AN ECOLOGICAL AND RIPARIAN IMPACT ASSESSMENT REPORT FOR THE PROPOSED CLEARANCE OF APPROXIMATELY 450 HA OF INDIGENOUS VEGETATION FOR TOMATO LANDS ON THE REMAINDER OF PORTION 3 OF THE FARM CONISTON 699 MS IN THE WATERPOORT AREA, MAKHADO LOCAL MUNICIPALITY, VHEMBE DISTRICT

An EOH Company

Prepared for: **AGES LIMPOPO**

Prepared by: **Exigo Sustainability**

Email info@exigo3.com
Tel +27 012 751 2160
Fax +27 086 607 2406

Eulophia Corner Building 1,
38 Gen Van Reyneveld St,
Persequor Park,
Pretoria, 0020

Postnet Suite 74,
Private Bag X07,
Arcadia, 0007

Vat nr: 4910184854
Registration nr: 2006/011434/07

An EOH Company

Innovation in Sustainability

www.exigo3.com

AN ECOLOGICAL AND RIPARIAN IMPACT ASSESSMENT REPORT FOR THE PROPOSED CLEARANCE OF APPROXIMATELY 450 HA OF INDIGENOUS VEGETATION FOR TOMATO LANDS ON THE REMAINDER OF PORTION 3 OF THE FARM CONISTON 699 MS IN THE WATERPOORT AREA, MAKHADO LOCAL MUNICIPALITY, VHEMBE DISTRICT

ECOLOGICAL REPORT

August 2022

Conducted on behalf of:
AGES Limpopo (Pty) Ltd

Compiled by:

Dr. BJ Henning (PhD plant Ecology; M.Sc Botany - Soil Science related Pr.Sci.Nat)

REPORT DISTRIBUTION LIST

Name	Institution
Mr. J. Botha	AGES Limpopo

DOCUMENT HISTORY

Date	Version	Status
August 2022	1.0	Draft

Table of contents

1 ASSIGNMENT 1

1.1 INFORMATION SOURCES 1

1.2 REGULATIONS GOVERNING THIS REPORT 2

1.2.1 National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) - Regulation No. R982 2
1.2.2 National Environmental Management Act, 1998 (Act No. 107 of 1998) - Regulation No. R984 3
1.2.3 Conservation of Agricultural Resources Act (Act No. 43 of 1983) 4
1.2.4 National Environmental Management Biodiversity Act (NEMBA: Act 10 0f 2004) 4
1.2.5 The National Forest Act (Act 84 of 1998) 4
1.2.6 Limpopo Environmental Management Act (2004) 4
1.2.7 The National Water Act (Act No. 36 of 1998) 4

1.3 TERMS OF REFERENCE 5

1.3.1 Objectives 5
1.3.2 Scope 6
1.3.3 Limitations and assumptions 7

2 STUDY AREA 8

2.1 LOCATION AND DESCRIPTION OF ACTIVITY 8

2.2 CLIMATE 11

2.3 GEOLOGY AND SOIL TYPES 12

2.4 TOPOGRAPHY AND DRAINAGE 12

2.5 LAND USE AND EXISTING INFRASTRUCTURE 13

3 METHODS 14

3.1 VEGETATION SURVEY 14

3.1.1 Data recorded: 14
3.1.2 Red data species 14
3.1.3 Protected trees 14
3.1.4 Protected plants 14
3.1.5 Data processing 14

3.2 FAUNA SURVEY 15

3.2.1 Data recorded: 15
3.2.2 Red data species lists 15
3.2.3 Data processing 16

3.3 WETLAND DELINEATION AND CLASSIFICATION 16

3.4 WETLAND CLASSIFICATION 17

3.5 RIPARIAN DELINEATION AND CLASSIFICATION 18

3.6 WETLAND INTEGRITY ASSESSMENTS 21

3.6.1 Present Ecological Status (PES) of wetlands 21
3.6.2 Ecological Importance and Sensitivity (EIS) 23

3.7 SENSITIVITY ASSESSMENT 24

3.7.1 Ecological function 24
3.7.2 Conservation importance 24
3.7.3 Sensitivity scale 25

3.8 IMPACT RATING ASSESSMENT 25

4 RESULTS: ECOLOGICAL ASSESSMENT 28

4.1 VEGETATION 28

4.1.1 Biomes 28
4.1.2 Vegetation types 28
4.1.3 Vegetation units 28
4.1.4 Senegalia mellifera – Vachellia grandicornuta shrubveld on calcareous soils 35
4.1.5 Secondary old fields 37
4.1.6 Hydrological features 38

4.2 FLORA: SPECIES LEVEL ASSESSMENT 39

4.2.1 Species of conservation concern 40
4.2.2 Protected tree species (DAFF) 41
4.2.3 Protected Plants (LEMA) 42
4.2.4 Invasive alien species (Alien and Invasive Species Regulations GNR 599 of 2014) 42
4.2.5 General 44

4.3 FAUNAL ASSESSMENT 44

4.3.1 Overview 44
4.3.2 Results of desktop survey and site visits during May 2019 45
4.3.3 Fauna habitats of the project area 45
4.3.4 Common fauna documented and potentially occurring on the development site 45
4.3.5 Red data species 47

4.4 WETLANDS / WATER COURSES OF THE PROJECT AREA 49

4.4.1 Delineation 49
4.4.2 Riverine Integrity Assessments 51

5 POTENTIAL IMPACTS OF THE PROPOSED CLEARANCE ON THE FAUNA AND FLORA ... 52

5.1 DIRECT HABITAT DESTRUCTION 52

5.1.1 Description of impact: 52
5.1.2 Mitigation measures: 52

5.2 HABITAT FRAGMENTATION 53

5.2.1 Description of impact: 53
5.2.2 Mitigation measures: 53

5.3 INCREASED SOIL EROSION AND SEDIMENTATION 53

5.3.1 Description of impact: 53
5.3.2 Mitigation measures: 54

5.4 SPILLAGES OF HARMFULL SUBSTANCES TO THE ECOSYSTEM 54

5.4.1 Description of impact: 54
5.4.2 Mitigation measures: 54

5.5 HABITAT DEGRADATION DUE TO DUST 54

5.5.1 Description of impact: 54
5.5.2 Mitigation measures: 55

5.6 SPREAD AND ESTABLISHMENT OF ALIEN INVASIVE SPECIES 55

5.6.1 Description of impact: 55
5.6.2 Mitigation measures: 55
5.7 IMPACT ASSESSMENT MATRIX FOR THE DEVELOPMENT PHASE OF THE CROPLAND DEVELOPMENT . 56
6 SENSITIVITY ANALYSIS AND CONSERVATION ANALYSIS TOOLS 58
6.1 CRITICAL BIODIVERSITY & ECOLOGICAL SUPPORT AREAS OF THE PROJECT AREA 58
6.2 PROTECTED AREAS NETWORK AND NATIONAL PROTECTED AREAS EXPANSION STRATEGY (NPAES) . 60
6.3 IMPORTANT BIRD AREAS 60
6.4 NATIONALLY THREATENED ECOSYSTEMS 63
6.5 ECOLOGICAL SENSITIVITY CLASSES 63
7 DISCUSSION 65
8 CONCLUSION 67
9 REFERENCES 68
APPENDIX A. PLANT SPECIES LISTS FOR SITE 71
APPENDIX B. PLANT SPECIES LIST FOR QDS 74
APPENDIX C. BIRD SPECIES LIST FOR QDS ACCORDING TO SABAP2 DATABASE 91
APPENDIX D – MAMMAL SPECIES LISTS 93
APPENDIX F – HERPETOFAUNA LIST 94
APPENDIX F PES SCORES OF THE RIVERS 97
APPENDIX G EIS SCORES OF THE RIVERS IN THE STUDY AREA 98

List of Figures

Figure 1. Regional Topography Map 9
Figure 2. Satellite image showing the proposed development site (Google Pro, 2010) 10
Figure 3. Climate diagram for the Waterpoort area 11
Figure 4. A cross section through a wetland showing how the soil form indicators and vegetation changes from the centre to the edge of the wetland (adapted from Kotze, 1996) 17
Figure 5. Cross section of topography associated with a channel and floodplains 20
Figure 6. Typical cross section of a river channel displaying riparian habitat (DWA, 2003) 20
Figure 7. Vegetation Map of the proposed cropland development site 30
Figure 8. South African red list categories indicating the categories to be used for Species of Conservation Concern 40
Figure 9. CBA Map of the project area and proposed infrastructure according to the LCPv2 59
Figure 10. Protected areas and NPAES in proximity to the project area 61
Figure 11. Important Bird Areas in close proximity to the project area 62
Figure 12. Sensitivity Map of the study area 64

List of Tables

Table 1. Landtypes, soils and geology of the proposed cropland sites 12
Table 2. Wetland Unit types based on hydrogeomorphic characteristics (Adapted from Kotze *et al.* 2005). 18
Table 3. Habitat integrity assessment criteria for wetlands (Adapted from DWAF, 2003) 21
Table 4. Present Ecological Status Class Descriptions 22
Table 5. Criteria for assessing the Ecological Importance and Sensitivity of Wetlands 23
Table 6. Ecological Importance and Sensitivity Classes 24
Table 7. Impact assessment matrix weights 27
Table 8. Botanical analysis and characteristics of the Mixed *Sclerocarya birrea – Combretum - Terminalia sandveld* 31
Table 9. Botanical analysis and characteristics of the *Terminalia prunoides – Commiphora pyracanthoides woodland* 32
Table 10. Botanical analysis and characteristics of the Mixed *Terminalia prunoides – Sclerocarya – Senegalia nigrescens woodland* 34
Table 11. Botanical analysis and characteristics of *Senegalia mellifera – Vachellia grandicornuta* shrubveld on calcareous soils 35
Table 12. Red data and endemic species occurring in the project area of the QDS 41
Table 13. Protected tree species of concern in the project area 41
Table 14. List of AIS documented in the project area 44
Table 15. Red data list of potential fauna for the study area 47
Table 16. Present Ecological State and Ecological Importance & Sensitivity of the riparian system on the proposed development sites 51
Table 17. Impact assessment Matrix for the croplands development 57

List of Photographs

Photograph 1. Mixed *Sclerocarya birrea – Combretum - Terminalia sandveld* in the project area 32
Photograph 2. *Terminalia prunoides – Commiphora pyracanthoides* woodland in the project area 33
Photograph 3. Mixed *Terminalia prunoides – Sclerocarya – Senegalia nigrescens woodland* on undulating plainsin the project area 35
Photograph 4. *Senegalia mellifera – Vachellia grandicornuta* shrubveld on calcareous soils in the project area 36
Photograph 5. Secondary old fields in the project area 37
Photograph 5. Small non-perennial drainage channel in the project area 39

Declaration

I, Barend Johannes Henning, declare that -

- I act as the independent specialist;
- I will perform the work relating to the project in an objective manner, even if this results in views and findings that are not favourable to the project proponent;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this project, including knowledge of the National Environmental Management Act, 1998 (Act No. 107 of 1998; the Act), regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in Regulation 8;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the project proponent and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the project; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority or project proponent;
- All the particulars furnished by me in this document are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

_____

SIGNATURE OF SPECIALIST

Company: Exigo Sustainability

Date: August 2022

Notations and terms

Alien vegetation Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome - usually international in origin.

Anthropogenic: of human creation

Alluvium (from the Latin, alluvius, from alluere, "to wash against") is loose, unconsolidated (not cemented together into a solid rock) soil or sediments, which has been eroded, reshaped by water in some form, and redeposited in a non-marine setting. Alluvium is typically made up of a variety of materials, including fine particles of silt and clay and larger particles of sand and gravel. When this loose alluvial material is deposited or cemented into a lithological unit, or lithified, it would be called an alluvial deposit.

Biome A broad ecological unit representing major life zones of large natural areas – defined mainly by vegetation structure and climate.

Biota: living things; plants, animals, bacteria

Bottomland: the lowlands along streams and rivers, on alluvial (river deposited) soil.

Ecologically sensitive ecosystem: One where relatively even minor disturbances may result in substantial and significant changes.

Ecoregion An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".

Ecosystems: Include living (e.g. plants, animals) and non-living (e.g. minerals, soil, water) components, which can be defined in terms of distinguishing characteristics (e.g. a wetland ecosystem, a freshwater ecosystem, a terrestrial ecosystem, a forest ecosystem, etc.).

Endemic or range-restricted species or ecosystem: One whose distribution is confined to a particular and often very limited geographical region.

Environment: Broadly covers our surroundings and the characteristics of those surroundings that influence our health and wellbeing. That is, the environment includes all living organisms (plants, animals and other life), the physical environment (land, water and air), as well as social, economic and cultural conditions. Sometimes we speak of 'the natural environment' and 'the built environment', to differentiate between natural and man-made systems.

Floristic: of flora (plants).

Floodplain: Wetland inundated when a river overtops its banks during flood events resulting in the wetland soils being saturated for extended periods of time.

Habitat: The place or type of site where an organism or population naturally occurs.

Indigenous vegetation Vegetation occurring naturally within a defined area.

Protected species or ecosystem: One that is protected by law from particular activities and land uses.

Seasonally wet soil: soil which is flooded or waterlogged to the soil surface for extended periods (>1 month) during the wet season, but is predominantly dry during the dry season.

Soil horizons: layers of soil that have fairly uniform characteristics and have developed through pedogenic processes; they are bound by air, hard rock or other horizons (i.e. soil material that has different characteristics).

Soil profile: the vertically sectioned sample through the soil mantle, usually consisting of two or three horizons (Soil Classification Working Group, 1991).

Species: A group of plants, animals, micro-organisms or other living organisms that are morphologically similar; that share inheritance from common ancestry; or whose genes are so similar that they can breed together and produce fertile offspring.

Temporarily wet soil: The soil close to the soil surface (i.e. within 50 cm) is wet for periods > 2 weeks during the wet season in most years. However, it is seldom flooded or saturated at the surface for longer than a month.

Terrain unit classes: areas of the land surface with homogenous form and slope. Terrain may be seen as being made up of all or some of the following units: crest (1), scarp (2), midslope (3), footslope (4) and valley bottom (5).

Threatened species or ecosystem: Species/ Ecosystems that are at risk of going extinct in its natural range. It may be 'critically endangered' at extremely high risk, 'endangered' at very high risk, or 'vulnerable' at high risk. Species or ecosystems at low or no risk are not 'threatened', and fall into the 'near threatened' or 'least concern' categories.

Water regime: When and for how long the soil is flooded or saturated.

1 ASSIGNMENT

Exigo Sustainability was appointed by AGES Limpopo on behalf of Koedoespan Boerdery (Pty) Ltd to undertake an ecological and riparian impact assessment as part of the environmental impact assessment process for the proposed clearance of 450 ha of indigenous vegetation for the development of tomato croplands on the Remainder of Portion 3 of the farm Coniston 699 MS in the Waterpoort area, Limpopo Province.

This report will include a detailed impact assessment of the development impacts on the biodiversity of the site, as well as riparian delineation and functionality assessment of drainage lines. This assessment is essential as it will contribute to meeting the requirements of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) in conjunction with Regulation 982 of 4 December 2014 (as amended), promulgated in terms of Section 24 (5) of NEMA and Chapter 4 of the National Water Act, Act 36 of 1998 Section 21 (c) and (i).

The study will be done according to guidelines and criteria set by the Limpopo Department of Economic Development, Environment and Tourism (LEDET) for biodiversity studies and the Department of Water and Sanitation (DWS) for wetland studies. In order to compile this, the following had to be done:

1.1 INFORMATION SOURCES

The following information sources were obtained:

1. All relevant topographical maps, aerial photographs and information (previous studies and environmental databases) related to the ecological components in the study area;
2. Requirements regarding the fauna and flora survey as requested by the LEDET;
3. Requirements regarding the wetland / riparian delineation and functionality assessment as stipulated in the following guidelines:
    a. A practical field procedure for identification and delineation of wetlands and riparian areas (DWAF, 2006);
    b. National Wetland Classification System for South Africa (SANBI, 2009);
4. Legislation pertaining to the biodiversity and wetlands of the study area as relevant;
5. Fauna and Flora species lists (including red data lists) from the South African National Biodiversity Institute (SANBI) databases.

1.2 REGULATIONS GOVERNING THIS REPORT

1.2.1 National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) - Regulation No. R982

This report was prepared in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Gazette No. 38282 Government Notice R. 982 of 4 December 2014 (as amended). Appendix 6 – Specialist reports includes a list of requirements to be included in a specialist report:

1. A specialist report or a 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;
    b. A declaration that the specialist is independent in a form as may be specified by the competent authority;
    c. An indication of the scope of, and purpose for which, the report was prepared;
    d. The date and season of the site investigation and the relevance of the season to the outcome of the assessment;
    e. A description of the methodology adopted in preparing the report or carrying out the specialized process;
    f. The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;
    g. An identification of any areas to be avoided, including buffers;
    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;
    i. A description of any assumptions made and any uncertainties or gaps in knowledge;
    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;
    k. any mitigation measures for inclusion in the EMPr;

l. any conditions for inclusion in the environmental authorisation;

m. any monitoring requirements for inclusion in the EMPr or environmental authorisation

n. a reasoned opinion –

i. As to whether the proposed activity or portions thereof should be authorised and

ii. If the opinion is that the proposed activity 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;

o. A description of any consultation process that was undertaken during the course of preparing the specialist report;

p. A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and

q. Any other information requested by the competent authority.

This Act also embraces all three fields of environmental concern namely: resource conservation and exploitation; pollution control and waste management; and land-use planning and development. The environmental management principles include the duty of care for wetlands and special attention is given to management and planning procedures.

1.2.2 National Environmental Management Act, 1998 (Act No. 107 of 1998) - Regulation No. R984

The Environmental Impact Assessment (EIA) Process is a requirement of the National Environmental Management Act, (Act 107 of 1998). The following listed activity under Regulation R984 of 4 December 2014 (as amended on 7 April 2017) requires a full environmental impact assessment to be conducted and authorization from the Limpopo Department of Economic Development, Environment and Tourism (LEDET).

- Activity 15 - The clearance of an area of 20 hectares or more of indigenous vegetation.

"indigenous vegetation" refers to vegetation consisting of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.

1.2.3 Conservation of Agricultural Resources Act (Act No. 43 of 1983)

This Act regulates the utilization and protection of wetlands, soil conservation and all matters relating thereto; control and prevention of veld fires, control of weeds and invader plants, the prevention of water pollution resulting from farming practices and losses in biodiversity.

1.2.4 National Environmental Management Biodiversity Act (NEMBA: Act 10 0f 2004)

The following aspects of the NEMBA (2004) are important to consider in the compilation of an ecological report. It:

- Lists ecosystems that are threatened or in need of national protection;
- Links to Integrated Environmental Management processes;
- Must be taken into account in EMP and IDPs;
- The Minister may make regulations to reduce the threats to listed ecosystems.

1.2.5 The National Forest Act (Act 84 of 1998)

The National Forest Act:

- Promotes the sustainable management and development of forests for the benefit of all;
- Creates the conditions necessary to restructure forestry in State Forests;
- Provide special measures for the protection of certain forests and protected trees;
- Promotes the sustainable use of forests for environmental, economic, educational, recreational, cultural, health and spiritual purposes.
- Promotes community forestry.

1.2.6 Limpopo Environmental Management Act (2004)

The Limpopo Environmental Management Act (2004) deals with the conservation of wild animals, fresh water fish and the conservation and protection of flora in the Limpopo Province. Animals and plants are both listed in the schedules with different degrees of protection afforded to each.

1.2.7 The National Water Act (Act No. 36 of 1998)

Chapter 4 of the National Water Act, Act 36 of 1998 specifies that:

“In general a water use must be licensed unless it is listed in Schedule I, is an existing lawful use, is permissible under a general authorisation, or if a responsible authority waives the need for a licence. The Minister may limit the amount of water which a responsible authority

may allocate. In making regulations the Minister may differentiate between different water resources, classes of water resources and geographical areas."

In section 21 of the NWA water uses are listed as:

c. Impeding or diverting the flow of water in a watercourse;

i. Altering the bed, banks, course or characteristics of a watercourse;

1.3 TERMS OF REFERENCE

1.3.1 Objectives

1. The primary aim of this project is to investigate options for enhancing and / or maintaining biodiversity to mitigate the impact of the proposed croplands development with the overall objective of preventing further loss of biodiversity. The end product would be a tool for promoting and lobbying for the recognition of the importance of species habitat and habitat conservation. Options available to maintain the current level of floral diversity include:
    a. Protection of native vegetation restored elsewhere in return for unavoidable clearing;
    b. Minimisation of habitat fragmentation;
    c. Minimisation of any threats to the native flora and fauna and their habitats during the development and operational phases of the developments and;
    d. Rehabilitation to establish plant communities / landscaping that will provide future habitat values.
2. To produce a clear and agreed species and habitat priorities for conservation actions. This includes the following:
    i. Determine the potential ecological impacts and actions the developments will have on the biodiversity on a species and habitat level;
    ii. Conduct a risk analyses of the impacts identified to determine the significance of the impacts on the fauna and flora of the study area;
    iii. Protection and enhancement of vegetation / habitats of high conservation value;
    iv. The retention of a substantial amount of native vegetation / habitat of adequate size and configuration to promote the conservation of the existing flora communities;
    v. The retention and / or creation of vegetation links, wildlife corridors and vegetation buffers wherever possible, subject to the appropriate bush fire risk

management; and

vi. The protection of water quality in the locality so as not to threaten native aquatic flora that rely on the watercourse for survival.

3. Delineate all wetlands and / or riparian areas associated with rivers / floodplains on site;
4. Determine the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of all wetlands and riparian areas along the proposed development site.
5. Provide recommendations on the ecological mitigation measures to be implemented by the developer and the way forward.

1.3.2 Scope

1. Detailed flora survey – in each vegetation type/plant community on site:
    a. After studying the aerial photograph identify specific areas to be surveyed and confirm location by making use of a Geographical Positioning System (GPS).
    b. Conduct a site visit and list the plant species (trees, shrubs, grasses, succulents and other herbaceous species of special interest) present for plant community and ecosystem delimitation.
    c. Identify potential red data plant species, possible encroacher species, medicinal plants of value and exotic plant species.
    d. Indicate suitable plant species that can be used for the landscaping around the proposed developments.
2. Plant community delimitation and description
    a. Process data (vegetation and habitat classification) to determine vegetation types on an ecological basis.
    b. Describe the habitat and vegetation.
3. Fauna scoping
    a. List the potential fauna (mammal species, red data birds, reptiles, amphibians, invertebrates) present linked to the specific potential habitats that occur as identified in the vegetation survey.
    b. Analyse the data and identify potential red data fauna species, as well as other endemic or protected species of importance.

c. Indicate species mitigation measures and management measures to be implemented to prevent any negative impacts on the fauna of the area.

4. Delineate and assess the wetland and / or riparian functionality on the proposed development site according to specific guidelines and methodology;

5. General
    a. Identify and describe ecologically sensitive areas. Create a sensitivity map to indicate specific sensitive areas based on various environmental parameters such as natural vegetation in a good condition, rockiness, slopes, flood lines etc.
    b. Identify problem areas in need of special treatment or management, e.g. bush encroachment, erosion, degraded areas, reclamation areas.
    c. Make recommendations, impact ratings and risk assessments for each specific impact.

1.3.3 Limitations and assumptions

- In order to obtain a comprehensive understanding of the dynamics of the flora of the study area, surveys should ideally be replicated over several seasons and over a number of years. However, due to project time constraints such long-term studies are not feasible and this floral study was conducted over two seasons;
- The large study area did not allow for the finer level of assessment that can be obtained in smaller study areas. Therefore, data collection in this study relied heavily on data from representative, homogenous sections of vegetation units, as well as general observations, aerial photograph analysis, generic data and a desktop analysis;
- Visibility proved to be a constraint in encroached areas where plant species might have been missed beneath the densely overgrown and obstructed by surface vegetation;

Thus, even though it might be assumed that survey findings are representative of the ecosystem of the project area, it should be stated that the possibility exists that individual plants species might have been missed due to the nature of the terrain (dense vegetation). Therefore, maintaining due cognisance of the integrity and accuracy of the ecological survey, it should be stated that the ecological resources identified during the study do not necessarily represent all the ecological resources present on the property.

