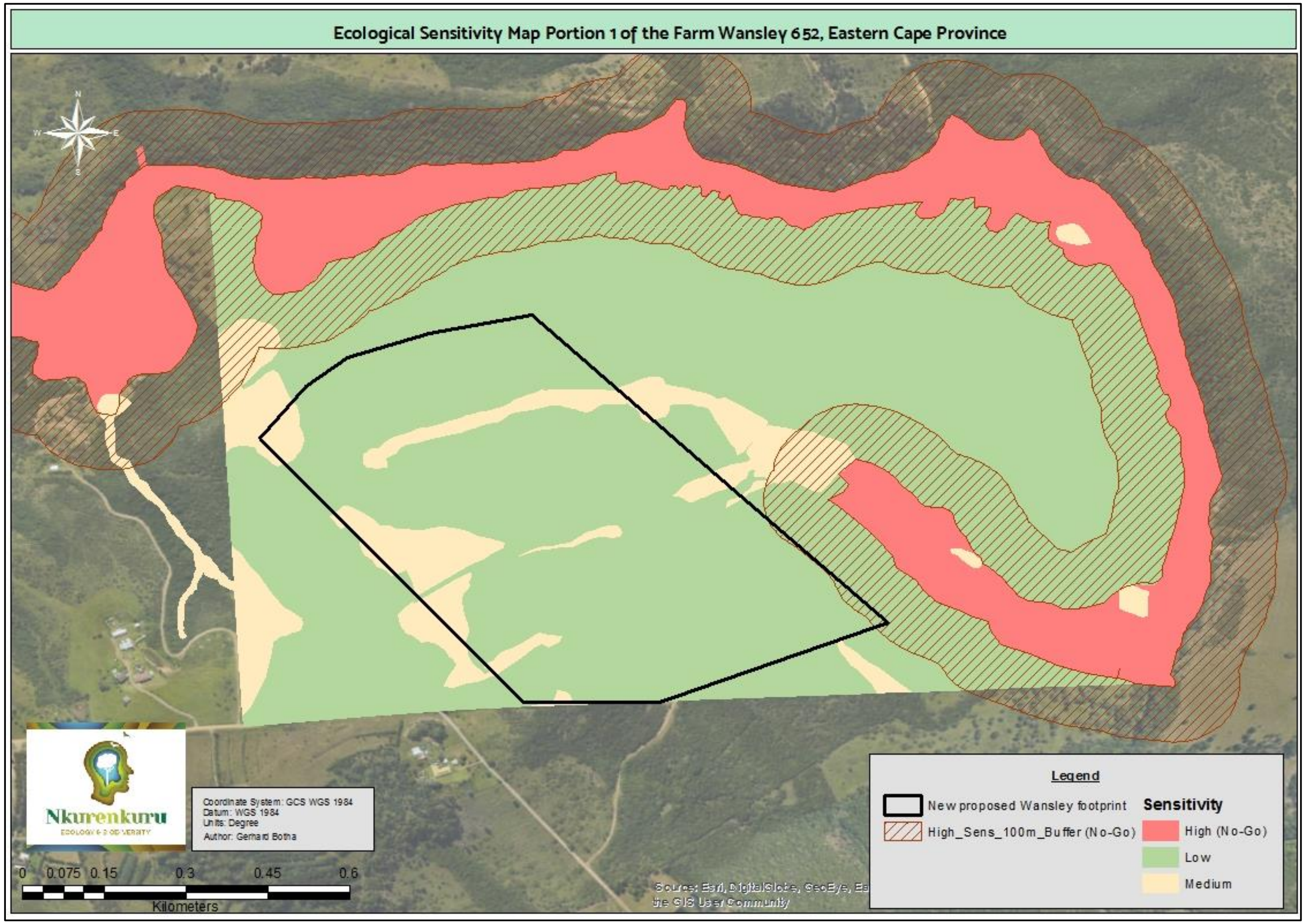


Figure 18: Map illustrating the ecological (aquatic and terrestrial) sensitivity of the project site.

8. ASSESSMENT OF PROPOSED IMPACTS

8.1 Assumptions

The following is assumed and/or known:

- » A thorough ecological walkthrough of all footprint areas will be conducted to detect and relocate, where possible, all plant species of conservation concern by a suitably qualified botanist before the commencement of activities.
- » Throughout the duration of the mining activities, the footprint will be routinely cleared of all alien invasive plants if detected.
- » The site establishment itself will be associated with clearing of vegetation within the footprint only.
- » After decommissioning, a continuous vegetation layer will be the most important aspect of ecosystem functionality within and beyond the project site.

- A weakened or absent vegetation layer not only exposes the soil surface but also lacks the binding and absorption capacity that creates the buffering functionality of vegetation to prevent or lessen erosion as a result of floods.

8.2 Localised vs. cumulative impacts: some explanatory notes

Ecosystems consist of a mosaic of many different patches. The size of natural patches affects the number, type, and abundance of species they contain. At the periphery of patches, influences of neighbouring patches become apparent, known as the 'edge effect'. Patch edges may be subjected to increased levels of heat, dust, desiccation, disturbance, invasion of exotic species and other factors. Edges seldom contain rare species, habitat specialists, or species that require larger tracts of undisturbed core habitat. Fragmentation due to development reduces core habitat and greatly extends edge habitat, which causes a shift in the species composition, which in turn puts great pressure on the dynamics and functionality of ecosystems (Perlman & Milder 2005).

Cumulative impacts of developments on population viability of species can be reduced significantly if new developments are kept as close as possible to existing developed and/or transformed areas or, where such is not possible, different sections of development be kept as close together as possible.

Due to the extent of this proposed mining footprint as well as the location within an already largely transformed and disturbed area mining activities will have a **very limited contribution** to the cumulative impacts of the area and will **not:**

- » compromise the ecological functioning of the larger "natural" environment; and

- » disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations
- » compromise the status and ecological functioning of the Ecological Support Areas (fracturing and disruption of the connectivity of these ESAs), and subsequently will not be impacting the Province's ability to meet its conservation targets.

Excessive clearing of vegetation can and will influence runoff and stormwater flow patterns and dynamics, which could cause excessive accelerated erosion of plains, and this could also have detrimental effects on the lower-lying areas.

- Rehabilitation and revegetation of all surfaces disturbed or altered during the operational phase are desirable.

Disturbance of indigenous vegetation creates a major opportunity for the establishment of invasive species and the uncontrolled spread of alien invasives into adjacent rangelands.

- » A regular monitoring and eradication protocol must be part of all the developments' long-term management plans.

After decommissioning, a continuous vegetation layer will be the most important aspect of ecosystem functionality within and beyond the project site.

- A weakened or absent vegetation layer not only exposes the soil surface but also lacks the binding and absorption capacity that creates the buffering functionality of vegetation to prevent or lessen erosion as a result of floods.

8.3 Identification of Potential Ecological Impacts and Associated Activities

Potential ecological impacts resulting from the proposed project would stem from a variety of different activities and risk factors associated with the site-establishment and operation phases of the project including the following:

8.3.1 Site-establishment and Operational Phase

- » Human presence and uncontrolled access to the site may result in negative impacts on fauna and flora through poaching of fauna and uncontrolled collection of plants for traditional medicine or other purposes.
- » Site clearing and exploration activities for site establishment.
- » Vegetation clearing could impact locally listed plant species. Vegetation clearing would also lead to the loss of vegetation communities and habitats for fauna and potentially the loss of faunal species, habitats, and ecosystems. On a larger and cumulative scale (if numerous and uncontrolled developments are allowed to occur in the future) the loss of these vegetation communities and habitats may

potentially lead to a change in the conservation status of the affected vegetation type as well as the ability of this vegetation type and associated features to fulfil its ecological responsibilities (functions).

» Soil compaction and increased erosion risk would occur due to the loss of plant cover and soil disturbance created during the construction phase. This may potentially impact the downstream watercourses and aquatic habitats. These potential impacts may result in a reduction in the buffering capacities of the landscape during extreme weather events.
» Movement of mining vehicles and machinery, as well as the placement of infrastructure within the boundary of the drainage line, may lead to the disturbance of these habitats, removal of vegetation cover and a potential increase in erosion which may eventually spread into downstream areas.
» Invasion by alien plants may be attributed to excessive disturbance to vegetation, creating a window of opportunity for the establishment of these alien invasive species. Also, regenerative material of alien invasive species may be introduced to the project site by machinery traversing through areas with such plants or materials that may contain regenerative materials of such species.
» Presence and operation of mining vehicles and machinery on the project site. This will create a physical impact as well as generate noise, potential pollution and other forms of disturbances at the site.
» Increased human presence can lead to poaching, illegal plant harvesting and other forms of disturbance such as fire.
» The facility will require management and if this is not done effectively, it could impact adjacent intact areas through impacts such as erosion and the invasion of alien plant species.

8.3.2 Cumulative Impacts

» The loss of unprotected vegetation types on a cumulative basis from the broad area may impact the country's ability to meet its conservation targets.
» Transformation of intact habitat would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna, avifauna, and flora and impair their ability to respond to environmental fluctuations.

8.4 Assessment of Impacts

The impacts identified above are assessed below, during the site-establishment and operation phases of the facility as well as before and after mitigation.

8.4.1 Assessment of impacts associated with Site-establishment and Operational Phases

Impact 1: *Potential Impacts on vegetation and listed and protected plant species*

Impact Nature: There are four protected species present within the proposed new mining footprint namely, *Aristia abyssinica, Moraea spp., Zanthoxylon capense and Pittosporum viridiflorum*. Vegetation clearing will lead to the loss of current habitat within the proposed mining footprint and is an inevitable consequence of this type of activity. The loss of local vegetation within the mining footprint would be of relatively minor significance when considered at a broad scale.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Long-term (4)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Highly Probable (4)
Significance	**Medium (50)**	**Low (28)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Unlikely	Unlikely
Can impacts be mitigated?	Reasonably but with limited full restoration potential.	
Residual Impacts	Very limited in extent (**Not Significant**): » Likely in the form of an altered vegetation cover. » Due to the alteration in the landscape morphology, it would be highly unlikely for the re-establishment of *Zanthoxylon capense and Pittosporum viridiflorum* species within the mining area post-operation phase. Subsequently a local (very limited extent) loss of these tree species within the mining footprint.	

Impact 2 *Potential Faunal Impacts.*

Impact Nature: Increased levels of noise, pollution, disturbance, and human presence during the operation phase may be detrimental to fauna. Sensitive and shy fauna would move away from the area during the mining area as a result of the noise and human activities present, while some slow-moving species would not be able to avoid the activities and might be killed. The mining area would also amount to habitat loss for most fauna, although some faunal species may return to the area after the decommissioning phase. Faunal habitat is already in a highly transformed and altered state with a very limited ability to sustain faunal populations in its current state, subsequently, the area was found to be very species-poor. As such impacts on current faunal populations will not be significant.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Medium-term (3)	Short-term (2)

Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Highly Probable (4)
Significance	**Medium (40)**	**Low (20)**
Status	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources	Unlikely	Unlikely
Can impacts be mitigated?	Noise and disturbance during the operational phase cannot be avoided but would be transient and with appropriate mitigation; no long-term impacts from the operational phase can be expected.	
Residual Impacts	The altered mining area will contain a lower diversity of habitat types and niches for faunal species. Faunal diversity is relatively low and subsequently, the residual impact will **not be significant**	

Impact 3: *Potential increased erosion risk during and post-operational phase*

Impact Nature: During the operational phase, there will be a lot of disturbed and loose soil at the site which will render the area vulnerable to erosion. It is critically important that proper erosion control measures and structures are put in place and maintained over the lifespan of the project.		
	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (4)	Short-term (1)
Magnitude	Moderate (6)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (36)**	**Low (8)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources	Moderate Probability	Unlikely
Can impacts be mitigated?	Yes, to a large extent	
Residual Impacts	The loss of fertile soil and soil capping resulting in areas that cannot fully rehabilitate itself with a good vegetation cover. With appropriate avoidance and mitigation, residual impacts will be **very low**.	

Impact 4: *Increased alien plant invasion during the operational phase*

Impact Nature: Increased alien plant invasion is one of the greatest risk factors associated with this activity. The disturbed and bare ground that is likely to be present at the site during and after the operational phase would leave the site vulnerable to alien plant invasion during the operation phase if not managed. Furthermore, the National

Environmental Management Biodiversity Act (Act No. 10 of 2004), as well as the Conservation of Agricultural Resources Act, (Act No. 43 of 1983) requires that listed alien species are controlled per the Act.		
	Without Mitigation	**With Mitigation**
Extent	Local and immediate surroundings (2)	Local (1)
Duration	Permanent (5)	Short-term (1)
Magnitude	High (8)	Minor (2)
Probability	Definite (5)	Highly Probable (4)
Significance	**High (75)**	**Low (16)**
Status	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources	Low Probability	Unlikely
Can impacts be mitigated?	Yes, to a large extent	
Residual Impacts	With appropriate mitigation such as regular monitoring and eradication residual impacts will be **very low** and will likely comprise of few alien plants establishing for short periods between monitoring and eradication phases.	

Impact 5: *Potential loss of riparian vegetation*

All streams and rivers with their associated riparian vegetation (including buffer areas) are located outside of the development footprint and there are no wetlands located within the proposed mining footprint, subsequently, the riparian vegetation will not be directly impacted. Vegetation may, however, be impacted indirectly due to erosion structures (as a result of increased surface runoff – Volume and Velocity) forming within the mining area. Subsequently, this impact of riparian vegetation will be dealt with during the discussion of the potential impacts associated with an increase in sedimentation and erosion

Impact 6: *Impact on downstream rivers and watercourses through possible alteration in water input and flooding magnitude and frequency*

Impact Nature: The low order tributary, as well as the associated drainage lines within the proposed new Wansley footprint, contain several instream farm dams as well as farm dams within the catchment area. These reservoirs have resulted in a reduction in the contribution this tributary makes to the hydrology of the Qinira River. Furthermore, the more frequent and smaller flooding events have been altered within this region (reduction in magnitude and frequency). Most of these farm dams have been constructed a long time ago when the area was predominantly under pineapple cultivation. The mining activities that followed also contributed to a change in water inputs and flooding characteristics within this area. However, due to the relatively small extent of this impacted micro-catchment, these modifications have a moderately small impact on the local hydrological character of this section of the Qinira River. It is expected that the expansion of the current mining activities within this area will subsequently also not contribute significantly to the hydrological character of the Qinira River.

	Without Mitigation	With Mitigation
Extent	Local (2)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Minor (2)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (52)**	**Low (24)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Low Probability	Unlikely
Can impacts be mitigated?	To some extent	
Residual Impacts	Minimal as there are already farm dams within the tributary watercourse.	

Impact 7: *Potential impact on localised surface water quality*

Impact Nature: For the downstream freshwater resources, the primary threat related to such a development is a reduction in water quality due to increase sediment inputs, as well as turbidity and the contamination of water resources through chemical pollutants (hydrocarbons from equipment and vehicles), cleaning fluids, cement, and contaminated mining.

The potential risk and significance of this impact will furthermore be significantly reduced through the implementation and maintenance of the recommended buffer areas as well as the implementation of mitigation measures as provided within the Storm Water Management Plan.

	Without Mitigation	With Mitigation
Extent	Local and downstream (3)	Local (1)
Duration	Long-term (4)	Short-term (1)
Magnitude	High (8)	Moderate (6)
Probability	Highly Probable (4)	Improbable (2)
Significance	**Medium (60)**	**Low (16)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Low Probability	Unlikely
Can impacts be mitigated?	Yes, to a large extent	
Residual Impacts	By avoiding the identified riparian areas and recommended buffer zones as well as the implementation of mitigation measures as provided within the Storm Water Management Plan, residual impacts are unlikely to be present.	

8.4.2 Assessment of Cumulative Impacts

Cumulative Impact 1: *Reduced ability to meet conservation obligations and targets*

Impact Nature: The loss of unprotected vegetation types on a cumulative basis from the broader area impacts the Province's ability to meet its conservation targets.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects within the area**
Extent	Local (1)	Regional (3)
Duration	Long Term (4)	Long-Term (4)
Magnitude	Small (1)	Low (4)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (12)**	**Low (22)**
Status	Neutral – Slightly Negative	Slightly Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Unlikely	Low Probability
Can impacts be mitigated?	Yes, to a large extent	

Cumulative Impact 2: *Impacts on CBA Areas and Broad-Scale Ecological Processes*

Impact Nature: Transformation of intact habitat could potentially compromise ecological processes of CBAs as well as ecological functioning of important habitats and would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects within the area**
Extent	Local (1)	Regional (2)
Duration	Long Term (4)	Long Term (4)
Magnitude	Small (1)	Low (4)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (12)**	**Low (20)**
Status	Neutral – Slightly Negative	Slightly Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Unlikely	Low Probability

Can impacts be mitigated?	Yes, to a large extent

8.5 Impact Mitigation and Management

IMPACT	MITIGATION
Site-Establishment and Operation Phase	
Impact 1: Potential Impacts on vegetation and listed and protected plant species	» Pre-construction walk-through of the final mining footprint, by a suitably qualified botanist, for species of conservation concern that would be affected (also to comply with the Eastern Cape Nature and Environmental Conservation Ordinance and DENC/DAFF permit conditions). » Permits must be kept on-site and in the possession of the flora search and rescue team at all times. » Pre-construction environmental induction for all staff on site must be provided to ensure that basic environmental principles are adhered to. This includes awareness of no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimising wildlife interactions, remaining within demarcated construction areas, etc. » Contractor's EO must provide supervision and oversight of vegetation clearing activities and other activities which may cause damage to the environment, especially at the initiation of the project, when the majority of vegetation clearing is taking place. » Blanket clearing of vegetation must be limited to the proposed mining footprint and associated infrastructure. No clearing outside of the minimum required footprint to take place. » Topsoil must be stripped and stockpiled separately during site preparation and replaced over disturbed areas on completion » Ensure that laydown areas, construction camps, and other temporary use areas are located in areas of low sensitivity and are properly fenced or demarcated as appropriate and practically possible. » All vehicles to remain on demarcated roads and no unnecessary driving in the veld outside these areas should be allowed. » Regular dust suppression during operation. » No plants may be translocated or otherwise uprooted or disturbed for rehabilitation or other purposes without express permission from the Contractor's EO and without the relevant permits. » No fires must be allowed on-site. » After the operation, rehabilitate an acceptable vegetation layer according to rehabilitation recommendations as provided within a site-specific Rehabilitation Plan compiled by a suitably qualified botanist o Revegetation should occur naturally where topsoils were not severely altered

Impact 2: Potential Faunal Impacts	» Any fauna directly threatened by the construction activities should be removed to a safe location by a suitably qualified person. » All personnel must undergo environmental induction with regards to fauna and in particular awareness about not harming or collecting species such as snakes, tortoises, and owls which are often persecuted out of superstition. » All hazardous materials used during operation should be stored appropriately to prevent contamination of the site. Any accidental chemical, fuel, and oil spills that occur at the site should be cleaned up appropriately as related to the nature of the spill. » All construction vehicles should adhere to a low-speed limit (30km/h is recommended) to avoid collisions with susceptible species such as snakes and tortoises. » When possible, no activity should be undertaken at the site between sunset and sunrise, except for security personnel guarding the development. » Any dangerous fauna (snakes, scorpions, etc.) that are encountered during construction should not be handled or antagonised by the construction staff. A suitably qualified person(s) should be contacted to remove the animals to safety. » No litter, food or other foreign material must be thrown or left around the site and must be placed in demarcated and fenced rubbish and litter areas that are animal proof. » The collection, hunting or harvesting of any plants or animals at the site must be strictly forbidden. Personnel must not be allowed to wander off the demarcated construction site. » Fires must not be allowed on site.
Impact 3: Potential increased erosion risk during and post-operational phase	» Adequate stormwater management should be considered in the detailed design of the proposed infrastructure to minimize undue erosion; » Existing access roads to be used as far as possible. » No activities or movement of any construction vehicles within the downstream semi-ephemeral stream or associated riparian fringe.

	» New vehicle crossing points of the upper drainage lines should be identified before the commencement of construction activities and no vehicles or machinery may be allowed to cross these identified drainage lines outside of the identified areas. » Any erosion problems observed, to be associated with the relating activity, should be rectified as soon as possible and monitored thereafter to ensure that they do not re-occur. » A Rehabilitation Plan should also be put in place addressing phased rehabilitation methods where areas that are no longer mined or utilised, are systematically rehabilitated. Any erosion problems within the mining area as a result of the mining activities observed should be rectified immediately and monitored thereafter to ensure that they do not re-occur. » All bare areas resulting from the development should be re-vegetated, post-operation, with locally occurring species, to bind the soil and limit erosion potential. » Roads and other disturbed areas within the project area should be regularly monitored for erosion problems and problem areas should receive follow-up monitoring to assess the success of the remediation. » Silt traps should be used where there is a danger of topsoil or material stockpiles eroding and entering downstream drainage lines and other sensitive areas. » Topsoil should be removed and stored separately from the subsoil. Topsoil should be reapplied where appropriate as soon as possible to encourage and facilitate the rapid regeneration of the natural vegetation on cleared areas. » Practical phased development and vegetation clearing should be practiced so that cleared areas are not left un-vegetated and vulnerable to erosion for extended periods. » Construction of gabions and other stabilisation features must be undertaken to prevent erosion, where deemed necessary. » Sheet runoff from cleared areas, paved surfaces and access roads needs to be curtailed; Runoff from paved surfaces should be slowed down by the strategic placement of berms; » Erosion can also be limited by ensuring that mine vehicles and human movement is limited to project-specific dedicated access ways.

Impact 4: Increased alien plant invasion during the operational phase	» Alien species must be removed from the site as per NEMBA requirements. » A suitable weed management strategy to be implemented in the construction and operation phases. » Regular monitoring for alien plants at the site should occur and could be conducted simultaneously with erosion monitoring. » When alien plants are detected, these should be controlled and cleared using the recommended control measures for each species to ensure that the problem is not exacerbated or does not re-occur and increase to problematic levels. » Clearing methods should aim to keep disturbance to a minimum and must be undertaken per relevant guidelines. » No planting or importing of any alien species to the site for landscaping, rehabilitation or any other purpose should be allowed. » The area is especially prone to the invasion of *Lantana camara, Cestrum laevigatum, Solanum mauritianum* and *Solanum chrysotrichum* all of which are classified as Category 1b IAPs. » The management and eradication of these species, as well as other IAPs, should be addressed in detail within the Management Plan. » This management plan/programme should also address the management and monitoring of especially *C. laevigatum* along the semi-ephemeral watercourse as this species has become severely invasive along this freshwater resource. » Monitoring and eradication along the drainage lines and within the annual watercourse and associated riparian fringe should occur annually.
Impact 5 & 6: Potential loss of riparian vegetation & Impact on downstream rivers and watercourses through possible alteration in water input	» Vegetation clearing within the development footprint must be kept to a minimum and phased development should occur. » As far as possible undertake construction activities in the dry season. » All material stockpiles should be located outside drainage lines and watercourse areas. » Regular monitoring for erosion. » Any erosion problems observed, to be associated with the relating activity, should be rectified as soon as possible and monitored thereafter to ensure that they do not re-occur.

and flooding magnitude and frequency	» Silt traps should be used where there is a danger of topsoil or material stockpiles eroding and entering streams and other sensitive areas. » Gabions and mattresses should be used to protect the portions of the drainage lines, immediately downstream of the construction footprint to slow down and regulate the flow of water into the annual watercourse and prevent erosion and a reduction in water quality throughout the construction phase; Water velocity should be reduced as far as feasible. » Construction of gabions and other stabilisation features to prevent erosion if deemed necessary. » All topsoil and waste stockpiles must have berms and catchment paddocks at their toe to contain runoff of the facilities » Only the vegetation within the identified footprint may be disturbed, and » No indigenous vegetation outside of the development footprint may be disturbed. » No equipment of any kind may be stored within the semi-ephemeral stream or associated riparian fringe. » All riparian areas and watercourses along with the recommended 100m buffer area are regarded as No-Go areas » Concerned semi-ephemeral stream may only be accessed by the staff conducting the Invasive Alien Plant monitoring and eradication. »
Impact 7: Potential impact on localised surface water quality	» Access to the construction site will be controlled; » Implement appropriate measures to ensure strict use and management of all hazardous materials used on site. » Operate using best practises by storing hazardous substances in an adequately sized bunded area, with appropriate safety equipment; » Collection of water within the bunded areas will be deemed hazardous and disposed of as such; » Bunded areas will be watertight and inspected for leaks on a frequent basis; » Leaks to the bunded areas will be rectified as soon as possible;

	» Drip trays will be utilised for the collection of leaks from vehicles and machinery parked for a long period; » Refuelling areas will be bunded and nozzles protected from spillage during refuelling; » Place spill kits on site which are operated by trained staff members for the adhoc remediation of minor chemical and hydrocarbon spillages. » No vehicles to refuel within drainage lines, streams/riparian vegetation. » Vehicular access to the annual stream will be restricted; » Implement appropriate measures to ensure strict management of potential sources of pollutants (e.g. litter, hydrocarbons from vehicles and machinery, cement during construction etc.). » All spillages will need to be cleaned up as soon as practically possible; » Should a spill occur, this will be handled at the source of the leak and prevented from transpiring to the downstream semi-ephemeral watercourse; » Ensure that routine maintenance on all vehicles is undertaken as per maintenance schedule and records are kept » Waste should be stored on-site in clearly marked containers in a demarcated area. » All waste material should be removed at the end of every working day to designated waste facilities at the main construction camp/suitable waste disposal facility. » All waste must be disposed of offsite. Working protocols incorporating pollution control measures (including approved method statements by the contractor) should be clearly set out in the Construction Environmental Management Plan (CEMP) for the project and strictly enforced. » Proper management of stormwater drainage infrastructure should be ensured; Hazardous substances stored on-site will be stored within a designated bunded areas fitted with a sump and value. » Sewage spillages will be seen as hazardous waste and will be handled as such » Construct diversion drains and containment dams/ponds (PCD dams) around the site timeously before the operation, and Ensure adherence to GNR 704 of the NWA.

	» Ensure that these diversions of the drainage lines enter the containment PCD dams. » Ensure that the capacity of these dams is sufficient to store all surface ("dirty") without overflowing and subsequently entering the annual stream.
Cumulative Impacts	
Cumulative Impact 1: Reduced ability to meet conservation obligations and targets	» The activity footprint must be kept to a minimum and natural vegetation should be encouraged to return where possible during the post-operational phase. » Reduce the footprint of mining areas as much as possible.
Cumulative Impact 2: Impacts on Ecological Support Areas and Broad-Scale Ecological Processes	» The footprints of the mining area should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas, where possible, post-operational phase. » Reduce the footprint of mining areas as much as possible.

9. CONCLUSION

The currently approved mining footprint is 5.2149 ha and the holder of the mining right now desires to expand the mining footprint to cover a total area of 37.8575. The proposed new footprint area will still fall within the boundaries of Portion 1 of the Farm 652.

The farm portion has been extensively transformed in the past for cultivation purposes (commercial pineapple crop production) however these activities have been abandoned in the mid-1980s. Mining (quarrying) activities were initiated around 1989 and are now the primary land use activity within this farm portion. Much of the historically cultivated areas are now covered by secondary vegetation.