2 STUDY AREA

2.1 LOCATION AND DESCRIPTION OF ACTIVITY

The project entails the development of tomato croplands of 450 ha on the Remainder of Portion 3 of the farm Coniston 699 MS in the Waterpoort area, Limpopo Province. The area to be cleared is approximately 7 km east-north-east of Waterpoort directly north of the R523 road.

The proposed project will entail the following:

- Clearance of approximately 450 hectares of indigenous vegetation;
- The lands are required for crop rotation and periods of rest for lands;
- Water for irrigation is available from the current Legal Water Use for the adjacent farms owned by ZZ2.

A full environmental impact assessment process (EIA) will be conducted for the following listed activity in terms of the National Environmental Management Act (Act 107 of 1998):

- *Regulation 984 of 4 December 2014 as amended on 7 April 2017, Activity 15: "The clearance of an area of 20 hectares or more of indigenous vegetation"*

According to the Forestry Act (Act 30 of 1998) and the Limpopo Environmental Management Act (Act 7 of 2003) permits will be required for the removal of any protected trees on the proposed lands.

The aerial image of the site is indicated in figure 2.

ZZ2 Coniston Tomato croplands Ecological Study

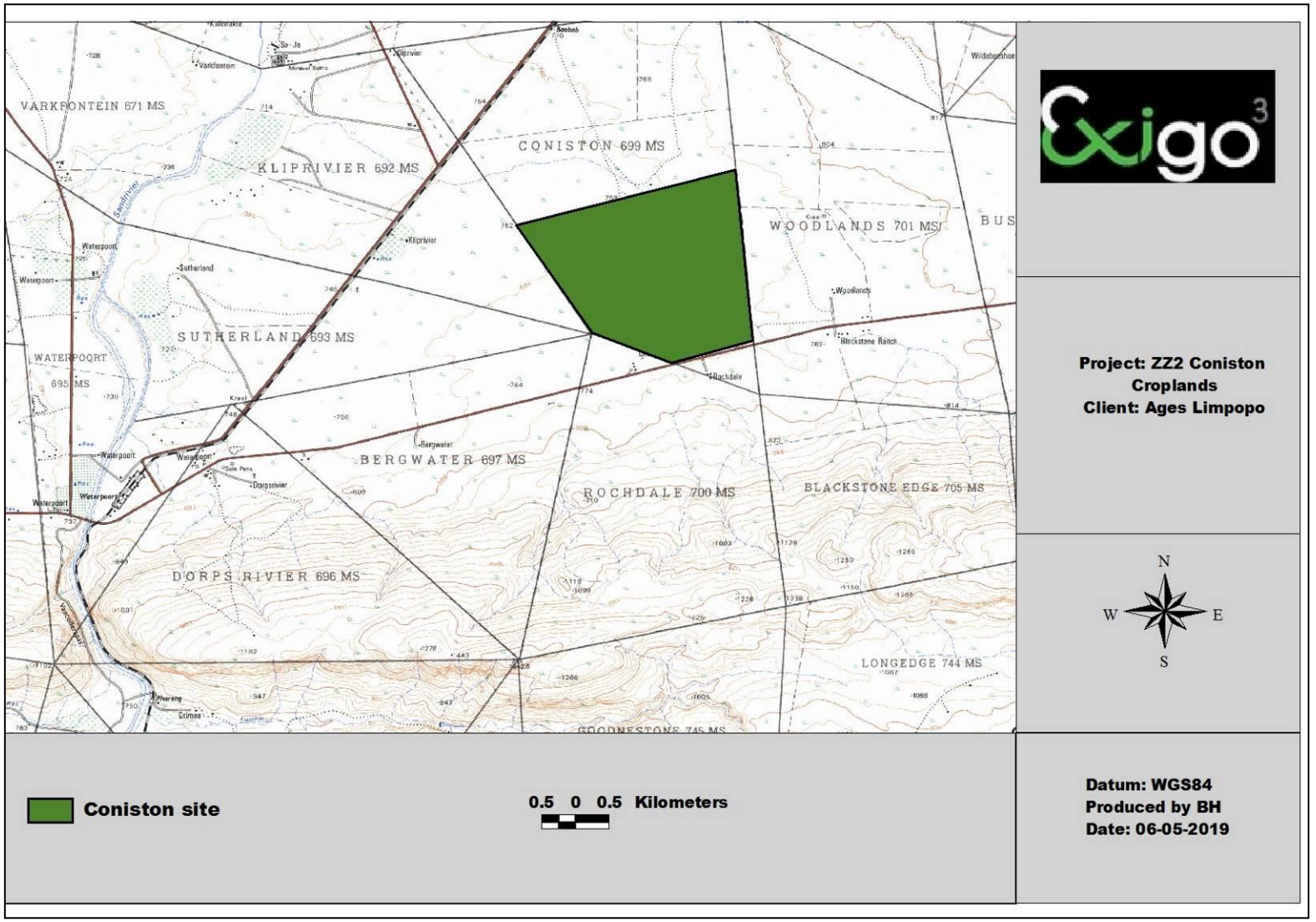


Figure 1. Regional Topography Map

ZZ2 Coniston Tomato croplands Ecological Study

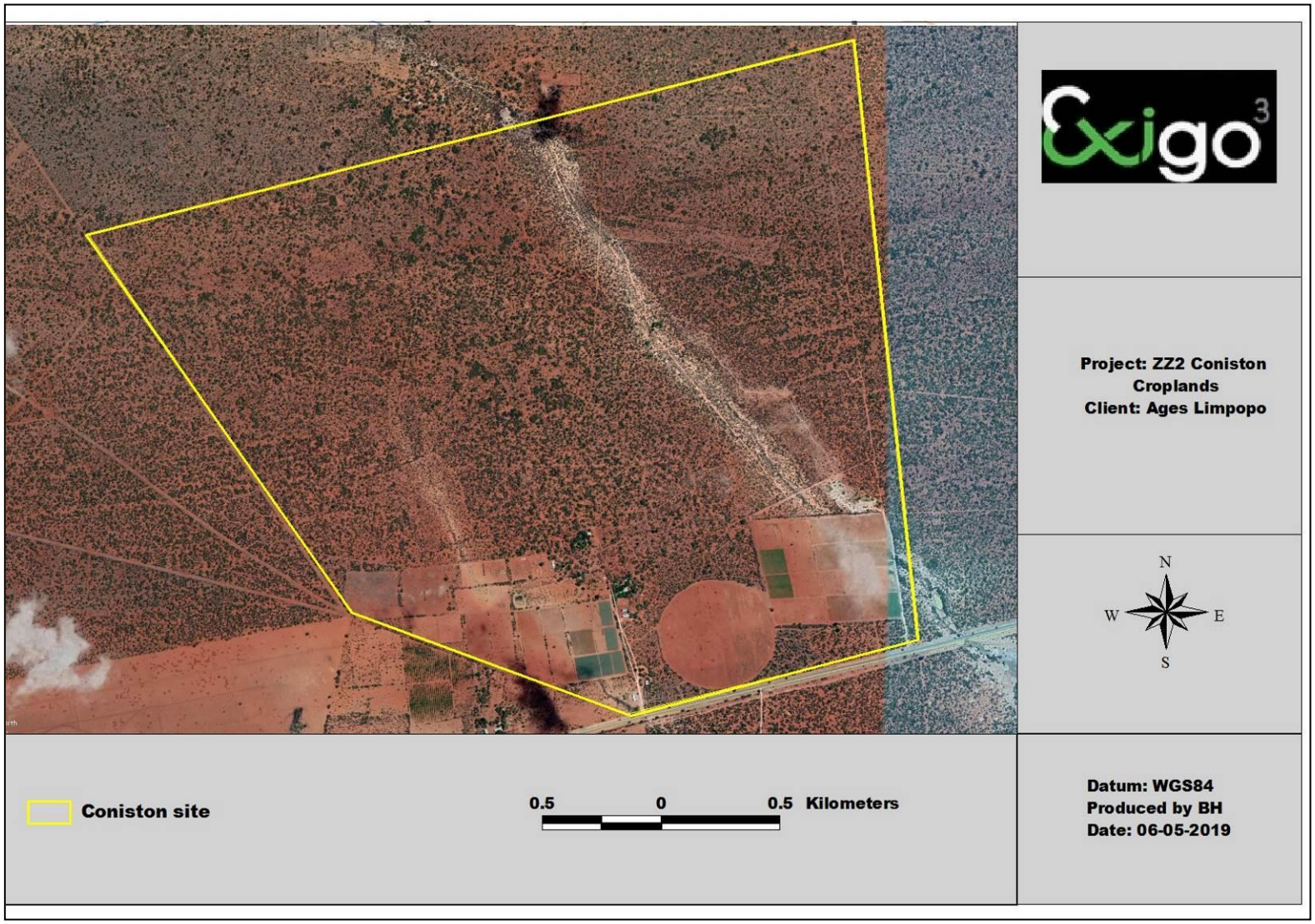


Figure 2. Satellite image showing the proposed development site (Google Pro, 2010)

2.2 CLIMATE

Climate in the broad sense is a major determinant of the geographical distribution of species vegetation types. However, on a smaller scale, the microclimate, which is greatly influenced by local topography, is also important. Within areas, the local conditions of temperature, light, humidity and moisture vary greatly and it is these factors which play an important role in the production and survival of plants (Tainton, 1981). In terrestrial environments, limitations related to water availability are always important to plants and plant communities. The spatial and temporal distribution of rainfall is very complex and has great effects on the productivity, distribution and life forms of the major terrestrial biomes (Barbour et al. 1987). Furthermore, aspects like topography, slope and altitude may further result in differences in precipitation and water availability to plants within the study area. The spatial and temporal distribution of rainfall is very complex and has great effects on the productivity, distribution and life forms of the major terrestrial biomes (Barbour et al. 1987).

The mean annual precipitation for the area measured over 25 years is approximately 437 mm, as measured at Sandow near Waterpoort (weather station 0765-253; Midgley et al, 1994). This is generally a frost-free area. The monthly distribution of average daily maximum temperatures shows that the average midday temperatures for Waterpoort range from 22°C in June to 30.4°C in January. The region is the coldest during July when the mercury drops to 5°C on average during the night.

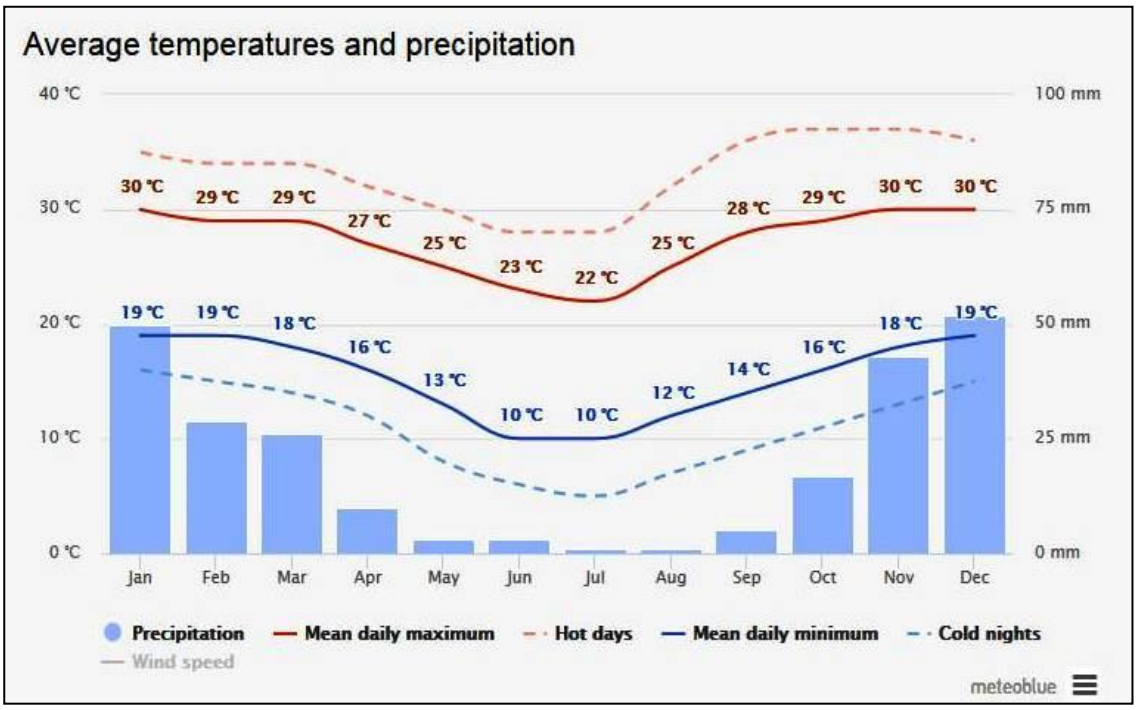


Figure 3. Climate diagram for the Waterpoort area

The project area should expect hot temperatures, with a maximum above 30°C in summer

and 25 to 28°C during winter months. This is an indication of very hot environment. The minimum temperature ranges from 18 to 20°C in summer and 7 to 10 °C in winter months (figure 3). The winter temperature is mild and signifies that the area does not experience frost. The variation between the maximum and minimum temperatures increases significantly from summer to winter. This is typical of continental type of climate.

2.3 GEOLOGY AND SOIL TYPES

Geology is directly related to soil types and plant communities that may occur in a specific area (Van Rooyen & Theron, 1996). A Land type unit is a unique combination of soil pattern, terrain and macroclimate, the classification of which is used to determine the potential agricultural value of soils in an area. The land type units represented within the study area include the Ae305, Ae303 and Ia151 land type (Land Type Survey Staff, 1987) (ENPAT, 2001). The land type, geology and associated soil types is presented in Table 1 below as classified by the Environmental Potential Atlas, South Africa (ENPAT, 2000).

Table 1. Landtypes, soils and geology of the proposed cropland sites

Landtype	Soils	Geology
Ae305	Red-yellow apedal, freely drained soils; red, high base status, > 300 mm deep (no dunes)	Mainly sand of the Quaternary System.
Ae303	Red-yellow apedal, freely drained soils; red, high base status, > 300 mm deep (no dunes)	Alluvium, sand and calcrete of the Quaternary System. Basalt of the Letaba Formation and Lebombo Group. Shale, mudstone and sandstone of the Klopperfontein Formation. Both formations of the Karoo Sequence; also leucogneiss and amphibolite.
Ia151	Miscellaneous land classes, undifferentiated deep deposits	Alluvium, mudstone, sandstone siltstone, shale and coal of the Clarens Formation and undifferentiated strata of the Karoo Sequence.

Most of the area for the proposed croplands forms slightly to moderately undulating plains on sandstone or limestone with 2 drainage channels bisecting the landscape.

2.4 TOPOGRAPHY AND DRAINAGE

The project area is located within the Limpopo Plain Eco-region and is situated to the north of the Soutpansberg. The study area is defined slightly undulating plains.

The study area is located in the Limpopo Catchment Management Area (CMA), and falls mainly in Quaternary Catchment Areas A71J. The study area is drained mainly by means of surface run-off (sheetflow) with storm water collecting along roads and footpaths cutting

through the area, to drain into the non-perennial streams that cut through the proposed development area. It must be noted that surface flow along these rivers generally only occurs in the period directly after precipitation events or a wet rainy season, and that these rivers may exhibit a large base-flow component with groundwater flow occurring within the sandy sediments lining its channel.

2.5 LAND USE AND EXISTING INFRASTRUCTURE

The land-use of the proposed development site is agriculture (tomatoes) with cattle & wildlife grazing at present, while the surrounding areas are mainly used for crop cultivation, grazing, and ecotourism.

3 METHODS

3.1 VEGETATION SURVEY

Two basic methods were used during the vegetation survey:

- Line transects were walked on the site surveyed to record the plant species present. Rare and threatened plant species and any botanically sensitive sites or habitats were searched for in the various vegetation units.
- The Braun-Blanquet survey technique to describe plant communities as ecological units was also used for this study. It allows for the mapping of vegetation and the comparison of the data with similar studies in the area.

The vegetation surveys were conducted on site during May 2019. The vegetation was in a moderate to good condition and most species could be identified, although some species might have been missed as a result of the large site. No further surveys were necessary considering that the area received sufficient precipitation during the wet season to allow for the identification of most plants in the study area.

3.1.1 Data recorded:

Plant names used in this report are in accordance with Arnold & De Wet (1993), with the exception of a few newly revised species. A list of all plant species present, including trees, shrubs, grasses, forbs, geophytes and succulents were compiled. All identifiable plant species were listed. Notes were additionally made of any other features that might have an ecological influence as well as potential fauna habitat that might occur.

3.1.2 Red data species

A species list of the red data species previously recorded in the vicinity of the proposed development was obtained from the South African Biodiversity Institute (SANBI), South Africa as classified by the IUCN red data list categories.

3.1.3 Protected trees

A species list of the protected tree species was obtained from the Department of Forestry. These trees are listed by the NFA (Act 84 of 1998) as protected.

3.1.4 Protected plants

A list of protected and specially protected plants was obtained from the LEMA (2004).

3.1.5 Data processing

A classification of vegetation data was done to identify, describe and map vegetation types. The descriptions of the vegetation units include the tree, shrub and herbaceous layers.

Conservation priority of each vegetation unit was assessed by evaluating the plant species composition in terms of the present knowledge of the vegetation of the Limpopo Province, as well as the vegetation types and Savanna Biome of South Africa.

The following four conservation priority categories were used for each vegetation unit:

- High: Ecologically sensitive and valuable land with high species richness that should be conserved and no development allowed.
- Medium: Land that should be conserved but on which low impact development could be considered with the provision of mitigation measures.
- Medium-low: Land that has some conservation value but on which development could be considered with limited impact on the vegetation / ecosystem. It is recommended that certain sections of the vegetation be maintained.
- Low: Land that has little conservation value and that could be considered for developed with little to no impact on the vegetation / ecosystem.

3.2 FAUNA SURVEY

The fauna survey was conducted as follows:

- A site survey was done to identify potential habitats after identifying the vegetation units. Fauna observed on site or any specific indication of species was noted as confirmed in the species lists.
- A scoping survey was then conducted by comparing the habitat types identified with the preferred habitats of species occurring in the area.

3.2.1 Data recorded:

A list of all species of fauna and their status as observed on the site or that could potentially occur on the site. Notes were made of any specific sensitive or specialized habitats that occur on the site.

3.2.2 Red data species lists

A species list of the red data species of the different faunal classes was obtained from the following references:

- Red Data Book of the Mammals of South Africa (Friedman & Daly, 2004)
- Bird distribution data of the Southern African Bird Atlas Project2 (SABAP 2) was obtained (http://sabap2.adu.org.za/), in order to ascertain which species occur in the pentads where the proposed line is located, in this case the Quarter Degree Grid Square . A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'×

5'). Each pentad is approximately 8 × 7.6 km.

- Atlas and red data book of the frogs of South Africa, Lesotho and Swaziland (Minter et al. 2004)
- South African Red Data Book – Reptiles and Amphibians. National Scientific Programmes Report no. 151;

3.2.3 Data processing

A comparison of the habitats (vegetation units) occurring on the property was made to the preferred habitats of the faunal species. In addition to species observed on the site, lists of the potential mammal, bird, reptile, amphibian and insect species were compiled and mitigating measures recommended if needed.

3.3 WETLAND DELINEATION AND CLASSIFICATION

The National Water Act, Act 36 of 1998, defines wetlands as follows:

"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."

Wetlands were delineated according to the delineation procedure given in "A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas" (DWAF, 2003).

Wetland indicators are divided into different unit indicators which need to be given consideration in the delineation of wetlands (Figure 5). The outer edge of the temporary zone requires the delineator to take the following specific indicators into account:

- The terrain unit indicator helps to identify those parts of the landscape where wetlands are more likely to occur.
- The Soil Form Indicator identifies the soil forms, as defined by Macvicar (1991), which are associated with prolonged and frequent saturation.
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation.
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

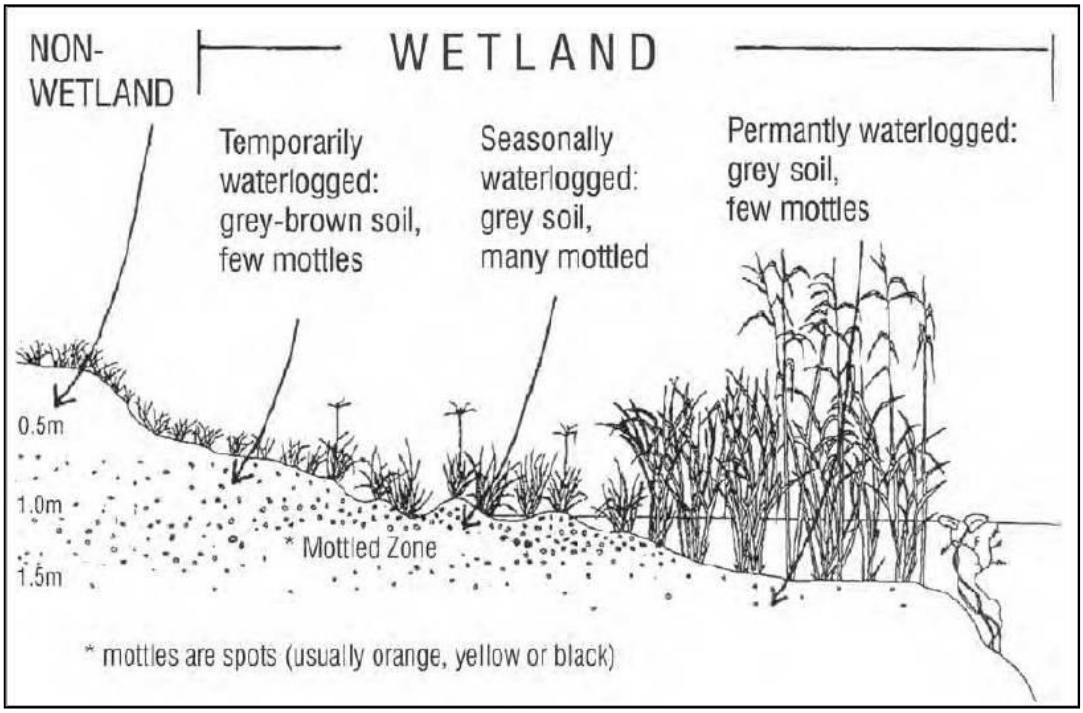


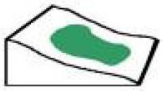
Figure 4. A cross section through a wetland showing how the soil form indicators and vegetation changes from the centre to the edge of the wetland (adapted from Kotze, 1996)

3.4 WETLAND CLASSIFICATION

The study area was sub-divided into transects and the soil profile was examined for signs of wetness within 50 cm of the surface using a hand auger along transects. The wetland boundaries were then determined by the positions of augered holes that showed signs of wetness as well as by the presence or absence of hydrophilic vegetation. The wetlands were subsequently classified according to their hydro-geomorphic setting based on the system proposed in the National Wetland Classification System (Table 2) (SANBI, 2009).

Furthermore, as a result of alluvial deposits being visible from the air, aerial photography was also used to assist in determining the extent of deposits, as well as the vegetation line indicating a difference in species composition or more vigorous growth. The aerial photographs were used to guide on-screen delineation of wetlands in ArcView GIS 3.3.

Table 2. Wetland Unit types based on hydrogeomorphic characteristics (Adapted from Kotze *et al.* 2005).

Hydro-geomorphic type	Code	Illustration	Description
Flood Plain	FP		Valley bottom areas with a well defined stream channel, gently sloped and characterized by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
Valley Bottom with a Channel	VBC		Valley bottom areas with a well defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterized by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
Valley Bottom Without a channel	VB		Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.
Channelled Hillslope Seepage feeding a Water course	CHSW		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well defined stream channel connecting the area directly to a watercourse.
Hillslope Seepage feeding a Water course	HSW		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow connecting the area directly to a watercourse.
Hillslope Seepage not feeding a water course	HS		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a watercourse.
Depression	D		A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent.

3.5 RIPARIAN DELINEATION AND CLASSIFICATION

Riparian areas often associated with streams or drainage lines are also important to protect due to the followings ecological and hydrological functions that it performs

(DWAF, 2003):

- Stabilize stream banks;
- Store water and aid in flood attenuation;
- Improve water quality by trapping nutrients and sediment;
- Maintain natural water temperature for aquatic species;
- Provide shelter and food for avifauna and other animals;
- Provide corridors for movement and migration of different species; and
- Act as a buffer between aquatic ecosystems and adjacent land uses.