From a national as well as provincial conservation planning context the project site:

- falls outside any protected area or focus area as identified within the NPAE;
- is located within a Least Concern Vegetation type (South Eastern Coastal Thornveld);
- is not listed within the Threatened Ecosystem List
- does not contain any river- or wetland FEPAs;
- falls with a terrestrial CBA2 as the area is considered to form part of an important biological corridor;
- falls within an aquatic CBA3 (A3b) as this sub-catchment forms part of an important management area for an E2 estuary.

Following the site visit an analysis of available data the following conclusions can be drawn in terms of the impact of the project on these CBAs:

- The Qinira River and its associated riparian fringe, as well as the abutting natural thicket, meet the criteria set out for a CBA2 Corridor. However, the remainder of the property does not meet the criteria and from field observations should rather be regarded as an Other Natural Areas with some Transformed Land (as described above).
- The maintenance of the riparian fringes is critically important for the sustainable functioning of this river as an ecological corridor. As such the Qinira River as well as the delineated riparian fringe and adjacent remaining natural thicket has been classified as High Sensitive Areas and are regarded as No-Go Areas for the proposed development. Furthermore, to ensure that this area's functionality (as an ecological corridor) is preserved, and to allow some lateral movement to and from the Qinira River, a Buffer Area of 100m has been recommended and should also be regarded as a No-Go Area for the proposed development. The current layout of the new mining footprint is situated outside of these High Sensitive (No-Go Areas) and will not contribute to a further reduction in landscape connectivity.

In terms of the surface hydrological character of the project site, this site is situated within the Quaternary Catchment R30F, which is drained by the Qinira River, forming part of the Mzimvubu to Keiskamma Water Management Area (WMA). The study site generally slopes in an eastern to southeastern direction and is drained by two ephemeral drainage lines which join up to the east of the proposed new mining footprint to form a small intermittent watercourse, flowing in a southeastern direction over a short distance to finally terminate into the seasonal Qinira River. The Qinira River is the main collecting non-perennial river system of the region and flows in a south-easterly direction along the northern and eastern boundary of the Wansley Property. Riparian vegetation within the area is typically an expression of the hydrological nature of watercourse with the stronger seasonal systems such as the Qinira River fringed by a well-developed, tall woody riparian fringe whilst the smaller intermittent stream comprising of narrower woody riparian fringe. The ephemeral drainage lines mostly lack riparian vegetation cover apart from the lower points where some riparian vegetation is present and have extended from the intermittent stream into these portions of the drainage lines. Another prominent feature of this property as well as the surrounding landscape are the numerous small gravel dams. Most of which have been constructed within drainage lines, in an attempt to store water runoff for longer periods. The Wansley Property can be divided into five drainage regions or micro-catchments. The proposed new Wansley mining footprint will mostly impact two of these micro-catchments, which are drained by the two ephemeral drainage lines.

The drainage lines are in a severely degraded and transformed condition and of low ecological importance and sensitivity. The downstream watercourses and their associated riparian zones have however been found to be in better condition, especially this section of the Qinira River. These habitats were also found to provide more important functions and services, subsequently, these habitats are of higher ecological importance and sensitivity.

The proposed development footprint is not located within these habitats and with good environmental management and adequate mitigation the proposed development will not have a significant impact on the ecological condition and functioning of these habitats. Due to a lack of space within the property any change or consideration of an alternative layout will likely result in a more severe impact on these habitats and may even reduce the current PES and EIS. As such it was deemed unnecessary to consider any other alternatives. The loss of the two drainage lines is regarded as acceptable as these drainage lines are already in severe degraded and transformed conditions with very limited functionality maintained. Water input from these drainage lines has been obstructed and prevented for a very long period due to the presence of instream dams. Subsequently the loss of these drainage lines will not have a significant impact on water inputs within the lower-lying aquatic environments.

In terms of the terrestrial vegetation and habitats the bulk of the vegetation within the study site resembles a severely modified and transformed form of South Eastern Coastal

Thornveld. These areas have been subjected to historical cultivation (pineapple cultivation) and can be described as secondary vegetation that has established within these areas. The more natural areas are associated with the riparian zones and small pockets of near-natural to natural pockets of thickets. Other disturbances within the property include severe invasion of IAPs (especially *Lantana camara, Solanum mauritianum, Solanum chrysotrichum,* and *Cestrum laevigatum* within the riparian areas), mining activities, building infrastructure, gravel roads, bush clearing, and farm dams.

The secondary vegetation can be divided into two distinguishable thicket types according to their dominant structure and species composition. The more gradual plateaus and slopes of the rolling hills comprise of a more open wooded grassland whilst the steeper north-facing slope is characterized by a much denser woodland thicket with a less prominent grass and herb/forb cover. Furthermore, this denser thicket contains a lower diversity of plants in comparison with the open wooded grassland.

Pockets and remnants of the original thicket vegetation have survived within less arable lands as well as narrow strips along portions of the riparian zone. Unfortunately, these patches have not remained unscathed and have been subjected to the invasion of *Lantana camara*. Fortunately, the dense natural stands of woody species have prohibited the “penetration” of these invasives and they mostly persist as a dense, almost impenetrable band around these patches and only establish where natural tree species have been removed.

The bulk of the proposed development will occur within the open wooded grassland with a small portion of natural thicket that will be impacted. This portion of natural thicket is however, limited in size and isolated from other natural areas and thus only provides limited functions and services. As such, the current layout is regarded as acceptable.

Regarding conservation important species, no Red Data Species were recorded within the development footprint, whilst four plant species were identified that are listed as protected within the Eastern Cape Nature Conservation Ordination namely *Aristia abyssinica, Moraea* spp., *Zanthoxylon capense, and Pittosporum viridiflorum. Pittosporum viridiflorum* is furthermore also protected within the National Forest Act. These species do not occur in high densities within the project footprint and it is not expected that this development will have a significant impact on the status or population structure of these species within the region. A pre-construction walk-through of the final mining footprint, by a suitably qualified botanist, for species of conservation concern that would be affected is recommended and accompany all plant permit applications (in compliance with the Eastern Cape Nature and Environmental Conservation Ordinance and DENC/DAFF permit conditions).

Furthermore, managing impacts such as the direct disturbance of vegetation/habitat, invasion of IAPs and erosion/sedimentation risks will be necessary to maintain the current

level of integrity and functioning of ecosystems and to this end, several recommendations have been made regarding the design of the project and infrastructure as well as the provision of practical mitigation measures and impact management considerations to deal with the anticipated construction phase and operational impacts and risks. With adequate mitigation and management measures in place for the construction and operational phases, continued
habitat functioning is likely to remain largely unchanged for this project.

From an ecological perspective, no objective or motives (identification of impacts of high ecological significance, etc.) were identified which would hinder the establishment of this development. Activities and Impacts are regarded as acceptable from an ecological perspective and will not cause detrimental impacts to the ecological features located within the affected area and surrounding properties. Therefore, it is the opinion of the specialist that the development may be authorised, subject to the implementation of the recommended mitigation measures.

10. REFERENCES

Apps, P. (ed.). 2012. *Smither's Mammals of Southern Africa*. A field guide. Random House Struik, Cape Town, RSA

Alexander, G. & Marais, J. 2007. *A Guide to the Reptiles of Southern Africa*. Struik Nature, Cape Town.

Anhaeusser, C.R., Johnson, M.R., Thomas, R.J. (2008). The Geology of South Africa. Council for Geosciences.

Bates, M.F., Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J. & de Villiers, M. S. 2014. A*tlas and Red List of the Reptiles of South Africa, Lesotho, and Swaziland*. Strelitzia 32. SANBI, Pretoria.

Branch W.R. 1998. *Field guide to snakes and other reptiles of southern Africa*. Struik, Cape Town.

Cobbing, J.E. 2017. *An updated water balance for the Grootfontein aquifer near Mahikeng*. Water SA, **44 (1)**: 54 – 64.

CRITICAL BIODIVERSITY AREAS MAPS (PER MUNICIPALITY) AND GIS DATA AVAILABLE FROM: Biodiversity GIS (BGIS), South African National Biodiversity Institute, Tel. +27 21

799 8739 or CapeNature, Tel. +27 21 866 8000. Or on the web at: http://bgis.sanbi.org/fsp/project.asp

Department of Environmental Affairs and Tourism, 2007. National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004): Publication of lists of Critically Endangered, Endangered, Vulnerable and Protected Species. Government Gazette, Republic of South Africa

Department of Water and Sanitation. 2014. A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Secondary: [W5 (for example)]. Compiled by RQIS DM: https://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.aspx accessed on 7/10/2018.

Department of Water Affairs and Forestry. 2002. Mzimvubu to Keiskamma Water Management Area. Water Resources Situation Assessment. Volume 1. DWAF Report No. P 12000/00/0101.

De Wit, M.C.J. 2016. *Early Permian diamond-bearing proximal eskers in the Lichtenburg/Ventersdorp area of the North West Province, South Africa*. S Afr J Geol., **119 (4)**: 585 - 606

Du Preez, L. & Carruthers, V. 2009. *A Complete Guide to the Frogs of Southern Africa*. Struik Nature., Cape Town.

Friedmann, Y. & Daly, B. 2004. Red data book of the mammals of South Africa, a conservation assessment. Johannesburg, Endangered Wildlife Trust.

Hoare, D. 2012. David Hoare Consulting cc (2012). Impact Assessment Report: Specialist ecological study on the potential impacts of the proposed Hidden Valley Wind Energy Facility Project near Matjiesfontein, Northern Cape.

Marais, J. 2004. *Complete Guide to the Snakes of Southern Africa.* Struik Nature, Cape Town.

Meyer, R. 2014. *Hydrogeology of Ground Water Region 10: The Karst Belt*. Water Research Commission, WRC Report No. TT553/15.

Morris, J.W. 1976. *Automatic classification of the highveld grassland of Lichtenburg, North-western Transvaal*. Bothalia, **12(4)**: 267 - 292

Mucina L. & Rutherford M.C. (eds) 2006. *The Vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. South African National Biodiversity Institute, Pretoria

Minter LR, Burger M, Harrison JA, Braack HH, Bishop PJ & Kloepfer D (eds). 2004. *Atlas and Red Data book of the frogs of South Africa, Lesotho and Swaziland.* SI/MAB Series no. 9. Smithsonian Institution, Washington, D.C.

Raimondo, D., Von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C. Kamundi, D.A. & Manyama, P.A. (Eds.). 2009. *Red list of South African plants* 2009. Strelitzia 25:1-668

Skinner, J.D. & Chimimba, C.T. 2005. The mammals of the Southern African Subregion. Cambridge University Press, Cambridge.

Strohbach, M. 2013. Mitigation of ecological impacts of renewable energy facilities in South Africa. The Sustainable Energy Resource Handbook (Renewable Energy) South Africa 4: 41 – 47.

Strohbach, M. 2013. Savannah Environmental (2013) Ecological Scoping Report: Proposed Gihon Solar Energy Facility South of Bela-Bela, Limpopo Province.

Tessema, A & Nzotta, U. 2014. Multi-Data Integration Approach in Groundwater Resource Potential Mapping: A Case Study from the North West Province, South Africa. WRC Report No. 2055/1/13. Water Research Commision.

Todd, S. 2015. Simon Todd Consulting (2015). Terrestrial Fauna & Flora Specialist Impact Assessment: Proposed Wolmaransstad 75 MW Solar Energy Facility in the North West Province.

Wilson, M.G.C., Henry, G. & Marshall, T.R. 2016. *A review of the alluvial diamond industry and the gravels of the North West Province, South Africa*. S Afr J Geol., **109**: 301 – 314.

Websites:

AGIS, 2007. Agricultural Geo-Referenced Information System, accessed from www.agis.agric.za

ADU, 2012. Animal Demography Unit, Department of Zoology, University of Cape Town. http://www.adu.org.za

BGIS: http://bgis.sanbi.org/website.asp

SANBI databases:

South African National Biodiversity Institute. 2016. Botanical Database of Southern Africa (BODATSA) [2018-07-13_235408064-BRAHMSOnlineData].

http://SIBIS.sanbi.org

Climate:

http://en.climate-data.org/location/10658/

11. APPENDICES

Appendix 1: List of Abbreviations

CARA:	Conservation of Agricultural Resources Act 43 of 1983
CBA:	Critical Biodiversity Area
CITES:	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CR:	Critically Endangered (threat status)
DAFF:	Department of Agriculture, Forestry and Fisheries
DEA:	Department of Environmental Affairs
DEDEA:	Eastern Cape Economic Development, Environmental Affairs and Tourism
DWS:	Department of Water and Sanitation
DDD:	Data Deficient – Insufficient Information (threat status)
DDT:	Data Deficient – Taxonomically Problematic (threat status)
NFA:	Nation Forest Act 1998; No 84 of 1998
DEA:	Department of Environmental Affairs
EA:	Environmental Authorisation
ECNECO:	Eastern Cape Nature and Environmental Conservation Ordinance No. 19 of 1974
ECO:	Environmental Control Officer
EIA:	Environmental Impact Assessment: EIA regulations promulgated under section 24(5) of NEMA and published in Government Notice R. 543 in Government Gazette 33306 of 18 June 2010
EI:	Ecological Infrastructure
EIS	Ecological Importance and Sensitivity
EMPr:	Environmental Management Programme

EN:	Endangered (threat status)
ESA:	Ecological Support Areas
EX:	Extinct (threat status)
EW:	Extinct in the Wild
FEPA:	Freshwater Ecosystem Priority Area
FW:	Facultative wetland species – usually grow in wetlands (67 – 99% occurrence) but occasionally found in non-wetland areas
GA:	General Authorisation
GIS:	Geographical Information System
CIS:	Conservation Important Species (species listed within IUCN and South African Red Data Lists or that are protected within relevant international, national and provincial legislation
GPS:	Global Positioning System
HGM:	Hydro-Geomorphic (unit)
IAPs:	Invasive Alien Plants
IHI:	Index of Habitat Integrity
IP:	Invasive Plant (indigenous or alien)
LC:	Least Concern
LT:	Least threatened
LFA:	Landscape Functional Analysis (Tongway and Hindley 2004)
NFA:	National Forest Act 84 of 1998
NE:	Not Evaluated (threat status)
NEMA:	National Environmental Management Act 107 of 1998
NEM:BA	National Environmental: Biodiversity Act (Act No. 10 of 2004)
NFEPA:	National Freshwater Ecosystem Priority Areas, identified to meet national freshwater conservation targets (CSIR, 2011)
NT:	Near Threatened (treat status)
NWA:	National Water Act No.36 of 1998
OW:	Obligate wetland species
PES:	Present Ecological State, referring to the current state or condition of an environmental resource in terms of its characteristics and reflecting a change from its reference condition
RE:	Regionally Extinct
SANBI:	South African National Biodiversity Institute
TOPS:	Threatened and Protected Species in terms of section 56 of the National Environment: Biodiversity Act (NEM:BA) of 2004 (Species list as published within Gazette No. 30568, 14 December 2007)
VU:	Vulnerable (treat status)
WULA:	Water Use Licence Application

Appendix 2: List of Definitions

Accelerated soil erosion: Soil erosion induced by human activities.

Acceptable cover: An acceptable cover shall mean that not less than 40% (in regions receiving less than 400 mm rain per annum), of the area rehabilitated and/or planted, shall be covered with grass and other species and that there shall be no bare patches of more than 500 cm in maximum dimension.

Alien: originating from another country or continent and originally different environment, commonly used to describe plants that are not indigenous to South Africa and have become problematic (spreading rapidly, threatening existing biodiversity)

Alluvium soils: Sedimentary material found in regions fringing river courses and composed of detrital matter transported and deposited by the river.

Bare soil: Un-vegetated soil surface, unaltered by humans

Biodiversity: The wide variety of plant and animal species occurring in their natural environment (habitats). The term encompasses different ecosystems, landscapes, communities, populations, and genes as well as the ecological and evolutionary processes that allow these elements of biodiversity to persist over time.

Biome: A broad ecological spatial unit representing major life zones of large natural areas, and defined mainly by vegetation structure, climate as well as major large-scale disturbance factors (such as fire) (after Low & Rebelo, 1998).

Bushveld: A local regional term translated from the Afrikaans 'bosveld' and generally applied to various forms of savanna vegetation south of the miombo belts in southern Africa. In regional terms (Central Bushveld), used for the elevated plateaus between Pretoria in the south and Limpopo River in the north.

Bush encroachment: means stands of plants of the kinds specified in CARA Table 4, where individual plants are closer to each other than three times the mean crown diameter

Catchment: A catchment is an area where water is collected by the natural landscape. In a catchment, all rain and run-off water eventually flow to a river, wetland, lake or ocean, or into the groundwater system.

Climax: That vegetation type or plant community structure that occurs at the end of the seral cycle. The climax communities may not be the final endpoint of the succession: frequent or even rare events, such as fire, frost, harvesting, or hurricanes, may hold the communities in a stable subclimax indefinitely (Low & Rebelo, 1998)

Compacted soil surface: A soil surface that has been hardened by an outside source, causing the soil to be more compacted than the surrounding area.

Conservation: The safeguarding of biodiversity and its processes (often referred to as Biodiversity Conservation).

Conservation Important Plant: Any plant species that are protected within relevant international, national and/or provincial legislation and any species that is listed within the Red List of South African plants (version 2017.1).

Delineation: Refers to the technique of establishing the boundary of a resource such as a wetland or riparian area.

Desirable end state: the future condition or target on which the rehabilitation is designed and that will serve later as a basis for rehabilitation success evaluation. This can be based on a reference site or modeled according to available information on historic vegetation

Ecotone: A zone in which two or more vegetation types or ecosystems merge. These areas may be rich in species from both systems or may occur as species-poor fringes.

Ecosystem Goods and Services: The goods and benefits people obtain from natural ecosystems. Various types of ecosystems provide a range of ecosystem goods and services. Aquatic ecosystems such as rivers and wetlands provide goods such as forage for livestock grazing or sedges for craft products and services such as pollutant trapping and flood attenuation. They also provide habitat for a range of aquatic biota.

Ecological rehabilitation: The process of assisting the recovery of a degraded or damaged ecosystem in a trajectory that renders the ecosystem fully functional, stable, and able to develop further, but not necessarily returning to the original historic state.

Ecological restoration: The process of assisting the recovery of an ecosystem that has been degraded damaged or destroyed, in a trajectory that ultimately returns the ecosystem to its natural successional stage.

Ecosystem: The combination of biota within a given area, together with a suitable environment that sustains the biota and the interactions between biota. It can have a spatial unit of any size but shows some degree homogeneity as far as structure, function, and species composition is concerned. Small-scale ecosystems typically link up to larger-scale ecosystems and all contribute to the ecosystem function and services at the landscape-scale.

Endemic: Refers to a plant, animal species, or a specific vegetation type that is naturally restricted to a particular defined region (not to be confused with indigenous). A species of animal may, for example, be endemic to South Africa in which case it occurs naturally anywhere in the country, or endemic only to a specific geographical area within the country, which means it is restricted to this area and grows naturally nowhere else in the country.

Ephemeroid: Referring to the life-form of a perennial plant that makes occasional appearances above-ground and maintains perennating organs underground (e.g. bulbous plants)

Floristic Classification: Referring to the use of plant species composition (flora) as a criterion for characterising or classifying vegetation

Forb: A plant without secondary thickening (i.e. non-woody), usually living for only one or two seasons

Forest: A plant community having a continuous tree layer, with or without a shrub/herbaceous layer (Geldenhuys et al. 1988). In his structural classification of vegetation types Edwards (1983) defined forests as a 'vegetation type possessing canopy cover ≥75% of trees taller than two meters.

Function/functioning/functional: Used here to describe natural systems working or operating in a healthy way, as opposed to dysfunctional, which means working poorly or in an unhealthy way.

Geophytic: Resprouting during the growing season from an underground storage organ such as bulbs, corms, tubers or rhizomes, and dying back completely during unfavourable seasons

Geoxylic Suffrutex: A plant with annual or short-lived woody above-ground shoots sprouting from a massive or extensive, perennial, underground stem

Graminoid: Pertaining to an herbaceous growth form characterised by a 'grass-like' appearance (tufted growth, usually long and narrow leaves, secondary root system) and including plants such as grasses, restios, sedges, and rushes.

Grassland: Vegetation dominated by grasses (or graminoids) usually with a single-layered structure and sometimes with an open, woody plant cover.

Groundwater: Subsurface water in the saturated zone below the water table.

Habitat: The general features of an area inhabited by animal or plant which are essential to its survival (i.e. the natural "home" of a plant or animal species).

Hydromorphic soil: A soil that in is undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).

Hydrology: The study of the occurrence, distribution, and movement of water over, on, and/or under the land surface.

Hydromorphy: A process of gleying and mottling resulting from the intermittent or permanent presence of excess water in the soil profile

Indigenous: refers to a plant or animal that occurs naturally in the place in which it is currently found

Invasive plant: a kind of plant which has under section 2 (3) of CARA been declared an invader plant, and includes the seed of such plant and any vegetative part of such plant which reproduces itself asexually

Intact: Used here to describe a natural environment that is not badly damaged, and is still operating healthily.

Koppie: Small hill or hillock, an Afrikaans term adopted by South African English

Landscape: Consists of a mosaic of two or more ecosystems that exchange organisms, energy, water, and nutrients.

Land Type: Map unit denoting land, mappable at 1:250 000 scale, over which there is a marked uniformity of climate, terrain form, and soil pattern.

Mitigate/Mitigation: Mitigating impacts refers to reactive practical actions that minimize or reduce in situ impacts. Examples of mitigation include "changes to the scale, design, location, siting, process, sequencing, phasing, and management and/or monitoring of the proposed activity, as well as restoration or rehabilitation of sites". Mitigation actions can take place anywhere, as long as their effect is to reduce the effect on the site where a change in ecological character is likely, or the values of the site are affected by those changes (Ramsar Convention, 2012).

Plagioclimax community: An area/habitat/plant community in which anthropogenic (human) influences have prevented the ecosystem from developing further. The ecosystem may have been stopped from reaching its full climax or deflected towards a different climax by activities such as long-term ploughing, deforestation, burning, grazing and trampling by domestic animals, etc.

Revegetation: The process of establishing a vegetative cover on exposed soils, regardless of species composition or structure, as long as the species are non-invasive and their presence will not impede the gradual process of ecological rehabilitation or – restoration.

Riparian area: Area of land directly adjacent to the active channel of a river, which is influenced by river-induced or river-related processes. The South African National Water Act (Act No. 36 of 1998) defines 'riparian habitat' to include "…the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils. And which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with composition and physical structure distinct from those of adjacent areas.

Risk: A prediction of the likelihood and impact of an outcome; usually referring to the likelihood of a variation from the intended outcome.

Savanna: Typically, vegetation with a grass-dominated herbaceous layer and scattered low to tall trees. It includes the closed woodland and open woodlands of Edwards (1983) with a tree cover less than 75% and generally greater than 1%

Savannoid / Savanna grasslands: Pertaining to open wooded grassland structurally similar to savanna, but from climatic reasons not belonging to the Savanna Biome. Savannoid vegetation is encountered within temperate zones.

Seep (Habitat): Usually sloping area temporary (or permanently) waterlogged by groundwater seeping through the surface. Small water springs develop in places.

Soil Erosion: is a natural process whereby the ground level is lowered by wind or water action and may occur as a result of inter alia chemical processes and or physical transport on the land surface**.**

Soil Mottles/Mottling: Soil mottling is a feature of hydromorphic (wet) soils and common to wetland areas. Mottles refer to secondary soil colours not associated with soil compositional properties that usually develop when soils are frequently wet for long periods. In water-logged soils, anaerobic (oxygen-deficient) conditions generally causes redoximorphic soils features such as red mottles to develop. Lithocromatic mottles on the other hand are a type of mottling associated with variations of colour due to weathering of parent materials.

Succession: A series of stages in which different plants and animals colonise an area following some kind of disturbance. The final stage of the succession is called the 'climax', but various disturbances may prevent the vegetation from attaining its potential climax

Thicket: Subtropical thicket is a closed shrubland to low forest dominated by evergreen, sclerophyllous or succulent trees, shrubs, and vines, many of which have stem spines. It is almost impenetrable, is generally not divided into strata, and has minimal herbaceous cover.

Thornveld: A woodland savanna dominated by trees with thorns, mainly *Acacia* species.

Threatened Ecosystem: In the context of this document, refers to Critically Endangered, Endangered, and Vulnerable ecosystems.

Threat Status: Threat status (of a species or community type) is a simple but highly integrated indicator of vulnerability. It contains information about past loss (of numbers and/or habitat), the number and intensity of threats, and current prospects as indicated by recent population growth or decline. Anyone of these metrics could be used to measure vulnerability. One much-used example of a threat status classification system is the IUCN Red List of Threatened Species (BBOP, 2009).

Topsoil: the uppermost layer of soil, in natural vegetation maximally 30 cm, in cultivated landscapes the total depth of cultivation, containing the layer with humus, seeds, and nutrients. Topsoils that are applied to landscapes to be rehabilitated must be free of refuse, large roots and branches, stones, alien weeds, and/or any other agents that would adversely affect the topsoils suitability for re-vegetation.

Transformation (Habitat Loss): Refers to the destruction and clearing an area of its indigenous vegetation, resulting in loss of natural habitat. In many instances, this can and has led to the partial or complete breakdown of natural ecological processes.

Vegetation structure: The horizontal, vertical, and temporal arrangement of vegetation, i.e. spatially explicit, e.g. layers, patches, etc.

Vegetation texture: The composition of the vegetation in terms of species, growth forms, life forms, leaf morphological types, etc.

Watercourse: Means a river or spring; a natural channel in which water flows regularly or intermittently: a wetland, lake or dam into which, or from which, water flows: und any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks (National Water Act, 1998).

Wetland: Refers to land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil (National Water Act, 1998).

Wetland Type: This is a combination between the vegetation group and Level 4 of the National Wetland Classification System, which describes the Landforms of the wetland.

Wetland Vegetation Group: Broad wetland vegetation groupings reflect differences in regional context such as geology, soils, and climate, which in turn affect the ecological characteristics and functionality of wetlands.

WGS84: Abbreviation of 'World Geodetic System of 1984'. A geocentric datum and geographical coordinate system created by the United States military and in world-wide use (ESRI 2006).

Weed: a plant that grows where it is not wanted, and can, therefore, be an indigenous or alien species. An unwanted plant growing in a garden is just called a weed, but the 198 listed IPs are called "declared weeds and invaders".

Appendix 3: Methodology: Ecology (Biodiversity)

Data scouring and review

Data sources from the literature and GIS spatial information was consulted and used where necessary in the study and include the following (also refer to Table 1):

Vegetation:

- Vegetation types and their conservation status were extracted from the South African National Vegetation Map (Mucina and Rutherford 2006) as well as the National List of Threatened Ecosystems (2011), where relevant.
- Critical Biodiversity Areas for the site and surroundings were extracted (CBA Map for Eastern Cape Province obtained from http://bgis.sanbi.org/fsp/project.asp).
- Information on plant and animal species recorded for the surrounding was extracted from the SABIF/SIBIS database hosted by SANBI. This is a considerably larger area than the study area but is necessary to ensure a conservative approach as well as counter the fact that the site itself has probably not been well sampled in the past.
- The IUCN conservation status of the species in the list was also extracted from the database and is based on the Threatened Species Programme, Red List of South African Plants (Version 2017.1).

Ecosystem:

- Freshwater and wetland information were extracted from the National Freshwater Ecosystem Priority Areas assessment, NFEPA (Nel et al. 2011). This includes rivers, wetlands, and catchments defined under the study.
- Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy 2008 (NPAES).
- Critical Biodiversity Areas were extracted from the Northern Cape Conservation Plan (Oosthuysen & Holness, 2016), available from the SANBI BGIS web portal.

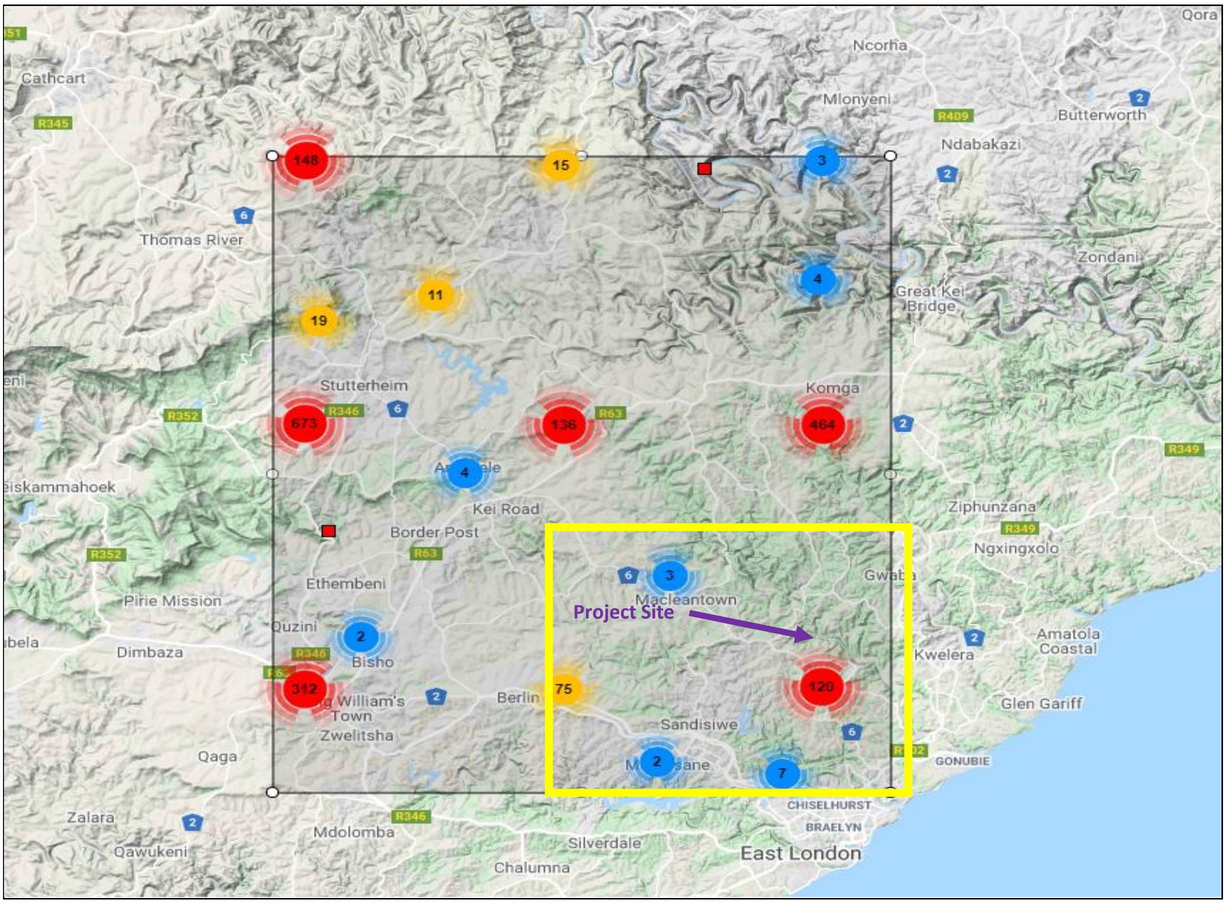


Figure 19: Larger (Regional) extracted area and sample locations from POSA. Extracted data was used to compile a plant species list of species that occur within the larger region and which may potentially occur within the project site and provide an indication of potential conservation important species that may be found within the area. The yellow polygon indicates the more local species list that was generated for the study site as well as immediate surroundings.

Methods to be followed during Field Sampling and Assessment

As part of the BA process, a detailed field survey of the vegetation was undertaken (on the 19th and 20th of June 2019) and the results include:

» A classification of the vegetation found in the study area according to vegetation survey data.
» A corresponding description of all defined plant communities and their typical habitats, including a full species list for each plant community and a representative photographic record taken on site of each community.
» A map of all plant communities within the boundaries of the study area.
» A description of the sensitivity of each plant unit, based on the sensitivity criteria outlined in section 5.1.
» A full assessment of impacts according to section 2.7.

Analysis and Interpretation of Desktop and In-field Sampled Data

Aspects of biodiversity that were used to guide the interpretation and assessment of the study area are summarized below (Table 11).

Table 11: Summary of the different aspects of biodiversity considered in the assessment of the study site.

Intrinsic / Ecological Values
Species-level aspects of biodiversity
» Protected species of fauna/flora; » Threatened Species (Red Data List); » Keystone species performing a key ecological role; » Large or congregatory species population; » Endemic species or species with restricted ranges; » Previously unknown species.
Community & ecosystem-level aspects of biodiversity
» Distinct or diverse communities or ecosystems; » Unique ecosystems; » Locally adapted communities or assemblages; » Species-rich or diverse ecosystems; » Communities with a high proportion of endemic species or species with restricted ranges; » Communities with a high proportion of threatened and/or declining species; » The main uses and users of the area and its ecosystem goods and services: important ecosystem services, valued ecosystem goods, valued cultural areas.
Community & ecosystem-level aspects of biodiversity
» Key ecological processes (e.g. seed dispersal, pollination, primary production, carbon sequestration); » Areas with large congregations or species and/or breeding grounds; » Migration routes/corridors; » Importance as a link or corridor to other fragments of the same habitat, to protected or threatened or valued biodiversity areas; » Importance and role in the landscape with regard to arrange of 'spatial components of ecological processes', comprising processes tied to fixed physical features (e.g. soil or vegetation interfaces, river or sand movement corridors, upland-lowland interfaces) and flexible processes (e.g. upland-lowland gradients and macro-climatic gradients), as well as important movement or migration corridor for species.

<u>The following methods were used to assess mapped terrestrial habitat:</u>

Vegetation Species Composition:

The vegetation species composition was documented during field surveys to estimate the relative abundance of indigenous species vs alien/exotic species. The level of naturalness was subjectively rated per habitat unit assessed using the table below:

% Indigenous Cover	Level of Naturalness	Score
> 90	Natural	5
75 – 90	High	4
31 – 74	Moderate	3

6 – 30	Low	2
1 – 5	Very Low	1
0	Non (transformed)	0

Grassland species composition:

The ecological status of grasses refers to the grouping of grasses based on their reaction to different levels of grazing and disturbance (Van Oudtshoorn, 2006). It can either become more dominant (increaser type) or less dominant (decreaser type). The status of species indicates the ecological or veld condition, as per the table below which was used to guide the condition rating of grasslands:

Abundant Grass Status	Description
Decreaser	Abundant in good veld, palatable climax species, that decrease when veld is overgrazed
Increaser I	Grasses that are abundant in the underutilised veld, unpalatable, and robust climax species.
Increaser II	Abundant in overgrazed veld, mostly pioneer and subclimax species that quickly establish on new ground.
Increaser III	Commonly found in overgrazed veld, usually unpalatable, dense climax grasses that are strong competitors
Invaders	Invader species

Structural intactness of habitat:

The structural intactness of habitat is rated based on visual assessments in the field and rated according to the matrix below which compares the present structure of habitat with the estimated reference structure (natural state):

Structural Intactness Matrix	Present State				
Reference State	Continuous	Clumped	Scattered	Sparse	Very Sparse
Continuous	5	4	3	2	1
Clumped	4	5	4	3	2
Scattered	3	4	5	4	3
Sparse	2	3	4	5	4
Very Sparse	1	2	3	4	5

The existing level of disturbance:

The existing level of disturbance was documented based on the presence of on-site and adjacent anthropogenic impacts such litter/pollution, soil erosion, vegetation removal/clearing, grazing/harvesting, cultivation, housing development, etc. which were documented in the field and used to provide a qualitative rating of the level of habitat disturbance according to the ratings in the table below:

Level of disturbance	Score
None	5
Low	4
Medium	3
High	2
Very High	1
Extreme (no natural vegetation remains)	0

Present Ecological Status:

The scores assigned to each habitat unit based on the rating tables (shown above) were then used to provide an overall PES (Present Ecological State) rating that describes the condition or integrity for each habitat unit based on the following calculation:

» **PES = (Level of disturbance + Structural Intactness + % indigenous) / 3**

Assessing species of conservation concern:

Species of conservation concern are species that have high conservation importance in terms of preserving South Africa's biodiversity. A description of the different SANBI categories of species of conservation concern is provided in Table 12, below.

Table 12: South African Red List Categories for species of conservation significance (adapted from SANBI, on-line at http://redlist.sanbi.org/redcat.php).

Present State			
Species of Conservation Concern		Extinct (EX)	A species is Extinct when there is no reasonable doubt that the last individual has died. Species should be classified as Extinct only once exhaustive surveys throughout the species' known range have failed to record an individual.
		Extinct in the Wild (EW)	A species is Extinct in the Wild when it is known to survive only in cultivation or as a naturalized population (or populations) well outside the past range.
		Regionally Extinct (RE)	A species is Regionally Extinct when it is extinct within the region assessed (in this case South Africa), but wild populations can still be found in areas outside the region.
	Threatened Species	Critically Endangered, Possibly Extinct (CR PE)	Possibly Extinct is a special tag associated with the category Critically Endangered, indicating species that are highly likely to be extinct, but the exhaustive surveys required for classifying the species as Extinct has not yet been completed. A small chance remains that such species may still be rediscovered.
		Critically Endangered (CR)	A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.
		Endangered (EN)	A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that the species is facing a very high risk of extinction.

		Vulnerable (VU)	A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction.
		Near Threatened (NT)	A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN criteria for Vulnerable, and is, therefore, likely to become at risk of extinction in the near future.
		Critically Rare	A species is Critically Rare when it is known to occur at a single site, but is not exposed to any direct or plausible potential threat and does not otherwise qualify for a category of threat according to one of the five IUCN criteria.
		Rare	A species is Rare when it meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria.
		Declining	A species is Declining when it does not meet or nearly meet any of the five IUCN criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline of the species.
		Data Deficient – Insufficient Information (DDD)	A species is DDD when there is inadequate information to assess its risk of extinction, but the species is well defined. Listing of species in this category indicates that more information is required and that future research could show that threatened classification is appropriate.
Other		Data Deficient – Taxonomically Problematic (DDT)	A species is DDT when taxonomic problems hinder the distribution range and habitat from being well defined so that an assessment of the risk of extinction is not possible.
		Least Concern (LC)	A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
		Not Evaluated (NE)	species is Not Evaluated when it has not been evaluated against the criteria. The national Red List of South African plants is a comprehensive assessment of all South African indigenous plants, and therefore all species are assessed and given a national Red List status. However, some species included in Plants of southern Africa: an online checklist are species that do not qualify for national listing because they are naturalized exotics, hybrids (natural or cultivated), or synonyms. These species are given the status Not Evaluated and the reasons why they have not been assessed are included in the assessment justification.

As mentioned, the flora of conservation significance (including threatened, protected and rare species) likely to occur in the various habitats of the study area were assessed at a desktop level using the outputs of SANBI's PRECIS (National Herbarium Pretoria Computerized Information System) electronic database. This information was used to identify potential habitat in the project area that could support these species based on information on each species' particular habitat preferences which were obtained from SANBI online species database. Special attention was given to the identification of any of these Red Data species as well as the identification of suitable habitat for Red Data species observed during field investigations.

Ecological Mapping

Mapping has been done by comparing georeferenced ground survey data to the visual inspection of available Google-Earth Imagery (which is a generalised colour composite image without any actual reflectance data attached to it) and in that way extrapolating survey reference points to the entire study area. Delineations are therefore approximate, and due to the intricate mosaics and often gradual mergers of vegetation units, generalisations had to be made. Mapped units will thus show where a certain vegetation unit is predominant, but smaller inclusions of another vegetation type in this area do exist but have not been mapped separately. The latter would require a supervised classification of georeferenced raw SPOT or similar satellite imagery (with all reflectance data), which has not been available to this project due to the high cost of such imagery.

Sensitivity Analysis and Criteria

The determination of specific ecosystem services and the sensitivity of ecosystem components, both biotic and abiotic, is rather complex and no single overarching criterion will apply to all habitats studied. The main aspects of an ecosystem that need to be incorporated in a sensitivity analysis, however, include the following:

» Describing the nature and number of species present, taking into consideration their conservation value as well as the probability of such species to survive or re-establish itself following disturbances, and alterations to their specific habitats, of various magnitudes
» Identifying the species or habitat features that are 'key ecosystem providers' and characterising their functional relationships (Kremen 2005)
» Determining the aspects of community structure that influence function, especially aspects influencing stability or rapid decline of communities (Kremen 2005)
» Assessing key environmental factors that influence the provision of services (Kremen 2005)
» Gaining knowledge about the spatial-temporal scales over which these aspects operate (Kremen 2005).

This implies that in the sensitivity analysis not only aspects that currently prevail on the area should be taken into consideration, but also if there is a possibility of a full restoration of the original environment and its biota, or at least the rehabilitation of ecosystem services resembling the original state after an area has been significantly disturbed.
According to the above, sensitivity classes have been summarised as follows:

» **High Sensitivity:** Areas that are relatively undisturbed or pristine and

- either very species-rich relative to immediate surroundings,
- or have a very unique and restricted indigenous species composition
- Alternatively, constitute specific habitats or a high niche diversity for fauna and/or flora species of conservation concern, and where the total extent of such habitats and associated species of conservation concern remaining in southern Africa is limited.
- Excessive disturbance of such habitats may lead to ecosystem destabilisation and/or species loss.
- This would also include areas where the abiotic environment is of such nature that the habitat and its niche-diversity are the main reason for higher species diversity and cannot be reconstructed or rehabilitated once physically altered in any way.
    - Note: depending on the species composition and abiotic habitat, High Sensitivity Areas can also be specifically denoted as No-Go Areas.

» **Medium Sensitivity:** Areas where disturbances are at most limited and

- Areas with a species diversity representative of its natural state, but not exceptionally high or unique compared to its surroundings
- Areas of which the abiotic or biotic configuration does not constitute a very specific or restricted habitat or very high niche diversity
- Areas that provide ecosystem services needed for the continued functioning of the ecosystem and the continued use thereof (e.g. grazing or pollinator resources).
- Although species of conservation concern may occur in the area, these are not restricted to these habitats only.
- Areas that need to remain intact to ensure the functioning of adjacent ecosystems, or wildlife corridors or portions of land that prevent the excessive fragmentation of natural fauna and flora populations, or areas that will be difficult or impossible to rehabilitate to a functional state after physical alteration
- where the landscape can be rehabilitated to allow the re-establishment of some of the original species composition after physical alteration, but some of the species of conservation concern or ecosystem functionality may be lost

» **Low Sensitivity:** Areas that have been previously transformed, disturbed or

- Areas that provide limited ecosystem services, or have a low ecological value.
- Species diversity may be low or all species present have a much wider distribution beyond this habitat or locality.
- Species of conservation concern may be present in such areas, but these are not restricted to these habitats and can be relocated with ease.
- Further arguments may include landscapes where the abiotic nature is such that it can be rehabilitated relatively easy to allow the re-establishment of the original species composition, and where the development will not lead to any unjustified degradation of landscapes or ecosystem services if adequately mitigated.

Appendix 4: Methodology: Surface Hydrology

Survey methods

The assessment was initiated with a survey of the pertinent literature, past reports, and the various conservation plans that exist for the study region. Maps and Geographical Information Systems (GIS) were then employed to ascertain, which portions of the proposed development, could have the greatest impact on the wetlands and associated habitats.

The desktop delineation of all surface water resources (i.e. rivers, streams, and wetlands) within 500m of the proposed development (i.e. the DWS regulated area for Water Use in terms of Section 21 of the National Water Act) was undertaken by analysing available contour data and colour aerial photography, supplemented by Google Earth™ imagery where applicable. Digitization and mapping were undertaken using ArcMap GIS software. All of the mapped watercourses were then broadly subdivided into distinct resource units (i.e. classified as either riverine or wetland systems/habitat) based on professional experience, topographical setting, and drainage patterns. Following the mapping of water resource units within 500m of the proposed development, the risk posed by the development to freshwater ecosystems was screened at a desktop level and ascribed a qualitative risk rating. The potential risks were also identified based on the nature of the proposed development and professional experience with similar developments, as well as based on ground-truthing of mapped watercourses in the field.

A two-day site visit was then conducted (19^{th} and 20^{th} of June, 2019) to ground-truth the above findings, thus allowing critical comments of the development when assessing the possible impacts and delineating the freshwater resource areas.

» The following equipment was utilized during fieldwork.
  - Canon EOS 450D Camera
  - Garmin Etrex Legend GPS Receiver
  - Soil Auger
  - Munsell Soil Colour Chart (2000)
  - Braun-Blanquet Data Form (for vegetation recording and general environmental recordings).

Freshwater resource areas were then assessed on the following basis:

» Identification and delineation of wetlands and riparian areas according to the procedures specified by DWAF (2005a).

» Vegetation type – verification of type and its state or condition-based, supported by species identification using Germishuizen and Meyer (2003), Vegmap (Mucina and Rutherford, 2006 as amended), and the South African Biodiversity Information Facility (SABIF) database.
» Plant species were further categorised as follows:
  - Terrestrial/Upland: species are rarely found within the riparian zone (<25% probability) and characterize the terrestrial landscape that borders the riparian zones. Upland species usually occur naturally in the upper parts of the riparian zone, but with low relative abundance (DWAF, 2008).
  - Facultative riparian: species may occur in either riparian zones or the upland (25>% probability of occurrence in the riparian zone). They can habituate to more mesic conditions with a high probability of survival, or can tolerate higher levels of flooding disturbance or soil moisture. They are not good national indicators, but rather circumstantial indicators good for particular regions (DWAF, 2008).
  - Preferential riparian: these area species that are preferentially, but not exclusively, found in the riparian zone (>75% probability). They may be found in non-riparian areas as indicators of wetness. Where they do occur in the upland, they show progressive reductions in abundance, statue, and vigour farther from the riparian zone. Preferential riparian species may harden to drought conditions, but will always indicate sites with increased moisture availability, and are therefore consistent indicators across geographic boundaries (DWAF, 2008).
  - Obligate: these species occur almost exclusively in the riparian zone (>90% probability). They are seldom found in non-riparian areas, but where they are outside of riparian areas, they still indicate wetness. They are not likely to occur in the upland. Obligate riparian species are conservative as such i.e. an obligate will remain obligate throughout all geographic regions (DWAF, 2008).
» Assessment of the freshwater resources based on the method discussed below and the required buffers.
» Mitigation or recommendations required.

Classification System for Wetlands and other Aquatic Ecosystems in South Africa System (SANBI, 2013)

Since the late 1960's, wetland (including other freshwater ecosystems) classification systems have undergone a series of international and national revisions. These revisions allowed for the inclusion of additional wetland types, ecological and conservation rating metrics, together with a need for a system that would allude to the functional requirements of any given wetland (Ewart-Smith et al., 2006). Wetland function is a consequence of biotic and abiotic factors, and wetland classification should strive to capture these aspects.

The South African National Biodiversity Institute (SANBI) in collaboration with several specialists and stakeholders developed in 2010 the newly revised accepted National Wetland Classification Systems (NWCS, 2010). In 2013 however, this classification system (National Wetland Classification System) underwent a name change to now be known as the 'Classification System for Wetlands and other Aquatic Ecosystems in South Africa'. This was done to avoid confusion around the term 'wetland' which is defined differently by the RAMSAR Convention and the South Africa National Water Act (Act No. 36 of 1998). The scope of the Classification System has not been changed, however, in that it still includes all ecosystems that the RAMSAR Convention is concerned with.

This classification system includes and distinguishes between three broad types of inland aquatic/freshwater systems namely:

- Rivers, which are 'lotic' aquatic ecosystems with flowing water concentrated within a distinct channel, either permanently or periodically.
- Open water bodies, which are permanently inundated 'lentic' aquatic ecosystems where standing water is the principal medium within which the dominant biota live. In this system, open water bodies with a maximum depth of greater than 2m are called limnetic (lake-like) systems.
- Wetlands are transitional between aquatic and terrestrial systems and are generally characterised by (permanently to temporarily) saturated soils and hydrophytic vegetation. These areas are, in some cases, periodically covered by shallow water and/or may lack vegetation.

The basis upon which this classification system is based on are the principles of the Hydrogeomorphic (HGM) approach at higher levels, including structural features at the finer or lower levels of classification (SANBI, 2013) (Table 13).

Table 13: Hydrogeomorphic (HGM) Units for Inland Systems, showing the primary HGM Types at Level 4A and sub-categories at Levels 4B to 4C.

Level 4: Hydrogeomorphic (HGM) Units		
HGM Type	**Longitudinal zonation/Landform/Outflow drainage**	**Landform/Inflow drainage**
River	Mountain headwater stream	Active channel
		Riparian Zone
	Mountain Stream	Active channel
		Riparian Zone
	Transitional	Active channel
		Riparian Zone
	Upper foothills	Active channel
		Riparian Zone
	Lower foothills	Active channel
		Riparian Zone
	Lowland river	Active channel

		Riparian Zone
	Rejuvenated bedrock fall	Active channel
		Riparian Zone
	Rejuvenated foothills	Active channel
		Riparian Zone
	Upland floodplain	Active channel
		Riparian Zone
Channeled valley-bottom wetland	N/A	N/A
Unchanneled valley-bottom wetland	N/A	N/A
Floodplain	Floodplain depression	N/A
	Floodplain flat	N/A
Depression	Exorheic	With channeled inflow
		Without channeled inflow
	Endroheic	With channeled inflow
		Without channeled inflow
	Dammed	With channeled inflow
		Without channeled inflow
Seep	With channeled outflow	N/A
	Without channeled outflow	N/A
Wetland Flat	N/A	N/A

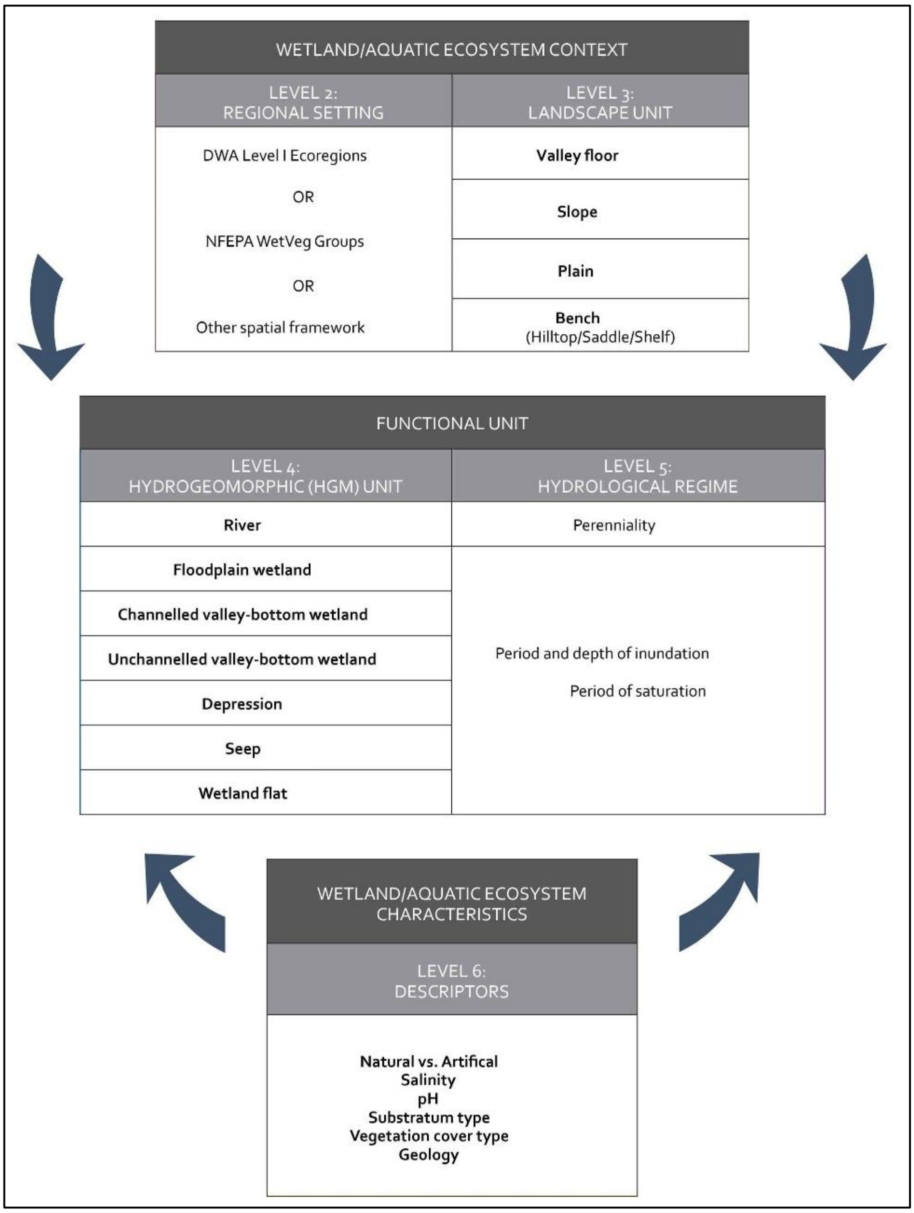


Figure 20: Basic structure of the National Wetland Classification System, showing how 'primary discriminators' are applied up to Level 4 to classify Hydrogeomorphic (HGM) Units, with 'secondary discriminators' applied at Level 5 to classify the hydrological regime, and 'descriptors' applied at Level 6 to categorise the characteristics of wetlands classified up to Level 5 (From SANBI, 2009).

It is widely accepted that hydrology (i.e. the presence or movement of water) and geomorphology (i.e. landform characteristics and processes) are the two fundamental features that determine the way in which an inland aquatic ecosystem functions, regardless of climate, soils, vegetation or origin. Subsequently, it is significant that the HGM approach has now been included in wetland classification as the HGM approach has been adopted throughout the water resources management realm with regard the determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) and WET-Health assessments for aquatic environments. All of these systems are then easily integrated using the HGM approach in line with the Eco-classification process of river and wetland reserve determinations used by the Department of Water Affairs.

In summary the overall structure of this classification system comprises six tiers. This tiered structure is summarised in Figure 21 with Level 4 tier (HGM Units), as mentioned, forming the focal point of this system together with Level 5 tier (hydrological regime).

Some of the terms and definitions used in this document are present below:

Wetland definition

Although the National Wetland Classification System (SANBI, 2009) is used to classify wetland types it is still necessary to understand the definition of a wetland. Wetland definitions as with classification systems have changed over the years. Terminology currently strives to characterise a wetland not only on its structure (visible form), but also to relate this to the function and value of any given wetland.