The riparian areas have their own unique set of indicators. DWAF (2003) states that in order to classify an area as a riparian area it must have one or more of the following attributes:

- Are associated with a watercourse;
- Contain distinctively different plant species than adjacent areas; and contain species

similar to adjacent areas but exhibiting more vigorous or robust growth forms; and

- May have alluvial soils.

The delineation process requires that the following be taken into account:

- Topography associated with the watercourse (figure 6);
- Vegetation (figure 7); and
- Alluvial soils and deposited material.

Many riparian areas display wetland indicators and should be classified as wetlands. However, other riparian areas are not saturated long enough or often enough to develop wetland characteristics, but also perform a number of important functions, which need to be safeguarded. In these areas alluvial deposits can predominate and/or the water table is too deep for most of the year to produce hydromorphic features in the top 50cm of the soil profile. These conditions do not support vegetation typically adapted to life in saturated soil and it is therefore important to delineate these riparian areas in addition to wetlands. Riparian areas commonly reflect the high-energy conditions associated with the water flowing in a water channel, whereas wetlands generally display more diffuse flow and are lower energy environments.

The general approach for delineating riparian areas in the field is to identify the active channel or the lowest part of the river course. Most likely cues like water with associated emergent vegetation, sedges and reeds or alluvial soil and bedrock will be visible. From this point some topographic units like sandbars, active channel bank, flood benches and macro-channel bank with associated riparian vegetation will be identifiable. The next step would be to proceed upwards towards the macro-channel bank, taking note of alluvial soil, topographic units and vegetation indicators. The outer boundary will be the point on the edge of the macro channel bank where there is a distinct difference between the riparian and terrestrial vegetation. In some cases where riparian vegetation is unrecognisable, because of land-use activities, indicators like alluvial material and topographical units can still be used to visualize the edge of a riparian area. If you are adjacent to a watercourse, it is also important to check for the presence of riparian indicators. The riparian areas were identified using the following information:

- Topographical maps: Riparian areas normally occur within the flood area of a river or stream.
- Aerial photographs: As a result of alluvial deposits being visible from the air, aerial photography can assist in determining the extent of deposits, as well as the vegetation line indicating a difference in species composition or more vigorous growth.

A combination of the abovementioned indicators were used during the field survey that was conducted during May 2019 to identify the indicator plant species, soil types and specific topography related to the wetland areas. The outer boundaries were then recorded using a Global Positioning System (GPS). Riparian areas were mapped by means of the computer programme Arcview 3.3.

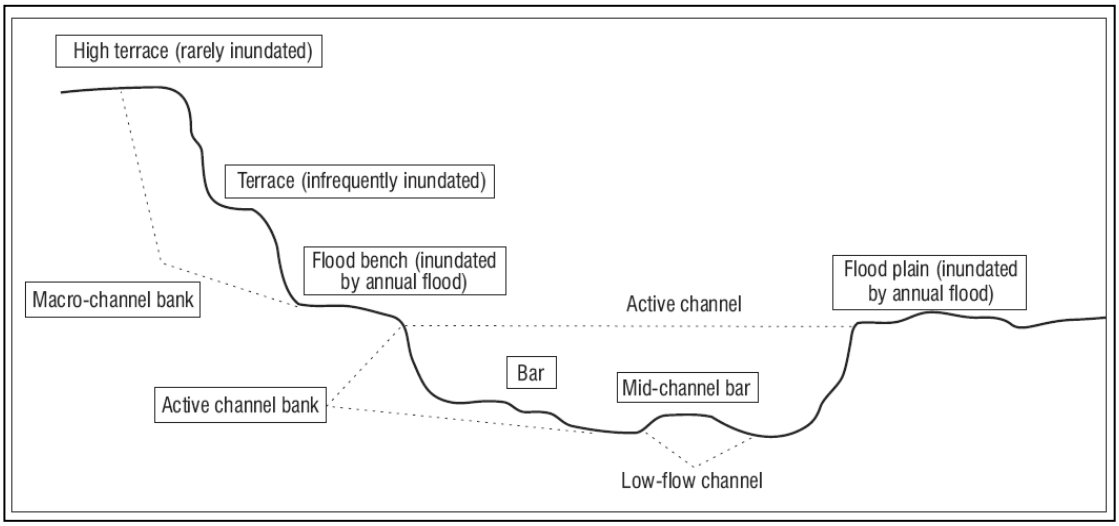


Figure 5. Cross section of topography associated with a channel and floodplains

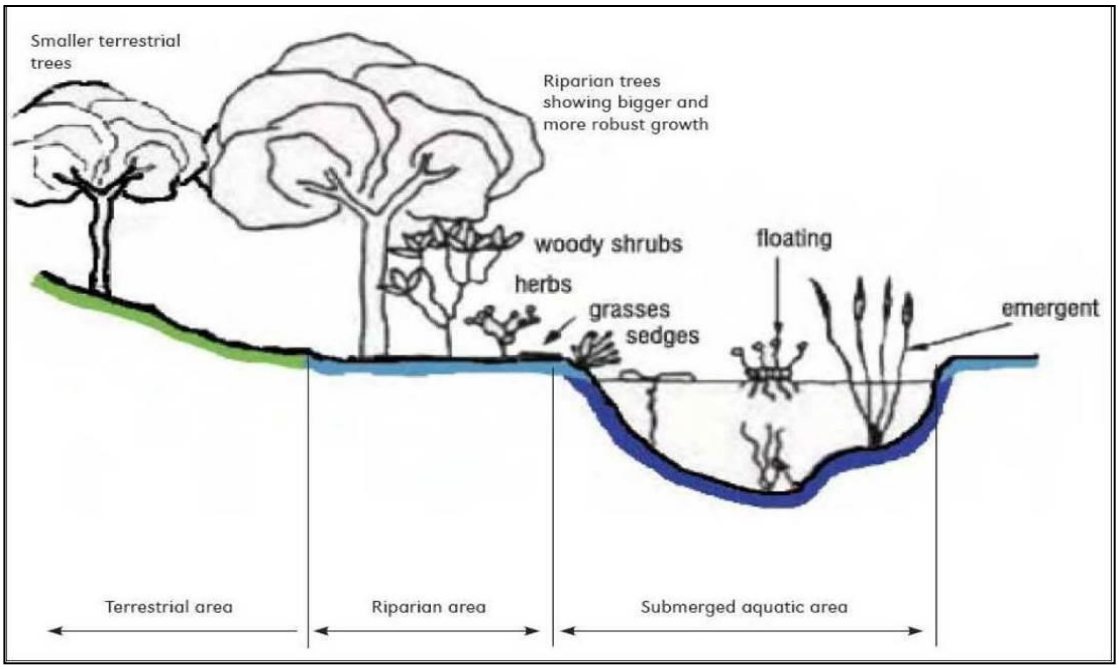


Figure 6. Typical cross section of a river channel displaying riparian habitat (DWA, 2003)

3.6 WETLAND INTEGRITY ASSESSMENTS

3.6.1 Present Ecological Status (PES) of wetlands

The Present Ecological State (PES) assessment of the wetlands within the study area was undertaken to determine the extent of departure of the wetlands from a natural state or reference condition. This method is based on the modified Habitat Integrity approach (Table 3) developed by Kleynhans (1999). Anthropogenic modification of the criteria and its attributes can have an impact on the ecological integrity of a wetland.

Table 3. Habitat integrity assessment criteria for wetlands (Adapted from DWAF, 2003)

Criteria and Attributes	*Relevance*
Hydrologic	
Flow Modification	Consequence of abstraction, regulation by impoundments or increased runoff from human settlements or agricultural land. Changes in flow regime (timing, duration, frequency), volumes, velocity which affect inundation of wetland habitats resulting in floristic changes or incorrect cues to biota. Abstraction of groundwater flows to or from a wetland.
Permanent Inundation	Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.
Water Quality	
Water Quality Modification	From point or diffuse sources. Measure directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland.
Sediment Load Modification	Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.
Hydraulic/Geomorphic	
Canalization	Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. River diversions or drainage.
Topographic Alteration	Consequence of infilling, ploughing, dykes, trampling, bridges, roads, railway lines and other substrate disruptive activities which reduce or changes wetland habitat directly in inundation patterns.
Biota	
Terrestrial Encroachment	Consequence of desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.
Indigenous Vegetation Removal	Direct destruction of habitat through farming activities, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and increases potential for erosion.
Invasive Plant Encroachment	Affects habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).
Alien Fauna	Presence of alien fauna affecting faunal community structure.
Over utilization of Biota	Overgrazing, over fishing, etc.
Attributes above are rated and scored as one of the following: Natural/Unmodified 5 Largely Natural 4 Moderately Modified 3 Largely Modified 2 Seriously Modified 1 Critically Modified 0	

For the purpose of this study, the scoring system as described in the document “Resource Directed Measures for Protection of Water Resources, Volume 4. Wetland Ecosystems” (DWAF, 1999) was applied for the determination of the PES (Table 4).

Two tools have recently been developed to facilitate the derivation of scores to reflect the present ecological sate, namely the Index of Habitat Integrity (IHI) DWA, 2007, and Wet-

Health, developed by Macfarlane et al., 2008. Both these tools have limitations in that they were developed primarily to assess conditions of floodplain and valley bottom wetlands and Hill slope seepage wetlands linked to drainage lines. The former tool was developed to provide a rapid assessment of the PES specifically for application in reserve studies, while the latter tool was developed to support the Working for Wetlands program. The objective of the latter tool was to provide a semi quantitative assessment of the state of wetland prior to rehabilitation, and one post rehabilitation to demonstrate "improvement". The intention in defining the health category (PES) of a wetland is to provide an indication of the current "condition" of a wetland in order to inform a management class. The latter provides the guidelines against that inform water quality and quantity required to maintain or improve the quality of the water resource.

The PES or health of wetlands has only been applied to the "natural" wetlands, i.e. those that have developed naturally as a consequence of the presence of water. Wetlands are rated on a scale of A to F, with A being a natural wetland and F being a completely modified and disturbed wetland (Table 4). The Wet-Health assesses the following four factors that influence the "health" or condition of wetlands and in this particular application floodplains and river channels associated with the site:

- Hydrology;
- Geomorphology
- Vegetation, and ideally
- Water quality.

The Present Ecological Status Class (PESC) of the wetlands was based on the available information for each of the criteria listed in Table 3 and the mean score determined for each wetland (Table 4). This approach is based on the assumption that extensive degradation of any of the wetland attributes may determine the PESC (DWAF, 2003).

Table 4. Present Ecological Status Class Descriptions

CLASS	CLASS BOUNDARY	CLASS DESCRIPTION
A	>4	**Unmodified, natural;** • The resource base reserve has not been decreased; • The resource capability has not been exploited
B	>3 and <=4	**Largely natural with few modification**; • The resource base reserve has been decreased to a small extent; • A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.

CLASS	CLASS BOUNDARY	CLASS DESCRIPTION
C	>2 and <=3	**Moderately modified**; • The resource base reserve has been decreased to a moderate extent. • A change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.
D	2	**Largely modified**; • The resource base reserve has been decreased to a large extent. • Large changes in natural habitat, biota and basic ecosystem functions have occurred.
E	>0 and <2	**Seriously modified**; • The resource base reserve has been seriously decreased and regularly exceeds the resource base; • The loss of natural habitat, biota and basic ecosystem functions is extensive.
F	0	**Critically modified**; • The resource base reserve has been critically decreased and permanently exceeds the resource base; • Modifications have reached a critical level and the resource has been modified completely with an almost total loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.

3.6.2 Ecological Importance and Sensitivity (EIS)

The Ecological Importance and Sensitivity (EIS) assessment was conducted according to the guidelines as discussed by DWAF (1999). Here DWAF defines “ecological importance” of a water resource as an expression of its importance to the maintenance of ecological diversity and function on local and wider scales. “Ecological sensitivity”, according to DWAF (1999), is the system’s ability to resist disturbance and its capability to recover from disturbance once it has occurred.

In the method outlined by DWAF a series of determinants for EIS are assessed for the wetlands on a scale of 0 to 4 (Table 5). The median of the determinants is used to determine the EIS of the wetland unit (Table 6).

Table 5. Criteria for assessing the Ecological Importance and Sensitivity of Wetlands

Determinant
PRIMARY DETERMINANTS
1. Rare & Endangered Species
2. Populations of Unique Species
3. Species/taxon Richness
4. Diversity of Habitat Types or Features

Determinant	
PRIMARY DETERMINANTS	
5.	Migration route/breeding and feeding site for wetland species
6.	Sensitivity to Changes in the Natural Hydrological Regime
7.	Sensitivity to Water Quality Changes
8.	Flood Storage, Energy Dissipation & Particulate/Element Removal
MODIFYING DETERMINANTS	
9.	Protected Status
10.	Ecological Integrity

Score guideline Very high = 4; High = 3, Moderate = 2; Marginal/Low = 1; None = 0

Confidence rating Very high confidence = 4; High confidence = 3; Moderate confidence = 2; Marginal/low confidence = 1

Table 6. Ecological Importance and Sensitivity Classes

Ecological Importance and Sensitivity Category (EIS)	Range of Median
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	>3 and <=4
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these Wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and <=2
Low/marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these Wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	>0 and <=1

3.7 SENSITIVITY ASSESSMENT

The ecological sensitivity of any piece of land is based on its inherent ecosystem service and overall preservation of biodiversity.

3.7.1 Ecological function

The ecological function relates to the degree of ecological connectivity between systems within a landscape matrix. Therefore, systems with a high degree of landscape connectivity amongst one another are perceived to be more sensitive and will be those contributing to ecosystem service (e.g. wetlands) or overall preservation of biodiversity.

3.7.2 Conservation importance

Conservation importance relates to species diversity, endemism (unique species or unique processes) and the high occurrence of threatened and protected species or ecosystems protected by legislation.

3.7.3 Sensitivity scale

- High – sensitive ecosystem with either low inherent resistance or low resilience towards disturbance factors or highly dynamic systems considered being important for the maintenance of ecosystem integrity. Most of these systems represent ecosystems with high connectivity with other important ecological systems or with high species diversity and usually provide suitable habitat for a number of threatened or rare species. These areas should be protected;
- Medium – These are slightly modified systems which occur along gradients of disturbances of low-medium intensity with some degree of connectivity with other ecological systems or ecosystems with intermediate levels of species diversity but may include potential ephemeral habitat for threatened species;
- Low – Degraded and highly disturbed / transformed systems with little ecological function and which are generally very poor in species diversity.

3.8 IMPACT RATING ASSESSMENT

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic environmental system that can be attributed to human activities related to alternatives under study for meeting a project need.

The significance of the impacts will be determined through a synthesis of the criteria below (Plomp, 2004):

Probability. This describes the likelihood of the impact actually occurring:

- Improbable: The possibility of the impact occurring is very low, due to the circumstances, design or experience.
- Probable: There is a probability that the impact will occur to the extent that provision must be made therefore.
- Highly Probable: It is most likely that the impact will occur at some stage of the development.
- Definite: The impact will take place regardless of any prevention plans, and there can only be relied on mitigation actions or contingency plans to contain the effect.

Duration. The lifetime of the impact

- Short term: The impact will either disappear with mitigation or will be mitigated through natural processes in a time span shorter than any of the phases.
- Medium term: The impact will last up to the end of the phases, where after it will be negated.

- Long term: The impact will last for the entire operational phase of the project but will be mitigated by direct human action or by natural processes thereafter.
- Permanent: Impact that will be non-transitory. Mitigation either by man or natural processes will not occur in such a way or in such a time span that the impact can be considered transient.

Scale. The physical and spatial size of the impact

- Local: The impacted area extends only as far as the activity, e.g. footprint.
- Site: The impact could affect the whole, or a measurable portion of the above mentioned properties.
- Regional: The impact could affect the area including the neighbouring areas.

Magnitude/ Severity. Does the impact destroy the environment, or alter its function.

- Low: The impact alters the affected environment in such a way that natural processes are not affected.
- Medium: The affected environment is altered, but functions and processes continue in a modified way.
- High: Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

Significance. This is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required.

- Negligible: The impact is non-existent or unsubstantial and is of no or little importance to any stakeholder and can be ignored.
- Low: The impact is limited in extent, has low to medium intensity; whatever its probability of occurrence is, the impact will not have a material effect on the decision and is likely to require management intervention with increased costs.
- Moderate: The impact is of importance to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.
- High: The impact could render development options controversial or the project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in mitigation.

The following weights will be assigned to each attribute (Table 7)

Table 7. Impact assessment matrix weights

Aspect	Description	Weight
Probability	Improbable	1
	Probable	2
	Highly Probable	4
	Definite	5
Duration	Short term	1
	Medium term	3
	Long term	4
	Permanent	5
Scale	Local	1
	Site	2
	Regional	3
Magnitude/Severity	Low	2
	Medium	6
	High	8
Significance	**Sum(Duration, Scale, Magnitude) x Probability**	
	Negligible	<20
	Low	<40
	Moderate	<60
	High	>60

The significance of each activity will be rated without mitigation measures and with mitigation measures for the development.

4 RESULTS: ECOLOGICAL ASSESSMENT

4.1 VEGETATION

4.1.1 Biomes

The development site lies within the Savanna biome which is the largest biome in Southern Africa. The Savanna Biome is characterized by a grassy ground layer and a distinct upper layer of woody plants (trees and shrubs). The environmental factors delimiting the biome are complex and include altitude, rainfall, geology and soil types, with rainfall being the major delimiting factor. Fire and grazing also keep the grassy layer dominant.

4.1.2 Vegetation types

The most recent classification of the area by Mucina & Rutherford shows the site to be part of the Musina Mopane Bushveld.

The Musina Mopane Bushveld vegetation unit (type) is the most diverse Mopane veld type in South Africa with only 2% statutorily conserved and roughly 3% transformed and a least threatened conservation status. The landscape is characterized by undulating to very irregular plains, with some hills. The gravelly hillsides and lower plains form moderately closed to open woodland dominated by *Colophospermum mopane* and *Terminalia prunoides*, while areas with deep sandy soils is characterized by moderately open savanna dominated by *Colophospermum mopane, Adansonia digitata, Commiphora mollis, Grewia flava* and *Combretum apiculatum*

4.1.3 Vegetation units

The proposed cropland development sites occur on a landscape that varies from slightly undulating plains to flat plans bisected by drainage channels. The importance to survey the area as a whole to have a better understanding of the ecosystem and the potential impact of the croplands on the natural environment was identified as a key factor, and subsequently the footprint areas was completely surveyed. The site forms part of a larger farm used for game farming and crop cultivation. The vegetation units on the site vary according to soil characteristics, topography and land-use. Vegetation units were identified on the footprint development sites and can be divided into 6 distinct vegetation units according to soil types and topography.

The vegetation communities identified on the proposed development site are classified as physiographic physiognomic units, where physiognomic refers to the outer appearance of the vegetation, and physiographic refers to the position of the plant communities in the landscape. The physiographic-physiognomic units will be

referred to as vegetation units in the following sections. These vegetation units are divided in terms of the land-use, plant species composition, topographical and soil differences that had the most definitive influence on the vegetation units. Each unit is described in terms of its characteristics and detailed descriptions of vegetation units are included in the following section. A species list for the site is included in Appendix A, while a plant species list for the quarter degree grid square (QDS) is included in Appendix B. Photographs of each unit is included in the next section to illustrate the grass layer, woody structure and substrate (soil, geology etc.). The following vegetation units were identified during the survey.

1. Mixed *Sclerocarya birrea – Combretum - Terminalia* sandveld
2. *Terminalia prunoides – Commiphora pyracanthoides* woodland
3. Mixed *Terminalia prunoides – Sclerocarya – Senegalia nigrescens* woodland
4. *Senegalia mellifera – Senegalia grandicornouta* shrubveld on calcareous soils;
5. Secondary old fields;
6. Hydrological features:
    - River with riparian woodland;
    - Artificial stormwater canal.

The vegetation units are presented in Figure 7:

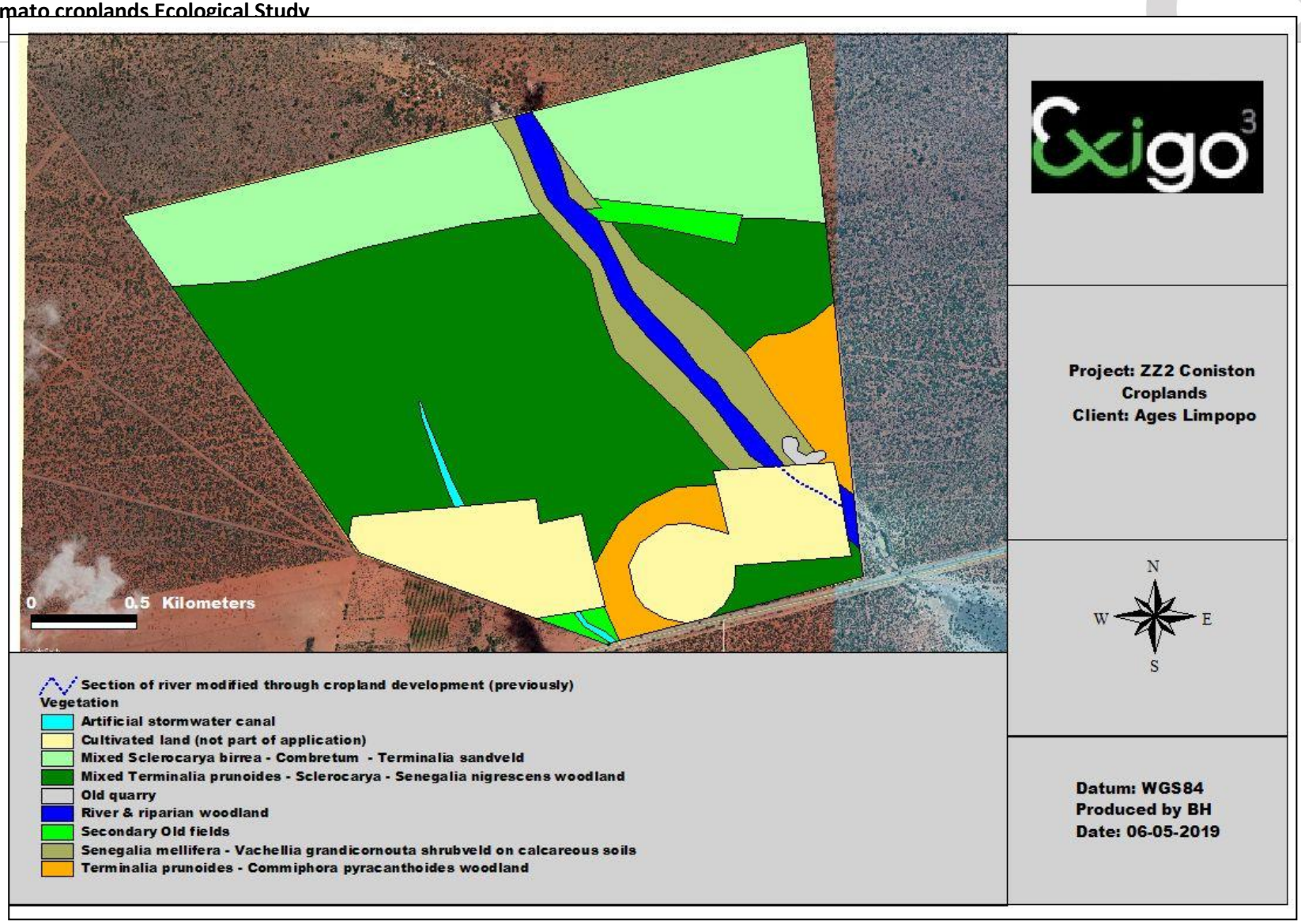


Figure 7. Vegetation Map of the proposed cropland development site

4.1.3.1 Mixed *Sclerocarya birrea – Combretum - Terminalia* sandveld

This vegetation unit is located in the northern section of the project area on a slightly undulating landscape with gravelly to red apedal soils. The woody layer is dominated by Sclerocarya birrea*, Terminalia sericea, Combretum apiculatum*, *Commiphora mollis* and *Grewia bicolor,* while the herbaceous layer is dominated by the grass species *Stipagrostis uniplumis.*

The characteristics of this vegetation unit are summarized in Table 8, while the state of the vegetation indicated in photograph 1.