The Ramsar Convention definition of a wetland is widely accepted as "**areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres**" (Davis 1994). South Africa is a signatory to the Ramsar Convention and therefore its extremely broad definition of wetlands has been adopted for the proposed NWCS, with a few modifications.

Whereas the Ramsar Convention included marine water to a depth of six metres, the definition used for the NWCS extends to a depth of ten metres at low tide, as this is recognised seaward boundary of the shallow photic zone (Lombard et al., 2005). An additional minor adaptation of the definition is the removal of the term 'fen' as fens are considered a type of peatland. The adapted definition for the NWCS is, therefore, as follows (SANBI, 2009):

WETLAND: an area of marsh, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed ten metres.

This definition encompasses all ecosystems characterised by the permanent or periodic presence of water other than marine waters deeper than ten metres. The only legislated definition of wetlands in South Africa, however, is contained within the National Water Act (Act No. 36 of 1998) (NWA), where wetlands are defined as "land which is transitional between terrestrial and aquatic systems, where the water table is usually at, or near the surface, or the land is periodically covered with shallow water and which land in normal circumstances supports, or would support, vegetation adapted to life in saturated soil." This definition is consistent with more precise working definitions of wetlands and therefore includes only a subset of ecosystems encapsulated in the Ramsar definition. It should be noted that the NWA definition is not concerned with marine systems and clearly distinguishes wetlands from estuaries, classifying the later as a watercourse (SANBI, 2009). The DWA is however reconsidering this position concerning the management of estuaries due to the ecological needs of these systems concerning water allocation. Table 14 provides a comparison of the various wetlands included within the main sources of wetland definition used in South Africa.

Although a subset of Ramsar-defined wetlands was used as a starting point for the compilation of the first version of the National Wetland Inventory (i.e. "wetlands", as defined by the National Water Act, together with open water bodies), it is understood that subsequent versions of the Inventory include the full suite of Ramsar-defined wetlands to ensure that South Africa meets its wetland inventory obligations as a signatory to the Convention (SANBI, 2009).

Wetlands must, therefore, have one or more of the following attributes to meet the above definition (DWAF, 2005):

» A high-water table that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil.
» Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils
» The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water-loving plants).

It should be noted that riparian systems that are not permanently or periodically inundated are not considered true wetlands, i.e. those associated with the drainage lines.

Table 14: Comparison of ecosystems considered to be 'wetlands' as defined by the proposed NWCS, the National Water Act (Act No. 36 of 1998), and ecosystems are included in DWAF's (2005) delineation manual.

Ecosystem	NWCS "wetland"	National Water Act wetland	DWAF (2005) delineation manual
Marine	YES	NO	NO
Estuarine	YES	NO	NO
Waterbodies deeper than 2 m (i.e. limnetic habitats often describe as lakes or dams)	YES	NO	NO

Rivers, channels and canals	YES	NO[1]	NO
Inland aquatic ecosystems that are not river channels and are less than 2 m deep	YES	YES	YES
Riparian[2] areas that are permanently / periodically inundated or saturated with water within 50 cm of the surface	YES	YES	YES3
Riparian areas that are not permanently / periodically inundated or saturated with water within 50 cm of the surface	NO	NO	YES[3]

Rivers: a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow (unidirectional) of water. A river is taken to include both the active channel and the riparian zone as a unit (SANBI, 2013).

Dominant water sources for rivers include concentrated surface flow from upstream channels and tributaries. Other inputs can include diffuse surface or subsurface flow (e.g. from an upstream seepage wetland), interflow (e.g. from an upstream seepage wetland), interflow (e.g. from valley side-slopes), and/or groundwater inflow (e.g. from springs). Water moves through the system, at least periodically, as concentrated flow and usually exits as such, except where there is a sudden decrease in gradient causing the outflow to become diffuse (in which case the river would grade into one of the wetland types). Other water outputs from a river include evapotranspiration and infiltration (SANBI, 2013) (refer to Figure 22).

[1] Although river channels and canals would generally not be regarded as wetlands in terms of the National Water Act, they are included as a 'watercourse' in terms of the Act.
[2] According to the National Water Act and Ramsar, riparian areas are those areas that are saturated or flooded for prolonged periods would be considered riparian wetlands, opposed to non –wetland riparian areas that are only periodically inundated and the riparian vegetation persists due to having deep root systems drawing on water many meters below the surface.
[3] The delineation of 'riparian areas' (including both wetland and non-wetland components) is treated separately to the delineation of wetlands in DWAF's (2005) delineation manual.

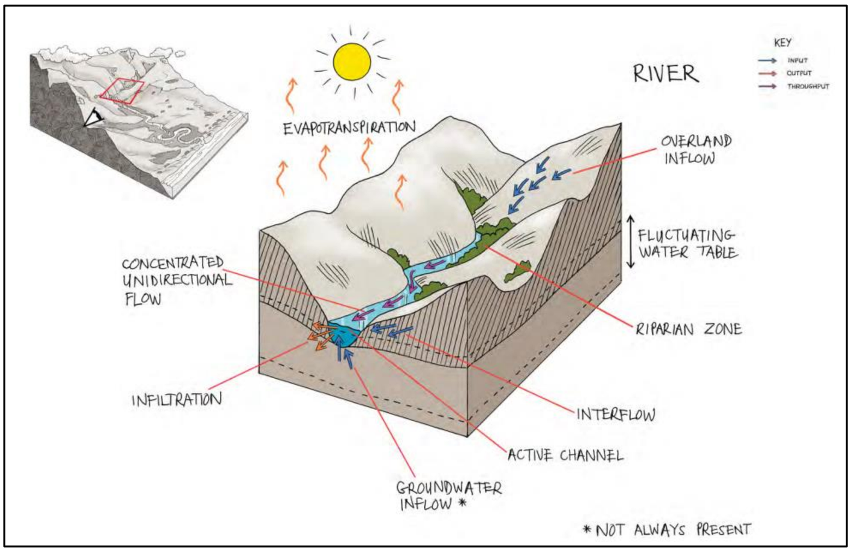


Figure 21: A conceptual illustration of a river as provided by SANBI, 2013.

Riparian zone: According to the definition provided by DWAF (2008), a riparian zone can be described as:

"*the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas*"

Furthermore, DWAF (2008) states that:

"*unlike wetland areas, riparian zones are usually not saturated for a long enough duration for redoxymorphic features to develop. Riparian zones instead develop in response to (and are adapted to) the physical disturbances caused by frequent overbank flooding from the associated river or stream channel*."

Riparian vegetation may be associated with both perennial and non-perennial watercourses/rivers. Riparian areas furthermore represent the transitional area between aquatic and terrestrial habitats. The vegetation associated with riparian zones typically require ample water and are adapted to shallow water table conditions as well as periodical flooding. Due to water availability and rich alluvial soils, riparian areas are usually very productive. Tree growth rate is high and the vegetation under the trees is usually lush in comparison to the upland terrestrial vegetation (refer to Figure 22).

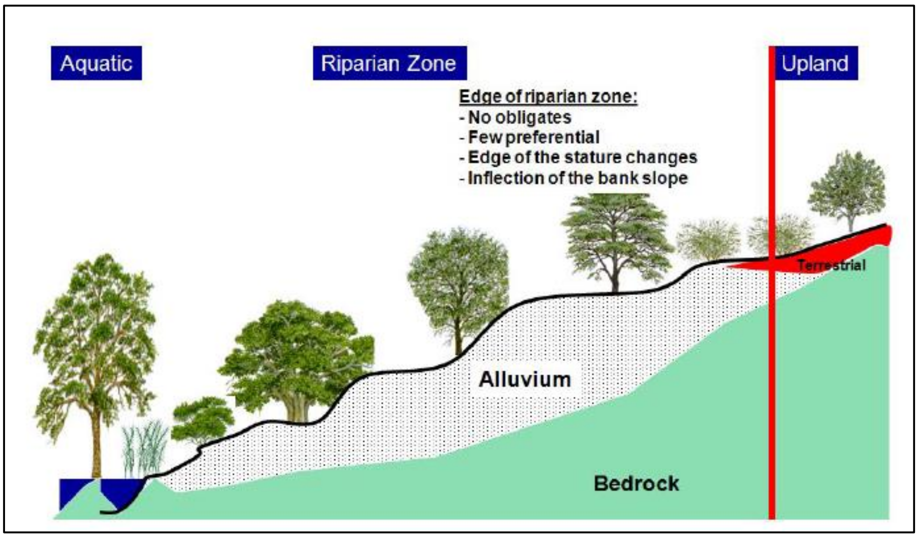


Figure 22: A schematic diagram illustrating the edge of the riparian zone on one bank of a large river (DWAF, 2008).

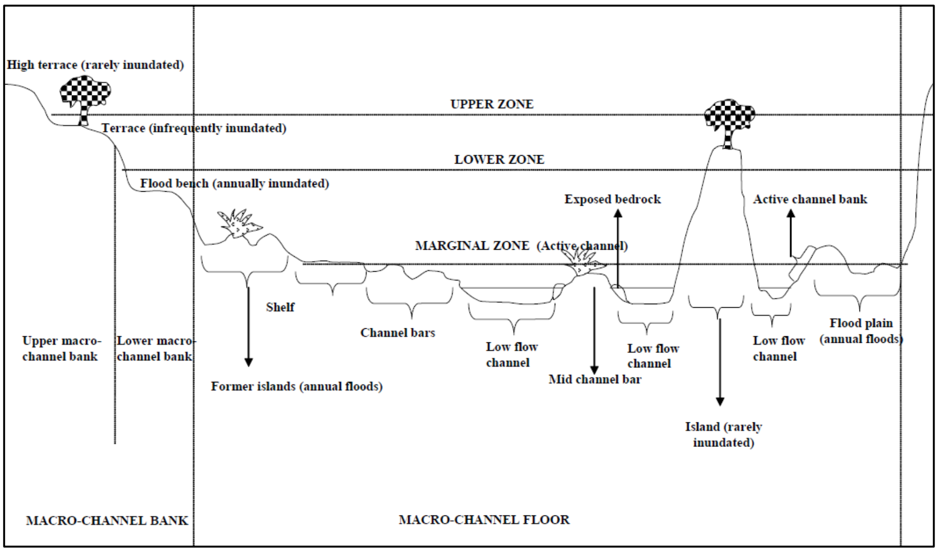


Figure 23: A schematic diagram illustrating (example) the different riparian zones relative to the different geomorphic zones typically associated with a river (Kleynhans *et al*., 2008).

The structure and dynamics of riparian zones are highly variable and are mostly an expression of the hydrological and geomorphological nature of watercourse (Figure 23 and Table 16). As such DWAF (2008) has recommended that the type of river or stream channel with which the riparian zone is associated be considered (Table 15).

Indicators of riparian areas include:

» Landscape position:
  - Riparian areas are associated with valley bottom landscape units (i.e. adjacent to the river/stream channel and floodplains).

» Alluvial soils and recently deposited material:

- Alluvial soils are soils derived from material deposited by flowing water.
- Alluvial soils cannot always be used as a primary indicator to accurately delineate riparian areas but it can be used to confirm the topographical and vegetative indicators.

» Topography:
- The National Water Act definition of riparian zones refers to the structure of the banks and likely the presence of alluvium.
- A good indicator of the presence of riparian zones is the presence of alluvial deposited material adjacent to the active channel (such as benches and terraces), as well as the wider incised "macro-channels" which are typical of many of southern Africa's eastern seaboard rivers.
- Recently deposited alluvial material outside of the main active channel banks can indicate a currently active flooding area; and thus, the likely presence of wetlands.

» Vegetation:
- The identification of riparian areas relies heavily on vegetative indicators (Unlike wetland delineation which relies on redoximorphic features in soil).
- Using vegetation, the outer boundary of a riparian area can be defined as the point where a distinctive change occurs:
  - in species composition relative to the adjacent terrestrial area; and
  - in the physical structure, such as vigour or robustness of growth forms of species similar to that of adjacent terrestrial areas. Growth form refers to the health, compactness, crowding, size, structure, and/or numbers of individual plants.
- In addition to indicators of structural differences in vegetation, indicator species themselves can be used to denote riparian areas (e.g. Obligate-, Preferential- and Facultative riparian species).

Table 15: Geomorphological longitudinal river zones for South African rivers as characterized by Rowtree & Wadeson (2000) (SANBI, 2013).

Longitudinal Zone (and zone class)	Characteristic gradient	Diagnostic channel characteristics
Zonation associated with a normal profile		
Source zone	Not specified	Low-gradient, upland plateau or upland basin able to store water. Spongy or peaty hydromorphic soils.
Mountain headwater stream	>0.1	A very steep-gradient stream dominated by vertical flow over bedrock with waterfalls and plunge pools. Normally first or second order. Reach types include bedrock fall and cascades.
Mountain stream	0.040-0.099	Steep-gradient steam dominated by bedrock and boulders, locally cobble or coarse gravels in pools. Reach types include cascades, bedrock fall, step-pool, plane bed. Approximate equal distribution of 'vertical' and 'horizontal' flow components.
Transitional	0.020-0.039	Moderately steep stream dominated by bedrock or boulders. Reach types include plane bed, pool-rapid, or

		pool-riffle. Confident or semi-confined valley floor with limited floodplain development.
Upper foothills	0.005-0.019	Moderately steep cobble-bed or mixed bedrock-cobble bed channel, with plane bed, pool-riffle reach types. Length of pools and riffles/rapids similar. Narrow floodplain of sand, gravel, or cobble often present.
Lower foothills	0.001-0.005	Lower gradient, mixed-bed alluvial channel with sand and gravel dominating the bed, locally may be bedrock-controlled. Reach types typically include pool-riffle or pool-rapid, sand bars common in pools. Pools of significantly greater extent than rapids or riffles. Floodplain often present.
Lowland River	0.0001-0.0010	Low-gradient, alluvial sand-bed channel, typically regime reach type. Often confined, but fully developed meandering pattern within a distinct floodplain develops in unconfined reaches where there is an increase in silt content in bed or banks.
B. Additional zones associated with a rejuvenated profile		
Rejuvenated bedrock fall/cascades	>0.02	Moderate to steep gradient, often confined channel (gorge) resulting from uplift in the middle to lower reaches of the long profile, limited lateral development of alluvial features, reach types include bedrock fall, cascades and pool-rapid.
Rejuvenated foothills	0.001-0.020	Steepened section within middle reaches of the river caused by uplift, often within or downstream of gorge; characteristic similar to foothills (gravel/cobble-bed rivers with pool-riffle/pool-rapid morphology) but of a higher order. A compound channel is often present with an active channel contained within a macro-channel activated only during infrequent flood events. A floodplain may be present between the active and macro-channel.
Upland floodplain	<0.005	An upland low-gradient channel, often associated with uplifted plateau areas as occur beneath the eastern escarpment.

Table 16: A description of the different riparian vegetation zones typically associated with a river/stream system (Kleynhans *et al.*, 2008).

	Marginal	Lower	Upper
Alternative Description	Active features (Wet bank)	Seasonal features (Wet bank)	Ephemeral features (Dry bank)
Extends from	Water level at low flow	Marginal Zone	Lower Zone
Extends to	Geomorphic features / substrates that are hydrologically activated (inundated or moistened) for the greater part of the year	Usually a marked increase in lateral elevation.	Usually a marked decrease in lateral elevation
Characterized by	See above; Moist substrates next to water's edge; water loving-species usually vigorous	Geomorphic features that are hydrologically activated (inundated or moistened) on a seasonal basis. May	Geomorphic features that are hydrological activated (inundated or moistened) on an ephemeral basis. Presence of riparian and

	due to near permanent access to soil moisture	have different species than marginal zone	terrestrial species with increased stature.

Importance and functions of riparian areas

Riparian areas perform a variety of functions that are of value to society, especially the protection and enhancement of water resources, and provision of habitat for plant and animal species.

Riparian areas can variously:

» store water and help reduce flood peaks;
» stabilize stream banks;
» improve water quality by trapping sediment and nutrients;
» maintain natural water temperature through shading for aquatic species;
» provide shelter, food and migration corridors for movement of both aquatic and terrestrial species;
» act as a buffer between aquatic ecosystems and adjacent upslope land uses;
» can be used as recreational sites; and
» provide material for building, muti, crafts and curios.

However, as mentioned, structure and dynamics of riparian zones are highly variable and as such not all riparian areas are capable of fulfilling all of these functions or to the same extent.

Habitat Integrity and Condition of the Affected Freshwater Resources:

Habitat is one of the most important factors that determine the health of river ecosystems since the availability and diversity of habitats (in-stream and riparian areas) are important determinants of the biota that are present in a river system (Kleynhans, 1996). The 'habitat integrity' of a river refers to the "maintenance of a balanced composition of physic-chemical and habitat characteristics on a temporal and spatial scale that is comparable to the characteristics of natural habitats of the region" (Kleynhans, 1996). It is seen as a surrogate for the assessment of biological responses to driver changes.

» ***<u>Smaller ephemeral watercourses (Drainage Lines):</u>***

To assess the PES or condition of the observed smaller ephemeral watercourses (drainage lines), a modified Wetland Index of Habitat Integrity (DWAF, 2007) was used. The Wetland Index of Habitat Integrity (WETLAND-IHI) is a tool developed for use in the National Aquatic Ecosystem Health Monitoring Programme (NAEHMP), formerly known as the River Health

Programme (RHP). The output scores from the WETLAND-IHI model are presented in the standard DWAF A-F ecological categories (Table 17) and provide a score of the PES of the habitat integrity of the freshwater resource system being examined.

Table 17: Description of the A-F Ecological Categories (after Kleynhans, 1996, 1999)

IMPACT CATEGORY	DESCRIPTION	SCORE
None (A)	No discernible modification or the modification is such that it has no impact on this component of wetland integrity.	0 – 0.9
Small (B)	Although identifiable, the impact of this modification on this component of wetland integrity is small.	1 – 1.9
Moderate (C)	The impact of this modification on this component of wetland integrity is clearly identifiable but limited	2 – 3.9
Large (D)	The modification has a clearly detrimental impact on this component of wetland integrity. Approximately 50% of wetland integrity has been lost.	4 – 5.9
Serious (E)	The modification has a highly detrimental effect on this component of wetland integrity. Much of the wetland integrity has been lost but remaining integrity is still clearly identifiable.	6 – 7.9
Critical (F)	The modification is so great that the ecosystem processes of this component of wetland integrity are almost totally destroyed, and 80% or more of the integrity has been lost.	8 - 10

» ***Larger seasonal to perennial streams and associated riparian fringes:***

For the larger seasonal to perennial streams The IHI (Index of Habitat Integrity) 1996, version 2 (Kleynhans, 2012) was used to assess habitat integrity and is based on an interpretation of the deviation from the reference condition for the river reach assessed and is approached from both an instream and riparian zone perspective. Specification of the reference state is followed by an impact-based approach, whereby the extent and intensity of anthropogenic impacts are interrogated to interpret the level of modification to the primary drivers of river health, namely hydrology, geomorphology and physic-chemical conditions. Naturally, the severity of impacts on habitat integrity will vary according to the natural characteristics of different rivers, with particular river types being inherently more sensitive to certain types of impacts than others. The IHI assessment involved the assessment and rating of a range of criteria for instream and riparian habitat (see Table 18, below) scored individually (using an impact magnitude rating scale from 0-25) using Table 1 as a guide. This assessment is informed by a site visit to a specific section of the river but is refined based on a desktop review of reach and catchment-scale impacts based on available aerial photography and land cover information.

Table 18: Criteria used in the assessment of habitat integrity (after Kleynhans, 1998)

Criterion	Diagnostic channel characteristics
Water abstraction	Direct impact on habitat type, abundance and size. Also implicated in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.

Flow modification	Consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow can have an impact on habitat attributes such as an increase in duration of low flow season, resulting in low availability of certain habitat types or water at the start of the breeding, flowering or growing season.
Bed modification	Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment. Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation is also included.
Channel modification	May be the result of a change in flow, which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Water quality modification	Originates from point and diffuse point sources. Measured directly or alternatively agricultural activities, human settlements and industrial activities may indicate the likelihood of modification. Aggravated by a decrease in the volume of water during low or no flow conditions.
Inundation	Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments.
Exotic macrophytes	Alteration of habitat by obstruction of flow and may influence water quality. Dependent upon the species involved and scale of infestation.
Exotic aquatic fauna	The disturbance of the stream bottom during feeding may influence the water quality and increase turbidity. Dependent upon the species involved and their abundance.
Solid waste disposal	A direct anthropogenic impact which may alter habitat structurally. Also, a general indication of the misuse and mismanagement of the river.
Indigenous vegetation removal	Impairment of the buffer the vegetation forms to the movement of sediment and other catchment runoff products into the river. Refers to physical removal for farming, firewood and overgrazing.
Exotic vegetation encroachment	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Allochthonous organic matter input will also be changed. Riparian zone habitat diversity is also reduced.
Bank erosion	Decrease in bank stability will cause sedimentation and possible collapse of the river bank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or exotic vegetation encroachment.

Table 19: Rating table used to assess impacts to river systems

Criterion	Diagnostic channel characteristics	Score
A: Natural	No discernible impact, or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.	0
B: Good	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability is also very small.	1-5
C: Fair	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability is also limited.	6-10
D: Poor	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	11-15

E: Seriously Modified	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area is affected. Only small areas are not influenced.	16-20
F: Critically Modified	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	21-25

Wetland Ecological Importance and Sensitivity (EIS)

The outcomes of the wetland functional assessment were used to inform an assessment of the importance and sensitivity of wetland systems using the Wetland EIS (Ecological Importance and Sensitivity) assessment tool. The Wetland EIS tool includes an assessment of three components:

- Biodiversity support;
- Landscape scale importance;
- Sensitivity of the wetland to floods and water quality changes.

The maximum score for these components was taken as the importance rating for the wetland which is rated using Table 20.

Table 20: Rating table used to rate level of ecosystem supply.

RATING	IMPORTANCE OR LEVEL OF SUPPLY OF ECOSYSTEM SERVICES
None, Rating=0	Rarely sensitive to changes in water quality/hydrological regime.
Low, Rating=1	One or a few elements sensitive to changes in water quality/hydrological regime.
Moderate, Rating=2	Some elements sensitive to changes in water quality/hydrological regime.
High, Rating=3	Many elements sensitive to changes in water, quality/hydrological regime.
Very High, Rating=4	Vary many elements sensitive to changes in water quality/hydrological regime.

Appendix 5: Methodology: Assessment of Impacts

The Environmental Impact Assessment methodology assists in the evaluation of the overall effect of a proposed activity on the environment. This includes an assessment of the significant direct, indirect, and cumulative impacts. The significance of environmental impacts is to be assessed by means of the criteria of extent (scale), duration, magnitude (severity), probability (certainty) and direction (negative, neutral or positive).

» The **nature**, which includes a description of what causes the effect, what will be affected and how it will be affected.

» The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development) or regional,

Immediate area	1
Whole site (entire surface right)	2
Neighboring areas	3
Regional	4
Global (Impact beyond provincial boundary and even beyond SA boundary)	5

» The **duration**, wherein it was indicated whether:

Lifetime of the impact will be of a very short duration (0 – 1 years)	1
The lifetime of the impact will be of a short duration (2 – 5 years)	2
Medium-term (5 -15 years)	3
Long term (> 15 years)	4
Permanent	5

» The **magnitude**, quantified on a scale from 0 – 10,

small and will have no effect on the environment	2
minor and will not result in an impact on processes	4
moderate and will result in processes continuing but in a modified way	6
high (processes are altered to the extent that they temporarily cease)	8
very high and results in complete destruction of patterns and permanent cessation of processes	10

» The **probability** of occurrence, which describes the likelihood of the impact actually occurring. Probability was estimated on a scale of 1 -5,

very improbable (probably will not happen)	1
improbable (some possibility, but low likelihood)	2
probable (distinct possibility)	3
highly probable (most likely)	4
definite (impact will occur regardless of any prevention measures)	5

» The **significance**, was determined through a synthesis of the characteristics described above and can be assessed as;

- **LOW**,
- **MEDIUM** or
- **HIGH**;

» the **status**, which was described as either positive, negative or neutral.
» the degree of which the impact can be reversed,
» the degree to which the impact may cause irreplaceable loss of resources,
» the degree to which the impact can be mitigated.

The significance was calculated by combining the criteria in the following formula:

S=(E+D+M)P where;

» S = Significance weighting
» E = Extent

» D = Duration
» M = Magnitude
» P = Probability

The significance weightings for each potential impact are as follows;

Table 21: Rating table used to rate level of significance.

RATING	CLASS	MANAGEMENT DESCRIPTION
< 30	**Low (L)**	Where the impact would not have a direct influence on the decision to develop the area.
30 - 60	**Medium (M)**	Where the impact could influence the decision to develop in the area unless it is effectively mitigated.
> 60	**High (H)**	Where the impact must have an influence on the decision process to develop in the area.

Appendix 6: Description of the Biophysical Environment

Climate and Rainfall

The climate associated with the study area has been derived from recorded and extrapolated climatic data (https://en.climate-data.org/africa/south-africa/eastern-cape/ducats-771137/) for Ducats (Figures 24 and 25). Ducats is influenced by the local temperate oceanic climate (Cfb classification according to Köppen and Geiger. The climate here is mild and generally warm and temperate. The is a great deal of rainfall in Ducats, even in the driest month. The temperature here averages 18.3 °C. About 834 mm of precipitation falls annually. Precipitation is generally the lowest in June (33 mm) with March receiving the greatest amount of precipitation (averaging about 94 mm). As mentioned, the average annual temperature in Ducats is 18.3°C with February being the warmest (Ave. 21.7°C) and July being the coldest (Ave 15.1°C). Frost is very uncommon within the region.

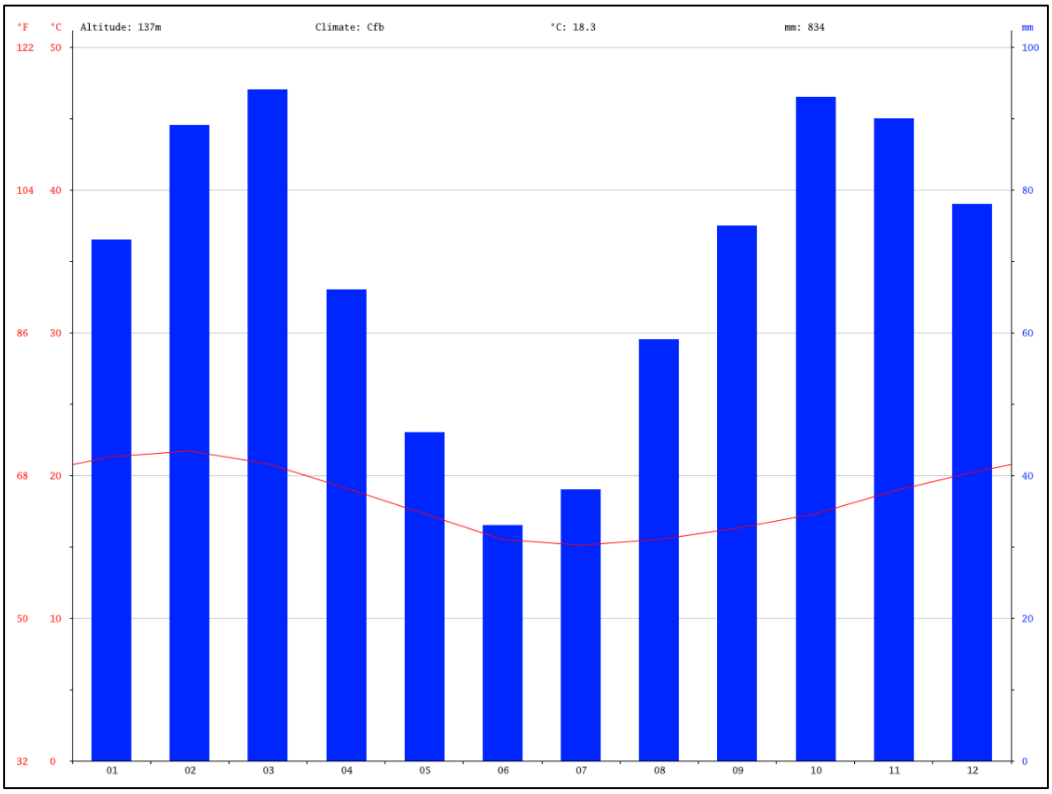


Figure 24: Climate graph of Ducats (https://en.climate-data.org/africa/south-africa/eastern-cape/ducats-771137/).

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	21.3	21.7	20.8	19.1	17.3	15.5	15.1	15.5	16.3	17.3	18.9	20.2
Min. Temperature (°C)	17.7	18.1	17.1	14.9	12.3	10	9.6	10.3	11.8	13.5	15.1	16.4
Max. Temperature (°C)	25	25.3	24.5	23.4	22.3	21	20.6	20.8	20.8	21.2	22.7	24.1
Avg. Temperature (°F)	70.3	71.1	69.4	66.4	63.1	59.9	59.2	59.9	61.3	63.1	66.0	68.4
Min. Temperature (°F)	63.9	64.6	62.8	58.8	54.1	50.0	49.3	50.5	53.2	56.3	59.2	61.5
Max. Temperature (°F)	77.0	77.5	76.1	74.1	72.1	69.8	69.1	69.4	69.4	70.2	72.9	75.4
Precipitation / Rainfall (mm)	73	89	94	66	46	33	38	59	75	93	90	78

Figure 25: Climate table of Ducats (https://en.climate-data.org/africa/south-africa/eastern-cape/ducats-771137/).

Physiography and soils

Landscape Features

According to Mucina and Rutherford (2006), the region can be described as gentle to moderately undulating landscapes with dissected hilltop slopes close to the coast. This description is furthermore consistent with the land type classification (AGIS 2007) which classifies the landscape as a Class C3 Terrain type (open hills or ridges) with 20 -50% of its surface containing slopes less than 8%. Land types represent areas that are uniform for climate, terrain form, geology, and soil. According to AGIS (2014), the study site is situated within the land type FA415. Across a landscape, usually, five terrain units can be identified. Wetlands in the form of valley-bottom wetlands, as well as non-perennial watercourses, occur most frequently in valley bottoms (unit 5). The catena within land types FA415 incorporates only 4 of the terrain units namely 1, 3, 4, and 5, as shown in Figure 26. The dominant terrain type within this land type is four (3) with 60% covered by the terrain type.

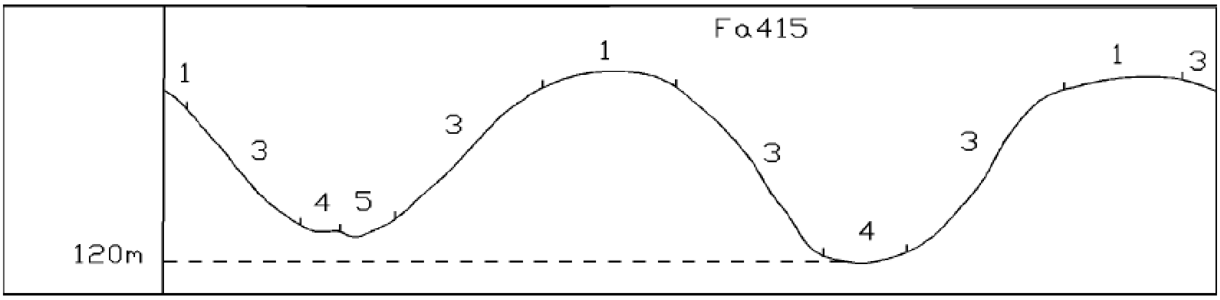


Figure 26: Terrain units occurring within land type Fa415

At a finer scale using a Google elevation profile for the study site as well as other spatial sources, the study site can be described as highly undulating comprising of low hills with moderate to gentle slopes. Ridges and steeper slopes are typically associated with the

Qinira valley, especially the northern and eastern slopes (Figure 18). The landscape within the proposed new mining footprint generally slopes in an eastern to a south-eastern direction towards the Qinira River (non-perennial flow) (Figure 19). The proposed new mining footprint is drained by two drainage lines, which merge into a small (short) non-perennial watercourse just east of the mining footprint. This short tributary flows in a south-eastern direction, draining into the Qinira River, east of the proposed mining footprint. Both drainage systems occurring within the proposed mining footprint have been significantly impacted and transformed. Almost the entire southern drainage line has been significantly altered by current mining activities. The northern drainage line has been significantly invaded within Invasive Alien Plants (IAPs) and contains small dam structures.

The proposed mining footprint is situated between elevations; 170m and 95m above sea level with an average elevation of 129m. As mentioned, the proposed mining footprint is undulating with an average slope of 11%; -10.9 (maximum slope: -34.6%). Steeper slopes within the mining footprint are associated with the quarry, especially the southern portion of the quarry which contains a relatively steep face.

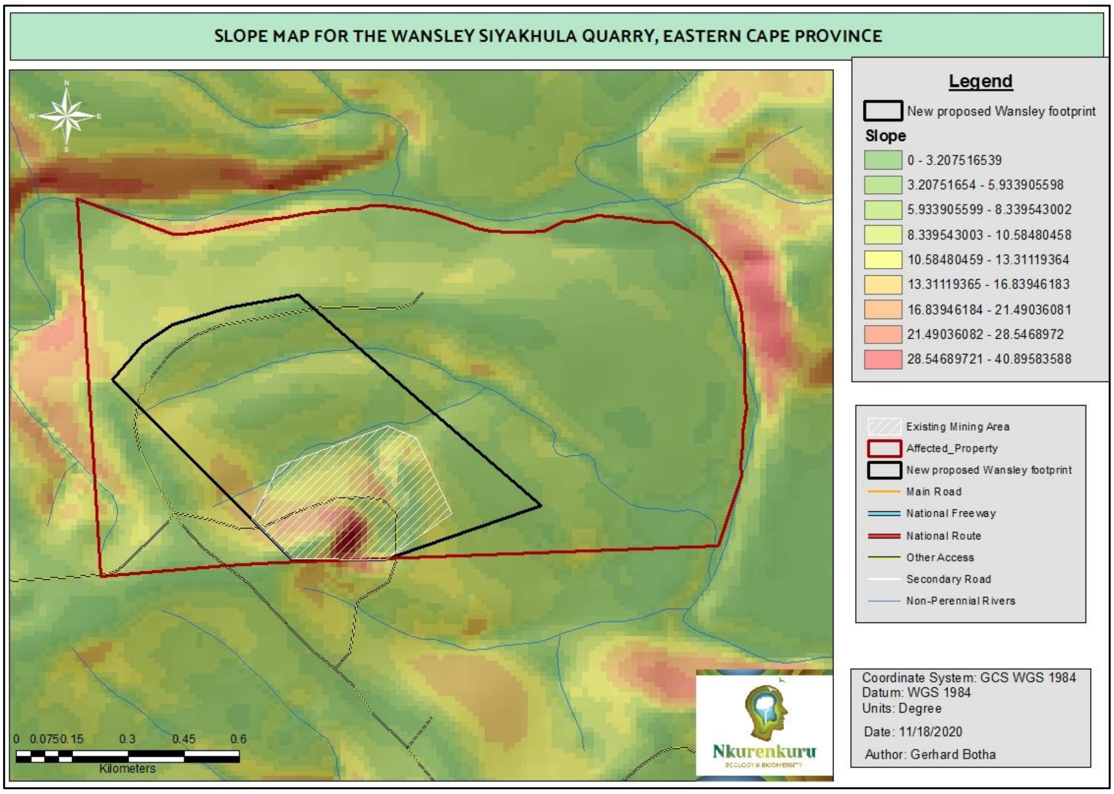


Figure 27: Map indicating the sloping character of the Wansley Property and immediate surroundings. Steeper slopes are associated with the northern and eastern boundaries of the Qinira river which is characterised by moderately deep incised valleys. The steepest slopes found within the mining footprint itself is associated with the southern face of the quarry itself.

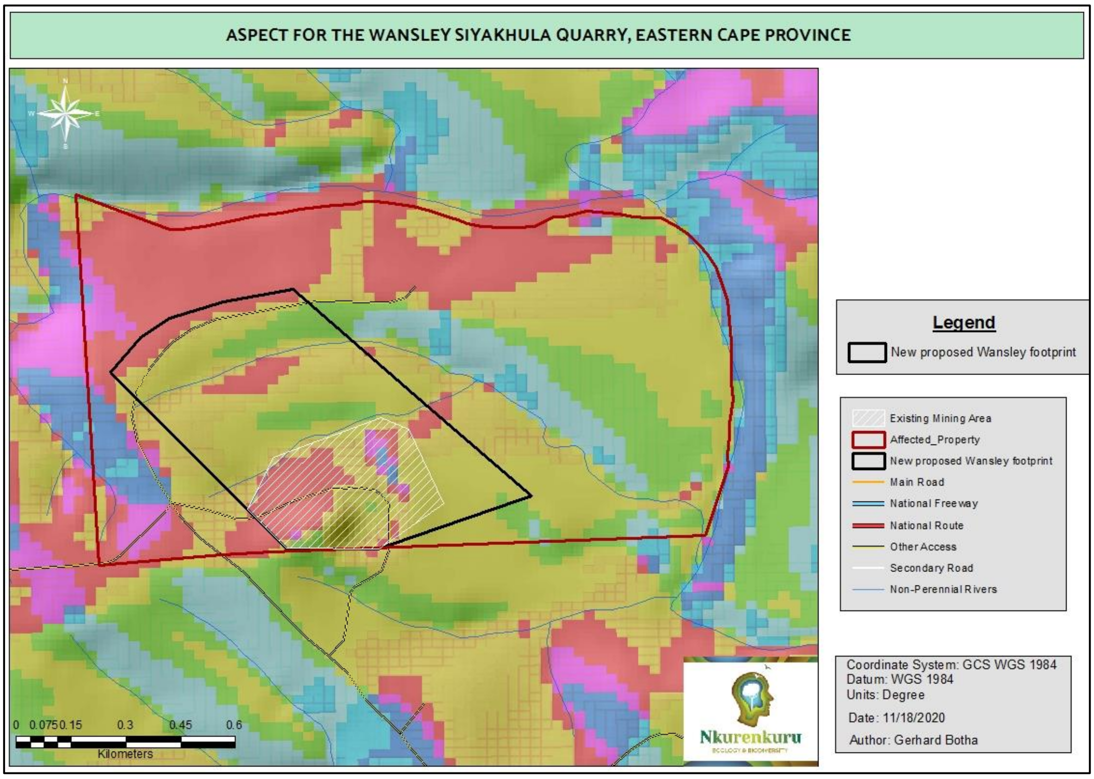
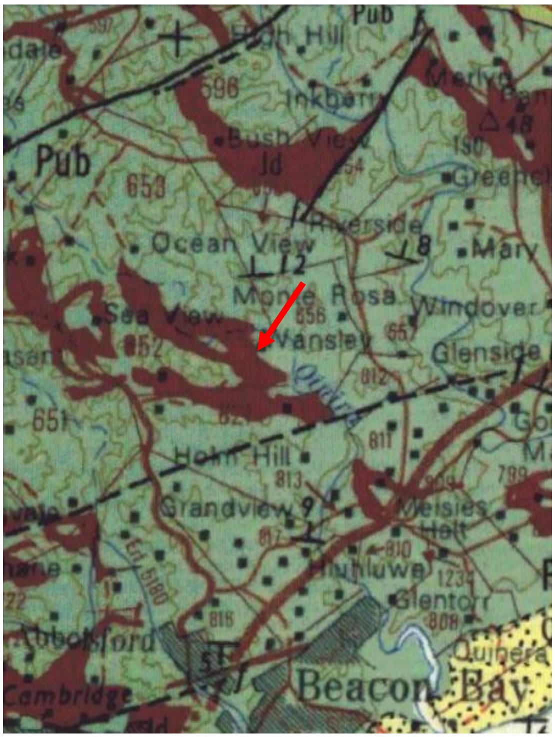


Figure 28: Aspect map illustrating the varying/undulating nature of this landscape. Generally, the landscape found within the Wansley property footprint, tend to slope in a northern and eastern direction towards the Qinira river.

Geology and Soils

The regional geology of the area is predominantly characterised by Permian Age rocks of the Balfour Formation (Beaufort Group). The Balfour Formation comprises grey mudstone, shale, and sandstone rocks (Figure 21). The Balfour Formation is approximately 2000m thick with sandstone dominant at the base. However, mudstone is the predominant lithology. The Balfour Formation rocks have been extensively intruded by dolerites of the Jurassic Age and occur mostly in the form of sills. These bedrocks are mantled with a range of Late Caenozoic superficial deposits such as alluvium, colluvium (slope deposits), and soils. Levels of bedrock exposure within the region are generally very low, except for a few roads and railway cuttings, farm dams, stream, and river banks, erosion gullies (dongas), quarries and borrow pits. The rolling uplands are generally covered by open grassland with some scattered woody species with some areas being transformed agriculture activities. The steeper slopes and valleys often comprise of dense woodlands/thickets.

Within the proposed Wansley mining footprint, the Balfour Formation comprise of fine-grained channel sandstones and greenish-grey overbank mudstones. An extensive area of this Balfour Formation, within the new mining footprint, has been intruded and baked by a dolerite sill, which will form the primary source to be mined.



Key Geological Units:

- Dark brown (Jd): Jurassic Karoo Dolerite Suite
- Green (Pub): Balfour Formation, Lower Beaufort Group (Adelaide Subgroup, Karoo Supergroup).

Red arrow indicates the location of the Wansley Siyakhula Quarry.

Figure 29: Regional geological map extracted from 1:250 000 geological map sheet 3226 King William's Town (Council for Geoscience, Pretoria) illustrating the extensive intrusion of dolerite into the Balfour Formation within the study site (new mining footprint)

Sediments of the Beaufort Group are largely argillaceous (clay-rich) and generally produce soils with pedocutanic B horizons. In the Eastern Cape they characteristically also produce bleached A horizon. In higher rainfall areas and on older landscapes red coloured neocutanic B horizons similar to those on Ecca sediments can form. The latter has a high agricultural potential but generally the soils on Beaufort sediments, particularly those on rolling and steeply sloping land are shallow and poor. Good agricultural soils within the area covered by Beaufort sediments are generally associated with dolerite outcrops, relict landscapes, or with alluvium.

Generally detailed soil information is not available for broad areas of the country. As a surrogate land type data was used to provide a general description of soil in the study area (land types are areas with largely uniform soils, topography, and climate). The study site is, as already mentioned situated within the Fa415 land type (Land Type Survey Staff, 1987).

» The F-group of land types represents young landscapes that are not predominantly rock and does not consist of Alluvial or Aeolian properties. It consists mainly of shallow soils of the Glenrosa or Mispah soil forms. The Oakleaf and Tukulu soil forms are accommodated here.

- The Fa soil class group of land types refer to shallow with a sandy texture, and/or rocky soils, often steep and highly leached (very little lime).

The soils on Beaufort sediments are characteristically erodible. The dense subsoil and often clear to abrupt transition between topsoil and subsoil lend towards excessive water accumulation in the surface following rains while the subsoil, especially in low lying positions in the landscape, can be sodic causing it to be highly erodible.

In higher rainfall areas and where the dolerite is pre-weathered, heavy textured red apedal B horizons occur providing very good agricultural potential. On the steeper ground the soils can be stony and shallow with red-structured B horizons or melanic A horizon. Doleritic soils generally have a high potential for both rainfed and irrigated crops and forestry.

Table 22: Soil forms and coverage per terrain unit (%) for the Fa415 land type (soils that are typically associated with wetlands are in blue font).

Soil Form	% Cover per Terrain Unit				Depth (mm)	Clay Content (%)	
	1	3	4	5			
Slope (%)	2-8	8-45	2-10	2-8		A	E
Rock	5	5		5			
Rutherglen Cf11, Arrochar Cf12	20	25	20	5	250-450	10-20	10-20
Dohne Es13, Rosemead Es16	20	20	15	5	150-450	10-20	10-20
Kanonkop Gs13, Williamson Gs16,	15	20	10	5	250-450	10-20	
Kroonstad Kd13, Bluebank Kd16	20	10	25	15	450-750	10-20	10-20

Kiora Bo10, Stanger Bo11, Glengazi Bo31	5	5	5		500-900	20-40	
Mayo My10, Msinsini My11	5	5	5		500-750	20-40	
Vaalrivier Oa33, Jozini Oa36				40	650-1200	6-20	
Stream beds				20			

Surface Hydrology

The project site is situated within the Mzimvubu to Keiskamma Water Management Area (WMA) 12, Quaternary Catchment R30F (Nahoon / Qinira River Catchment) and Ecoregion 31.02 (Eastern Coastal Belt Ecoregion) (Figures 12, 13, 14 and 30).

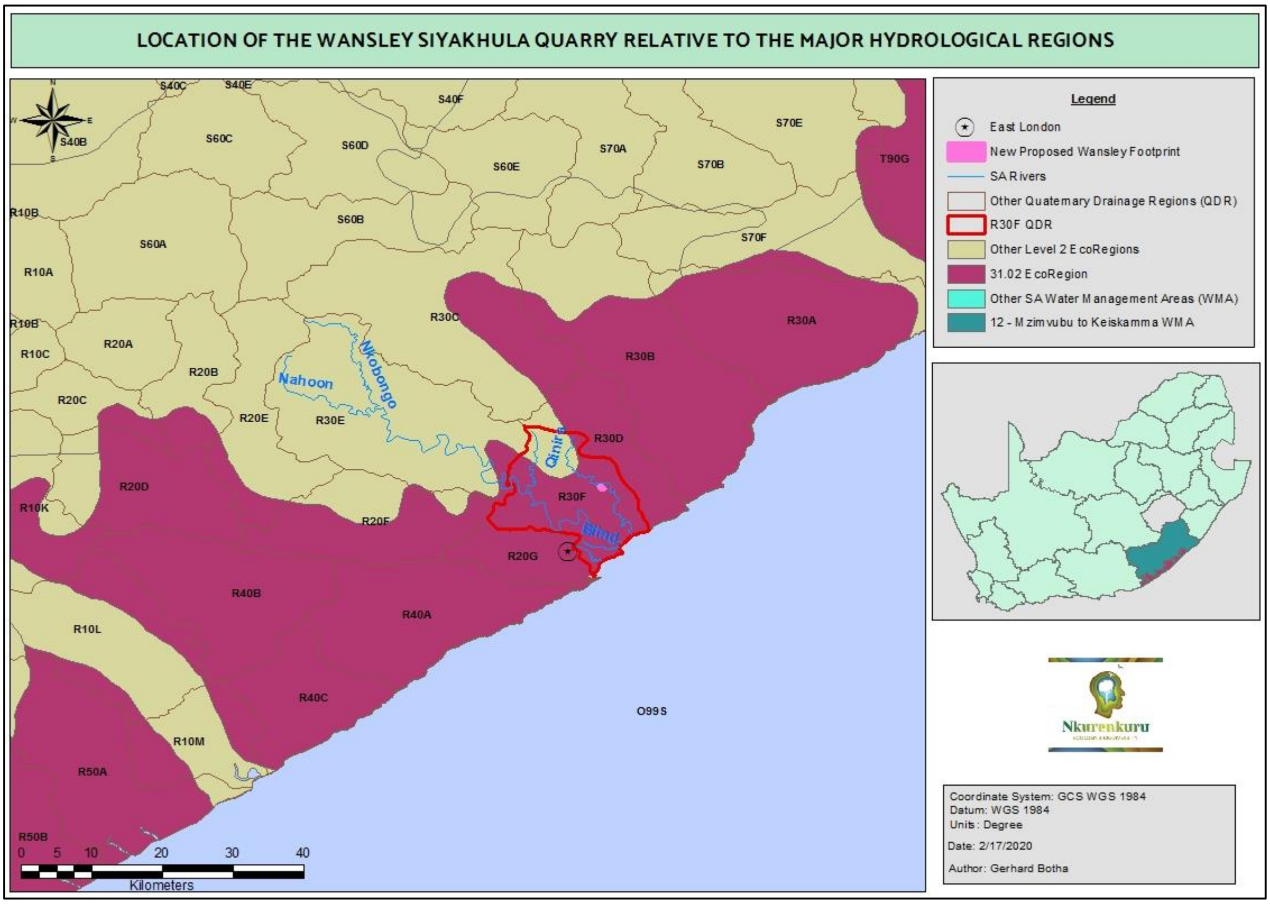


Figure 30: Major Hydrological Regions.

WMA 12 consists of three large drainage basins and the catchments of several smaller rivers that lie between the major drainage basins and the Indian Ocean. The major drainage basins are the Great Kei, the Mbashe, and the Mzimvubu. The total area of the WMA is some 66 211 km^2 and comprise of 194 quaternary catchments. (Figure 12 and 13). Approximately 6% of the total surface area lies within the KwaZulu-Natal Province whilst the remainder of WMA12 is contained within the boundaries of the Eastern Cape Province. The topography of this WMA is hilly to mountainous throughout with the high mountains of the Drakensberg along the north-eastern boundary. The rivers are deeply incised in the coastal strip. This WMA can furthermore be subdivided into three major drainage regions (Sub Water Management Areas) namely the Amathole Drainage Region, the Great Kei River Drainage Region as well as the Central- and North-Eastern Drainage Region. The rivers of the northern coastal catchments are of high to very high ecological importance and sensitivity and have largely natural present ecological status classes. Consequently, they have high ecological flow requirements. Most of the other rivers are of moderate ecological importance and sensitivity, have moderately modified to largely modified present ecological status classes, and have correspondingly lower ecological flow requirements. The proposed mining footprint is located within the Amathole Drainage Region and the Nahoon Quaternary Catchment (R30E and R30F).

The proposed new mining footprint is situated with the R30F Quaternary Catchment which comprises of the middle, lower reaches of the Nahoon River as well as numerous smaller non-perennial watercourses including the Blind- and Qinira Rivers. The most notable lake/dam and wetland features within this quaternary catchment are the Nahoon Dam and the Estuarine Functional Zones associated with the Nahoon- and Qinira River systems. The affected quaternary catchment areas (R30A – R30F) are predominantly used for rough grazing for livestock, mostly sheep and goat. Within the R30F catchment it is estimated that 5784 large stock units are present. No larger irrigation schemes exist within these catchments. Only a relatively small portion of the water yield (Catchment R30F) is utilized for irrigation (an area of approximately 1.75 km^2, mainly for the cultivation of vegetables on alluvial soils close to rivers). Water-related infrastructure is minimal within the rivers associated with these catchment areas. Major impacts/water use and the calculated water requirements of the sub-catchments are summarised in Tables 23 - 26 below.

The C30F Quaternary Catchment can be further divided into eight sub-quaternary catchments/reaches (SQR) with the proposed development footprint situated within the SQR 8005, which is approximately 12 325 ha in size and is drained by the non-perennial Qinira river and associated tributaries and drainage lines. The Qinira river is approximately 26.6 km long and flows in a predominantly south-eastern direction, where it terminates into the Indian Ocean via the Qinira Estuary. The average slope of the Qinira river is 4.317°, with a maximum slope of 17.628°. The Qinira catchment can be described as highly undulating and hilly (average slope of 5.227°) with numerous small non-perennial streams and drainage lines feeding into the Qinira river. The Qinira river is typically fringed with a narrow, dense, tall woodland (including a riparian fringe). According to land use the catchment can be divided into two regions namely the rural area (covering the bulk of the catchment) and the highly urbanized south-eastern portion. The primary land use within the rural section is agricultural, especially livestock grazing with some small-scale crop cultivation, likely vegetable crops, lucerne, and pastures. Due to the ephemeral nature of this watercourse, the morphology of the river has remained larger intact with water-related infrastructure being largely absent and irrigation directly from the river being unlikely. Only a single dam structure is present within the Qinira channel and some irrigation from this dam may however be possible. A prominent feature of the Qinira catchment is, however, the numerous gravel dams of various sizes (mostly small to small-moderate in size) storing overland flow and channelled flow within the many drainage lines and smaller tributaries, subsequently impacting water input from the catchment into the Qinira river. The most prominent wetland feature within this catchment is the Qinira Estuary which covers an area of approximately 110.734 ha. Agricultural activities as well as urbanization within the south-eastern portion have significantly impacted water inputs from the catchment, connectivity (especially lateral connectivity) as well as vegetation structure and composition (however large areas of the riparian fringe, appears from spatial data, to have remained mostly natural).

The Wansley Siyakhula Quarry is situated just south of the middle reach of the Qinira river (SQR 8005) with the nearest point of the proposed expansion footprint being a little more than 200m from this river.

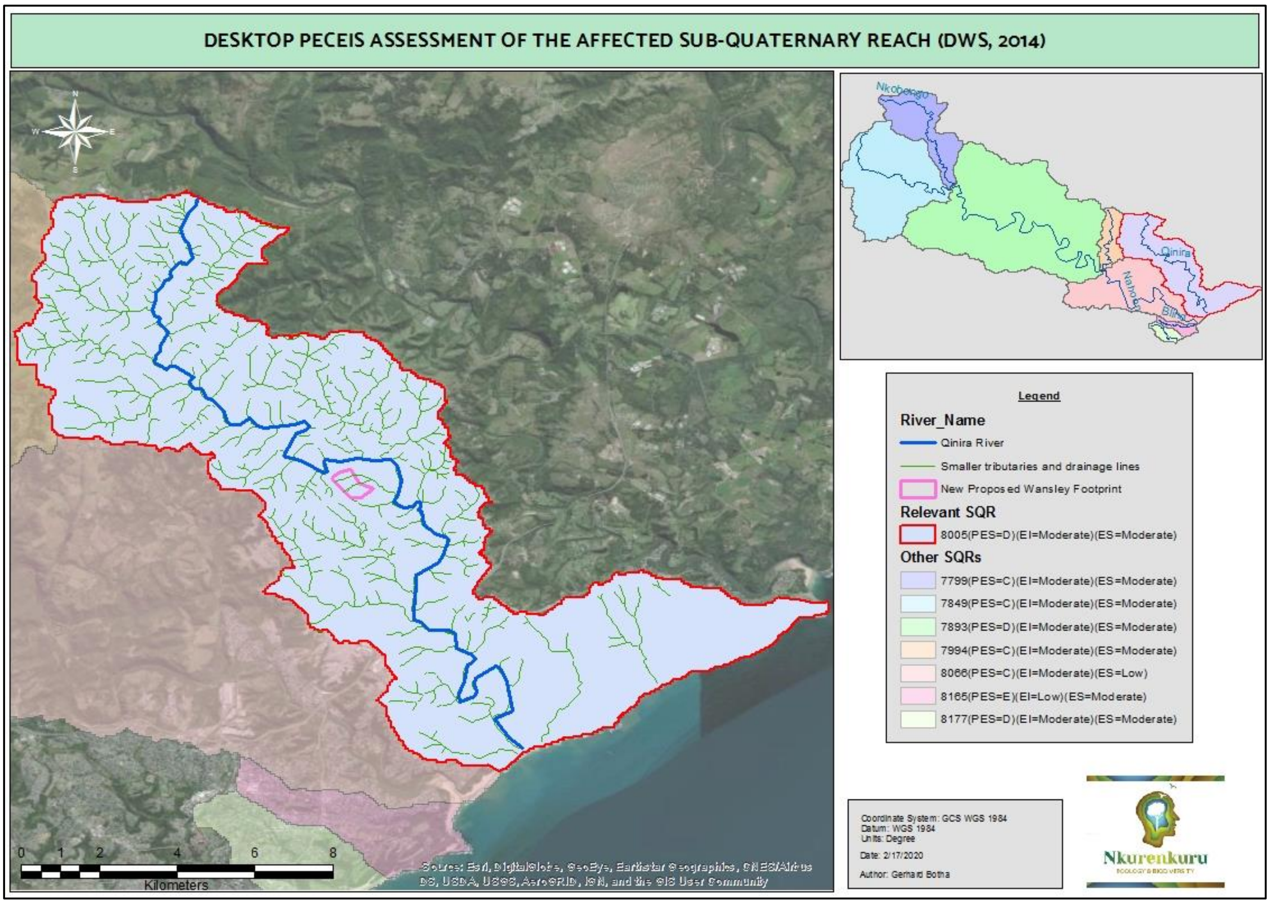


Figure 31: Location of the proposed new Wansley mining footprint within the sub-quaternary reach.