Table 8. Botanical analysis and characteristics of the Mixed *Sclerocarya birrea – Combretum - Terminalia* sandveld

Vegetation unit characteristics	
State of the vegetation:	Slightly degraded woodland
Need for rehabilitation	Low
Conservation priority	Medium
Characteristics	Open to denser woodland on slightly undulating plains
Soils & Geology	Red apedal soils of the Hutton soil form and gravelly soils of the Glenrosa soil form derived from quartsite
Dominant spp.	*Sclerocarya birrea, Terminalia sericea, Combretum apiculatum, Grewia bicolor, Commiphora mollis*
Density of woody layer	Trees: 10-15% (avg. height: 3-6m) Shrubs: 10% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 6-700% (avg. height: 0.8-1.2m) Forbs: <1% (avg. height: 0.8m)
Sensitivity	Medium
Red data species	None observed
Protected species	*Sclerocarya birrea, Boscia albitrunca, Adansonia digitata, Vachellia erioloba*

The following specific recommendations for the vegetation unit regarding the proposed development should be adhered to:

- The vegetation unit is classified as having a medium sensitivity due its widespread occurrence in the Savanna Biome and the mopaneveld;
- The eradication of protected trees would need a permit from DAFF. Where possible the larger protected trees such as baobabs and marulas should be incorporated as part of the croplands;
- The development of croplands is considered suitable in this area, provided that

the soil depth is confirmed as suitable for crop cultivation under irrigation.

Photograph 1. Mixed *Sclerocarya birrea – Combretum - Terminalia* sandveld in the project area

4.1.3.2 *Terminalia prunoides – Commiphora pyracanthoides* woodland

This vegetation unit is located on slightly undulating terrain in the project area. The soils are shallow red-yellow apedal soils over limestone and support both broad and microphyllous woodland components. The woody layer is dominated by *Terminalia prunoides* and *Commiphora pyracanthoides.* The characteristics of this vegetation unit are summarized in Table 9, while the state of the vegetation indicated in photograph 2.

Table 9. Botanical analysis and characteristics of the *Terminalia prunoides – Commiphora pyracanthoides woodland*

Vegetation unit characteristics	
State of the vegetation:	Slightly degraded woodland
Need for rehabilitation	Low
Conservation priority	Medium
Characteristics	Open woodland on undulating plains
Soils & Geology	Shallow red-yellow apedal soils of the Hutton / Clovelly soil form overlying limestone

Vegetation unit characteristics	
Dominant spp.	*Terminalia prunoides, Commiphora pyracanthoides, Grewia bicolor,*
Density of woody layer	Trees: 10-15% (avg. height: 3-6m) Shrubs: 10-15% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 60-70% (avg. height: 0.8-1.2m) Forbs: <1% (avg. height: 0.8m)
Sensitivity	Medium
Red data species	None observed
Protected species	*Boscia albitrunca, Adansonia digitata, Sclerocarya birrea*

The following specific recommendations for the vegetation unit regarding the proposed development should be adhered to

- The vegetation unit is classified as having a medium sensitivity due its widespread occurrence in the Savanna Biome and the mopaneveld;
- The eradication of protected trees would need a permit from DAFF. Where possible the larger protected trees such as baobabs and marulas should be incorporated as part of the croplands;
- The development of croplands is considered suitable in this area.

Photograph 2. *Terminalia prunoides – Commiphora pyracanthoides* woodland in the project area

4.1.3.3 Mixed *Terminalia prunoides – Sclerocarya – Senegalia nigrescens* woodland

This vegetation unit occur in the central and western sections of the proposed croplands site. The substrate forms medium depth red-yellow apedal soils derived from sandstone or limestone. The deeper sandy-loam soils are indicated by the presence of tall tree species such as knobthorn and marula that are adapted to grow in these deeper soils. The woody structure is open woodland with a well-developed shrub layer. *Sclerocarya birrea, Terminalia prunoides, Combretum apiculatum* and *Senegalia nigrescens* occur scattered through the area, while the shrub layer is characterized by the dominance of *Commiphora pyracanthoides* and *Grewia bicolor*. Photograph 3 indicates the state of the woody and herbaceous layer. The characteristics of this vegetation unit are summarized in Table 10.

Table 10. Botanical analysis and characteristics of the Mixed *Terminalia prunoides – Sclerocarya – Senegalia nigrescens* woodland

Vegetation unit characteristics	
State of the vegetation:	Slightly degraded woodland
Need for rehabilitation	Low
Conservation priority	Medium
Characteristics	Open to denser woodland on undulating plains
Soils & Geology	Medium depth red-yellow apedal soils overlying limestone
Dominant spp.	*Terminalia prunoides, Sclerocarya birrea, Senegalia nigrescens, Combretum apiculatum, Grewia bicolor*
Density of woody layer	Trees: 15-20% (avg. height: 3-6m) Shrubs: 10% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 60-70% (avg. height: 0.8-1.2m) Forbs: <1% (avg. height: 0.8m)
Sensitivity	Medium
Red data species	None observed
Protected species	*Sclerocarya birrea, Boscia albitrunca, Adansonia digitata*

The following specific recommendations for the vegetation unit regarding the proposed development should be adhered to

- The vegetation unit is classified as having a medium sensitivity due its widespread occurrence in the Savanna Biome and the mopaneveld;
- The eradication of protected trees would need a permit from DAFF. Where possible the larger protected trees such as baobabs and marulas should be incorporated as part of the croplands;
- The development of croplands is considered suitable in this area;

Photograph 3. Mixed *Terminalia prunoides – Sclerocarya – Senegalia nigrescens* woodland on undulating plainsin the project area

4.1.4 *Senegalia mellifera – Vachellia grandicornuta* shrubveld on calcareous soils

This vegetation unit occur directly adjacent to the riverine areas in the project area on soils that is shallower compared to the remainder of the site and is derived from calcrete. It can be clearly distinguished from the remainder of the site through the dominance of the woody species *Senegalia mellifera* and *Vachellia grandicornouta*. The woody layer is classified shrubveld and the herbaceous layer is low and patchy. No red data species occurs; probably as a result of the habitat being different compared to the potential red data species that could occur. The state of the woody and herbaceous layer is indicated in photograph 4 and the characteristics of this vegetation unit are summarized in Table 11.

Table 11. Botanical analysis and characteristics of *Senegalia mellifera – Vachellia grandicornuta* shrubveld on calcareous soils

Vegetation unit characteristics	
State of the vegetation:	Natural woodland in a slightly degraded state
Need for rehabilitation	Low
Conservation priority	Medium
Characteristics	Open to dense shrubveld on shallow calcareous soils
Soils & Geology	Shallow nodular soils derived from limestone

Vegetation unit characteristics	
State of the vegetation:	Natural woodland in a slightly degraded state
Need for rehabilitation	Low
Conservation priority	Medium
Dominant spp.	*Dichrostachys cinerea, Senegalia mellifera, Vachellia grandicornuta*
Density of woody layer	Trees: 2-5% (avg. height: 3-6m) Shrubs: 15-20% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 10-20% (avg. height: 0.8-1.2m) Forbs: <1% (avg. height: 0.8m)
Sensitivity	Medium
Red data species	None observed
Protected species	*Boscia albitrunca*

Photograph 4. *Senegalia mellifera – Vachellia grandicornuta* shrubveld on calcareous soils in the project area

The following specific recommendations for the area should be adhered to

- The vegetation unit is classified as having a medium sensitivity due its widespread occurrence in the Savanna Biome and the mopaneveld;
- The shallow soils make the potential for cropland development in this area

unsuitable;

4.1.5 Secondary old fields

The old field occur as a small section in the northeastern section of the proposed cropland site, while another small old field occur in the southern section of the site. When cultivated fields are left fallow, it results in a landscape mosaic of patches of secondary vegetation varying in age and dominated by various grass species (Moll, 1965). Different stages of succession occur in the old fields, and Wildi (2002) described how dynamic these systems are over time and space. The old field on the site is in an advanced state of succession considering that some scattered trees were observed on it.

The dominant tree species on the old field area include *Vachellia tortilis* and *Dichrostachys cinerea*, while typical herbs/forbs include *Solanum incanum* and *Sesamum triphyllum*. This vegetation unit is defined as a secondary old field variant/modified land which is evident from the higher tree cover/diversity, compared to younger old fields in the larger area.

No red data species was observed as a result of the modified state of the vegetation. Unlimited development could be supported in this area. This area would be the most suitable area for the development of croplands.

Photograph 5. Secondary old fields in the project area

4.1.6 Hydrological features

4.1.6.1 Drainage channels and riparian woodland

One river bisects the proposed development site and have been modified partially when croplands were developed previously on site. The river with associated riparian vegetation (Photograph 6) in the project area are considered to be ecologically sensitive, forming important, limited and specialised habitats for several plant and fauna species. The species composition is unique and relatively limited in distribution and coverage. These habitats also form linear corridors linking different open spaces. The smaller drainage channel in the project area eventually flows into the Sand River that runs to the west of the site. The riparian zone varies from 10-20 m wide as identified from the aerial photograph. No development should take place within the 1:100 year flood line. A buffer zone of about 30 meter is also needed for the non-perennial drainage channel. These areas should remain natural without any development or landscaping. The riparian zone delineation should form part of the ecological study, and the functional status of the riparian zone of the major drainage channels in the study area should be assessed.

The riverine woodland would be important dry season refuge areas for many fauna species in their natural state. It is also a centre of floral diversity. Riparian areas have been identified as important dry season refuge areas for a variety of large mammal species. The impacts on the sensitive riparian ecosystems, regardless of the source, need to be restricted. Impacts on this system include erosion, habitat loss and degradation and the associated impacts on faunal and floral diversity, dewatering of marshes and wetlands, water abstraction as well as increased sedimentation (SANParks 2003). Continued impacts on the riverine ecosystems may also ultimately reduce the capacity of this system to absorb dramatic flooding events.

Although no red data species were noted in the area the vegetation unit as an entity represents a sensitive ecozone. The following specific recommendations for the area should be adhered to

- No cropland development can be supported in this vegetation unit considering the river represents a biodiversity “hotspot” in the area. The potential to impact on the sensitive habitat is high and therefore the woodland on calcareous soils along the periphery of the river provides a sufficient buffer zone of 30 meters.

Photograph 6. Small non-perennial drainage channel in the project area

4.1.6.2 Artificial stormwater canal

A stormwater canal was constructed many years ago that diverted water from the Soutpansberg to the south of the site through the previously cultivated lands. The stormwater canal shows some signs of riparian vegetation along its edges, and some tall grasses in the canal itself, although it is still considered as artificial. The canal has been modified when the croplands were developed through it in recent times, although no rehabilitation of this area would be needed. The owner still needs to manage stormwater to divert around the cropland where necessary. Although the canal is considered artificial it still has limited functionality in terms of ecosystem and hydrological functioning and is therefore classified as having a Medium-Low Sensitivity.

4.2 FLORA: SPECIES LEVEL ASSESSMENT

South Africa has been recognized as having remarkable plant diversity with high levels of endemism. The major threats to plants in the study area are urban expansion, non-sustainable harvesting, collecting, overgrazing/browsing, mining and agriculture. The objective of this section was to compile a list of plant species for which there is conservation concern. This included threatened, rare, declining, protected and endemic species.

4.2.1 Species of conservation concern

Species of conservation concern are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare, Declining and Data Deficient – Insufficient Information (DDD). It should also be noted that not all species listed as protected are threatened or vice versa.

Threatened species are also seen as indicators of the overall health of an ecosystem (Hilton-Taylor, 1996). No individuals of the endemic or biogeographically important plants listed by Mucina & Rutherford for the relevant vegetation types were observed during the survey as a result of the habitat not being suitable, while the degraded state of the vegetation for the remainder of the area makes the probability of findings these species improbable, even though it might have been previously found in the larger area. Habitat degradation is one of the main reasons for plant species becoming extinct in a particular area.

A list of SCC plant species previously recorded in the study area in which the proposed development is planned was obtained from the Plants of Southern Africa (POSA) database of SANBI. Figure 8 indicates the classification system used by Sanbi for SCC:

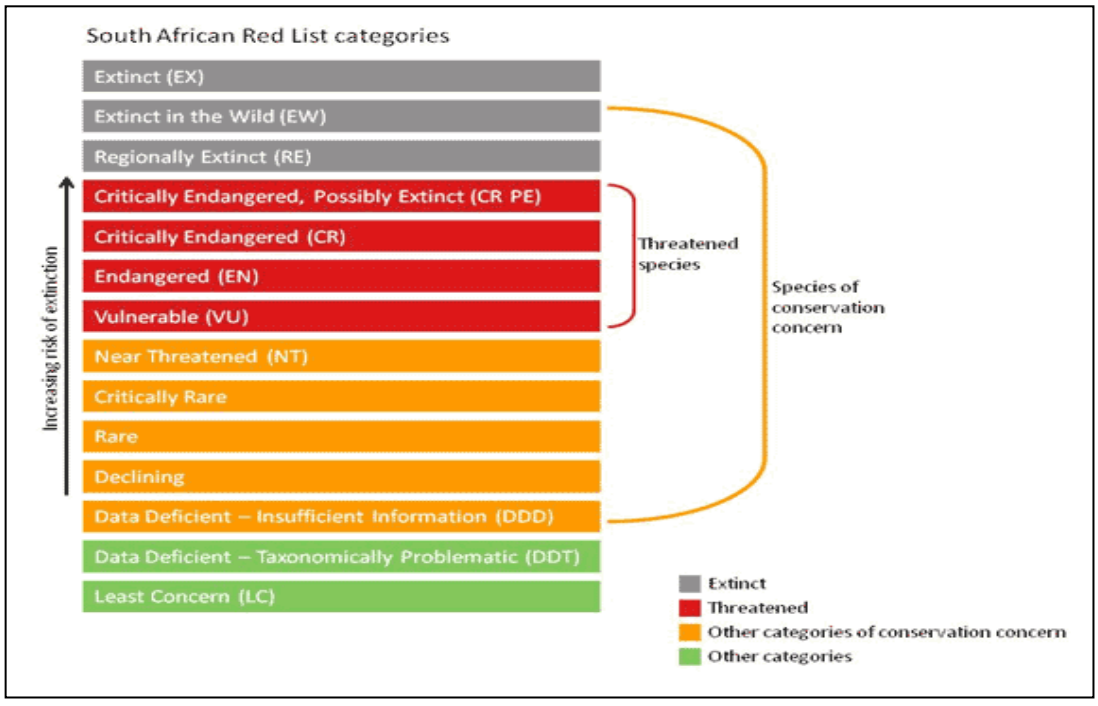


Figure 8. South African red list categories indicating the categories to be used for Species of Conservation Concern

Mucina and Rutherford (2006) identified the following plant species as endemic to the main vegetation types (Musina Mopane Bushveld) in the region:

Low shrub: *Pavonia dentata*

Herb: *Cleome oxyphylla var. robusta*

Habitat degradation is one of the main reasons for plant species becoming extinct in a particular area. Threatened species are also seen as indicators of the overall health of an ecosystem (Hilton-Taylor, 1996).

Threatened plant species according to grid square data of SANBI associated with the larger project area includes the following species (Table 12).

Table 12. Red data and endemic species occurring in the project area of the QDS

Family	Genus	Species	IUCN classification
Myrothamnaceae	*Myrothamnus*	*flabellifolius*	Data Deficient
Santalaceae	*Thesium*	*resinifolium*	Data Deficient
Asphodelaceae	*Aloe*	*vogtsii*	Near Threatened

None of these species were documented during the surveys.

4.2.2 Protected tree species (DAFF)

Four tree species listed as protected under the national list of declared protected tree species as promulgated by the National Forest Act (NFA), 1998 (No. 84 of 1998) was observed in the project area. The trees species listed in National Forest Act protected tree species list (Table 13) have a wide distribution in Southern Africa, although these trees have an importance in terms of medicinal, cultural and heritage value to local communities. The following protected tree species of concern occur in the area:

Table 13. Protected tree species of concern in the project area

Species	National Conservation status	Status in project area
Adansonia digitata	Protected (NFA)	Widespread
Boscia albitrunca	Protected (NFA)	Widespread
Sclerocarya birrea	Protected (NFA)	Widespread
Vachellia erioloba	Protected (NFA)	Widespread

The baobab trees occurring throughout the area to the north of the Soutpansberg are declared national monuments. Regarded as the largest succulent plant in the world, the baobab tree is steeped in a wealth of mystique, legend and superstition wherever it occurs in Africa. It is a tree that can provide food, water, shelter and relief from sickness. The baobab was declared a protected tree under the Forest Act in South Africa in 1941. Often referred to as 'grotesque' by some authors, the main stem of larger baobab trees may reach enormous proportions of up to 28 m in girth. These trees should be protected and

future developments should rather incorporate baobab trees as part of landscaping. Therefore, the development should be planned around the baobab trees and eradication of these declared national monuments should be prevented. The baobab is a tree with a high aesthetic value and would enhance the aesthetical value of any development in the area in the future.

The listed protected tree species in terms of the National Forest Act of 1998, may not be cut, disturbed, damaged, destroyed and their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold – except under license granted by Department of Agriculture, Forestry and Fisheries (DAFF) or a delegated authority. Obtaining relevant permits are therefore required prior to any impact on these individuals.

4.2.3 Protected Plants (LEMA)

Plant species are also protected in the Limpopo Province according to the Limpopo Environmental Management Act. According to this ordinance, no person may pick, import, export, transport, possess, cultivate or trade in a specimen of a specially protected or protected plant species. The Appendices to the ordinance provide an extensive list of species that are protected, comprising a significant component of the flora expected to occur on site. Communication with Provincial authorities indicates that a permit is required for all these species, if they are expected to be affected by the proposed project.

After a detailed survey was conducted during May 2019, the following listed protected species in the ordinance was found in the footprint areas of the project area:

- *Adansonia digitata* (baobab)
- *Spirostachys africana* (tamboti) – confined to riparian zones and impact therefore negligible

4.2.4 Invasive alien species (Alien and Invasive Species Regulations GNR 599 of 2014)

Invasive alien plants pose a direct threat not only to South Africa's biological diversity, but also to water security, the ecological functioning of natural systems and the productive use of land. They intensify the impact of fires and floods and increase soil erosion. Of the estimated 9000 plants introduced to this country, 198 are currently classified as being invasive. It is estimated that these plants cover about 10% of the country and the problem is growing at an exponential rate.

The Alien and Invasive Species Regulations (GNR 599 of 2014) are stipulated as part of the National Environmental Management: Biodiversity Act (10/2004). The regulation listed a total of 559 alien species as invasive and further 560 species are listed as prohibited and may not be introduced into South Africa. Below is a brief explanation of the four

categories of Invasive Alien Plants as per the regulation.

- Category 1a: Invasive species requiring compulsory control. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.
- Category 1b: Invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued.
- Category 2: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants to exist in riparian zones.
- Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy or accept as a gift) involving a Category 3 species. No permits will be issued for Cat 3 plants to exist in riparian zones.

The fight against invasive alien plants is spearheaded by the Working for Water (WfW) programme, launched in 1995 and administered through the DWA. This programme works in partnership with local communities, to whom it provides jobs, and also with Government departments including the Departments of Environmental Affairs and Tourism, Agriculture, and Trade and Industry, provincial departments of agriculture, conservation and environment, research foundations and private companies.

WfW currently runs over 300 projects in all nine of South Africa's provinces. Scientists and field workers use a range of methods to control invasive alien plants. These include:

- Mechanical methods - felling, removing or burning invading alien plants.
- Chemical methods - using environmentally safe herbicides.
- Biological control - using species-specific insects and diseases from the alien plant's country of origin. To date 76 bio-control agents have been released in South Africa against 40 weed species.
- Integrated control - combinations of the above three approaches. Often an integrated approach is required in order to prevent enormous impacts.

Vehicles often transport many seeds and some may be of invader species, which may become established along the roads through the area, especially where the area is

disturbed. The development phase of the development will almost certainly carry the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that invasive alien species such as the seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites.

Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project. After a detailed survey, the following species was documented on the proposed cropland areas.

Table 14. List of AIS documented in the project area

Species	Category
Argemone ochroleuca	1b
Datura stramonium	1b
Opuntia ficus-indica	1b
Opunita stricta	1b

4.2.5 General

An important aspect relating to the proposed development should be to protect and manage the biodiversity (structure and species composition) of the vegetation types which are represented on the proposed development site. Vegetation removal should be kept to the footprint areas of the proposed croplands development. The unnecessary impact on the surrounding woodland areas outside the development area should be avoided as far as possible.

4.3 FAUNAL ASSESSMENT

4.3.1 Overview

A healthy environment is inhabited by animals that vary from micro-organisms to the birds and mammals. The species composition and diversity are often parameters taken into consideration when determining the state of the environment. A comprehensive survey of all animals is a time consuming task that will take a long time and several specialists to conduct. The alternative approach to such a study is to do a desktop study from existing databases and conduct a site visit to verify the habitat requirements and condition of the habitat. If any rare or endangered species are discovered in the desktop study that will be negatively influenced by the proposed development, specialist surveys will be conducted.

4.3.2 Results of desktop survey and site visits during May 2019

A survey was conducted during May 2019 to identify specific fauna habitats, and to compare these habitats with habitat preferences of the different fauna groups (birds, mammals, reptiles, amphibians) occurring in the quarter degree grid.

The number of mammal species supported by a plant community depends on several factors like the primary production, seasonal availability of resources, floral heterogeneity, diversity of plant structure, nature of the substratum and previous history (Delany, 1982). Each mammal species have a particular niche, which can be regarded as the sum of all ecological requirements of a species namely food, space, shelter and physical conditions. Mills & Hes (1997) stated that the distribution and abundance of animal species does not rigorously follow that of plant communities or biomes. Instead, mammal species seem to have certain preferences for a specific habitat type (Skinner & Smithers, 1990). Several authors have shown this preference of mammals to certain habitats through analysis (Beardall et al. 1984; Ben-Shahar, 1991; Dekker et al. 1996). The area represents a diverse vegetation structure and height class. A detailed species list for the fauna of the area is included in Appendix C, D and E.

4.3.3 Fauna habitats of the project area

Two major fauna habitats were observed in the area namely:

- Riparian woodland;
- Mixed undulating woodland;

4.3.3.1 Habitat B: Riparian woodland

The riparian woodland along the banks of the riverine systems is important habitat for various birds, mammals and Herpetofauna (reptiles and amphibians).

4.3.3.2 Habitat C: Mixed woodland associated with plains and valleys

The woodland area of the lower-lying plains and open valleys play an important role as habitat for various generalized fauna species. Birds and arboreal reptiles would utilize the larger trees species (baobab, knobthorn, marula) for breeding, roosting and foraging.

4.3.4 Common fauna documented and potentially occurring on the development site

4.3.4.1 Mammals

Large mammals such as elephant, lion, buffalo and rhinoceros species that occurred historically in the habitats observed on site that forms part of the development site are today mainly restricted to game reserves and national parks in the area, although they

might migrate occasionally through the area. This loss of large species on the private land that forms part of the project area means that the mammal diversity on these sites is far from its original natural state not only in terms of species richness but also with regards to functional roles in the ecosystem.

Larger predators such as leopard and brown hyena still occur in the natural areas and signs of brown hyena were also confirmed in the project area.

The majority of the habitat types are still intact. Therefore, the expected mammalian richness on these areas is considered high. Red data mammals that still roam freely in the area include larger predators such as leopard and brown hyena (red data). Antelope species such as klipspringer, kudu, bushbuck and duiker will roam freely through the area and are not restricted by game fences. Smaller mammal species such as honey badgers and serval can become habituated to anthropogenic influences, while other species such as brown hyena will rather move away from the construction activities and will seldom use the area. Many of the bat species of conservation concern in the project area are cave-dependant for roosting. Any individuals that utilize the area would therefore either be foraging or migrating and would not be affected by the localized loss of habitat due to the development. The dominant species composition therefore comprises of widespread taxa with unspecialised life history traits.

Most mammal species are highly mobile and will move away during construction of the croplands. The most important corridors that need to be preserved for free-roaming mammal species in the area include the rocky ridges and riparian woodland.

4.3.4.2 Birds (avifauna)

Two major bird habitat systems were identified within the cropland footprint areas, including the riparian woodland and mixed broadleaf woodland.

The woodland biome in Southern Africa supports the highest diversity of bird species of all the vegetation types in the sub region. This includes such characteristic and colourful woodland birds as rollers, bee eaters and waxbills, as well as large birds of prey such as vultures and eagles. The broadleaved woodland occurring in the project area has quite a higher diversity of birds as a result of the crossover of habitats. Typical examples of broad-leaved-woodland birds are Pallid Flycatcher, Greencapped Eremomela, White-bellied Korhaan and Meyer's Parrot.