This zone of the Qinira river is classified as an Upper Foothill Zone characterised by moderately steep, cobble-bed, or mixed bedrock-cobble bed channels, with plain-bed, pool-riffle or pool-rapid reach types. The length of the pools and riffles/rapids are in most cases similar. Narrow floodplains of sand, gravel, or cobble are often present. Drainage within the Wansley property occurs through both channelled flow (drainage lines and small ephemeral watercourses) and diffuse surface flow, however, most surface flow into the Qinira would be through channelled flow during the wet season. These drainage lines and ephemeral tributaries flow mostly in an eastern, south-eastern direction and will only contain surface flows for short periods following sufficient rainfall events. To store some of this periodical surface water numerous small to medium-sized gravel dams/reservoirs have been constructed by landowners. According to DEA's Land Cover Data (2015) the surrounding landscape predominantly comprise of thicket and open grassland and is likely utilized as grazing for livestock and some game (refer to Figure 20).

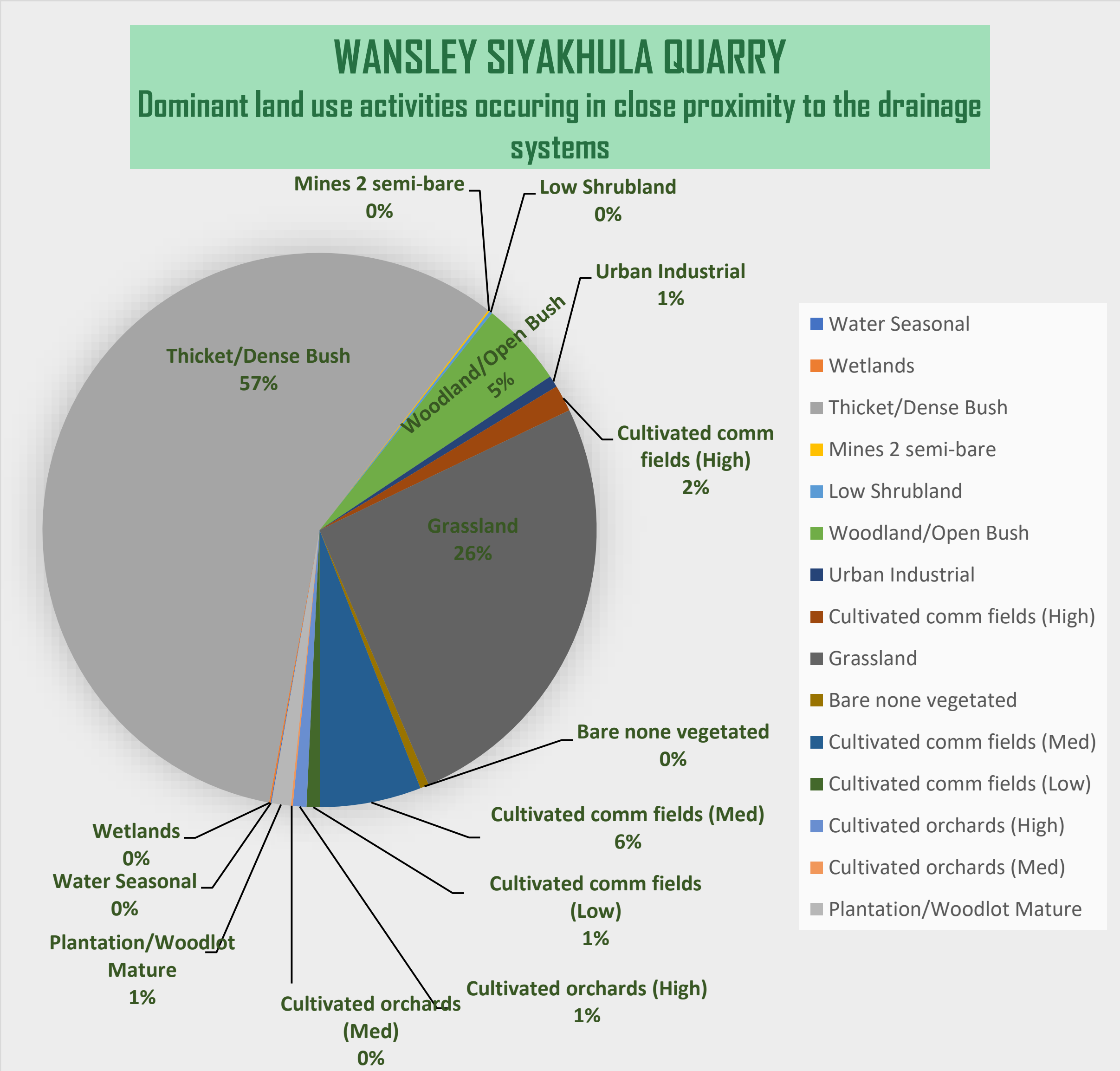


Figure 32: Land cover and land use within a radius of 500m around all surface hydrological features that may potentially be impacted by the proposed expansion of the Wansley Quarry (DEA, 2015).

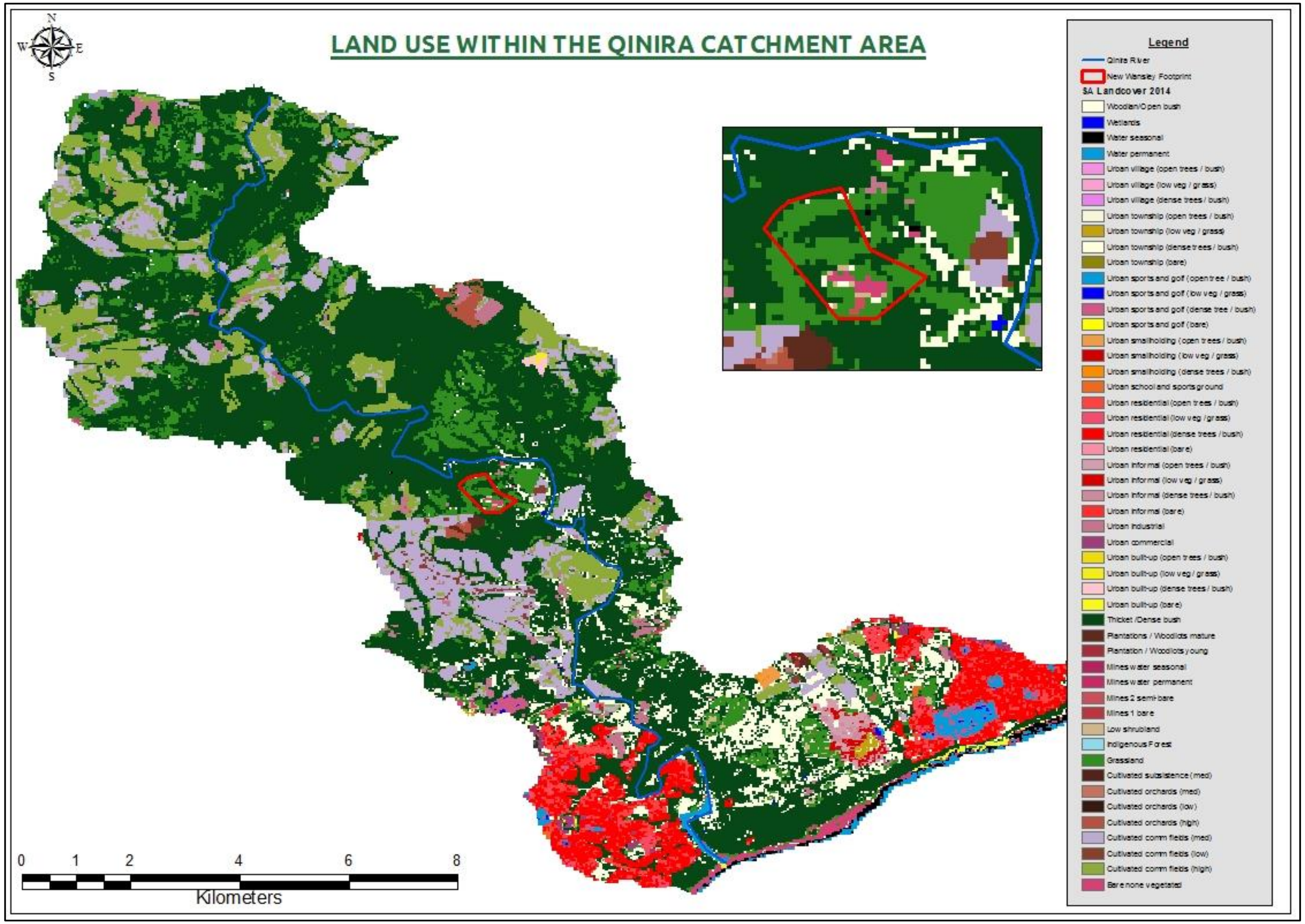


Figure 33: Land Cover Map for the Qinira River Catchment area indicating that most of the central and northern portion comprises largely of grassland and thicket whilst the southern portion has been impacted by rural and urban development.

Table 23: Land use within the secondary catchment areas of the Amatole Region (Relevant catchment area highlighted in red font) (DWAF, 2002)

Catchments			Irrigation (km²)	Other Dry Land Crops (km²)	Afforestation (km²)	Indigenous Forests	Alien Vegetation (km²)	Nature Reserves (km²)	Urban and Rural Village Areas (km²)	Rough Grazing and Other (km²)	Total Area (km²)
Secondary		Tertiary/ Quaternary									
No.	Description	No.									
R5	Southern Coastal Catchments	R50A, R50B	4.22	92	0	0	18.01	0	17.75	675.02	807
R1	Keiskamma	R10A to R10M	10.13	219	68.45	29.04	46.11	0	124.75	2199.52	2697
R4	Amatola Coastal Catchment	R40A to R40C	10.06	102	4.81	0	28.40	12.68	27.70	668.35	854
R2	Buffalo	R20A to R20G	6.77	98	74.87	0	14.64	12.54	152.97	926.21	1286
R3	Nahoon, Gqunube	R30A to R30F	28.82	136	0.78	0	8.37	12.94	40.18	2064.91	2292
Total in Amatole Region			60	1681	233.84	40.35	307.37	66.77	532.00	17459.13	20485

Table 24: Water Requirement (million m³/a) of the sub-catchments of the Lower Vaal Management Area (Relevant catchment area highlighted in red font) (DWAF, 2002).

Catchments			Incremental Catchment Area (km²)	Mean Annual Precipitation (mm/a)	Mean Annual Evaporation (mm/a)	Natural MAR		Increment Yield (1:50 Year)		
Secondary		Tertiary/ Quaternary				Incremental (million/m³)	Cumulative (million/m³)	Available in 1995 (million m3/a)	Utilised in 1995 (million m³/a)	Total Potential (million m³/a)
No.	Description	No.								
R5	Southern Coastal Catchments	R50A, R50B	807	580	1400	42.20	42.20	3	3	12
R1	Keiskamma	R10A to R10M	2697	668	1500	137.66	137.66	56.60	56.6	63.6
R4	Amatola Coastal Catchment	R40A to R40C	854	680	1375	77.12	77.12	6.01	6.01	22.1
R2	Buffalo	R20A to R20G	1286	746	1425	98.02	98.02	54.26	54.26	54.3
R3	Nahoon, Gqunube	R30A to R30F	2292	766	1350	204.25	204.25	20.13	20.13	62.9
Total in Amatole Region			7936	701	1430	559.25	559.25	140.00	140.00	214.9

Table 25: Urban and rural domestic water requirements in 1995 (Relevant catchment area highlighted in red font) (DWAF, 2002).

Catchments			Urban Requirements (million m³/a)	Rural Domestic Water Requirements (million m³/a)	Combined Urban and Rural Domestic Requirements (million m³/a)	Requirements at 1:50 Year Assurance (million m³/a)	Human Reserve
Secondary		Tertiary/ Quaternary					
No.	Description	No.					
R5	Southern Coastal Catchments	R50A, R50B	0	0.28	0.28	0.28	0.28
R1	Keiskamma	R10A to R10M	1.35	1.34	2.69	2.69	1.50
R4	Amatola Coastal Catchment	R40A to R40C	0	0.30	0.3	0.30	0.30
R2	Buffalo	R20A to R20G	49.70	1.05	50.75	50.75	6.35
R3	Nahoon, Gqunube	R30A to R30F	0.32	0.39	0.71	0.71	0.48
Total in Amatole Region			51.37	3.36	54.73	54.73	8.89

Table 26: Water requirements for the ecological component of the reserve (Relevant catchment area highlighted in red font) (DWAF, 2002).

Catchments			Present Ecological Status Class (PESC)	Riverine Ecological Water Requirements for PESC			
Secondary		Tertiary/ Quaternary		% Virgin MAR	Long-Term Average Requirement (million m³/a)	Cumulative Impact on 1:50 Year Yield (million m³/a)	Incremental Impact on 1:50 Year Yield (million m³/a)
No.	Description	No.					
R5	Southern Coastal Catchments	R50A, R50B	C	12.8	5.4	0	0
R1	Keiskamma	R10A to R10M	D	9.9	13.6	3.1	3.1
R4	Amatola Coastal Catchment	R40A to R40C	C	12.8	9.8	0	0
R2	Buffalo	R20A to R20G	D	9.6	9.4	4.6	4.6
R3	Nahoon, Gqunube	R30A to R30F	D	9.1	18.5	1.3	1.3

Vegetation Overview

According to the latest vegetation map provided for South Africa (SANBI, 2018), the project site is situated within the South-Eastern Coastal Thornveld (Figure 8), previously classified as Albany Coastal Belt. Within the new SANBI map, the Albany Coastal Belt have been split in five separate vegetation types, four of which still belong to the Albany Thicket Biome (Nanaga Savanna Thicket, Hamburg Dune Thicket, Kasouga Dune Thicket, Grahamstown Grassland Thicket), whilst the South Eastern Coastal Thornveld forms part of the Savanna Biome (Sub-escarpment Savanna Bioregion).

Based on the description provided by Mucina and Rutherford in 2006, for the Albany Coastal Belt Vegetation Type (ACB), it is clear that the Albany Coastal Belt as described by Mucina and Rutherford shows the strongest resemblance to the South Eastern Coastal Thornveld and the Nanaga Savanna Thicket and in some way can be regarded as a synonym for these two vegetation types. Subsequently as no formal description exist for the Coastal Thornveld, the description provided by Mucina and Rutherford (2006) will be provided below and can be regarded as mostly applicable to South Eastern Coastal Thornveld.

The South Eastern Coastal Thornveld/Albany Coastal Belt Vegetation Type

The vegetation in and surrounding the project site is Albany Coastal Belt Vegetation (Figure 8). This vegetation type is located within the Eastern Cape Province where it occurs within 15 km (sometimes up to 30 km) of the Indian Ocean coastline. This vegetation type stretches from the Kei Mouth in the north to the Sundays River in the south and is regularly interrupted by many valleys. Typically, this vegetation type can be found between elevations of 10 m to 400 m above sea level. The larger and more prominent valleys (interrupting this vegetation type) are covered by Buffels Thicket. The interior boundary of the Albany Coastal Belt transitions into the Savanna Biome (Bhisho Thornveld Vegetation Type). According to the classification of thicket vegetation types done by Lombard et al. (2003) for the Subtropical Thicket Ecosystem Planning Project (STEP) the affected vegetation is classified as Berlin Savannah Thicket which roughly incorporates both Albany Coastal Belt and the Bhisho Thornveld Vegetation Types as classified by Mucina and Rutherford (2006).

The vegetation of Albany Coastal Belt covers gentle to moderately undulating landscapes and dissected hilltop slopes close to the coast and are dominated by short grasslands punctuated by scattered bush clumps or solitary *Acacia natalitia* (now *Vachelia natalitia*) trees.

Key species associated with the Albany Coastal Belt are summarised in Table 27 below.

Table 27: Key species associated with the Albany Coastal Belt.

DOMINANT SPECIES	
Growth Form	**Key Species**
Tall Trees	*Erythrina caffra*
Small Trees	*Acacia natalitia, Brachylaena elliptica, Canthium spinosum, Cussonia spicata, Ficus sur, Ochna arborea, Ochna arborea, Sideroxylon inerme, Sideroxylon inerme, Zanthoxylum capense,*
Tall Shrubs	*Clausena anisata, Clerodendrum glabrum, Coddia rudis, Croton rivularis, Diospyros villosa var. parvifolia, Grewia occidentalis, Gymnosporia heterophylla, Hippobromus pauciflorus, Mystroxylon aethiopicum, Pavetta lanceolata, Psydrax obovata, Pterocelastrus tricuspidatus, Rhus lucida, Scutia myrtina, Tarchonanthus camphoratus, Turraea obtusifolia*
Low Shrubs	*Rhynchosia ciliata, Carissa bispinosa, Chaetacanthus setiger, Helichrysum asperum var. albidulum, Pelargonium alchemilloides, Phyllanthus maderaspatensis, Selago corymbosa, Senecio pterophorus, Tephrosia capensis var. acutifolia*
Herbs	*Chamaecrista mimosoides, Abutilon sonneratianum, Acalypha ecklonii, Centella asiatica, Commelina africana, Commelina benghalensis, Cynoglossum hispidum, Eriosema squarrosum, Lactuca inermis, Lobelia erinus, Monsonia emarginata, Phyllopodium cuneifolium, Senecio burchellii, Sonchus dregeanus*
Graminoids	*Brachiaria serrata, Cynodon dactylon, Dactyloctenium australe, Digitaria natalensis, Ehrharta calycina, Eragrostis capensis, Eragrostis curvula, Eragrostis plana, Heteropogon contortus, Panicum deustum, Panicum maximum, Setaria sphacelata, Sporobolus africanus, Themeda triandra, Tristachya leucothrix, Cymbopogon marginatus, Ehrharta erecta, Elionurus muticus, Melica racemosa, Setaria megaphylla, Trachypogon spicatus*
Geophytic Herb	*Cheilanthes hirta, Moraea pallida, Oxalis smithiana, Sansevieria hyacinthoides, Strelitzia reginae,*
Succulent Herb	*Plectranthus verticillatus*
Succulent Tree	*Euphorbia triangularis*
Woody Climbers	*Asparagus aethiopicus, Asparagus racemosus, Capparis sepiaria var. citrifolia, Clematis brachiata, Rhoiacarpos capensis, Rhoicissus digitata, Rhoicissus tridentata, Secamone alpini, Tecoma capensis*
Woody Succulent Climbers	*Crassula pellucida subsp. marginalis, Sarcostemma viminale*
Herbaceous Climbers	*Rhynchosia caribaea, Rhynchosia totta, Thunbergia capensis, Zehneria scabra*
Semi-parasitic Epiphytic Shrub	*Viscum obscurum*
ENDEMIC SPECIES	
Growth Form	**Key Species**
Geophytic Herbs	*Bobartia gracilis, Apodolirion amyanum, Aspidoglossum flanaganii, Drimia chalumnensis*
Herb	*Monsonia galpinii*
Low Shrub	*Acmadenia kiwanensis*
Succulent Herbs	*Brachystelma franksiae subsp. grandiflorum, Bulbine frutescens var. nov, Faucaria subintegra, Haworthia coarctata var. tenuis, Haworthia cooperi var. venusta, Haworthia reinwardtii var. reinwardtii forma chalumnensis Stapelia praetermissa var. luteola, Stapelia praetermissa var. praetermissa*

Succulent Shrub	*Bergeranthus concavus*

BODATSA species observation

A BODATSA (Botanical Database of Southern Africa) generated species list for the region has been extracted on the 18th of February 2020. According to this list a total of 2 481 species have been observed within the region with 281 species recorded within the more immediate surroundings. This recorded high diversity is consistent with the comments made by Cowling & Hilton-Taylor (1994) that stated that the area's high phyto- and growth form diversity is a reflection of the transitional nature of thicket vegetation, being an interface between various types of biomes. Due to the high diversity of habitat types, numerous growth forms are represented within this region with a total of 27 forms observed. The herbaceous and tall to medium-sized shrub layers are well represented within this region, especially the herbaceous layer is extremely high in diversity with over 1 600 species observed (63.7%). Furthermore, almost 10% of the total species composition comprises of succulents (241 species observed). Geophytes and surffrutex species were also relatively well represented within the region with 302 species observed (11.4%). Climbers and creepers were represented by just over 130 species (5%). As mentioned, this high diversity of phyto- and growth form diversity is due to the high diversity and turnover of habitat types within the region. Additionally, almost 25% of all recorded species are regarded as South African endemics. Of the 281 species recorded within the immediate surroundings, 87 species are regarded as South African Endemics

Due to the moderate climatic conditions of the region, favourable conditions persist for the establishment and invasion of non-indigenous plant species. A total of 172 non-indigenous species (6.5%) have been observed, of which 86 are regarded as invasive aliens. Within the immediate surroundings 15 non-indigenous species were recorded of which 9 species are regarded as invasive.

In terms of conservation important species, a total of 27 Red Data (IUCN) species have been recorded within the region, with only one Red Data species recorded within the immediate surroundings. Furthermore, of the total species recorded, according to the relevant Provincial Nature Conservation Ordinance, two species are listed as Endangered and 311 are listed as Protected. At a national level only one species has been recorded which is listed within TOPS whilst a total of five protected tree species have been recorded (as listed within the NFA). At an international level two CITES I and 78 CITES II floral species have been recorded. A total of 36 conservation important species (provincially- nationally and internationally) have been recorded within the immediate environment of the proposed development.

Table 28: Different types of growth forms recorded within the region according to BODATSA.

RECORDED FLORA	
Growth Form	**Number of Species**
Herb	1190
Bryophyte	141
Dwarf Shrub	112
Dwarf Shrub; Climber	2
Dwarf Shrub; Succulent	16
Epiphyte	1
Graminoid	226
Herb; Carnivore	3
Herb; Climber	37
Herb; Creeper;	3
Herb; Geophyte	259
Herb; Parasite	18
Herb; Scrambler	5
Herb; Succulent	119
Shrub	278
Shrub; Climber	41
Shrub; Scrambler	8
Shrub; Succulent	23
Succulent; Climber; Dwarf Shrub	3
Succulent; Climber; Geophyte	4
Succulent; Climber; Herb	26
Succulent; Climber; Shrub	2
Succulent; Geophyte; Herb	29
Succulent; Parasite; Shrub	9
Suffrutex	10
Tree	78
Tree; Succulent	10

Table 29: Red Data species (IUCN) recorded within the region (species that have been listed as Data Deficient have been excluded). The Red Data species recorded within the small immediate area are indicated in bold.

Family	Taxon	IUCN
Alliaceae	*Tulbaghia cominsii*	CR
Anacardiaceae	*Searsia albomarginata*	CR
Geraniaceae	*Pelargonium heterophyllum*	CR
Isoetaceae	*Isoetes wormaldii*	CR
Rutaceae	*Acmadenia kiwanensis*	CR
Acanthaceae	***Metarungia galpinii***	**EN**
Amaryllidaceae	*Cyrtanthus suaveolens*	EN
Orchidaceae	*Habenaria mossii*	EN
Orchidaceae	*Satyrium hallackii subsp. hallackii*	EN
Amaryllidaceae	*Crinum campanulatum*	NT
Crassulaceae	*Cotyledon orbiculata var. flanaganii*	NT
Fabaceae	*Aspalathus intermedia*	NT
Hyacinthaceae	*Albuca bifolia*	NT
Hyacinthaceae	*Merwilla plumbea*	NT
Iridaceae	*Aristea elliptica*	NT
Aizoaceae	*Faucaria subintegra*	VU
Apocynaceae	*Brachystelma caffrum*	VU
Apocynaceae	*Brachystelma sandersonii*	VU
Apocynaceae	*Ceropegia radicans subsp. radicans*	VU
Asteraceae	*Helichrysum oligopappum*	VU
Ericaceae	*Erica glumiflora*	VU
Euphorbiaceae	*Euphorbia flanaganii*	VU
Fabaceae	*Aspalathus katbergensis*	VU
Fabaceae	*Umtiza listeriana*	VU
Hyacinthaceae	*Drimia echinostachya*	VU
Iridaceae	*Syringodea flanaganii*	VU
Ranunculaceae	*Anemone bracteata*	VU

Table 30: Protected species within all relevant Provincial, National and International Legislations.
ECNECO Schedule 3 = Green Font; ECNECO Schedule 4 = Purple Font; TOPS = Highlighted in Red; NFA = Highlighted in Yellow; CITES I = Highlighted in Orange; CITES II = Highlighted in Grey. All conservation important species recorded within the immediate surroundings of the proposed development are indicated in bold.