Some bird species such as the redbilled oxpeckers and vulture species that occur in the area where the croplands are planned are primarily dependant on the presence of their food source.

There is a long list of red data bird species that have a geographical distribution that

includes the site. The presence of the habitat of these species is mostly confined to the open water habitats and rocky habitats that occur outside the project area.

4.3.4.3 Herpetofauna (Reptiles and Amphibians)

There are no amphibian species of conservation concern that have a distribution that includes the development footprint areas. No specific breeding habitat of frogs and toads occur on site.

Reptile species such as the southern rock python, the black mamba, puff adder, boomslang, vine snake, spotted bush snake and several members of the green snakes (*Philothamnus* spp.) is expected to occur in the habitats of the proposed cropland sites, although the presence of these snakes is dependant on the presence of their prey species (rodents, frogs etc.). The general habitat type for reptiles consists of open to very dense bushveld, with limited available habitat for diurnally active and sit-and-wait predators, such as terrestrial skinks and other reptiles. Arboreal species are the more prominent components of the local herpetofauna.

The only species listed in the IUCN red data categories that could potentially be impacted on by the croplands is the South African python. The proposed development activities should allow the species to still have optimal living conditions on the remainder of the area.

4.3.4.4 Insects and invertebrates

All of the potential invertebrate habitats are well represented by a high family richness of insects and spiders. Spiders occur throughout all the habitats, and both web builders and active hunters find their ways in trapping and actively hunt around for potential food.

4.3.5 Red data species

According to the existing databases and field survey the following number of fauna species included in the IUCN red data lists can potentially be found on the cropland footprint areas (Table 15):

Table 15. Red data list of potential fauna for the study area

English Name	Conservation status	Probability of occurrence
BIRDS		
Bustard, Kori	Near threatened	Medium-High
Eagle, Martial	Endangered	Medium-High
Eagle, Tawny	Endangered	Medium-High
Falcon, Lanner	Vulnerable	Medium
Roller, European	Near threatened	High

English Name	Conservation status	Probability of occurrence
Secretarybird	Vulnerable	Medium-High
Stork, Abdim's	Near threatened	Medium
Stork, Marabou	Near threatened	Medium
Vulture, Cape	Endangered	Medium
Vulture, Lappet-faced	Endangered	Medium
Vulture, White-backed	Endangered	Medium
MAMMALS		
Leopard	Vulnerable (2016)	High
Ground Pangolin	Vulnerable (2016)	Medium
HERPETOFAUNA		
Soutpansberg Worm Lizard	Vulnerable (SARCA 2014)	Low
Muller's Velvet Gecko	Vulnerable (SARCA 2014)	Medium
Soutpansberg Dwarf Gecko	Near Threatened (SARCA 2014)	Low
White-bellied Dwarf Burrowing Skink	Near Threatened (SARCA 2014)	Medium
Cryptic Dwarf Gecko	Data Deficient (SARCA 2014)	Medium

The impact of the proposed croplands on the red data and other mammal species will mostly have a medium to low probability as a result of the following:

- The vulture species (Cape vulture; Whitebacked vulture, Lappetfaced vulture) will occur periodically in the area as a result of their feeding patterns (presence of carcasses). The tall trees on the property provide potential breeding habitat for the Whitebacked vultures. The development of the croplands will create habitat loss for species such as whitebacked vultures that will lose potential nesting sites in tall trees although a monitoring project on the populations in the Limpopo Province will give clearer indications what the actual impact of any development is on these rare birds;
- If one considers the habitat descriptions of the red data species, some of them are limited in range or threatened as a direct result of habitat loss in the southern African sub-region (hedgehogs, pangolins etc.), although other species with large home ranges (e.g. martial eagle) are not directly threatened by habitat loss. The impact of the dam development sites on the red data species would therefore be less than predicted.
- Most of the larger mammal species no longer occur naturally in the area and are confined to nature reserves;
- Martial eagles, tawny eagles and other birds of prey might occur periodically on the property as well, although the large size of their home range make the probability of them occurring on the property low. The large trees present on the property will provide them of roosting places;

- The development of the croplands will not influence the natural feeding and movement patterns of the existing fauna in the area.

The cumulative negative impact of cropland development on the fauna has the potential to be moderate to high should development disregard the environment. However, considering the following general mitigation and management actions taken on site, the impact on faunal populations should be low.

- The removal of vegetation should be confined to the footprints of the croplands and access roads for construction. Peripheral impacts on the larger area should be avoided.
- Where trenches pose a risk to animal safety, they should be adequately cordoned off to prevent animals falling in and getting trapped and/or injured. This could be prevented by the constant excavating and backfilling of trenches during construction process;
- No animals may be poached during any constructional processes of any kind. Many animals are protected by law and poaching or other interference could result in a fine or jail term;
- Do not feed any wild animals on the proposed cropland construction site;
- Poisons for the control of problem animals should rather be avoided since the wrong use thereof can have disastrous consequences for the vulture species as well as other birds of prey occurring in the area. The use of poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist;
- Waste bins and foodstuffs should be made scavenger proof on the construction site;
- Roads in the area should be designed without pavements to allow for the movement of small mammals;

4.4 WETLANDS / WATER COURSES OF THE PROJECT AREA

4.4.1 Delineation

DWAF (2003) states that in order to classify an area as a wetland it must have one or more of the following attributes:

- Hydromorphic soils that exhibit features characteristic of prolonged saturation;
- The presence of hydrophytes (even if only infrequently);
- A shallow water table that results in saturation at or near the surface, leading to

the development of anaerobic conditions in the top 50cm of the soil.

The delineation map is indicated in Figures 6 as part of the vegetation map. The identification of the water courses was done according to the aerial photograph and a field survey where the topography of the landscape and vegetation were used to delineate the water course or riparian zone.

The wetland classification system of the National Water Act classifies the HGM unit associated with the drainage channel as a channel. A channel (river, including the banks) is an open conduit with clearly defined margins that (i) continuously or periodically contains flowing water, or (ii) forms a connecting link between two water bodies. Dominant water sources include concentrated surface flow from upstream channels and tributaries, diffuse surface flow or interflow, and/or groundwater flow. Water moves through the system as concentrated flow and usually exits as such but can exit as diffuse surface flow because of a sudden change in gradient. Unidirectional channel-contained horizontal flow characterises the hydrodynamic nature of these units. As a result of the erosive forces associated with concentrated flow, channels characteristically have relatively obvious active channel banks. At Level 4A of the classification system, the entire active channel (including wetlands occurring on the banks, i.e. in the riparian zone) is treated as a unit.

This channel is not a “true” wetland as stipulated in the National Water Act due to the soil not indicating wetness in the top 50cm and therefore represents a water course classified as a river.

Section 1.1 (xi) of the National Water Act (1998) described “instream habitat" as the area which includes the physical structure of a watercourse and the associated vegetation in relation to the bed of the watercourse. The water course on the site is a non-perennial channel representing tributaries of the main rivers. The channel has a sandy riverbed with some small pebbles and rocks along its bottom.

Riparian Habitat are described by the National Water Act (1998) Section 1.1 (xxi) as follows: “riparian habitat" includes 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 land areas”.

The drainage channel on site is non-perennial. The band of trees that occurs along the channel can be classified as riparian vegetation. This vegetation is very important for connectivity with adjacent vegetation as well as a migratory route for riparian animals. The most abundant and most conspicuous trees in the riparian woodland are *Vachellia karroo, Vachellia nilotica, Vachellia grandicornouta* and *Senegalia mellifera* occur on the

riverbanks adjacent to the channel. Typical grasses include *Panicum maximum* and *Eragrostis rotifer*.

The artificial canal was developed for stormwater management on the site and considered an artificial drainage feature that can be rehabilitated. The canal should be designed to manage stormwater on site.

4.4.2 Riverine Integrity Assessments

In determining the integrity of the water courses, the condition of the site and the indirect and direct disturbances is taken into account. The embankments, roads, alien invasive vegetation species, littering etc. was taken into account in determining the PES and EIS of this water course. Appendix F and G indicate the scores for the PES and EIS respectively.

Evidence was observed on site of transformation of the floristic characteristics of the site. Impacting activities which may have altered the expected floristic composition include impoundment and sedimentation.

Table 16 indicate the PES and EIS as determined for this river and riparian zone. The roads, alien invasion, sedimentation and agricultural activities had a definite impact on downstream areas.

Table 16. Present Ecological State and Ecological Importance & Sensitivity of the riparian system on the proposed development sites

HGM unit	PES	EIS
River and riparian woodland	Class C: Moderately Modified	Moderate

The drainage channel and riparian woodland has a Class C PES (Moderately Modified), mainly due to the channel being modified by existing croplands. The riparian woodland plays an important role as corridor for fauna in the area and has only been impacted by upstream agricultural activities and road crossings. Considering the importance as fauna corridor as well as the red data species associated with the riverine woodland, the area has a Moderate EIS. This HGM unit is therefore considered to be ecologically sensitive and important at a local scale. The biodiversity of this riparian zone may be sensitive to flow and habitat modification, while the channel plays a significant role in moderating the quantity and quality of water entering downstream areas.

5 POTENTIAL IMPACTS OF THE PROPOSED CLEARANCE ON THE FAUNA AND FLORA

The impact of the proposed development on a measurable scale will be on a medium sized footprint area. The vegetation on site varies from slightly degraded to pristine. Impacts described will occur during the development and operational phases of the croplands, although the intensity (significance) of these impacts will differ due to different development activities during the phases.

5.1 DIRECT HABITAT DESTRUCTION

5.1.1 Description of impact:

The development of the croplands will result in loss of and damage to habitats if the vegetation is cleared. Most habitat destruction will be caused during the development phase. Vegetation communities are likely to be impacted on a small spatial scale in comparison to the extent of the vegetation communities' total area in the region.

The impact of the habitat destruction will be on the flora and fauna of the study area in the following ways:

- The clearing of areas for the croplands will lead to the loss of individual plants such as grasses, forbs, trees and shrubs that will be cleared on the footprint areas. This will mostly occur during the development phase;
- Due to habitat loss and development activities animals will migrate from the impacted areas and terrestrial numbers will decrease;
- This impact could also take place because of hunting and snaring of animals in natural areas not used for the clearance sites.

5.1.2 Mitigation measures:

- The removal of the indigenous trees and shrubs should only occur on the footprint area of the croplands. No vegetation should be cleared on adjacent areas. The protected trees could be preserved where possible. The eradication of protected trees would need a licence being obtained from DAFF, although the larger baobab trees will be protected;
- Conduct flora species search and rescue efforts before ground clearing of land for development of croplands in order to reduce negative impacts on species of concern;
- The ECO should advise the development team in all relevant matters to ensure minimum destruction and damage to the environment. The ECO should enforce any measures that he/she deem necessary. Regular environmental training

should be provided to workers to ensure the protection of the habitat, fauna and flora and their sensitivity to conservation;

- Limit pesticide use to non-persistent, immobile pesticides and apply in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications;
- Poisons for the control of problem animals should rather be avoided since the wrong use thereof can have disastrous consequences for the raptors (refer to Appendix C) occurring in the area. The use of poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist;

5.2 HABITAT FRAGMENTATION

5.2.1 Description of impact:

The development of the croplands will inevitably result in natural movement patterns being disrupted and, to a varying degree depending on how different species react to these barriers will result in the fragmentation of natural populations.

5.2.2 Mitigation measures:

- Use existing facilities (e.g., access roads, degraded areas) to the extent possible to minimize the amount of new disturbance.
- Ensure protection of important resources by establishing protective buffers to exclude unintentional disturbance. All possible efforts must be made to ensure as little disturbance as possible to the sensitive habitats on site during development;
- During development, sensitive habitats must be avoided by vehicles and equipment, wherever possible, in order to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place.
- Development activities must remain within defined croplands and the road servitudes. No disturbance will occur outside these areas.

5.3 INCREASED SOIL EROSION AND SEDIMENTATION

5.3.1 Description of impact:

The development activities associated with the cleared areas for croplands may result in widespread soil disturbance and is usually associated with accelerated soil erosion. Soil erosion promotes a variety of terrestrial ecological changes associated with disturbed areas, including the establishment of alien invasive plant species, altered plant community species composition and loss of habitat for indigenous flora.

5.3.2 Mitigation measures:

- Cover disturbed soils as completely as possible, using vegetation or other materials;
- Minimize the amount of land disturbance and develop and implement stringent erosion and dust control practices.
- Repair all erosion damage as soon as possible to allow for sufficient rehabilitation growth;
- Gravel roads must be well drained in order to limit soil erosion;

5.4 SPILLAGES OF HARMFULL SUBSTANCES TO THE ECOSYSTEM

5.4.1 Description of impact:

Development work will further carry a risk of soil and water pollution, with tractors and other vehicles contributing substantially due to potential oil and fuel spillages. If not promptly dealt with, spillages or accumulation of waste matter can contaminate the soil and surface or ground water, leading to potential medium/long-term impacts on fauna and flora.

5.4.2 Mitigation measures:

- Any excess or waste material or chemicals should be removed from the development sites and discarded in an environmental friendly way. The ECO should enforce this rule rigorously;
- Spill kits should be on-hand to deal with spills immediately;
- All vehicles should be inspected for oil and fuel leaks on a regular basis. Vehicle maintenance yards on site should make provision for drip trays that will be used to capture any spills. Drip trays should be emptied into a holding tank and returned to the supplier.

5.5 HABITAT DEGRADATION DUE TO DUST

5.5.1 Description of impact:

The following activities will typically cause air pollution at the proposed croplands:

- Land clearing operations;
- Vehicle entrainment on unpaved roads;

Dust pollution will impact the most severe during the development phase on the flora of the surrounding areas. Vehicles and equipment are the major contributors to the impact on

air quality. Dust is generated during site clearance for the croplands. Diesel exhaust gasses and other hydrocarbon emissions all add to the deterioration in air quality during this phase. Vehicles travelling at high speeds on dirt roads significantly aggravate the problem.

Dust in the area will be greatly increased in the dry season due to the nature of the soil in the area, with very small particulates.

5.5.2 Mitigation measures:

- Implement standard dust control measures on access roads to the croplands.
- A speed limit should be enforced on dirt roads (preferably 30km/h).

5.6 SPREAD AND ESTABLISHMENT OF ALIEN INVASIVE SPECIES

5.6.1 Description of impact:

Continued movement of personnel and vehicles on and off the site during the development phase will result in a risk of importation of alien species. Vehicles often transport many seeds and some may be of invader species, which may become established along the road, especially where the area is disturbed. The development carries by far the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites.

5.6.2 Mitigation measures:

- Control involves killing the plants present, killing the seedlings which emerge, and establishing and managing an alternative plant cover to limit re-growth and re-invasion. Weeds and invader plants will be controlled in the manner prescribed for that category by the CARA or in terms of Working for Water guidelines.
- ZZ2 Coniston is responsible for the control of weeds and invader plants within the development site for the duration of the development phase. Alien invasive tree species listed by the CARA regulations should be eradicated;
- Rehabilitate disturbed areas as quickly as possible to reduce the area where invasive species would be at a strong advantage and most easily able to establish;
- Institute a monitoring programme to detect alien invasive species early, before they become established and, in the case of weeds, before the release of seeds. Once detected, an eradication/control programme should be implemented to ensure that the

species' do not spread to surrounding natural ecosystems.

5.7 IMPACT ASSESSMENT MATRIX FOR THE DEVELOPMENT PHASE OF THE CROPLAND DEVELOPMENT

Table 17 indicates the impacts described above and specific ratings of significance the impact during development will potentially have on the flora and fauna of the area. The most significant impacts are habitat destruction (clearing of the area) and dust, although impacts such as alien species invasion and spillages are limited during the development phase or can be successfully mitigated.

Table 17. Impact assessment Matrix for the croplands development

No	Activity	Impact	P	D	S	M	Significance anticipated before development without any management measures		Mitigation Measures	P	D	S	M	Significance assessed after development provided that monitoring and rehabilitation are implemented	
Pre-Development and Development Phase									Pre-Development and Development Phase						
1	Clearing of vegetation for cropland development.	Habitat destruction	5	5	1	6	60	Moderate - High	See section 5.1.2	5	5	1	2	40	Moderate - low
2	Clearing of vegetation for cropland development.		5	5	1	6	60	Moderate - High	See section 5.2.2	5	5	1	2	40	Moderate-low
3	Exposure of soils to rainfall and wind during development	Soil erosion	4	4	3	6	52	Moderate	See section 5.3.2	4	3	2	2	28	Low
4	Spillages from vehicles during development	Spillages of harmful substances	2	4	3	6	26	Low	See section 5.4.2	2	3	2	2	18	Negligible
5	Exposure of soils to rainfall and wind during development and rehabilitation	Dust contamination	5	4	1	6	55	Moderate	See section 5.5.2	5	3	1	2	30	Low
6	Continued movement of personnel and vehicles on and off the site during the development phase, as well as occasional delivery of materials required for maintenance	Spread of alien invasive species	4	4	3	6	52	Moderate	See section 5.6.2	4	3	2	2	28	Low

6 SENSITIVITY ANALYSIS AND CONSERVATION ANALYSIS TOOLS

There are several assessments for South Africa as a whole, as well as on provincial levels that allow for detailed conservation planning as well as meeting biodiversity targets for the country's variety of ecosystems. These guides are essential to consult for development projects, and will form an important part of the sensitivity analysis. Areas earmarked for conservation in the future, or that are essential to meet biodiversity and conservation targets should not be developed, and have a high sensitivity as they are necessary for overall functioning. In addition, sensitivity analysis in the field based in much finer scale data can be used to ground truth the larger scale assessments and put it into a more localised context.

6.1 CRITICAL BIODIVERSITY & ECOLOGICAL SUPPORT AREAS OF THE PROJECT AREA

The purpose of the Limpopo Conservation Plan version 2 (LCPv2) is to develop the spatial component of a bioregional plan (i.e. map of Critical Biodiversity Areas (CBA) and associated land-use guidelines).

The Limpopo Conservation Plan categories for the proposed croplands are presented in Figure 10. None of the CBA classes are present on site, with the site being classified as "Other Natural Areas".

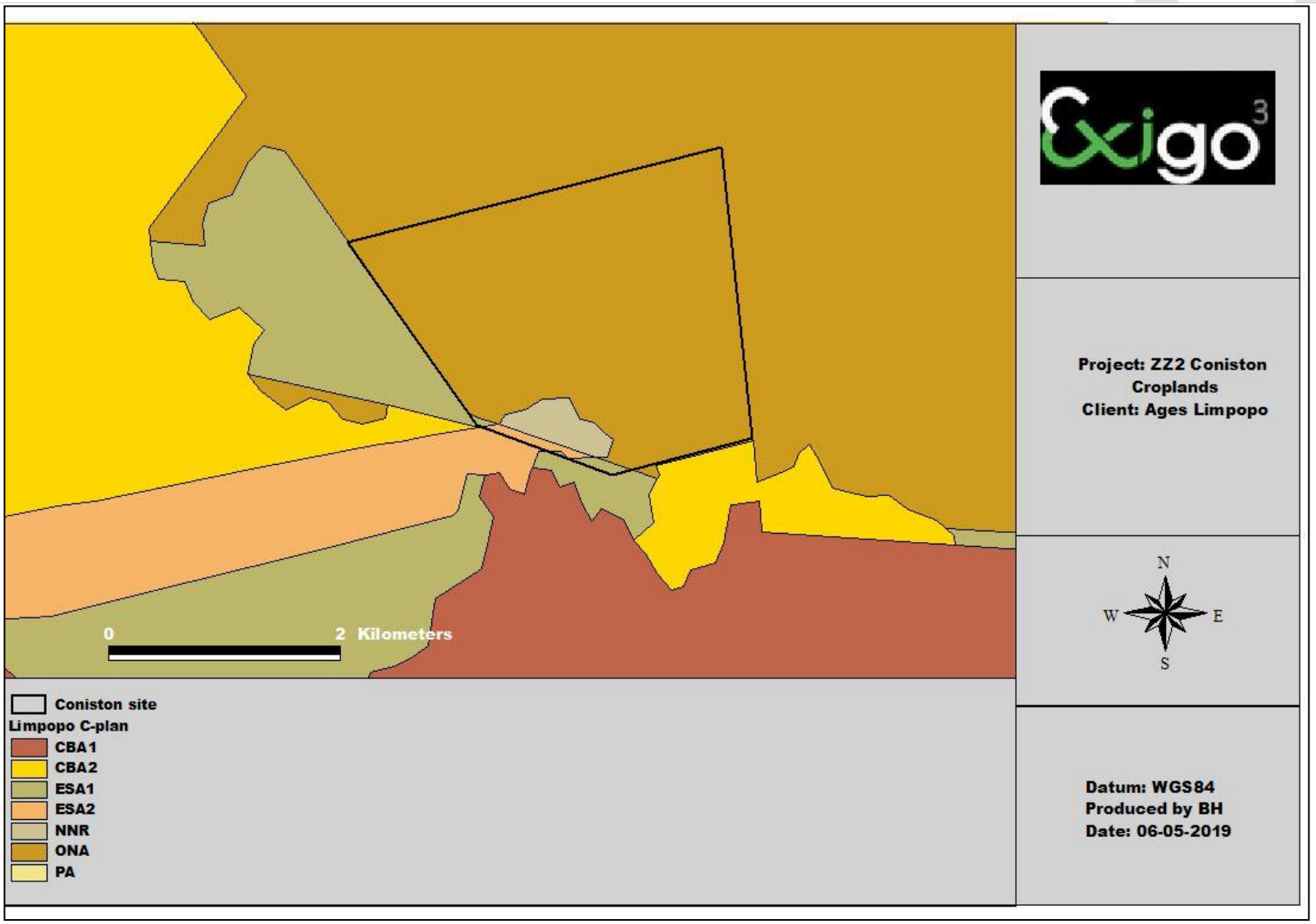


Figure 9. CBA Map of the project area and proposed infrastructure according to the LCPv2

6.2 PROTECTED AREAS NETWORK AND NATIONAL PROTECTED AREAS EXPANSION STRATEGY (NPAES)

Officially protected areas, either Provincially or Nationally that occur close to a project site could have consequences as far as impacts on these areas are concerned. For the proposed development and associated infrastructure no protected areas occur in close proximity, with the closest being the Happy Rest Nature Reserve to the south (Figure 10).

The NPAES are areas designated for future incorporation into existing protected areas (both National and informal protected areas). These areas are large, mostly intact areas required to meet biodiversity targets, and suitable for protection. They may not necessarily be proclaimed as protected areas in the future and are a broad scale planning tool allowing for better development and conservation planning. The Blouberg / Langjan NPAES occur in close proximity to the project area, although to the south of the site (Figure 10).

6.3 IMPORTANT BIRD AREAS

An Important Bird Area (IBA) is an area recognized as being globally important habitat for the conservation of bird populations. Currently there are about 10,000 IBAs worldwide. At present, South Africa has 124 IBA's, covering over 14 million hectares of habitat for our threatened, endemic and congregatory birds. Yet only million hectares of the total land surface covered by our IBA's legally protected. The BirdLife SA IBA programme continues a programme of stewardship which will ultimately achieve formal protection (Birdlife, 2013). The project area does not overlap with any IBA although the Soutpansberg IBA is located directly south of the area (Figure 11).