Abbreviations:
ECNECO: Eastern Cape Nature and Environmental Conservation Ordinance No. 19 of 1974;
NFA: National Forest Act 84 of 1998;
CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora;
TOPS: Threatened and Protected Species in terms of section 56 of the National Environment: Biodiversity Act (NEM:BA) of 2004 (Species list as published within Gazette No. 30568, 14 December 2007)

Family	Species
Zamiaceae	*Encephalartos cycadifolius*
Zamiaceae	*Encephalartos sp.*
Apocynaceae	*Pachypodium succulentum*
Asphodelaceae	*Aloe arborescens*
Asphodelaceae	*Aloe ecklonis*
Asphodelaceae	*Aloe maculata*
Asphodelaceae	***Aloe myriacantha***
Asphodelaceae	*Aloe pluridens*
Asphodelaceae	*Aloe speciosa*
Asphodelaceae	*Aloiampelos ciliaris*
Asphodelaceae	*Aloiampelos tenuior*
Asphodelaceae	*Aloidendron barberae*
Euphorbiaceae	***Euphorbia bupleurifolia***
Orchidaceae	*Acrolophia cochlearis*
Orchidaceae	*Acrolophia micrantha*
Orchidaceae	*Aerangis mystacidii*
Orchidaceae	*Angraecum conchiferum*
Orchidaceae	***Angraecum pusillum***
Orchidaceae	*Angraecum sacciferum*
Orchidaceae	*Bonatea cassidea*
Orchidaceae	*Bonatea porrecta*
Orchidaceae	*Brownleea recurvata*
Orchidaceae	*Bulbophyllum scaberulum*
Orchidaceae	*Calanthe sylvatica*
Orchidaceae	*Cyrtorchis arcuata*
Orchidaceae	*Disa aconitoides*
Orchidaceae	*Disa cephalotes*
Orchidaceae	*Disa cornuta*
Orchidaceae	*Disa crassicornis*
Orchidaceae	*Disa patula*
Orchidaceae	*Disa polygonoides*
Orchidaceae	*Disa pulchra*
Orchidaceae	*Disa sagittalis*
Orchidaceae	*Disa sp.*
Orchidaceae	*Disa stricta*
Orchidaceae	*Disa tysonii*
Orchidaceae	*Disa versicolor*
Orchidaceae	*Disperis cardiophora*
Orchidaceae	*Disperis disaeformis*
Orchidaceae	*Disperis lindleyana*
Orchidaceae	*Disperis micrantha*
Orchidaceae	*Disperis oxyglossa*
Orchidaceae	*Disperis renibractea*
Orchidaceae	*Disperis stenoplectron*
Orchidaceae	*Disperis thorncroftii*
Orchidaceae	***Disperis woodii***
Orchidaceae	***Eulophia hians***
Orchidaceae	*Eulophia macowanii*
Orchidaceae	*Eulophia tenella*
Orchidaceae	*Eulophia zeyheriana*
Orchidaceae	*Habenaria dregeana*
Orchidaceae	*Habenaria epipactidea*
Orchidaceae	*Habenaria falcicornis*
Orchidaceae	*Habenaria laevigata*
Orchidaceae	*Habenaria lithophila*
Orchidaceae	*Habenaria malacophylla*
Orchidaceae	*Habenaria mossii*
Orchidaceae	*Habenaria pseudociliosa*
Orchidaceae	*Habenaria tridens*
Orchidaceae	*Holothrix burchellii*
Orchidaceae	*Holothrix exilis*
Orchidaceae	*Holothrix orthoceras*

Orchidaceae	*Holothrix parviflora*
Orchidaceae	*Holothrix schlechteriana*
Orchidaceae	*Pterygodium magnum*
Orchidaceae	*Rhipidoglossum xanthopollinium*
Orchidaceae	*Satyrium longicauda*
Orchidaceae	*Schizochilus zeyheri*
Orchidaceae	*Tridactyle bicaudata*
Aizoaceae	*Bergeranthus concavus*
Aizoaceae	*Bergeranthus leightoniae*
Aizoaceae	*Carpobrotus deliciosus*
Aizoaceae	*Carpobrotus dimidiatus*
Aizoaceae	*Carpobrotus edulis*
Aizoaceae	*Delosperma frutescens*
Aizoaceae	*Delosperma sp.*
Aizoaceae	*Delosperma tradescantioides*
Aizoaceae	*Drosanthemum floribundum*
Aizoaceae	*Faucaria subintegra*
Aizoaceae	*Mesembryanthemum aitonis*
Aizoaceae	*Mesembryanthemum cordifolium*
Aizoaceae	*Mesembryanthemum sp.*
Aizoaceae	*Ruschia sp.*
Aizoaceae	*Tetragonia decumbens*
Aizoaceae	*Tetragonia echinata*
Aizoaceae	*Trichodiadema orientale*
Amaryllidaceae	*Boophone disticha*
Amaryllidaceae	*Brunsvigia grandiflora*
Amaryllidaceae	*Brunsvigia gregaria*
Amaryllidaceae	***Brunsvigia radulosa***
Amaryllidaceae	***Clivia sp.***
Amaryllidaceae	*Crinum campanulatum*
Amaryllidaceae	*Crinum macowanii*
Amaryllidaceae	***Cyrtanthus brachyscyphus***
Amaryllidaceae	*Cyrtanthus clavatus*
Amaryllidaceae	*Cyrtanthus contractus*
Amaryllidaceae	*Cyrtanthus epiphyticus*
Amaryllidaceae	*Cyrtanthus flanaganii*
Amaryllidaceae	*Cyrtanthus helictus*
Amaryllidaceae	*Cyrtanthus loddigesianus*
Amaryllidaceae	*Cyrtanthus mackenii*
Amaryllidaceae	*Cyrtanthus macowanii*
Amaryllidaceae	***Cyrtanthus obliquus***

Amaryllidaceae	***Cyrtanthus sanguineus***
Amaryllidaceae	*Cyrtanthus smithiae*
Amaryllidaceae	*Cyrtanthus suaveolens*
Amaryllidaceae	*Cyrtanthus tuckii*
Amaryllidaceae	***Haemanthus albiflos***
Amaryllidaceae	*Haemanthus humilis*
Amaryllidaceae	*Nerine angustifolia*
Amaryllidaceae	*Nerine filifolia*
Amaryllidaceae	*Nerine undulata*
Amaryllidaceae	***Scadoxus membranaceus***
Amaryllidaceae	*Scadoxus multiflorus*
Amaryllidaceae	*Scadoxus puniceus*
Anacampse-rotaceae	*Anacampseros rufescens*
Apocynaceae	***Asclepias albens***
Apocynaceae	*Asclepias crispa*
Apocynaceae	*Asclepias expansa*
Apocynaceae	*Asclepias fulva*
Apocynaceae	*Asclepias gibba*
Apocynaceae	*Asclepias hastata*
Apocynaceae	*Asclepias monticola*
Apocynaceae	*Asclepias multicaulis*
Apocynaceae	*Asclepias navicularis*
Apocynaceae	***Asclepias peltigera***
Apocynaceae	*Asclepias sp.*
Apocynaceae	*Aspidoglossum carinatum*
Apocynaceae	*Aspidoglossum fasciculare*
Apocynaceae	*Aspidoglossum flanaganii*
Apocynaceae	*Aspidoglossum gracile*
Apocynaceae	*Aspidoglossum heterophyllum*
Apocynaceae	*Aspidoglossum ovalifolium*
Apocynaceae	*Aspidoglossum virgatum*
Apocynaceae	*Aspidonepsis diploglossa*
Apocynaceae	*Astephanus zeyheri*
Apocynaceae	*Brachystelma caffrum*
Apocynaceae	*Brachystelma meyerianum*
Apocynaceae	*Brachystelma rubellum*
Apocynaceae	*Brachystelma sandersonii*
Apocynaceae	*Ceropegia ampliata*
Apocynaceae	*Ceropegia bowkeri*
Apocynaceae	*Ceropegia carnosa*
Apocynaceae	*Ceropegia crassifolia*
Apocynaceae	*Ceropegia haygarthii*

Apocynaceae	*Ceropegia linearis*
Apocynaceae	*Ceropegia meyeri*
Apocynaceae	*Ceropegia radicans*
Apocynaceae	*Ceropegia stapeliiformis*
Apocynaceae	*Cynanchum ellipticum*
Apocynaceae	*Cynanchum gerrardii*
Apocynaceae	***Cynanchum natalitium***
Apocynaceae	*Miraglossum anomalum*
Apocynaceae	*Orbea variegata*
Apocynaceae	*Orbea verrucosa*
Apocynaceae	*Pachycarpus appendiculatus*
Apocynaceae	***Pachycarpus campanulatus***
Apocynaceae	*Pachycarpus concolor*
Apocynaceae	*Pachycarpus dealbatus*
Apocynaceae	*Pachycarpus grandiflorus*
Apocynaceae	*Pachycarpus linearis*
Apocynaceae	*Pachycarpus reflectens*
Apocynaceae	*Pachycarpus rigidus*
Apocynaceae	*Pachycarpus vexillaris*
Apocynaceae	*Periglossum angustifolium*
Apocynaceae	*Raphionacme flanaganii*
Apocynaceae	*Raphionacme hirsuta*
Apocynaceae	*Riocreuxia flanaganii*
Apocynaceae	*Riocreuxia polyantha*
Apocynaceae	*Riocreuxia torulosa*
Apocynaceae	*Schizoglossum aschersonianum*
Apocynaceae	*Schizoglossum atropurpureum*
Apocynaceae	*Schizoglossum cordifolium*
Apocynaceae	*Schizoglossum hamatum*
Apocynaceae	*Schizoglossum linifolium*
Apocynaceae	*Sisyranthus barbatus*
Apocynaceae	*Sisyranthus compactus*
Apocynaceae	*Sisyranthus imberbis*
Apocynaceae	*Sisyranthus randii*
Apocynaceae	*Stapelia hirsuta*
Apocynaceae	*Strophanthus speciosus*
Apocynaceae	*Woodia mucronata*
Apocynaceae	*Xysmalobium involucratum*
Apocynaceae	*Xysmalobium orbiculare*
Apocynaceae	*Xysmalobium parviflorum*
Apocynaceae	*Xysmalobium undulatum*

Aquifoliaceae	*Ilex mitis*
Asphodelaceae	*Gasteria acinacifolia*
Asphodelaceae	*Gasteria bicolor*
Asphodelaceae	*Gasteria excelsa*
Asphodelaceae	***Gasteria sp.***
Asphodelaceae	*Haworthia angustifolia*
Asphodelaceae	***Haworthia cooperi***
Asphodelaceae	***Haworthia cymbiformis***
Asphodelaceae	*Haworthia mucronata*
Asphodelaceae	***Haworthia sp.***
Asphodelaceae	*Haworthiopsis coarctata*
Asphodelaceae	*Haworthiopsis reinwardtii*
Asphodelaceae	*Kniphofia bruceae*
Asphodelaceae	*Kniphofia citrina*
Asphodelaceae	*Kniphofia fibrosa*
Asphodelaceae	*Kniphofia linearifolia*
Asphodelaceae	*Kniphofia parviflora*
Asphodelaceae	*Kniphofia rooperi*
Asphodelaceae	*Kniphofia sp.*
Asphodelaceae	*Kniphofia triangularis*
Asphodelaceae	*Kniphofia uvaria*
Crassulaceae	*Crassula perfoliata*
Crassulaceae	*Kalanchoe thyrsiflora*
Cunoniaceae	*Cunonia capensis*
Cyatheaceae	*Alsophila capensis*
Dioscoreaceae	*Dioscorea cotinifolia*
Dioscoreaceae	*Dioscorea dregeana*
Dioscoreaceae	*Dioscorea retusa*
Dioscoreaceae	*Dioscorea rupicola*
Dioscoreaceae	*Dioscorea sp.*
Dryopteridaceae	*Rumohra adiantiformis*
Fabaceae	*Erythrina humeana*
Gesneriaceae	*Streptocarpus meyeri*
Gesneriaceae	*Streptocarpus primulifolius*
Gesneriaceae	*Streptocarpus rexii*
Iridaceae	***Aristea abyssinica***
Iridaceae	*Aristea anceps*
Iridaceae	*Aristea capitata*
Iridaceae	*Aristea ecklonii*
Iridaceae	*Aristea elliptica*
Iridaceae	***Aristea schizolaena***
Iridaceae	*Bobartia gracilis*

Iridaceae	***Bobartia orientalis***
Iridaceae	*Chasmanthe aethiopica*
Iridaceae	*Crocosmia aurea*
Iridaceae	*Dierama atrum*
Iridaceae	*Dierama igneum*
Iridaceae	*Dierama mossii*
Iridaceae	*Dierama pulcherrimum*
Iridaceae	*Dierama sp.*
Iridaceae	***Dietes bicolor***
Iridaceae	*Dietes grandiflora*
Iridaceae	*Dietes iridioides*
Iridaceae	***Freesia laxa***
Iridaceae	*Gladiolus dalenii*
Iridaceae	*Gladiolus ecklonii*
Iridaceae	*Gladiolus gueinzii*
Iridaceae	*Gladiolus longicollis*
Iridaceae	***Gladiolus ochroleucus***
Iridaceae	*Gladiolus oppositiflorus*
Iridaceae	***Gladiolus permeabilis***
Iridaceae	*Gladiolus pubigerus*
Iridaceae	***Gladiolus wilsonii***
Iridaceae	*Hesperantha bachmannii*
Iridaceae	*Hesperantha coccinea*
Iridaceae	*Hesperantha huttonii*
Iridaceae	*Hesperantha longituba*
Iridaceae	*Hesperantha pulchra*
Iridaceae	*Hesperantha radiata*
Iridaceae	*Hesperantha sp.*
Iridaceae	*Moraea elliotii*
Iridaceae	*Moraea graminicola*
Iridaceae	*Moraea polystachya*
Iridaceae	*Moraea reticulata*
Iridaceae	*Moraea stricta*
Iridaceae	*Romulea longipes*
Iridaceae	*Syringodea bifucata*
Iridaceae	*Syringodea flanaganii*
Iridaceae	*Tritonia disticha*
Iridaceae	***Tritonia gladiolaris***
Iridaceae	*Tritonia laxifolia*
Iridaceae	*Tritonia sp.*
Iridaceae	*Tritoniopsis caffra*
Iridaceae	*Watsonia amatolae*

Iridaceae	*Watsonia angusta*
Iridaceae	*Watsonia pillansii*
Orchidaceae	*Bonatea speciosa*
Orchidaceae	*Brachycorythis ovata*
Orchidaceae	*Brownleea coerulea*
Orchidaceae	*Brownleea parviflora*
Orchidaceae	*Eulophia ovalis*
Orchidaceae	*Eulophia speciosa*
Orchidaceae	*Eulophia streptopetala*
Orchidaceae	*Habenaria arenaria*
Orchidaceae	***Habenaria clavata***
Orchidaceae	*Mystacidium capense*
Orchidaceae	*Mystacidium flanaganii*
Orchidaceae	*Mystacidium venosum*
Orchidaceae	*Orthochilus aculeatus*
Orchidaceae	*Orthochilus foliosus*
Orchidaceae	*Polystachya ottoniana*
Orchidaceae	*Polystachya pubescens*
Orchidaceae	*Pterygodium nigrescens*
Orchidaceae	*Satyrium cristatum*
Orchidaceae	*Satyrium hallackii*
Orchidaceae	*Satyrium membranaceum*
Orchidaceae	*Satyrium neglectum*
Orchidaceae	*Satyrium odorum*
Orchidaceae	*Satyrium parviflorum*
Orchidaceae	*Satyrium sphaerocarpum*
Orchidaceae	*Stenoglottis fimbriata*
Proteaceae	*Protea acaulos*
Proteaceae	*Protea caffra*
Proteaceae	*Protea simplex*
Proteaceae	*Protea subvestita*
Pteridaceae	*Adiantum capillus-veneris*
Pteridaceae	*Adiantum poiretii*
Rutaceae	*Acmadenia kiwanensis*
Rutaceae	*Agathosma ovata*
Rutaceae	*Agathosma peglerae*
Rutaceae	*Calodendrum capense*
Rutaceae	*Clausena anisata*
Rutaceae	*Diosma oppositifolia*
Rutaceae	*Ptaeroxylon obliquum*
Rutaceae	*Vepris lanceolata*
Rutaceae	*Vepris natalensis*

Rutaceae	*Vepris sp.*
Rutaceae	***Zanthoxylum capense***
Rutaceae	*Zanthoxylum davyi*
Scrophulariaceae	***Diascia personata***
Scrophulariaceae	*Diascia rigescens*
Strelitziaceae	*Strelitzia reginae*
Hyacinthaceae	*Merwilla plumbea*
Celastraceae	*Catha edulis*
Pittosporaceae	*Pittosporum viridiflorum*
Podocarpaceae	*Podocarpus latifolius*
Sapotaceae	*Mimusops caffra*
Sapotaceae	***Sideroxylon inerme***

Asphodelaceae	*Aloe ferox*
Cyatheaceae	*Alsophila dregei*
Euphorbiaceae	***Euphorbia bubalina***
Euphorbiaceae	*Euphorbia flanaganii*
Euphorbiaceae	***Euphorbia pentagona***
Euphorbiaceae	*Euphorbia spartaria*
Euphorbiaceae	*Euphorbia stellata*
Euphorbiaceae	***Euphorbia tetragona***
Euphorbiaceae	***Euphorbia tirucalli***
Euphorbiaceae	***Euphorbia triangularis***
Fabaceae	*Dalbergia multijuga*
Fabaceae	***Dalbergia obovata***

Conservation Planning / Context

National Protected Areas Expansion Strategy

Focus areas for land-based protected area expansion are large, intact and unfragmented areas of high importance for biodiversity representation and ecological persistence, suitable for the creation or expansion of large protected areas. The focus areas were identified through a systematic biodiversity planning process undertaken as part of the development of the National Protected Area Expansion Strategy 2008 (NPAES). They present the best opportunities for meeting the ecosystem-specific protected area targets set in the NPAES and were designed with a strong emphasis on climate change resilience and requirements for protecting freshwater ecosystems. These areas should not be seen as future boundaries of protected areas, as in many cases only a portion of a particular focus area would be required to meet the protected area targets set in the NPAES. They are also not a replacement for fine-scale planning which may identify a range of different priority sites based on local requirements, constraints, and opportunities.

According to the NPAES spatial data (Holness, 2010), the proposed development footprint is located well outside of any Focus Area (Figure 9) with closest focus area located approximately 14.34km to the north-west (Bisho Kei Focus Area). The nearest Informal Protected Area is located approximately 1.96km to the east (Lombardy Private Nature Reserve (Figure 11). Subsequently no NPAES Focus Areas will be impacted by the borrow pit. The closest Formal Protected Area is the Nahoon Point to Gonubie Point Marine Protected Area (MPA) which is located 7.85km south-east of the proposed Wansley footprint.

Subsequently the proposed new Wansley mining footprint is located well outside of any protected or potentially protected area and will have no impact on such areas.

National Level of Conservation Priorities (Threatened Ecosystems)

The vegetation types of South Africa have been categorized according to their conservation status which is, in turn, assessed according to the degree of transformation and rates of conservation. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. On a national scale, these thresholds are as depicted in the table below, as determined by the best available scientific approaches (Driver et al. 2005). The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver et al. 2005).

Table 31: Determining ecosystem status (from Driver et al. 2005). *BT = biodiversity target (the minimum conservation requirement.

Habitat remaining (%)		
80–100	least threatened	LT
60–80	vulnerable	VU
*BT–60	endangered	EN
0–*BT	critically endangered	CR

A national process has been undertaken to identify and list threatened ecosystems that are currently under threat of being transformed by other land uses. The first national list of threatened terrestrial ecosystems for South Africa was gazetted on 9 December 2011 (National Environmental Management: Biodiversity Act or NEMBA: National list of ecosystems that are threatened and in need of protection, G 34809, GoN 1002, 9 December 2011). The purpose of listing threatened ecosystems is primarily to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function, and composition of threatened ecosystems (SANBI, 2011). The NEMBA provides for listing of threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. There are four main types of implications of listing ecosystems:

» Planning related implications which are linked to the requirement in the Biodiversity Act (Act 10 of 2004) for listed ecosystems to be taken into account in municipal IDPs and SDFs;
» Environmental authorisation implications in terms of NEMA and the EIA regulations;
» Proactive management implications in terms of the National Biodiversity Act;
» Monitoring and reporting implications in terms of the Biodiversity Act.

According to Mucina and Rutherford (2006), this vegetation type is classified as Least Threatened with a conservation target of 19%. Currently, only 1% of this vegetation type is conserved (within 20 local-authority and provincial nature reserves as well as in the Greater Addo Elephant National Park). Approximately 12% of this vegetation type has recently been altered by cultivation, 1% by plantation forestry and 4% by urbanisation. According to land-cover data, at least 7% consists of degraded vegetation (Mucina and Rutherford, 2006). Mucina and Rutherford (2006) furthermore state that it is however, difficult to determine the proportion of the vegetation that is in a secondary state, since land-cover data do not distinguish between primary and secondary vegetation.

Furthermore, this area is not listed within the Threatened Ecosystem List (NEMA:BA) (Figure 9).

It is highly unlikely that this development will have an impact on the status of the Ecosystem as well as Vegetation Type Status due to the extent of the development as well as the presence of already disturbed areas within the footprint (almost the entire proposed footprint is located on secondary vegetation that have established on old cultivated lands).

NFEPA (National Freshwater Ecosystem Priority Areas)

The National Freshwater Ecosystem Priority Area (NFEPA) project (Nel et al., 2011), is the first formally adopted national freshwater conservation plan that provides strategic spatial priorities for conserving the country's freshwater ecosystems and supporting the sustainable use of water resource units that includes rivers, wetlands and estuaries.

No wetlands have been identified within the 500m radius of the proposed new mining footprint, with the nearest wetland FEPA (a channelled valley-bottom wetland) located approximately 1.35 km north-west of the site (Figure 10).

Furthermore, the non-perennial Qinira River is not classified as a river FEPA and has been categorised as category D (Largely Modified) River according to its Present Ecological Status (PES), with a moderate (C) Ecological Importance and Sensitivity.

Eastern Cape Biodiversity Conservation Plan (ECBCP): Critical Biodiversity Areas and Broad Ecological Processes

The Eastern Cape Biodiversity Conservation Plan (ECBCP) (Hayes et al., 2007; Berliner & Desmet, 2007) addresses the urgent need for integrative systematic conservation planning and capacity building for land-use decision making in the Eastern Cape. The ECBCP is a systematic conservation plan that identifies and spatially maps Critical Biodiversity Areas (CBAs) required for biodiversity persistence and to inform protected area planning and rural land-use planning in the Province. For successful implementation of the ECBCP, the CBAs need to be incorporated at all levels of spatial development planning.

Critical Biodiversity Areas (CBAs) are terrestrial and aquatic features in the landscape that are critical for conserving biodiversity and maintaining ecosystem functioning.

The ECBCP developed two maps, one showing terrestrial (land-based) CBAs, and the other showing aquatic (freshwater) CBAs. The map of terrestrial CBAs was compiled by undertaking a systematic biodiversity planning analysis and adding all biodiversity priority areas identified by other systematic biodiversity planning projects (such as STEP) in the Province. Aquatic CBAs were identified on the basis of sub-quaternary catchments, addressing the linkages between catchments, important rivers and sensitive estuaries. Priorities were identified through a systematic conservation planning analysis. Refer to Table 32 below for a summary of the various biodiversity features that were used to define the terrestrial and aquatic CBAs.

Table 32: Criteria used in the mapping of CBAs and other categories within the ECBCP

CRITERIA USED TO MAP CBAs AND OTHER CATEGORIES IN THE ECBCP		
CATEGORY	**CODE**	**FEATURES USED TO DEFINE CATEGORIES**
Protected Areas		
Protected Area 1	PA1	Statutory protected areas. They include all national parks and provincial nature reserves.
Protected Area 2	PA2	Non-statutory protected areas: municipal and private conservation areas
Terrestrial Critical Biodiversity Areas:		
Terrestrial CBA1	T1	Critically endangered vegetation types (ecosystems) identified though ECBCP the systematic conservation assessment.
		Critically endangered vegetation types from STEP.
		Critically endangered forest patches in terms of the National Forest Assessment.
		Areas essential for meeting biodiversity targets for biodiversity features (SA vegetation types, expert mapped priority areas)
		KZN systematic conservation planning priorities
		Forest clusters identified as critical in the forestry planning process (Berliner et al 2006)
Terrestrial CBA2	T2	Endangered vegetation types identified through the ECBCP systematic conservation assessment.
		Endangered vegetation types from STEP.
		Endangered forest patches in terms of the National Forest Assessment.
		All expert-mapped areas less than 25 000ha in size (includes expert data from this project, STEP birds, SKEP, Wild Coast, Pondoland and marine studies).
		All other forest clusters (includes 500m buffers).
		1km coastal buffer strip
	C1	Ecological corridors identified in other studies (e.g. from STEP, Wild Coast, Pondoland, WMA 12 SEA, etc.) and corridors mapped by experts.
	C2	Ecological corridors identified by the ECBCP using an integrated corridor design for the whole Province.
Aquatic Critical Biodiversity Areas		
Aquatic CBA 1	A1	Critically important river sub-catchments, and all wetlands.
	E1	Critically important estuaries.
Aquatic CBA 2	A2a	Important sub-catchments.
	A2b	Free-flowing rivers important for fish migration.
	E2	Important estuaries.
Aquatic CBA 3	A3a	Hydrological primary catchment management areas for E1 estuaries.
	A3b	Hydrological primary catchment management areas for E2 estuaries.

Other Map Categories		
Other Natural Areas	ONA T3	Vulnerable vegetation types identified through the ECBCP systematic conservation assessment.
		Vulnerable vegetation types from STEP
	ONA	All remaining natural areas not included in the above CBA categories.
Transformed Land	TF	Urban and rural settlements, cultivated lands and plantations

In order to facilitate the use of the ECBCP information, a land management objectives-based approach has been adopted. This approach rests on the concept of Biodiversity Land Management Classes (BLMCs). Each BLMC sets out the desired ecological state that an area should be kept in to ensure biodiversity persistence. Refer to Table 33 below for a description of the different BLMCs and how they relate to the various CBAs.

Terrestrial BLMCs set out the desired ecological state of a parcel of land. Only land use types that are compatible with maintaining this desired state should be allowed. Aquatic BLMCs set out suggested catchment transformation thresholds. These are a set of recommended permissible upper limits to the loss of natural vegetation cover in each sub-quaternary catchment.

Table 33: The different Biodiversity Land Management Classes (BLMCs) and how they relate to the CBAs

CATEGORY	CODE	BLMC	
Terrestrial CBAs and BLMCs			
Protected Area 1	PA1	BLMC 1	Natural Landscapes
Protected Area 2	PA2		
Terrestrial CBA1 (not degraded)	T1		
Terrestrial CBA1 (degraded)	T1	BLMC 2	Near-natural Landscapes
Terrestrial CBA2	T2		
	C1		
	C2		
Other Natural Areas	ONA T3	BLMC 3	Functional Landscapes
	ONA		
Transformed Land	TF	BLMC 4	Transformed Landscapes
Aquatic CBAs and BLMCs			
Aquatic CBA 1	A1	ABLMC 1	Natural State
	E1		
	A3a		
Aquatic CBA 2	A2a	ABLMC 2a	Near Natural State
	E2		
Aquatic CBA 3	A3b		
Aquatic CBA 2	A2b	ABLMC 2b	Near Natural State

Within the ECBCP various land use objectives have been set out for each terrestrial BLMC. A decision to approve a land use change should be guided by the objective of the BLMC for that land. In the same way, forward planning in an area should also be guided by the objectives of the BLMCs for that area. Table 34 summarises the recommended land use objectives for each BLMC.

Table 34: Terrestrial BLMCs and their recommended land use objectives

BLMC	Recommended land use objectives
BLMC 1: Natural Landscapes	Maintain biodiversity in as natural state as possible. Manage for no biodiversity loss.
BLMC 2: Near Natural Landscapes	Maintain biodiversity in near natural state with minimal loss of ecosystem integrity. No transformation of natural habitat should be permitted.
BLMC 3: Functional Landscapes	Manage for sustainable development, keeping natural habitat intact in wetlands (including wetland buffers) and riparian zones. Environmental authorisations should support ecosystem integrity.
BLMC 4: Transformed Landscapes	Manage for sustainable development.

In terms of the aquatic BLMCs land-use planning needs to take into account the linkages between catchments, important rivers and sensitive estuaries. Ad hoc land transformation can result in fragmented landscapes and loss of ecosystem connectivity. When landscapes are transformed beyond certain critical thresholds, ecological processes such as fire and the water cycle show dramatic changes. Transformation of catchments also results in loss in stream flow and a decline in water quality (through increased sedimentation and agricultural chemicals run off). This can damage estuaries, many of which are important CBAs. The ECBCP recommends limits (thresholds) to the total amount of land transformation that should be allowed in an ABLMC 1 and 2, if biodiversity is to be conserved. The goal is to maintain sufficiently large intact and well-connected habitat patches in each sub-quaternary catchment, to prevent the consequences outlined above. Table 35 below summarises the recommended transformation thresholds for each BLMC.

Table 35: Aquatic BLMCs and their recommended transformation thresholds

BLMC	CBA CODE	Description of CBAs	ABLMC Transformation Threshold
ABLMC 1	A1; A3a	Critically important river sub-catchments; Priority primary catchments for E1 estuaries	Less than 10 % of total area of sub-quaternary catchment
ABLMC 2a	A2a; A3b	Important sub-catchments, Primary catchment management areas for E2 estuaries.	Less than 15 % of total area of sub-quaternary catchment
ABLMC 2b	A2b	Catchments of free-flowing rivers important for fish migration	Less than 20 % of total area of sub-quaternary catchment

Hayes *et al*. (2007) made the following cautionary statements:

» Always verify the information with a site visit: The ECBCP is based on the best available data and methods, but it **is not a fine-scale plan**. In addition, the data is **not always 100% accurate**. This means that when a development application is assessed, or when a forward plan is developed, it is **crucially important to conduct site visits** to check the information on the ground.

» The ECBCP is not a substitute for a full evaluation: These guidelines will help with identifying appropriate land uses for each BLMC. However, land use decision-making for biodiversity conservation is complex and involves many variables that cannot be fully represented within a simple matrix. There is still a need to assess each application and proposed land use type fully against appropriate objectives and criteria.
» The ECBCP should not be used for urban and fine-scale planning: The ECBCP provides a broad framework to assess proposals for land use change and to develop forward plans and fine scale plans. The information it contains is not at a scale suitable for fine scale planning and urban planning."

Description of Critical Biodiversity Areas within the project site (following a field survey).

» Terrestrial Critical Biodiversity Areas (Figure 10):

The entire project site is located within a CBA2 due to the fact that this area forms part of an extensive ecological corridor as identified by the ECBCP. Furthermore, this CBA 2 area is regarded as a near-natural landscape which falls within the BLMC 2.

However, during the sit visit it was found that a large portion of the Wansley property as well as some of the surrounding landscape do not meet the criteria that justify the area as a CBA2. A portion of the property have already been severely transformed due to current mining activities and meets the criteria for Transformed Land Classification. Furthermore, the bulk of the property is covered by a secondary (degraded) vegetation cover which have established on old cultivated area (old ploughing contours are still visible). These areas should rather be regarded as Other Natural Areas.

The Qinira River and its riparian fringe however was found to be in a near-natural state and do indeed function as an important corridor for species movement. The functionality of a corridor is however, largely dependent on the connectivity of the landscape. This section of the Qinira River has a mostly unbroken longitudinal connectivity and will allow for species movement up and down this section of the Qinira River. However, lateral connectivity along the Qinira River (including the Wansley property) have been largely impacted. Numerous fences, roads, infrastructure and cultivation have fractured the area influencing lateral connectivity. Within the Wansley property the disturbed nature of the bulk of the vegetation cover, fencing around the property, as well as current anthropogenic activities (including current mining activities) have significantly reduced the area outside of the riparian fringe's capability of functioning as an important corridor.

Subsequently it can be concluded that the Qinira River and its associated riparian fringe as well as the abutting natural thicket meet the criteria set out for a CBA2 Corridor.

However, the remainder of the property do not meet the criteria and from field observations should rather be regarded as an Other Natural Areas with some Transformed Land (as described above).
The maintenance of the riparian fringes is critically important for the sustainable functioning of this river as an ecological corridor. As such the Qinira River as well as the delineated riparian fringe and adjacent remaining natural thicket have been classified as High Sensitive Areas and are regarded as No-Go Areas for the proposed development. Furthermore, in order to ensure that this area's functionality (as an ecological corridor) is preserved, and to allow some lateral movement to and from the Qinira River, a Buffer Area of 100m has been recommended and should also be regarded as a No-Go Area for the proposed development. The current layout of the new mining footprint is situated outside of these High Sensitive (No-Go Areas) and will not contribute to a further reduction in landscape connectivity.

» Aquatic Critical Biodiversity Areas (Figure 11):

The entire project site is located within an Aquatic CBA3_A3b due to the fact that this area falls within hydrological primary catchment management area for an Aquatic CBA2_E2 Estuary.

The proposed new Wansley mining footprint is located outside of the primary hydrological features of this catchment area, namely the Qinira River. As already mentioned, the Qinira River as well as its riparian fringe and the abutting natural thicket has been classified as a No-Go Area (High Sensitive) as well as a 100m Buffer Area around these features. This area has been classified as a No-Go Area in order to preserve the integrity and functionality of this aquatic resource.

The proposed new Wansley mining footprint is located predominantly within two micro-catchments (Refer to Figure 13). Surface drainage within these micro-catchments as well as other micro-catchments within the Wansley property have been largely modified with numerous gravel dams located within the catchment areas as well directly within drainage systems. Furthermore, these micro-catchments have been largely transformed by the current mining activities, roads, building infrastructure and historical cultivation practices. Even though, two drainage lines will be impacted by the proposed expansion of the mining footprint, it is highly unlikely that this expansion will significantly impact hydrological nature of the important downstream aquatic resources maintaining the Qinira Estuary. Furthermore, with the implementation of mitigation measures impacts such as pollution and sedimentation will be avoided within this downstream aquatic resource.

As such it can be concluded that the proposed development will not impact the functioning of the CBA_A3b primary catchment area and subsequently not the Qinira Estuary (CBA2_E2).

Appendix 6. Specialist CV.

CURRICULUM VITAE:

Gerhard Botha

Name:	:	Gerhardus Alfred Botha
Date of Birth	:	11 April 1986
Identity Number	:	860411 5136 088
Postal Address	:	PO Box 12500 Brandhof 9324
Residential Address	:	3 Jock Meiring Street Park West Bloemfontein 9301
Cell Phone Number	:	084 207 3454
Email Address	:	gabotha11@gmail.com
Profession/Specialisation	:	Ecological and Biodiversity Consultant
Nationality:	:	South African
Years Experience:	:	8
Bilingualism	:	Very good – English and Afrikaans

Professional Profile:

Gerhard is a Managing Director of Nkurenkuru Ecology and Biodiversity (Pty) Ltd. He has a BSc Honours degree in Botany from the University of the Free State Province and is currently completing a MSc Degree in Botany. He began working as an environmental specialist in 2010 and has since gained extensive experience in conducting ecological and biodiversity assessments in various development field, especially in the fields of conventional as well as renewable energy generation, mining and infrastructure development. Gerhard is a registered Professional Natural Scientist (Pr. Sci. Nat.)

Key Responsibilities:

Specific responsibilities as an Ecological and Biodiversity Specialist include, inter alia, professional execution of specialist consulting services (including flora, wetland and fauna studies, where required), impact assessment reporting, walk through surveys/ground-truthing to inform final design, compilation of management plans, compliance monitoring and audit reporting, in-house ecological awareness training to on-site personnel, and the development of project proposals for procuring new work/projects.

Skills Base and Core Competencies

- Research Project Management
- Botanical researcher in projects involving the description of terrestrial and coastal ecosystems.
- Broad expertise in the ecology and conservation of grasslands, savannahs, karroid wetland, and aquatic ecosystems.
- Ecological and Biodiversity assessments for developmental purposes (BAR, EIA), with extensive knowledge and experience in the renewable energy field (Refer to Work Experiences and References)
- Over 3 years of avifaunal monitoring and assessment experience.

- Mapping and Infield delineation of wetlands, riparian zones and aquatic habitats (according to methods stipulated by DWA, 2008) within various South African provinces of KwaZulu-Natal, Mpumalanga, Free State, Gauteng and Northern Cape Province for inventory and management purposes.
- Wetland and aquatic buffer allocations according to industry best practice guidelines.
- Working knowledge of environmental planning policies, regulatory frameworks, and legislation
- Identification and assessment of potential environmental impacts and benefits.
- Assessment of various wetland ecosystems to highlight potential impacts, within current and proposed landscape settings, and recommend appropriate mitigation and offsets based on assessing wetland ecosystem service delivery (functions) and ecological health/integrity.
- Development of practical and achievable mitigation measures and management plans and evaluation of risk to execution
- Qualitative and Quantitative Research
- Experienced in field research and monitoring
- Working knowledge of GIS applications and analysis of satellite imagery data
- Completed projects in several Provinces of South Africa and include a number of projects located in sensitive and ecological unique regions.

Education and Professional Status

Degrees:

- *2015:* Currently completing a M.Sc. degree in Botany (Vegetation Ecology), University of the Free State, Bloemfontein, RSA.
- *2009:* B.Sc. Hons in Botany (Vegetation Ecology), University of the Free State, Bloemfontein, RSA.
- *2008:* B.Sc. in Zoology and Botany, University of the Free State, University of the Free State, Bloemfontein, RSA.

Courses:

- *2013*: Wetland Management (ecology, hydrology, biodiversity, and delineation) – University of the Free State accredited course.
- *2014*: Introduction to GIS and GPS (Code: GISA 1500S) – University of the Free State accredited course.

Professional Society Affiliations:

- The South African Council of Natural Scientific Professions: Pr. Sci. Nat. Reg. No. 400502/14 (Botany and Ecology).

Employment History

- December 2017 – Current: Nkurenkuru Ecology and Biodiversity (Pty) Ltd
- 2016 – November 2017: ECO-CARE Consultancy
- *2015 - 2016*: Ecologist, Savannah Environmental (Pty) Ltd
- *2013 – 2014*: Working as ecologist on a freelance basis, involved in part-time and contractual positions for the following companies
  - Enviroworks (Pty) Ltd
  - Greenmined (Pty) Ltd
  - Eco-Care Consultancy (Pty) Ltd

- Enviro-Niche Consulting (Pty) Ltd
- Savannah Environmental (Pty) Ltd
- Esicongweni Environmental Services (EES) cc

- *2010 - 2012*: Enviroworks (Pty) Ltd

Publications

Publications:

- Botha, G.A. & Du Preez, P.J. 2015. A description of the wetland and riparian vegetation of the Nxamasere palaeo-river's backflooded section, Okavango Delta, Botswana. S. *Afr. J. Bot*., **98**: 172-173.

Congress papers/posters/presentations:

- Botha, G.A. 2015. A description of the wetland and riparian vegetation of the Nxamasere palaeo-river's backflooded section, Okavango Delta, Botswana. 41st Annual Congress of South African Association of Botanists (SAAB). Tshipise, 11-15 Jan. 2015.
- Botha, G.A. 2014. A description of the vegetation of the Nxamasere floodplain, Okavango Delta, Botswana. 10st Annual University of Johannesburg (UJ) Postgraduate Botany Symposium. Johannesburg, 28 Oct. 2014.

Other

- Guest speaker at IAIAsa Free State Branch Event (29 March 2017)
- Guest speaker at the University of the Free State Province: Department of Plant Sciences (3 March 2017):

References:

- Christine Fouché
  Manager: Greenmined (Pty) LTD
  Cell: 084 663 2399
- Professor J du Preez
  Senior lecturer: Department of Plant Sciences
  University of the Free State
  Cell: 082 376 4404

Appendix 7. Specialist's Work Experience and References

WORK EXPERIENCES

&

References

Gerhard Botha

ECOLOGICAL RELATED STUDIES AND SURVEYS

Date Completed	Project Description	Type of Assessment/Study	Client
2019	Sirius Three Solar PV Facility near Upington, Northern Cape	Ecological Assessment (Basic Assessment)	Aurora Power Solutions
2019	Sirius Four Solar PV Facility near Upington, Northern Cape	Ecological Assessment (Basic Assessment)	Aurora Power Solutions
2019	Lichtenburg 1 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Lichtenburg 2 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Lichtenburg 3 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Ecological Assessment (Basic Assessment)	Moeding Solar
2019	Expansion of the Raumix Aliwal North Quarry, Eastern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	GreenMined
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Faunal and Flora Rescue and Protection Plan	Zevobuzz
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Zevobuzz
2018	Proposed Kruisvallei Hydroelectric Power Generation Scheme in the Ash River, Free State Province	Ecological Assessment (Basic Assessment)	Zevobuzz
2018	Proposed Zonnebloem Switching Station (132/22kV) and 2X Loop-in Loop-out Power Lines (132kV), Mpumalanga Province	Ecological Assessment (Basic Assessment)	Eskom
2018	Clayville Thermal Plant within the Clayville Industrial Area, Gauteng Province	Ecological Comments Letter	Savannah Environmental
2018	Iziduli Emoyeni Wind Farm near Bedford, Eastern Cape Province	Ecological Assessment (Re-assessment)	Emoyeni Wid Farm Renewable Energy
2018	Msenge Wind Farm near Bedford, Eastern Cape Province	Ecological Assessment (Re-assessment)	Amakhala Emoyeni Renewable Energy
2017	H2 Energy Power Station near Kwamhlanga, Mpumalanga Province	Ecological Assessment (Scoping and EIA phase assessments)	Eskom
2017	Karusa Wind Farm (Phase 1 of the Hidden Valley Wind Energy Facility near Sutherland, Northern Cape Province)	Ecological Assessment (Re-assessment)	ACED Renewables Hidden Valley
2017	Soetwater Wind Farm (Phase 2 of the Hidden Valley Wind Energy Facility near Sutherland, Northern Cape Province)	Ecological Assessment (Re-assessment)	ACED Renewables Hidden Valley
2017	S24G for the unlawful commencement or continuation of activities within a watercourse, Honeydew, Gauteng Province	Ecological Assessment	Savannah Environmental

2016 - 2017	Noupoort CSP Facility near Noupoort, Northern Cape Province	Ecological Assessment (Scoping and EIA phase assessments)	Cresco
2016	Buffels Solar 2 PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Kabi Solar
2016	Buffels Solar 1 PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Kabi Solar
2016	132kV Power Line and On-Site Substation for the Authorised Golden Valley II Wind Energy Facility near Bedford, Eastern Cape Province	Ecological Assessment (Basic Assessment)	Terra Wind Energy
2016	Kalahari CSP Facility: 132kV Ferrum–Kalahari–UNTU & 132kV Kathu IPP–Kathu 1 Overhead Power Lines, Kathu, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Kathu Solar Park
2016	Kalahari CSP Facility: Access Roads, Kathu, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Kathu Solar Park
2016	Karoshoek Solar Valley Development – Additional CSP Facility including tower infrastructure associated with authorised CSP Site 2 near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Karoshoek Solar Valley Development –Ilanga CSP 7 and 8 Facilities near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Karoshoek Solar Valley Development –Ilanga CSP 9 Facility near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Lehae Training Academy and Fire Station, Gauteng Province	Ecological Assessment	Savannah Environmental
2016	Metal Industrial Cluster and Associated Infrastructure near Kuruman, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Northern Cape Department of Economic Development and Tourism
2016	Semonkong Wind Energy Facility near Semonkong, Maseru District, Lesotho	Ecological Pre-Feasibility Study	Savannah Environmental
2015 - 2016	Orkney Solar PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Genesis Eco-Energy
2015 - 2016	Woodhouse 1 and Woodhouse 2 PV Facilities near Vryburg, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Genesis Eco-Energy
2015	CAMCO Clean Energy 100kW PV Solar Facility, Thaba Eco Lodge near Johannesburg, Gauteng Province	Ecological Assessment (Basic Assessment)	CAMCO Clean Energy
2015	CAMCO Clean Energy 100kW PV Solar Facility, Thaba Eco Lodge near Johannesburg, Gauteng Province	Ecological Assessment (Basic Assessment)	CAMCO Clean Energy
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Aurora Power Solutions
2015	Sirius 2 Solar PV Project near Upington, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Invasive Plant Management Plan	Aurora Power Solutions
2015	Sirius 2 Solar PV Project near Upington, Northern Cape Province	Invasive Plant Management Plan	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Plant Rehabilitation Management Plan	Aurora Power Solutions

2015	Sirius Phase 2 Solar PV Project near Upington, Northern Cape Province	Plant Rehabilitation Management Plan	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Plant Rescue and Protection Plan	Aurora Power Solutions
2015	Sirius Phase 2 Solar PV Project near Upington, Northern Cape Province	Plant Rescue and Protection Plan	Aurora Power Solutions
2015	Expansion of the existing Komsberg Main Transmission Substation near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ESKOM
2015	Karusa Wind Farm near Sutherland, Northern Cape Province)	Invasive Plant Management Plan	ACED Renewables Hidden Valley
2015	Proposed Karusa Facility Substation and Ancillaries near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ACED Renewables Hidden Valley
2015	Eskom Karusa Switching Station and 132kV Double Circuit Overhead Power Line near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ESKOM
2015	Karusa Wind Farm near Sutherland, Northern Cape Province)	Plant Search and Rescue and Rehabilitation Management Plan	ACED Renewables Hidden Valley
2015	Karusa Wind Energy Facility near Sutherland, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	ACED Renewables Hidden Valley
2015	Soetwater Facility Substation, 132kV Overhead Power Line and Ancillaries, near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ACED Renewables Hidden Valley
2015	Soetwater Wind Farm near Sutherland, Northern Cape Province)	Invasive Plant Management Plan	ACED Renewables Hidden Valley
2015	Soetwater Wind Energy Facility near Sutherland, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	ACED Renewables Hidden Valley
2015	Soetwater Wind Farm near Sutherland, Northern Cape Province	Plant Search and Rescue and Rehabilitation Management Plan	ACED Renewables Hidden Valley
2015	Expansion of the existing Scottburgh quarry near Amandawe, KwaZulu-Natal	Botanical Assessment (for EIA)	GreenMined Environmental
2015	Expansion of the existing AFRIMAT quarry near Hluhluwe, KwaZulu-Natal	Botanical Assessment (for EIA)	GreenMined Environmental
2014	Tshepong 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Nyala 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Eland 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Transalloys circulating fluidised bed power station near Emalahleni, Mpumalanga Province	Ecological Assessment (for EIA)	Trans-Alloys
2014	Umbani circulating fluidised bed power station near Kriel, Mpumalanga Province	Ecological Assessment (Scoping and EIA)	Eskom
2014	Gihon 75MW Solar Farm: Bela-Bela, Limpopo Province	Ecological Assessment (for EIA)	NETWORX Renewables
2014	Steelpoort Integration Project & Steelpoort to Wolwekraal 400kV Power Line	Fauna and Flora Pre-Construction Walk-Through Assessment	Eskom
2014	Audit of protected *Acacia erioloba* trees within the Assmang Wrenchville housing development footprint area	Botanical Audit	Eco-Care Consultancy
2014	Rehabilitation of the N1 National Road between Sydenham and Glen Lyon	Peer review of the ecological report	EKO Environmental
2014	Rehabilitation of the N6 National Road between Onze Rust and Bloemfontein	Peer review of the ecological report	EKO Environmental
2011	Illegally ploughed land on the Farm Wolwekop 2353, Bloemfontein	Vegetation Rehabilitation Plan	EnviroWorks
2011	Rocks Farm chicken broiler houses	Botanical Assessment (for EIA)	EnviroWorks

2011	Botshabelo 132 kV line	Ecological Assessment (for EIA)	CENTLEC
2011	De Aar Freight Transport Hub	Ecological Scoping and Feasibility Study	EnviroWorks
2011	The proposed establishment of the Tugela Ridge Eco Estate on the farm Kruisfontein, Bergville	Ecological Assessment (for EIA)	EnviroWorks
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Vegetation Rehabilitation Plan for illegally cleared areas	NEOTEL
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Invasive Plant Management Plan	NEOTEL
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Protected and Endangered Species Walk-Through Survey	NEOTEL
2011	Optic Fibre Infrastructure Network, Swartland Municipality	Botanical Assessment (for EIA) - Assisted Dr. Dave McDonald	Dark Fibre Africa
2011	Optic Fibre Infrastructure Network, City of Cape Town Municipality	Botanical Assessment (for EIA) - Assisted Dr. Dave McDonald	Dark Fibre Africa
2010	Construction of an icon at the southernmost tip of Africa, Agulhas National Park	Botanical Assessment (for EIA)	SANPARKS
2010	New boardwalk from Suiderstrand Gravel Road to Rasperpunt, Agulhas National Park	Botanical Assessment (for EIA)	SANPARKS
2010	Farm development for academic purposes (Maluti FET College) on the Farm Rosedale 107, Harrismith	Ecological Assessment (Screening and Feasibility Study)	Agri Development Solutions
2010	Basic Assessment: Barcelona 88/11kV substation and 88kV loop-in lines	Botanical Assessment (for EIA)	Eskom Distribution
2011	Illegally ploughed land on the Farm Wolwekop 2353, Bloemfontein	Vegetation Rehabilitation Plan	EnviroWorks

WETLAND DELINEATION AND HYDROLOGICAL ASSESSMENTS

Date Completed	Project Description	Type of Assessment/Study	Client
In progress	Steynsrus PV 1 & 2 Solar Energy Facilities near Steynsrus, Free State Province	Wetland Assessment	Cronimet Mining Power Solutions
2019	Lichtenburg 1 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Lichtenburg 2 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Lichtenburg 3 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Wetland Assessment (Basic Assessment)	Moeding Solar
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Wetland Assessment (Basic Assessment	Zevobuzz
2017	Nyala 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Wetland Assessment	BBEnergy
2017	Eland 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Wetland Assessment	BBEnergy
2017	Olifantshoek 10MVA 132/11kV Substation and 31km Power Line	Surface Hydrological Assessment (Basic Assessment)	Eskom
2017	Expansion of the Elandspruit Quarry near Ladysmith, KwaZulu-Natal Province	Wetland Assessment	Raumix
2017	S24G for the unlawful commencement or continuation of activities within a watercourse, Honeydew, Gauteng Province	Aquatic Assessment & Flood Plain Delineation	Savannah Environmental

2017	Noupoort CSP Facility near Noupoort, Northern Cape Province	Surface Hydrological Assessment (EIA phase)	Cresco
2016	Wolmaransstad Municipality 75MW PV Solar Energy Facility in the North West Province	Wetland Assessment (Basic Assessment)	BlueWave Capital
2016	BlueWave 75MW PV Plant near Welkom Free State Province	Wetland Delineation	BlueWave Capital
2016	Harmony Solar Energy Facilities: Amendment of Pipeline and Overhead Power Line Route	Wetland Assessment (Basic Assessment)	BBEnergy

AVIFAUNAL ASSESSMENTS

Date Completed	Project Description	Type of Assessment/Study	Client
2019	Sirius Three Solar PV Facility near Upington, Northern Cape	Avifauna Assessment (Basic Assessment)	Aurora Power Solutions
2019	Sirius Four Solar PV Facility near Upington, Northern Cape	Avifauna Assessment (Basic Assessment)	Aurora Power Solutions
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Avifauna Assessment (Basic Assessment)	Moeding Solar
2018	Proposed Zonnebloem Switching Station (132/22kV) and 2X Loop-in Loop-out Power Lines (132kV), Mpumalanga Province	Avifauna Assessment (Basic Assessment)	Eskom
2017	Olifantshoek 10MVA 132/11kV Substation and 31km Power Line	Avifauna Assessment (Basic Assessment)	Eskom
2016	TEWA Solar 1 Facility, east of Upington, Northern Cape Province	Wetland Assessment (Basic Assessment	Tewa Isitha Solar 1
2016	TEWA Solar 2 Facility, east of Upington, Northern Cape Province	Wetland Assessment	Tewa Isitha Solar 2

ENVIRONMENTAL IMPACT ASSESSMENT

- Barcelona 88/11kV substation and 88kV loop-in lines – BA (for Eskom).
- Thabong Bulk 132kV sub-transmission inter-connector line – EIA (for Eskom).
- Groenwater 45 000 unit chicken broiler farm – BA (for Areemeng Mmogo Cooperative).
- Optic Fibre Infrastructure Network, City of Cape Town Municipality – BA (for Dark Fibre Africa (Pty) Ltd).
- Optic Fibre Infrastructure Network, Swartland Municipality – BA (for Dark Fibre Africa).
- Construction and refurbishment of the existing 66kV network between Ruigtevallei Substation and Reddersburg Substation – EMP (for Eskom).
- Lower Kruisvallei Hydroelectric Power Scheme (Ash river) – EIA (for Kruisvallei Hydro (Pty) Ltd).
- Construction of egg hatchery and associated infrastructure – BA (For Supreme Poultry).
- Construction of the Klipplaatdrif flow gauging (Vaal river) – EMP (DWAF).

ENVIRONMENTAL COMPLIANCE AUDITING AND ECO

- National long haul optic fibre infrastructure network project, Bloemfontein to Laingsburg – ECO (for

Enviroworks (Pty) Ltd.).

- National long haul optic fibre infrastructure network project, Wolmaransstad to Klerksdorp – ECO (for Enviroworks (Pty) Ltd.).
- Construction and refurbishment of the existing 66kV network between Ruigtevallei Substation and Reddersburg Substation – ECO (for Enviroworks (Pty) Ltd.).
- Construction and refurbishment of the Vredefort/Nooitgedacht 11kV power line – ECO (for Enviroworks (Pty) Ltd.).
- Mining of Dolerite (Stone Aggregate) by Raumix (Pty) Ltd. on a portion of Portion 0 of the farm Hillside 2830, Bloemfontein – ECO (for GreenMined Environmental (Pty) Ltd.).
- Construction of an Egg Production Facility by Bainsvlei Poultry (Pty) Ltd on Portions 9 & 10 of the farm, Mooivlakte, Bloemfontein – ECO (for Enviro-Niche Consulting (Pty) Ltd.).
- Environmental compliance audit and botanical account of Afrisam's premises in Bloemfontein – Environmental Compliance Auditing (for Enviroworks (Pty) Ltd.).

OTHER PROJECTS:

- Keeping and breeding of lions (*Panthera leo*) on the farm Maxico 135, Ficksburg – Management and Business Plan (for Enviroworks (Pty) Ltd.)
- Keeping and breeding of lions (*Panthera leo*) on the farm Mooihoek 292, Theunissen – Management and Business Plan (for Enviroworks (Pty) Ltd.)
- Keeping and breeding of wild dogs (*Lycaon pictus*) on the farm Mooihoek 292, Theunissen – Management and Business Plan (for Enviroworks (Pty) Ltd.)
- Existing underground and aboveground fuel storage tanks, TWK AGRI: Pongola – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks on Erf 171, TWK AGRI: Amsterdam – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 14 000 L of fuel (diesel) aboveground on Erf 32, TWK AGRI: Carolina – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 23 000 L of fuel (diesel) above ground on Portion 10 of the Farm Oude Bosch, Humansdorp – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 16 000 L of fuel (diesel) aboveground at Panbult Depot – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks, TWK AGRI: Mechanisation and Engineering, Piet Retief – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks on Portion 38 of the Farm Lothair, TWK AGRI: Lothair – Environmental Management Plan (for TWK Agricultural Ltd).