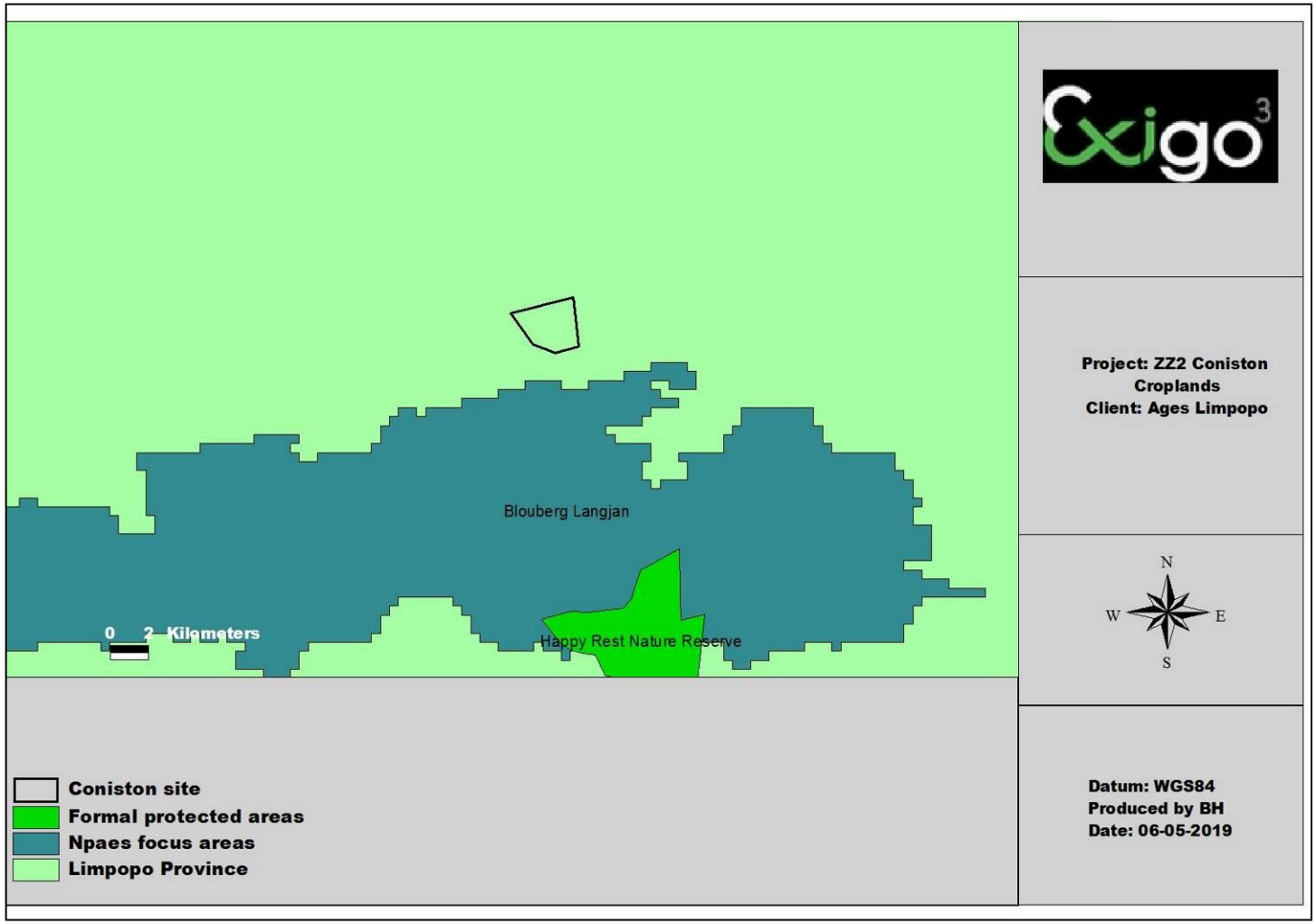


Figure 10. Protected areas and NPAES in proximity to the project area

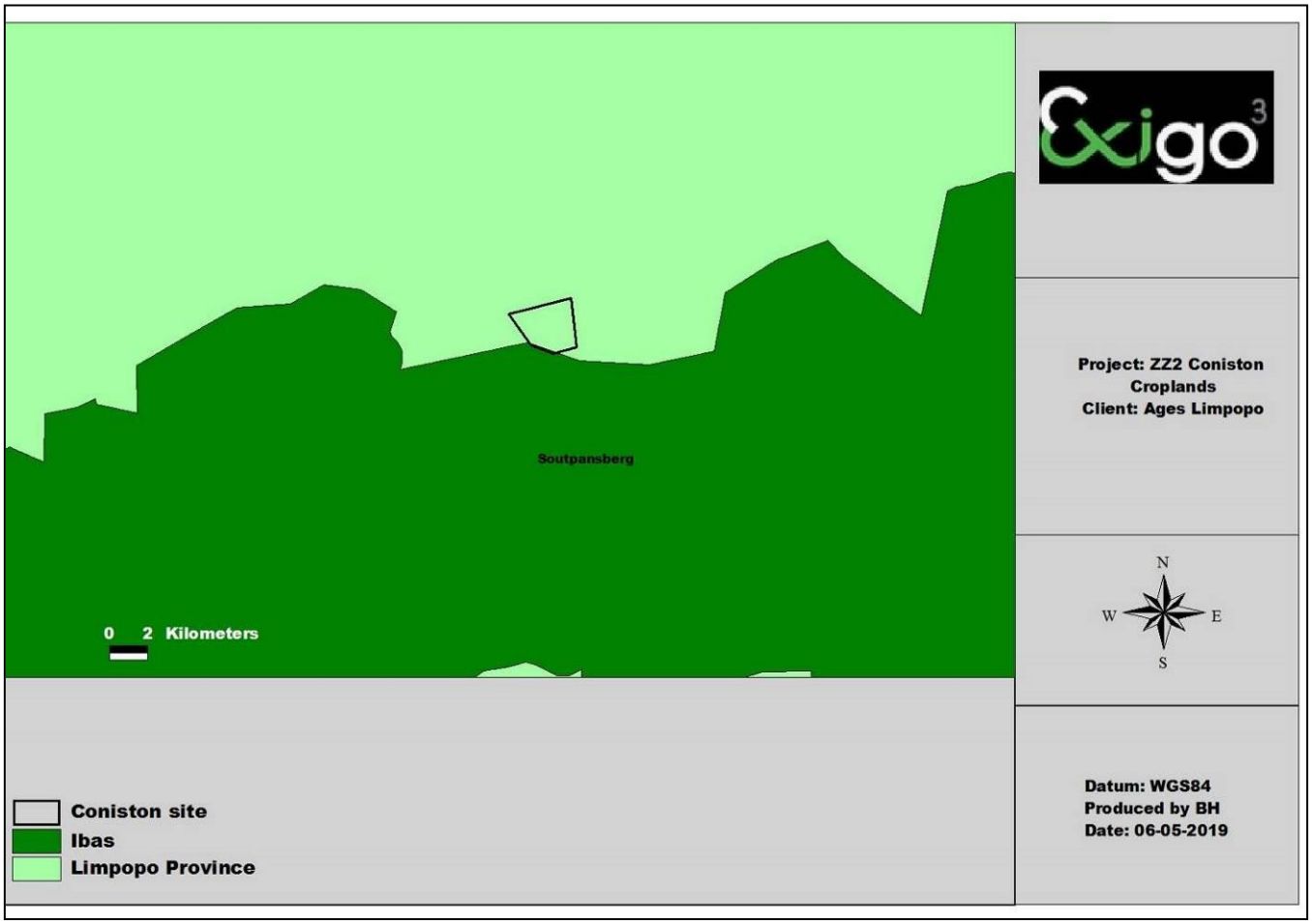


Figure 11. Important Bird Areas in close proximity to the project area

6.4 NATIONALLY THREATENED ECOSYSTEMS

The list of national Threatened Ecosystems has been gazetted (NEMBA: National list of ecosystems that are threatened and in need of protection) and result in several implications in terms of development within these areas. Four basic principles were established for the identification of threatened ecosystems. These include:

- The approach must be explicit and repeatable;
- The approach must be target driven and systematic, especially for threatened ecosystems;
- The approach must follow the same logic as the IUCN approach to listing threatened species, whereby a number of criteria are developed and an ecosystem is listed based on its highest ranking criterion; and
- The identification of ecosystems to be listed must be based on scientifically credible, practical and simple criteria, which must translate into spatially explicit identification of ecosystems.

Areas were delineated based on as fine a scale as possible and are defined by one of several assessments: These areas are essential for conservation of the country's ecosystems as well as meeting conservation targets. No listed ecosystem overlaps with the project area.

6.5 ECOLOGICAL SENSITIVITY CLASSES

Following the ecological surveys, the classification of the study area into different sensitivity classes and development zones was based on information collected at various levels on different environmental characteristics. Factors which determined sensitivity classes were as follows:

- Presence, density and potential impact of development on rare, endemic and protected plant species;
- Conservation status of vegetation units;
- Soil types, soil depth and soil clay content;
- Previous land-use;
- State of the vegetation in general as indicated by indicator species.

Below included is the sensitivity map for the total area (Figure 12). Only criteria applicable to the specific vegetation units were used to determine the sensitivity of the specific unit.

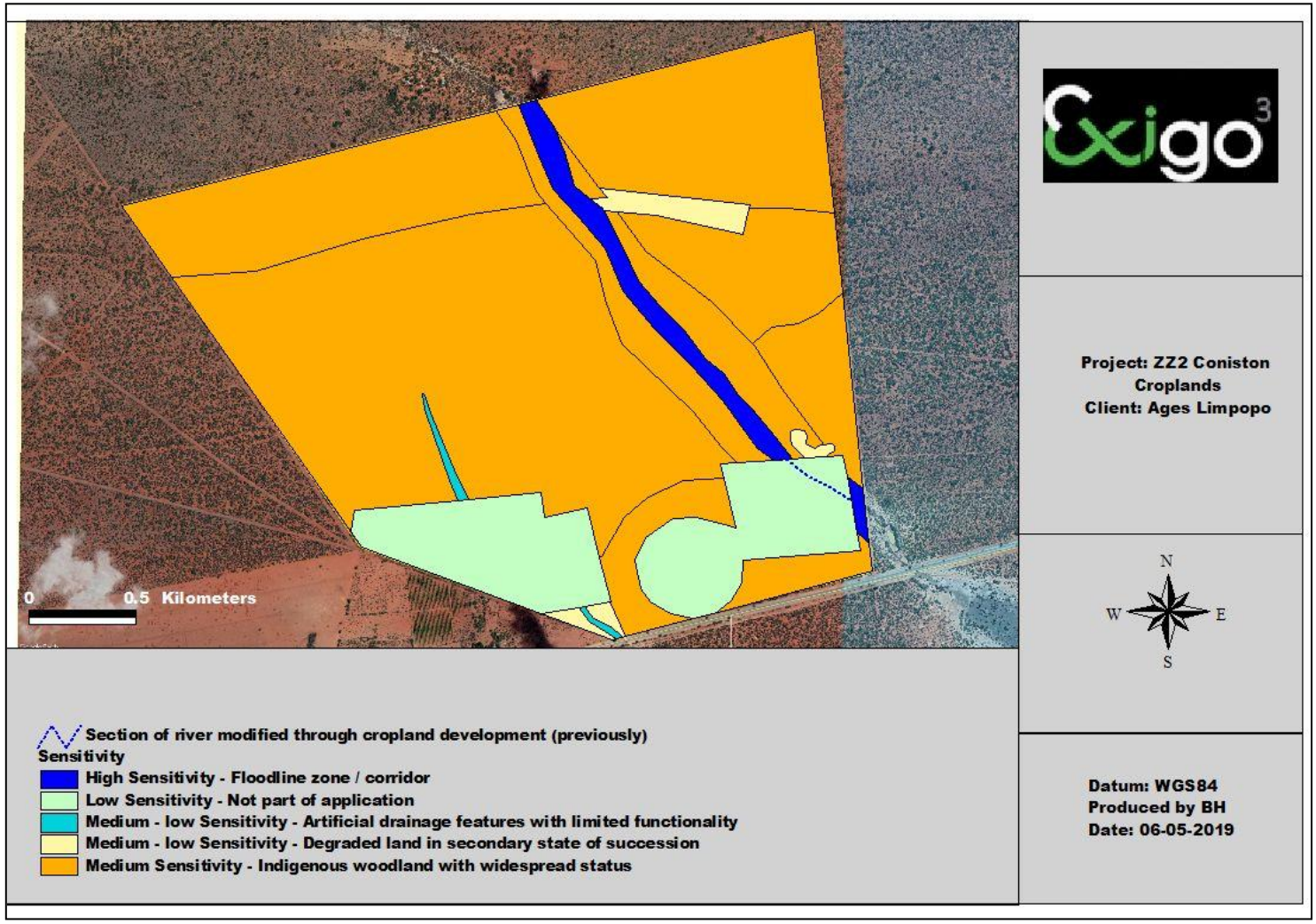


Figure 12. Sensitivity Map of the study area

7 DISCUSSION

Following the investigation and ecological impact of the proposed ZZ2 Coniston croplands in the project area, some conclusions can be made:

All aspects of the environment, especially living organisms, are vulnerable to disturbance of their habitat. The development will have a definite impact on the vegetation and faunal habitats on the planned croplands footprint areas. Most of the vegetation on the footprint areas will be cleared for the croplands, although the protected trees can only be cleared with a licence obtained from DAFF. Detailed ecological (fauna habitat & flora) surveys were conducted during May 2019 to verify the ecological sensitivity and ecological components of the site at ground level.

The proposed site for the croplands is mostly on mixed woodland variations. A sensitivity analyses was conducted to identify the most suitable sites for the development. From these investigation and ecological surveys the following main observations was made:

- The natural woodland areas have a have a Medium Sensitivity due to its widespread distribution in the project area. The cropland developments can be supported in these areas, provided that a licence is obtained for the eradication of the protected trees;
- The drainage channel and riparian woodland have a High Sensitivity. These areas play important corridors to rare and endemic fauna found in the area. Where the croplands modifieid the river channel the area should be rehabilitated;
- The secondary old fields in a state of succession have a Medium-low sensitivity;
- The artificial stormwater canal has a Medium-low sensitivitiy and still represents a drainage feature with limited functionality.

The importance of rehabilitation and implementation of mitigation processes to prevent any negative impacts on the environment on the areas surrounding the croplands should be considered a high priority.

No red data plant species were found on the site due to the state of the vegetation and physical environment of the larger area mostly not being suitable for any of the red data plant species that may be found in the area.

Some potential rare fauna may also occur in the area, and specific mitigation measures need to be implemented to ensure that the impact of the development on the species' habitat will be low. Specific mitigation relating to red data fauna includes the following:

- Disturbances in close vicinity of the development (periphery) should be limited to the smallest possible area in order to protect species habitat;

- Corridors such as the riverine woodland are important to allow fauna to move freely between the areas of disturbance and a 30 meter buffer should be implemented around these areas.

A number of impacts the cropland development might have on the fauna and flora of the site were identified and assessed. A few of these were assessed as having potentially medium or high significance, including the following:

- Destruction or disturbance to sensitive ecosystems leading to reduction in the overall extent of a particular habitat;
- Increased soil erosion;
- Impairment of the movement and/or migration of animal species resulting in genetic and/or ecological impacts;
- Destruction/permanent loss of individuals of rare, endangered, endemic and/or protected species;
- Soil and water pollution through spillages;
- Establishment and spread of declared weeds and alien invader plants;
- Air pollution through dusts and fumes from vehicles.

Mitigation measures are provided that would reduce these impacts from a higher to a lower significance.

8 CONCLUSION

All aspects of the environment, especially living organisms, are vulnerable to disturbance of their habitat. If we can bring about a more integrated approach to living within our ecosystems, we are much more likely to save the fundamental structure of biodiversity. Positive contributions can be made even on a small scale such as within the proposed ZZ2 Coniston cropland developments.

The development will still have definite impact on the ecosystem though, although it can be considered as ecologically sound and rehabilitation and monitoring of the area should be ongoing future actions. The development can be supported provided that all mitigation measures are implemented for these sites.

9 REFERENCES

Acocks, J.P.H. 1988. Veld types of South Africa, 3rd ed. Memoirs of the Botanical Survey of South Africa. 57: 1–146.

Barbour, M.G., J.H. Burk, and W.D. Pitts. 1987. Terrestrial Plant Ecology. Second Edition. Benjamin/Cummings Publishing, Menlo Park, CA.

BOTHMA, J. DU. P. 1996. Game Ranch Management. Van Schaick, Pretoria.

Bredenkamp, G.J. & Brown, L.R. 2001. Vegetation – A reliable ecological basis for environmental planning. Urban Greenfile Nov-Dec 2001: 38-39.

Branch, B. (1998). Field guide to snakes and other reptiles of Southern Africa. Struik Publishers. Cape Town.

Briza publications. 2001. Problem plants of South Africa. Pretoria.

CHECHI, F. & ROBERTS, L. 2005. Interpreting and using mortality data in humanitarian emergencies: A primer for non-epidemiologists. Humanitarian practice Network at ODI.

CONSERVATION OF AGRICULTURAL RESOURCES ACT, 1983. (ACT No. 43 OF 1983)

Convention on Biological Diversity. Signed 1993 and ratified 2 November 1995.

Cowling, W. E. 2005. Tourism- A Catalyst For Attitudinal Changes in Aitutaki, Cook Islands University of Waikato, Hamilton, New Zealand

DEAT, 1998. Guideline Document on the EIA Regulations implementation of sections 21, 22 and 26 of the Environment Act, Government Printer, Pretoria.

DEAT, 2002. Impact Significance, Integrated Environmental Management, Information Series 5, Department of Environmental Affairs and Tourism, Pretoria

Enpat, 2000.Environmental Potential Atlas. Department of Environmental Affairs and Tourism, Pretoria.

Fabian, A & Germishuizen, G. 1997. Wild flowers of Northern South Africa. Fernwood Press.

Friedman, Y & Daly, B. 2004. Red Data Book of the Mammals of South Africa: A Conservation Assessment: CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust. South Africa.

Germishuizen, G. and Clarke, B. (2003). Illustrated Guide to the Wildflowers of Northern South Africa. Briza Publications, Pretoria

GERTENBACH, W. P. D. 1983. Landscapes of the Kruger National Park. Koedoe 26: 9-121.

GOLDING, J. (Ed.) 2002. Southern African Plant Red Data Lists. Southern African Botanical Diversity Network report no. 14. National Botanical Institute. pp. 237.

HILTON-TAYLOR, C. 1996a. Red Data list of southern African plants. Strelitzia 4: 1 - 117.

HILTON-TAYLOR, C. 1996b. Red Data list of southern African plants. 1. corrections and additions. Bothalia 26: 177 - 182.

HILTON-TAYLOR, C. 1997. Red Data list of southern African plants. 2. corrections and

additions. Bothalia 27:

195 - 209.

IFC. Performance Standard 6 Biodiversity Conservation and Sustainable Natural Resource Management

Kent, LE. 1980. Stratigraphy of South Africa. Part 1: Lithostratigraphy of the Republic of South Africa, South West Africa/Namibia and the Republics of Bophuthatswana, Transkei and Venda. Pretoria: Department of Mineral and Energy Affairs, Handbook 8.

Land type Survey Staff, 1987. Land types of the maps. Mem. Agric. Nat. Resour. S. Afr. no. 8.

LEE, K. E. & WOOD, T. G. 1971. Termites and Soils. Academic Press, London.

LOW, A. B. & REBELO, A. G. 1996. Vegetation of South Africa, Lesotho and Swaziland. Dept. Environmental Affairs and Tourism, Pretoria.

MacKay, H. 1998: Towards a Classification System for Water Resources in South Africa. Institute for Water Quality Studies. Internal Report. Department of Water Affairs and Forestry, Pretoria, South Africa.

Manning, J. (2003). Photographic Guide to the Wildflowers of South Africa. Briza Publications. Pretoria.

Minter, L.R., Burger, M., Harrison, J.A., Braack, H.H., Bishop, P.J. and Kloepfer, D. (2004). Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland. Smithsonian Institute, Washington, DC.

Mucina, L., Bredenkamp, G.J., Hoare, D.B. & McDonald, D.J. 2000. A National vegetation database for South Africa. South Africa Journal of Science 96:497-498.

Mueller-Dombois, D. & Ellenberg, H. 1974. Aims and methods of vegetation ecology. Wiley, New York.

Mucina, L & Rutherford, M. C. 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19, SANBI, Pretoria.

NATIONAL FOREST ACT, 1998 (Act No. 84 of 1998). Government Gazette No. 29062, Notice 897, 8 September 2006)

NATIONAL WATER ACT, 1998. Act No 36 of 1998.

Onderstall, J. (1996). Wild Flower Guide for Mpumalanga and Northern Province. DynamicAd. Nelspruit.

Palgrave, M.C. (2002). Trees of Southern Africa.Struik Publishers.Cape Town.

Pooley, E. 1998. A field guide to wild flowers of Kwazulu Natal and the Eastern Region. Natal Flora Publications Trust.

SANBI & DEAT. 2009. Threatened Ecosystems in South Africa: Descriptions and Maps. DRAFT for Comment. South African National Biodiversity Institute, Pretoria, South Africa.

Sinclair, A. R. E. & A. E. Byrom. 2006. Understanding ecosystem dynamics for conservation of biota. Journal of Animal Ecology, 75: 64–79

Smithers, R.H.N. (1983). Soogdiere van die Suider-Afrikaanse Substreek. Universiteit van Pretoria. Pretoria

Tainton, N. M. (ed.), 1981. Veld and Pasture Management in South Africa. Shuter and Shooter, Pietermaritzburg, 481pp.

The National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004).

Government Gazette RSA Vol. 467, 26436, Cape Town, June 2004.

The National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004). Draft. List of Threatened Ecosystems. Government Gazette RSA Vol. 1477, 32689, Cape Town, 6 Nov 2009.

The Natural Scientific Professions Act (Act 27 of 2003)

THOMPSON H (2006) Water Law: A Practical Approach to Resource Management and the Provision of Services. Juta, Cape Town.

Van Der Merwe, C. R. 1952. Soil Groups and subgroups of South Africa. Science Bulletin356.

VAN WYK, B-E. & GERICKE, N. 2000. People's Plants: A Guide to useful plants of southern Africa. Briza publications, Pretoria.

Van Wyk, B & Malan, S. 1988. Field Guide to the wild flowers of the Highveld. Struik Publishers.

Van Wyk, B. & Van Wyk, P. 1997. Field Guide to Trees of Southern Africa. Struik Publishers. Cape Town.

Van Wyk, B.E., Van Oudtshoorn, B. & Gericke, N. 1997. Medicinal plants of South

Africa. Briza, Pretoria.

Van Oudtshoorn, F. (1991) Gids tot grasse van Suid Afrika. Briza Publikasies. Pretoria.

WERGER, M.J.A. 1978. Biogeography and Ecology of Southern Africa. Monographie Biologicae vol. 31. Junk, The Hague.

Westhoff, V. & Van der Maarel, E. 1978. The Braun-Blanquet approach. In: Whittaker, R.H. (ed.) Classification of plant communities. W. Junk, The Hague.

WHITE, F. 1983. The vegetation of Africa: a descriptive memoir to accompany the UNESCO/AETFAT/UNSO vegetation map of Africa. UNESCO, Paris, France.

APPENDIX A. PLANT SPECIES LISTS FOR SITE

Woody species
Adansonia digitata
Albizia anthelmintica
Aloe marlothii
Boscia albitrunca
Boscia foetida
Cassia abbreviata
Catophractes alexandrii
Combretum apiculatum
Combretum zeyheri
Commiphora africana
Commiphora glandulosa
Commiphora mollis
Commiphora pyracanthoides
Cordia grandycalyx
Dichrostachys cinerea
Euclea divinorum
Gardenia volkensii
Gossypium herbaceum
Grewia bicolor
Grewia flava
Grewia hexamita
Gymnosporia buxifolia
Ozoroa paniculosa
Peltophorum africanum
Schotia brachypetala
Senegalia mellifera
Spirostachys africana
Strychnos madagascriensis
Terminalia prunoides
Terminalia sericea
Vachellia erioloba
Vachellia grandicornouta
Vachellia karroo
Vachellia nilotica
Vachellia tortilis
Xanthocercis zambesiaca
Ximenia americana
Grass species
Aristida congesta

Aristida stipitata
Brachiaria deflexa
Enneapogon scoparius
Eragrosits lehmanniana
Eragrostis pallens
Eragrostis rigidor
Melinis repens
Panicum coloratum
Panicum maximum
Perotis patens
Pogonarthria squarrosa
Schmiditia pappophoroides
Stipagrostis uniplumis
Tragus bertertronianus
Tricholaena monachne
Forbs, geophytes & succulents
Abutilon angulatum
Achyranthes aspera
Aloe maculata
Aloe zebrina
Aptosimum lineare
Asparagus laricinus
Barleria spp.
Blepharis saxatallis
Blepharis subvolubilis
Ceratotheca triloba
Cleome angustifolia
Commelina ereca
Convolvulus sagittatus
Crotalaria spp.
Dicerocarium eriocarpum
Dicoma anomala
Dicoma anomala
Evolvulus alsinoides
Geigeria ornativa
Heiotropium steudneuri
Hermbstaedtia odorata
Hermbstaedtia odorata
Indigofera nebrowniana
Indigofera nebrowniana
Indigofera oxytropis

Ipomoea transvaalensis
Jamesbrittenea aurentiaca
Justicia flava
Kalanchoe paniculata
Kohautia amatymbica
Kylinga alba
Lantana rugosa
Opuntia ficus indica
Opuntia stricta
Pavonia burchelli
Pupalia lapaceae
Salacia kraussii
Sarcostemma viminale
Sida alba
Sida alba
Solanum spp.
Solanum supinum
Tithonia divaricata
Walteria indica
Zansevieria pearsonii

APPENDIX B. PLANT SPECIES LIST FOR QDS

Family	Genus	Sp1	IUCN	Ecology
Rubiaceae	*Vangueria*	*lasiantha*	LC	Indigenous
Cyperaceae	*Kyllinga*	*alba*	LC	Indigenous
Poaceae	*Sporobolus*	*pyramidalis*	LC	Indigenous
Fabaceae	*Albizia*	*brevifolia*	LC	Indigenous
Poaceae	*Danthoniopsis*	*pruinosa*	LC	Indigenous
Ebenaceae	*Diospyros*	*lycioides*		Indigenous
Orthotrichaceae	*Macrocoma*	*tenuis*		Indigenous
Fabaceae	*Tephrosia*	*purpurea*	NE	Indigenous
Cucurbitaceae	*Coccinia*	*rehmannii*	LC	Indigenous
Meteoriaceae	*Papillaria*	*africana*		Indigenous
Malvaceae	*Grewia*	*retinervis*	LC	Indigenous
Scrophulariaceae	*Peliostomum*	*leucorrhizum*	LC	Indigenous; Endemic
Hypodontiaceae	*Hypodontium*	*dregei*		Indigenous
Combretaceae	*Combretum*	*vendae*	LC	Indigenous; Endemic
Pedaliaceae	*Sesamum*	*triphyllum*	LC	Indigenous
Thelypteridaceae	*Thelypteris*	*confluens*	LC	Indigenous
Rutaceae	*Ptaeroxylon*	*obliquum*	LC	Indigenous
Talinaceae	*Talinum*	*tenuissimum*		Indigenous
Convolvulaceae	*Ipomoea*	*sp.*		
Corbichoniaceae	*Corbichonia*	*decumbens*	LC	Indigenous
Cleomaceae	*Cleome*	*oxyphylla*	LC	Indigenous
Malvaceae	*Grewia*	*rogersii*	LC	Indigenous; Endemic
Melastomataceae	*Dissotis*	*princeps*	LC	Indigenous
Vitaceae	*Rhoicissus*	*tomentosa*		Indigenous
Zygophyllaceae	*Tribulus*	*zeyheri*	LC	Indigenous
Apocynaceae	*Secamone*	*parvifolia*	LC	Indigenous
Capparaceae	*Maerua*	*edulis*	NE	Indigenous
Santalaceae	*Thesium*	*impeditum*	LC	Indigenous; Endemic
Malvaceae	*Sida*	*cordifolia*	LC	Indigenous
Asphodelaceae	*Aloe*	*vogtsii*	NT	Indigenous; Endemic
Asteraceae	*Felicia*	*bechuanica*	LC	Indigenous; Endemic
Aizoaceae	*Zaleya*	*pentandra*	LC	Indigenous
Asphodelaceae	*Bulbine*	*capitata*	LC	Indigenous
Salicaceae	*Salix*	*mucronata*	LC	Indigenous; Endemic
Rubiaceae	*Coddia*	*rudis*	LC	Indigenous
Apocynaceae	*Ancylobotrys*	*capensis*	LC	Indigenous; Endemic
Poaceae	*Aristida*	*sp.*		
Bryaceae	*Bryum*	*pycnophyllum*		Indigenous
Kewaceae	*Kewa*	*bowkeriana*	LC	Indigenous

ZZ2 Coniston Tomato croplands Ecological Study

Family	Genus	Sp1	IUCN	Ecology
Scrophulariaceae	*Aptosimum*	*patulum*	LC	Indigenous; Endemic
Fabaceae	*Albizia*	*anthelmintica*	LC	Indigenous
Euphorbiaceae	*Euphorbia*	*inaequilatera*	NE	Indigenous
Portulacaceae	*Portulaca*	*oleracea*		Not indigenous; Naturalised
Amaranthaceae	*Alternanthera*	*sessilis*		Not indigenous; Naturalised; Invasive
Fabaceae	*Tephrosia*	*rhodesica*	LC	Indigenous
Menispermaceae	*Cocculus*	*hirsutus*		Not indigenous; Naturalised
Malvaceae	*Sida*	*sp.*		
Rubiaceae	*Canthium*	*armatum*	LC	Indigenous
Apocynaceae	*Gomphocarpus*	*tomentosus*	LC	Indigenous
Gisekiaceae	*Gisekia*	*pharnaceoides*	LC	Indigenous
Passifloraceae	*Adenia*	*repanda*	LC	Indigenous
Poaceae	*Chloris*	*virgata*	LC	Indigenous
Poaceae	*Bothriochloa*	*insculpta*	LC	Indigenous
Euphorbiaceae	*Croton*	*pseudopulchellus*	LC	Indigenous
Loganiaceae	*Strychnos*	*spinosa*	LC	Indigenous
Apocynaceae	*Marsdenia*	*sylvestris*	LC	Indigenous
Loranthaceae	*Tapinanthus*	*quequensis*	LC	Indigenous
Rutaceae	*Vepris*	*bremekampii*		Indigenous
Moraceae	*Ficus*	*tettensis*	LC	Indigenous
Loranthaceae	*Helixanthera*	*garciana*	LC	Indigenous
Vitaceae	*Cissus*	*quadrangularis*		Indigenous
Fabaceae	*Indigofera*	*arrecta*	LC	Indigenous
Fabaceae	*Vachellia*	*sieberiana*	LC	Indigenous
Apocynaceae	*Fockea*	*angustifolia*	LC	Indigenous
Poaceae	*Tristachya*	*sp.*		
Euphorbiaceae	*Euphorbia*	*aeruginosa*	LC	Indigenous; Endemic
Poaceae	*Acrachne*	*racemosa*	LC	Indigenous
Passifloraceae	*Adenia*	*spinosa*	LC	Indigenous
Phyllanthaceae	*Phyllanthus*	*maderaspatensis*	LC	Indigenous
Poaceae	*Sporobolus*	*sp.*		
Malvaceae	*Corchorus*	*asplenifolius*	LC	Indigenous
Ruscaceae	*Sansevieria*	*pearsonii*	LC	Indigenous
Asteraceae	*Geigeria*	*burkei*	LC	Indigenous; Endemic
Capparaceae	*Maerua*	*angolensis*	LC	Indigenous
Malvaceae	*Gossypium*	*sp.*		
Fabaceae	*Rhynchosia*	*minima*	NE	Indigenous
Rubiaceae	*Vangueria*	*infausta*	LC	Indigenous
Amaranthaceae	*Pupalia*	*lappacea*	LC	Indigenous
Euphorbiaceae	*Croton*	*megalobotrys*	LC	Indigenous
Rubiaceae	*Canthium*	*inerme*	LC	Indigenous

Family	Genus	Sp1	IUCN	Ecology
Asparagaceae	*Asparagus*	*bechuanicus*	LC	Indigenous; Endemic
Combretaceae	*Combretum*	*apiculatum*	LC	Indigenous
Cucurbitaceae	*Corallocarpus*	*triangularis*	LC	Indigenous; Endemic
Cyperaceae	*Rhynchospora*	*brownii*	LC	Indigenous
Poaceae	*Tricholaena*	*monachne*	LC	Indigenous
Euphorbiaceae	*Euphorbia*	*guerichiana*	LC	Indigenous
Santalaceae	*Thesium*	*gracilarioides*	LC	Indigenous; Endemic
Euphorbiaceae	*Euphorbia*	*lugardiae*		Indigenous
Clusiaceae	*Garcinia*	*livingstonei*	LC	Indigenous
Euphorbiaceae	*Jatropha*	*erythropoda*	LC	Indigenous
Pedaliaceae	*Sesamothamnus*	*lugardii*	LC	Indigenous
Convolvulaceae	*Seddera*	*suffruticosa*	LC	Indigenous
Capparaceae	*Boscia*	*foetida*	LC	Indigenous
Poaceae	*Cenchrus*	*ciliaris*	LC	Indigenous
Fabaceae	*Bolusanthus*	*speciosus*	LC	Indigenous
Amaryllidaceae	*Pancratium*	*tenuifolium*	LC	Indigenous
Phyllanthaceae	*Pseudolachnostylis*	*maprouneifolia*	NE	Indigenous
Fabaceae	*Crotalaria*	*lotoides*	LC	Indigenous
Fabaceae	*Indigofera*	*flavicans*	LC	Indigenous
Ochnaceae	*Ochna*	*pretoriensis*	LC	Indigenous; Endemic
Myrtaceae	*Syzygium*	*cordatum*	LC	Indigenous
Bryaceae	*Bryum*	*argenteum*		Indigenous
Scrophulariaceae	*Tetraselago*	*wilmsii*	LC	Indigenous; Endemic
Fabaceae	*Erythrina*	*humeana*	LC	Indigenous
Burseraceae	*Commiphora*	*viminea*	LC	Indigenous
Malvaceae	*Pavonia*	*burchellii*	LC	Indigenous
Limeaceae	*Limeum*	*fenestratum*	LC	Indigenous
Fabaceae	*Acacia*	*sp.*		
Verbenaceae	*Lippia*	*javanica*		Indigenous
Fabaceae	*Vachellia*	*erioloba*	LC	Indigenous
Asteraceae	*Kleinia*	*longiflora*	LC	Indigenous
Apocynaceae	*Orbea*	*carnosa*	LC	Indigenous
Asteraceae	*Schkuhria*	*pinnata*		Not indigenous; Naturalised
Asparagaceae	*Asparagus*	*exuvialis*	NE	Indigenous; Endemic
Poaceae	*Eragrostis*	*sp.*		
Cucurbitaceae	*Cucumis*	*hirsutus*	LC	Indigenous
Convolvulaceae	*Evolvulus*	*alsinoides*	LC	Indigenous
Polygonaceae	*Persicaria*	*madagascariensis*		Indigenous
Cyperaceae	*Kyllinga*	*melanosperma*	LC	Indigenous
Solanaceae	*Solanum*	*tomentosum*		Indigenous; Endemic
Ricciaceae	*Riccia*	*atropurpurea*		Indigenous

Family	Genus	Sp1	IUCN	Ecology
Orchidaceae	*Tridactyle*	*tricuspis*	LC	Indigenous
Apiaceae	*Centella*	*asiatica*	LC	Indigenous
Poaceae	*Schmidtia*	*pappophoroides*	LC	Indigenous
Equisetaceae	*Equisetum*	*ramosissimum*	LC	Indigenous
Lamiaceae	*Volkameria*	*glabra*	LC	Indigenous
Malvaceae	*Grewia*	*subspathulata*	LC	Indigenous
Zygophyllaceae	*Tribulus*	*terrestris*	LC	Indigenous
Lamiaceae	*Ocimum*	*filamentosum*	LC	Indigenous
Fabaceae	*Vachellia*	*tortilis*	LC	Indigenous
Cyperaceae	*Schoenoplectus*	*muricinux*	LC	Indigenous
Asteraceae	*Parapolydora*	*fastigiata*		Indigenous
Malvaceae	*Grewia*	*flavescens*	LC	Indigenous
Asteraceae	*Lasiospermum*	*pedunculare*	LC	Indigenous; Endemic
Fabaceae	*Tephrosia*	*euchroa*	LC	Indigenous; Endemic
Cyperaceae	*Fimbristylis*	*dichotoma*	LC	Indigenous
Malvaceae	*Hibiscus*	*micranthus*	LC	Indigenous
Malvaceae	*Grewia*	*hexamita*	LC	Indigenous
Malvaceae	*Abutilon*	*austro-africanum*	LC	Indigenous
Malvaceae	*Sterculia*	*rogersii*	LC	Indigenous
Crassulaceae	*Crassula*	*setulosa*	NE	Indigenous; Endemic
Apocynaceae	*Orbea*	*maculata*	LC	Indigenous
Nyctaginaceae	*Boerhavia*	*coccinea*	LC	Indigenous
Loranthaceae	*Erianthemum*	*ngamicum*	LC	Indigenous
Aponogetonaceae	*Aponogeton*	*stuhlmannii*	LC	Indigenous
Anacardiaceae	*Searsia*	*lucida*		Indigenous
Limeaceae	*Limeum*	*viscosum*	NE	Indigenous
Fabaceae	*Otholobium*	*foliosum*	LC	Indigenous
Pedaliaceae	*Pterodiscus*	*ngamicus*	LC	Indigenous
Fabaceae	*Indigofera*	*inhambanensis*	LC	Indigenous
Annonaceae	*Hexalobus*	*monopetalus*		Indigenous
Poaceae	*Eragrostis*	*lehmanniana*	LC	Indigenous
Solanaceae	*Lycium*	*cinereum*	LC	Indigenous; Endemic
Rutaceae	*Vepris*	*reflexa*	LC	Indigenous
Ebenaceae	*Diospyros*	*whyteana*		Indigenous
Cyperaceae	*Fuirena*	*stricta*	LC	Indigenous
Poaceae	*Echinochloa*	*jubata*	LC	Indigenous
Malvaceae	*Gossypium*	*herbaceum*	LC	Indigenous
Convolvulaceae	*Ipomoea*	*magnusiana*	LC	Indigenous
Boraginaceae	*Ehretia*	*rigida*	LC	Indigenous; Endemic
Meliaceae	*Ekebergia*	*pterophylla*	LC	Indigenous; Endemic
Lamiaceae	*Plectranthus*	*fruticosus*	LC	Indigenous

ZZ2 Coniston Tomato croplands Ecological Study

Family	Genus	Sp1	IUCN	Ecology
Poaceae	*Setaria*	*sagittifolia*	LC	Indigenous
Poaceae	*Sporobolus*	*panicoides*	LC	Indigenous
Hyacinthaceae	*Dipcadi*	*glaucum*		Indigenous
Polygalaceae	*Polygala*	*leptophylla*	LC	Indigenous
Acanthaceae	*Blepharis*	*sp.*		
Amaranthaceae	*Cyathula*	*orthacantha*	LC	Indigenous
Poaceae	*Digitaria*	*eriantha*	LC	Indigenous
Myrothamnaceae	*Myrothamnus*	*flabellifolius*	DD	Indigenous
Santalaceae	*Viscum*	*combreticola*		Indigenous
Juncaceae	*Juncus*	*lomatophyllus*	LC	Indigenous
Asteraceae	*Pechuel-Loeschea*	*leubnitziae*	LC	Indigenous; Endemic
Solanaceae	*Solanum*	*retroflexum*	LC	Indigenous; Endemic
Selaginellaceae	*Selaginella*	*dregei*		Indigenous
Malvaceae	*Hibiscus*	*surattensis*	LC	Indigenous
Annonaceae	*Artabotrys*	*monteiroae*		Indigenous
Bignoniaceae	*Markhamia*	*zanzibarica*	LC	Indigenous
Melastomataceae	*Dissotis*	*canescens*	LC	Indigenous
Phyllanthaceae	*Phyllanthus*	*reticulatus*	LC	Indigenous
Santalaceae	*Thesium*	*gracile*	LC	Indigenous
Euphorbiaceae	*Euphorbia*	*monteiroi*	LC	Indigenous; Endemic
Moraceae	*Ficus*	*abutilifolia*	LC	Indigenous
Lamiaceae	*Endostemon*	*tereticaulis*	LC	Indigenous
Poaceae	*Cynodon*	*dactylon*	LC	Indigenous
Amaranthaceae	*Suaeda*	*fruticosa*	LC	Indigenous
Fabaceae	*Senegalia*	*senegal*	LC	Indigenous
Pedaliaceae	*Holubia*	*saccata*	LC	Indigenous
Asteraceae	*Gymnanthemum*	*amygdalinum*	LC	Indigenous
Orchidaceae	*Eulophia*	*petersii*	LC	Indigenous
Fabaceae	*Albizia*	*versicolor*	LC	Indigenous
Polygonaceae	*Polygonum*	*plebeium*	LC	Indigenous
Poaceae	*Aristida*	*congesta*	LC	Indigenous
Cucurbitaceae	*Cucumis*	*zeyheri*	LC	Indigenous
Scrophulariaceae	*Jamesbrittenia*	*micrantha*	LC	Indigenous
Hyacinthaceae	*Albuca*	*sp.*		
Apocynaceae	*Landolphia*	*kirkii*	LC	Indigenous
Exormothecaceae	*Exormotheca*	*holstii*		Indigenous
Combretaceae	*Combretum*	*kraussii*	LC	Indigenous
Cyperaceae	*Cyperus*	*palmatus*	LC	Indigenous
Poaceae	*Enneapogon*	*cenchroides*	LC	Indigenous
Nyctaginaceae	*Phaeoptilum*	*spinosum*	LC	Indigenous; Endemic
Vitaceae	*Rhoicissus*	*tridentata*		Indigenous

Family	Genus	Sp1	IUCN	Ecology
Scrophulariaceae	*Tetraselago*	*sp.*		
Fabaceae	*Abrus*	*laevigatus*	LC	Indigenous
Asparagaceae	*Asparagus*	*setaceus*	LC	Indigenous
Olacaceae	*Olax*	*dissitiflora*		Indigenous
Fabaceae	*Listia*	*bainesii*	LC	Indigenous
Celastraceae	*Elaeodendron*	*zeyheri*	LC	Indigenous
Malvaceae	*Corchorus*	*tridens*	NE	Not indigenous; Naturalised
Malvaceae	*Hibiscus*	*meyeri*	LC	Indigenous
Fabaceae	*Senegalia*	*schweinfurthii*	LC	Indigenous
Poaceae	*Hyperthelia*	*dissoluta*	LC	Indigenous
Cyperaceae	*Cyperus*	*zollingeri*	LC	Indigenous
Orobanchaceae	*Cycnium*	*tubulosum*	LC	Indigenous
Fabaceae	*Crotalaria*	*monteiroi*	LC	Indigenous
Rubiaceae	*Vangueria*	*madagascariensis*	LC	Indigenous
Araliaceae	*Hydrocotyle*	*verticillata*	LC	Indigenous
Asteraceae	*Psiadia*	*punctulata*	LC	Indigenous
Burseraceae	*Commiphora*	*mollis*	LC	Indigenous
Orobanchaceae	*Alectra*	*orobanchoides*	LC	Indigenous
Phyllanthaceae	*Antidesma*	*venosum*	LC	Indigenous
Poaceae	*Tragus*	*berteronianus*	LC	Indigenous
Asparagaceae	*Asparagus*	*falcatus*	LC	Indigenous
Boraginaceae	*Heliotropium*	*ciliatum*	LC	Indigenous
Iridaceae	*Tritonia*	*nelsonii*	LC	Indigenous; Endemic
Kirkiaceae	*Kirkia*	*acuminata*		Indigenous
Acanthaceae	*Barleria*	*obtusa*		Indigenous
Hypnaceae	*Hypnum*	*cupressiforme*		Indigenous
Pottiaceae	*Trichostomum*	*brachydontium*		Indigenous
Leucobryaceae	*Leucobryum*	*acutifolium*		Indigenous
Acanthaceae	*Thunbergia*	*amoena*	LC	Indigenous; Endemic
Celastraceae	*Catha*	*edulis*	LC	Indigenous
Malvaceae	*Hibiscus*	*schinzii*	LC	Indigenous
Meliaceae	*Entandrophragma*	*caudatum*	LC	Indigenous
Annonaceae	*Artabotrys*	*brachypetalus*		Indigenous
Acanthaceae	*Barleria*	*gueinzii*		Indigenous
Sapindaceae	*Cardiospermum*	*corindum*		Indigenous
Verbenaceae	*Chascanum*	*incisum*		Indigenous
Malvaceae	*Hibiscus*	*vitifolius*	LC	Indigenous
Limeaceae	*Limeum*	*dinteri*	LC	Indigenous
Poaceae	*Phragmites*	*mauritianus*	LC	Indigenous
Cyperaceae	*Cyperus*	*decurvatus*	LC	Indigenous; Endemic
Fabaceae	*Xanthocercis*	*zambesiaca*	LC	Indigenous

ZZ2 Coniston Tomato croplands Ecological Study

Family	Genus	Sp1	IUCN	Ecology
Salicaceae	*Dovyalis*	*caffra*	LC	Indigenous
Hernandiaceae	*Gyrocarpus*	*americanus*		Indigenous
Fabaceae	*Vigna*	*sp.*		
Poaceae	*Cymbopogon*	*nardus*	LC	Indigenous
Limeaceae	*Limeum*	*sulcatum*	LC	Indigenous
Asteraceae	*Hirpicium*	*bechuanense*	LC	Indigenous
Combretaceae	*Combretum*	*molle*	LC	Indigenous
Pedaliaceae	*Ceratotheca*	*triloba*	LC	Indigenous
Fabaceae	*Eriosema*	*buchananii*	LC	Indigenous; Endemic
Scrophulariaceae	*Zaluzianskya*	*katharinae*	LC	Indigenous; Endemic
Vitaceae	*Cyphostemma*	*puberulum*		Indigenous
Pedaliaceae	*Dicerocaryum*	*senecioides*	LC	Indigenous
Malvaceae	*Hibiscus*	*engleri*	LC	Indigenous
Lamiaceae	*Clerodendrum*	*ternatum*		Indigenous
Phyllanthaceae	*Flueggea*	*virosa*	LC	Indigenous
Boraginaceae	*Heliotropium*	*nelsonii*	LC	Indigenous; Endemic
Fabaceae	*Vachellia*	*grandicornuta*	LC	Indigenous
Malvaceae	*Hibiscus*	*palmatus*	LC	Indigenous
Limeaceae	*Limeum*	*aethiopicum*	NE	Indigenous; Endemic
Apiaceae	*Heteromorpha*	*arborescens*	LC	Indigenous
Xyridaceae	*Xyris*	*capensis*		Indigenous
Portulacaceae	*Portulaca*	*kermesina*		Indigenous
Polygalaceae	*Securidaca*	*longepedunculata*	LC	Indigenous
Fabaceae	*Decorsea*	*schlechteri*	LC	Indigenous
Poaceae	*Sporobolus*	*natalensis*	LC	Indigenous
Asparagaceae	*Asparagus*	*nodulosus*	LC	Indigenous
Acanthaceae	*Asystasia*	*mysorensis*		Indigenous
Burseraceae	*Commiphora*	*africana*	LC	Indigenous
Asteraceae	*Felicia*	*mossamedensis*	LC	Indigenous
Celastraceae	*Maytenus*	*acuminata*	LC	Indigenous
Asteraceae	*Felicia*	*clavipilosa*	LC	Indigenous
Bignoniaceae	*Rhigozum*	*sp.*		
Poaceae	*Dactyloctenium*	*giganteum*	LC	Indigenous
Poaceae	*Eragrostis*	*lappula*	LC	Indigenous
Aizoaceae	*Trianthema*	*salsoloides*	LC	Indigenous
Apocynaceae	*Stapelia*	*gigantea*	LC	Indigenous
Polygonaceae	*Persicaria*	*decipiens*	LC	Indigenous
Apocynaceae	*Rauvolfia*	*caffra*	LC	Indigenous
Poaceae	*Bewsia*	*biflora*	LC	Indigenous
Convolvulaceae	*Merremia*	*pinnata*	LC	Indigenous
Poaceae	*Heteropogon*	*contortus*	LC	Indigenous

Family	Genus	Sp1	IUCN	Ecology
Lamiaceae	*Tinnea*	*rhodesiana*	LC	Indigenous
Malvaceae	*Grewia*	*flava*	LC	Indigenous
Fabaceae	*Indigofera*	*sp.*		
Rhamnaceae	*Berchemia*	*discolor*		Indigenous
Vitaceae	*Rhoicissus*	*revoilii*		Indigenous
Asteraceae	*Eriocephalus*	*longifolius*	LC	Indigenous; Endemic
Fabaceae	*Indigofera*	*circinnata*	LC	Indigenous
Apocynaceae	*Stapelia*	*sp.*		
Acanthaceae	*Justicia*	*montis-salinarum*		Indigenous; Endemic
Poaceae	*Danthoniopsis*	*dinteri*	LC	Indigenous
Boraginaceae	*Cordia*	*monoica*	LC	Indigenous
Moraceae	*Ficus*	*glumosa*	LC	Indigenous
Lentibulariaceae	*Utricularia*	*gibba*	LC	Indigenous
Acanthaceae	*Isoglossa*	*origanoides*		Indigenous; Endemic
Moraceae	*Ficus*	*sycomorus*	LC	Indigenous
Asteraceae	*Calostephane*	*divaricata*	LC	Indigenous
Acanthaceae	*Barleria*	*galpinii*		Indigenous; Endemic
Acanthaceae	*Ruspolia*	*australis*		Indigenous
Acanthaceae	*Justicia*	*flava*		Indigenous
Asteraceae	*Dicoma*	*arenaria*	LC	Indigenous; Endemic
Orobanchaceae	*Striga*	*gesnerioides*	LC	Indigenous
Fabaceae	*Eriosema*	*nutans*	LC	Indigenous
Crassulaceae	*Cotyledon*	*barbeyi*		Indigenous
Fabaceae	*Colophospermum*	*mopane*	LC	Indigenous
Phyllanthaceae	*Bridelia*	*mollis*	LC	Indigenous
Moraceae	*Ficus*	*thonningii*		Indigenous
Commelinaceae	*Commelina*	*subulata*	LC	Indigenous
Apocynaceae	*Huernia*	*zebrina*	LC	Indigenous
Nyctaginaceae	*Boerhavia*	*diffusa*		Not indigenous; Naturalised
Acanthaceae	*Barleria*	*saxatilis*		Indigenous
Capparaceae	*Cadaba*	*aphylla*	LC	Indigenous
Rutaceae	*Vepris*	*lanceolata*	LC	Indigenous
Poaceae	*Paspalum*	*scrobiculatum*	LC	Indigenous
Gentianaceae	*Anthocleista*	*grandiflora*	LC	Indigenous
Asteraceae	*Verbesina*	*encelioides*		Not indigenous; Naturalised
Turneraceae	*Tricliceras*	*glanduliferum*		Indigenous
Acanthaceae	*Hypoestes*	*aristata*		Indigenous
Acanthaceae	*Blepharis*	*maderaspatensis*		Indigenous
Fabaceae	*Neorautanenia*	*mitis*	LC	Indigenous
Ericaceae	*Erica*	*cerinthoides*	NE	Indigenous; Endemic
Asteraceae	*Doellia*	*cafra*	LC	Indigenous

ZZ2 Coniston Tomato croplands Ecological Study

Family	Genus	Sp1	IUCN	Ecology
Pedaliaceae	*Harpagophytum*	*procumbens*	NE	Indigenous
Cyperaceae	*Cyperus*	*sexangularis*	LC	Indigenous
Malvaceae	*Waltheria*	*indica*	LC	Indigenous
Fabaceae	*Mundulea*	*sericea*	LC	Indigenous
Asteraceae	*Schistostephium*	*crataegifolium*	LC	Indigenous
Crassulaceae	*Crassula*	*perfoliata*		Indigenous
Cyperaceae	*Cyperus*	*albostriatus*	LC	Indigenous; Endemic
Poaceae	*Pogonarthria*	*squarrosa*	LC	Indigenous
Burseraceae	*Commiphora*	*sp.*		
Malvaceae	*Grewia*	*bicolor*	LC	Indigenous
Poaceae	*Panicum*	*maximum*	LC	Indigenous
Malvaceae	*Sida*	*ovata*	LC	Indigenous
Acanthaceae	*Blepharis*	*integrifolia*	LC	Indigenous
Lamiaceae	*Aeollanthus*	*rehmannii*	LC	Indigenous
Talinaceae	*Talinum*	*portulacifolium*		Indigenous
Myrtaceae	*Syzygium*	*legatii*	LC	Indigenous; Endemic
Talinaceae	*Talinum*	*caffrum*		Indigenous
Molluginaceae	*Paramollugo*	*nudicaulis*		Indigenous
Fabaceae	*Otoptera*	*burchellii*	LC	Indigenous
Capparaceae	*Cadaba*	*termitaria*	LC	Indigenous
Orobanchaceae	*Alectra*	*pumila*	LC	Indigenous; Endemic
Malvaceae	*Cienfuegosia*	*digitata*	LC	Indigenous
Cucurbitaceae	*Coccinia*	*sessilifolia*	LC	Indigenous; Endemic
Ruscaceae	*Sansevieria*	*aethiopica*	LC	Indigenous
Rubiaceae	*Psydrax*	*livida*	LC	Indigenous
Cyperaceae	*Eleocharis*	*limosa*	LC	Indigenous
Fabaceae	*Tephrosia*	*capensis*	LC	Indigenous
Burseraceae	*Commiphora*	*glandulosa*	LC	Indigenous
Passifloraceae	*Adenia*	*digitata*	LC	Indigenous
Elatinaceae	*Bergia*	*salaria*	LC	Indigenous
Loranthaceae	*Agelanthus*	*lugardii*		Indigenous
Portulacaceae	*Portulaca*	*quadrifida*		Indigenous
Cyperaceae	*Pycreus*	*polystachyos*	LC	Indigenous
Pterigynandraceae	*Trachyphyllum*	*gastrodes*		Indigenous
Linderniaceae	*Lindernia*	*parviflora*	LC	Indigenous
Fabaceae	*Philenoptera*	*violacea*		Indigenous
Fabaceae	*Indigofera*	*heterotricha*	LC	Indigenous
Santalaceae	*Viscum*	*verrucosum*		Indigenous
Hypericaceae	*Hypericum*	*aethiopicum*	LC	Indigenous
Araliaceae	*Cussonia*	*spicata*		Indigenous
Boraginaceae	*Heliotropium*	*lineare*	LC	Indigenous

ZZ2 Coniston Tomato croplands Ecological Study

Family	Genus	Sp1	IUCN	Ecology
Malvaceae	*Hibiscus*	*dongolensis*	LC	Indigenous
Malvaceae	*Hermannia*	*boraginiflora*	LC	Indigenous
Asteraceae	*Launaea*	*intybacea*	LC	Indigenous
Lamiaceae	*Pycnostachys*	*reticulata*	LC	Indigenous
Malvaceae	*Hermannia*	*modesta*	LC	Indigenous
Asteraceae	*Orbivestus*	*cinerascens*	LC	Indigenous
Asteraceae	*Pegolettia*	*senegalensis*	LC	Indigenous
Commelinaceae	*Commelina*	*benghalensis*	LC	Indigenous
Malvaceae	*Hermannia*	*grisea*	LC	Indigenous; Endemic
Acanthaceae	*Ruellia*	*patula*		Indigenous
Capparaceae	*Capparis*	*tomentosa*	LC	Indigenous
Poaceae	*Tragus*	*racemosus*	LC	Indigenous
Cyperaceae	*Pycreus*	*nitidus*	LC	Indigenous
Poaceae	*Eragrostis*	*trichophora*	LC	Indigenous
Euphorbiaceae	*Acalypha*	*indica*	LC	Indigenous
Proteaceae	*Protea*	*caffra*	LC	Indigenous
Fabaceae	*Neonotonia*	*wightii*	LC	Indigenous
Achariaceae	*Rawsonia*	*lucida*	LC	Indigenous
Fabaceae	*Peltophorum*	*africanum*	LC	Indigenous
Acanthaceae	*Barleria*	*virgula*		Indigenous
Fabaceae	*Tephrosia*	*zoutpansbergensis*	LC	Indigenous
Oleaceae	*Chionanthus*	*battiscombei*	LC	Indigenous
Apocynaceae	*Stapelia*	*gettliffei*	LC	Indigenous
Asteraceae	*Dicoma*	*tomentosa*	LC	Indigenous
Convolvulaceae	*Ipomoea*	*adenioides*		Indigenous
Apocynaceae	*Orbea*	*conjuncta*	LC	Indigenous; Endemic
Aizoaceae	*Sesuvium*	*sesuvioides*	LC	Indigenous
Euphorbiaceae	*Euphorbia*	*pulvinata*	LC	Indigenous; Endemic
Boraginaceae	*Heliotropium*	*curassavicum*		Not indigenous; Naturalised
Cucurbitaceae	*Cucumis*	*anguria*	LC	Indigenous
Asteraceae	*Lopholaena*	*festiva*	LC	Indigenous; Endemic
Poaceae	*Setaria*	*incrassata*	LC	Indigenous
Convolvulaceae	*Ipomoea*	*adenioides*	LC	Indigenous
Fabaceae	*Rhynchosia*	*sp.*		
Asphodelaceae	*Aloe*	*chabaudii*	LC	Indigenous
Rubiaceae	*Hyperacanthus*	*amoenus*	LC	Indigenous
Acanthaceae	*Barleria*	*bremekampii*	LC	Indigenous
Poaceae	*Urochloa*	*panicoides*	LC	Indigenous
Fabaceae	*Cassia*	*abbreviata*	LC	Indigenous
Meliaceae	*Turraea*	*obtusifolia*	LC	Indigenous
Poaceae	*Melinis*	*repens*	LC	Indigenous

ZZ2 Coniston Tomato croplands Ecological Study

Family	Genus	Sp1	IUCN	Ecology
Lauraceae	*Cassytha*	*filiformis*	NE	Indigenous
Nyctaginaceae	*Commicarpus*	*pilosus*	LC	Indigenous
Asteraceae	*Cineraria*	*lobata*	LC	Indigenous; Endemic
Malvaceae	*Pavonia*	*dentata*	LC	Indigenous; Endemic
Ochnaceae	*Ochna*	*inermis*	LC	Indigenous
Capparaceae	*Maerua*	*juncea*	LC	Indigenous
Rubiaceae	*Pavetta*	*harborii*	LC	Indigenous
Asteraceae	*Distephanus*	*divaricatus*		Indigenous
Fabaceae	*Tylosema*	*fassoglense*	LC	Indigenous
Asteraceae	*Helichrysum*	*lepidissimum*	LC	Indigenous
Fabaceae	*Stylosanthes*	*fruticosa*	LC	Indigenous
Limeaceae	*Limeum*	*sulcatum*	LC	Indigenous
Araceae	*Lemna*	*aequinoctialis*		Indigenous
Asphodelaceae	*Aloe*	*zebrina*	LC	Indigenous
Acanthaceae	*Asystasia*	*atriplicifolia*		Indigenous; Endemic
Portulacaceae	*Portulaca*	*hereroensis*		Indigenous
Cleomaceae	*Cleome*	*angustifolia*	LC	Indigenous
Poaceae	*Sporobolus*	*ioclados*	LC	Indigenous
Euphorbiaceae	*Dalechampia*	*capensis*	LC	Indigenous
Apocynaceae	*Stapelia*	*kwebensis*	LC	Indigenous
Apocynaceae	*Pergularia*	*daemia*	LC	Indigenous
Crassulaceae	*Kalanchoe*	*sexangularis*		Indigenous
Loganiaceae	*Strychnos*	*madagascariensis*	LC	Indigenous
Fabaceae	*Indigofera*	*schimperi*	LC	Indigenous
Rubiaceae	*Tricalysia*	*capensis*		Indigenous; Endemic
Lamiaceae	*Acrotome*	*inflata*	LC	Indigenous
Acanthaceae	*Blepharis*	*diversispina*		Indigenous
Convolvulaceae	*Seddera*	*capensis*	LC	Indigenous
Fabaceae	*Crotalaria*	*capensis*	LC	Indigenous
Combretaceae	*Combretum*	*sp.*		
Santalaceae	*Thesium*	*resinifolium*	DD	Indigenous; Endemic
Hyacinthaceae	*Albuca*	*abyssinica*	LC	Indigenous
Solanaceae	*Solanum*	*tettense*		Indigenous
Rubiaceae	*Gardenia*	*volkensii*	NE	Indigenous
Violaceae	*Hybanthus*	*enneaspermus*		Not indigenous; Naturalised
Malvaceae	*Grewia*	*inaequilatera*	LC	Indigenous
Nyctaginaceae	*Commicarpus*	*plumbagineus*	LC	Indigenous
Malvaceae	*Hermannia*	*glanduligera*	LC	Indigenous
Cactaceae	*Pereskia*	*aculeata*	NE	Not indigenous; Naturalised; Invasive
Anacardiaceae	*Searsia*	*pyroides*		Indigenous
Asteraceae	*Brachylaena*	*huillensis*	LC	Indigenous

ZZ2 Coniston Tomato croplands Ecological Study

Family	Genus	Sp1	IUCN	Ecology
Poaceae	*Urochloa*	*mosambicensis*	LC	Indigenous
Anacardiaceae	*Searsia*	*pyroides*		Indigenous
Malvaceae	*Dombeya*	*rotundifolia*	LC	Indigenous
Burseraceae	*Commiphora*	*schimperi*	LC	Indigenous
Poaceae	*Aristida*	*congesta*	LC	Indigenous
Apocynaceae	*Chlorocyathus*	*monteiroae*	LC	Indigenous
Dichapetalaceae	*Dichapetalum*	*cymosum*	LC	Indigenous
Malvaceae	*Hibiscus*	*lunarifolius*	LC	Indigenous
Malvaceae	*Sida*	*chrysantha*	LC	Indigenous
Malvaceae	*Hibiscus*	*meyeri*	LC	Indigenous; Endemic
Moraceae	*Ficus*	*salicifolia*	LC	Indigenous
Combretaceae	*Combretum*	*zeyheri*	LC	Indigenous
Poaceae	*Leptochloa*	*fusca*	LC	Indigenous
Portulacaceae	*Portulaca*	*trianthemoides*		Indigenous; Endemic
Poaceae	*Aristida*	*spectabilis*	LC	Indigenous; Endemic
Ricciaceae	*Riccia*	*okahandjana*		Indigenous
Amaryllidaceae	*Crinum*	*crassicaule*	LC	Indigenous
Fabaceae	*Indigofera*	*sordida*	LC	Indigenous
Olacaceae	*Ximenia*	*americana*		Indigenous
Apocynaceae	*Adenium*	*oleifolium*	LC	Indigenous; Endemic
Geraniaceae	*Pelargonium*	*graveolens*	LC	Indigenous
Crassulaceae	*Kalanchoe*	*paniculata*		Indigenous
Apocynaceae	*Stomatostemma*	*monteiroae*	LC	Indigenous
Fabaceae	*Senna*	*petersiana*	LC	Indigenous
Rutaceae	*Calodendrum*	*capense*	LC	Indigenous
Malvaceae	*Melhania*	*rehmannii*	LC	Indigenous
Fabaceae	*Ptycholobium*	*contortum*	LC	Indigenous
Convolvulaceae	*Ipomoea*	*albivenia*	LC	Indigenous
Fabaceae	*Sesbania*	*bispinosa*	NE	Not indigenous; Naturalised
Hyacinthaceae	*Dipcadi*	*gracillimum*		Indigenous
Araliaceae	*Cussonia*	*natalensis*		Indigenous
Ricciaceae	*Riccia*	*rosea*		Indigenous
Acanthaceae	*Justicia*	*debilis*		Indigenous
Agavaceae	*Chlorophytum*	*galpinii*		Indigenous
Acanthaceae	*Barleria*	*sp.*		
Fabaceae	*Eriosema*	*psoraleoides*	LC	Indigenous
Poaceae	*Brachiaria*	*deflexa*	LC	Indigenous
Lamiaceae	*Plectranthus*	*sp.*		
Meliaceae	*Ekebergia*	*capensis*	LC	Indigenous
Combretaceae	*Terminalia*	*prunioides*	LC	Indigenous
Sapotaceae	*Englerophytum*	*magalismontanum*	LC	Indigenous

ZZ2 Coniston Tomato croplands Ecological Study

Family	Genus	Sp1	IUCN	Ecology
Malvaceae	*Adansonia*	*digitata*	LC	Indigenous
Acanthaceae	*Barleria*	*crossandriformis*		Indigenous
Lobeliaceae	*Monopsis*	*decipiens*	LC	Indigenous
Fabaceae	*Senna*	*italica*	LC	Indigenous
Talinaceae	*Talinum*	*arnotii*		Indigenous
Lamiaceae	*Ocimum*	*americanum*	LC	Indigenous
Anacardiaceae	*Searsia*	*transvaalensis*		Indigenous; Endemic
Fabaceae	*Schotia*	*brachypetala*	LC	Indigenous
Fabaceae	*Burkea*	*africana*	LC	Indigenous
Sematophyllaceae	*Sematophyllum*	*brachycarpum*		Indigenous
Crassulaceae	*Crassula*	*setulosa*	NE	Indigenous; Endemic
Fabaceae	*Indigofera*	*adenoides*	LC	Indigenous
Malpighiaceae	*Triaspis*	*hypericoides*	LC	Indigenous
Apocynaceae	*Cryptolepis*	*oblongifolia*	LC	Indigenous
Poaceae	*Eragrostis*	*gummiflua*	LC	Indigenous
Asteraceae	*Gymnanthemum*	*triflorum*		Indigenous; Endemic
Dennstaedtiaceae	*Microlepia*	*speluncae*		Indigenous
Asteraceae	*Dimorphotheca*	*spectabilis*	LC	Indigenous; Endemic
Acanthaceae	*Sclerochiton*	*ilicifolius*		Indigenous; Endemic
Malvaceae	*Grewia*	*villosa*	LC	Indigenous
Lamiaceae	*Rabdosiella*	*calycina*	LC	Indigenous; Endemic
Fabaceae	*Dolichos*	*trilobus*	LC	Indigenous; Endemic
Malvaceae	*Corchorus*	*kirkii*	LC	Indigenous
Cyperaceae	*Cyperus*	*indecorus*	NE	Indigenous
Poaceae	*Aristida*	*junciformis*	LC	Indigenous; Endemic
Hernandiaceae	*Gyrocarpus*	*sp.*		
Poaceae	*Stipagrostis*	*uniplumis*	LC	Indigenous
Cleomaceae	*Cleome*	*maculata*	LC	Indigenous
Fabaceae	*Indigofera*	*melanadenia*	LC	Indigenous
Celastraceae	*Mystroxylon*	*aethiopicum*	LC	Indigenous; Endemic
Polygonaceae	*Oxygonum*	*sinuatum*		Indigenous
Ptychomitriaceae	*Ptychomitrium*	*crispatum*		Indigenous
Euphorbiaceae	*Acalypha*	*glabrata*	LC	Indigenous
Malvaceae	*Grewia*	*olukondae*	LC	Indigenous
Fabaceae	*Calpurnia*	*aurea*	LC	Indigenous
Scrophulariaceae	*Zaluzianskya*	*angustifolia*	LC	Indigenous; Endemic
Asteraceae	*Nidorella*	*resedifolia*	LC	Indigenous
Fabaceae	*Indigofera*	*lyallii*	LC	Indigenous
Celastraceae	*Gymnosporia*	*tenuispina*	LC	Indigenous; Endemic
Poaceae	*Trichoneura*	*grandiglumis*	LC	Indigenous
Salvadoraceae	*Salvadora*	*australis*	LC	Indigenous

Family	Genus	Sp1	IUCN	Ecology
Celastraceae	*Pristimera*	*longipetiolata*		Indigenous
Vitaceae	*Cissus*	*cactiformis*		Indigenous
Verbenaceae	*Lantana*	*rugosa*		Indigenous
Lamiaceae	*Leonotis*	*ocymifolia*		Indigenous
Fabaceae	*Elephantorrhiza*	*elephantina*	LC	Indigenous
Fabaceae	*Psoralea*	*arborea*	LC	Indigenous; Endemic
Bignoniaceae	*Catophractes*	*alexandri*	LC	Indigenous
Pottiaceae	*Pseudocrossidium*	*crinitum*		Indigenous
Onagraceae	*Ludwigia*	*octovalvis*	LC	Indigenous
Myrtaceae	*Eugenia*	*capensis*	LC	Indigenous; Endemic
Nyctaginaceae	*Commicarpus*	*helenae*	NE	Indigenous
Aponogetonaceae	*Aponogeton*	*desertorum*	LC	Indigenous
Acanthaceae	*Barleria*	*senensis*		Indigenous
Malvaceae	*Grewia*	*monticola*	LC	Indigenous
Asphodelaceae	*Aloe*	*sp.*		
Asteraceae	*Bidens*	*kirkii*	LC	Indigenous
Euphorbiaceae	*Spirostachys*	*africana*	LC	Indigenous
Cyperaceae	*Cyperus*	*chersinus*	LC	Indigenous
Apocynaceae	*Huernia*	*loeseneriana*	LC	Indigenous; Endemic
Ebenaceae	*Euclea*	*divinorum*		Indigenous
Cupressaceae	*Widdringtonia*	*nodiflora*	LC	Indigenous
Cleomaceae	*Cleome*	*hirta*	LC	Indigenous
Apocynaceae	*Duvalia*	*polita*	LC	Indigenous
Capparaceae	*Maerua*	*parvifolia*	LC	Indigenous
Asparagaceae	*Asparagus*	*cooperi*	LC	Indigenous
Osmundaceae	*Osmunda*	*regalis*	LC	Indigenous
Poaceae	*Digitaria*	*velutina*	LC	Indigenous
Combretaceae	*Terminalia*	*sericea*	LC	Indigenous
Rubiaceae	*Otiophora*	*calycophylla*	LC	Indigenous; Endemic
Acanthaceae	*Megalochlamys*	*revoluta*		Indigenous
Proteaceae	*Protea*	*roupelliae*		Indigenous; Endemic
Malvaceae	*Melhania*	*acuminata*	LC	Indigenous
Acanthaceae	*Metarungia*	*longistrobus*		Indigenous
Amaranthaceae	*Dysphania*	*ambrosioides*		Not indigenous; Naturalised; Invasive
Poaceae	*Trichoneura*	*eleusinoides*	LC	Indigenous; Endemic
Ebenaceae	*Euclea*	*natalensis*	LC	Indigenous
Fabaceae	*Pterocarpus*	*angolensis*	LC	Indigenous
Euphorbiaceae	*Acalypha*	*glabrata*	LC	Indigenous; Endemic
Pedaliaceae	*Pterodiscus*	*speciosus*	LC	Indigenous
Burseraceae	*Commiphora*	*pyracanthoides*	LC	Indigenous
Pteridaceae	*Pellaea*	*calomelanos*	LC	Indigenous

ZZ2 Coniston Tomato croplands Ecological Study

Family	Genus	Sp1	IUCN	Ecology
Anacardiaceae	*Searsia*	*magalismontana*		Indigenous; Endemic
Maesaceae	*Maesa*	*lanceolata*	LC	Indigenous
Myrtaceae	*Syzygium*	*guineense*	LC	Indigenous
Acanthaceae	*Justicia*	*odora*		Indigenous
Fabaceae	*Senegalia*	*erubescens*	LC	Indigenous
Pteridaceae	*Cheilanthes*	*parviloba*	LC	Indigenous
Amaranthaceae	*Psilotrichum*	*scleranthum*	LC	Indigenous
Fabaceae	*Tephrosia*	*glomeruliflora*	LC	Indigenous
Lamiaceae	*Plectranthus*	*rubropunctatus*	LC	Indigenous; Endemic
Pedaliaceae	*Sesamum*	*capense*	LC	Indigenous; Endemic
Boraginaceae	*Cordia*	*ovalis*	LC	Indigenous
Asteraceae	*Linzia*	*glabra*	LC	Indigenous
Acanthaceae	*Ruttya*	*ovata*		Indigenous
Lamiaceae	*Syncolostemon*	*canescens*	LC	Indigenous; Endemic
Marsileaceae	*Marsilea*	*macrocarpa*	LC	Indigenous
Rubiaceae	*Sericanthe*	*andongensis*	LC	Indigenous
Burseraceae	*Commiphora*	*marlothii*	LC	Indigenous
Acanthaceae	*Blepharis*	*inaequalis*		Indigenous; Endemic
Lamiaceae	*Plectranthus*	*mutabilis*	LC	Indigenous; Endemic
Cucurbitaceae	*Acanthosicyos*	*naudinianus*	LC	Indigenous
Apocynaceae	*Tylophora*	*coddii*	LC	Indigenous; Endemic
Zygophyllaceae	*Balanites*	*pedicellaris*	LC	Indigenous
Moraceae	*Ficus*	*sur*	LC	Indigenous
Asteraceae	*Senecio*	*sp.*		
Burseraceae	*Commiphora*	*angolensis*	LC	Indigenous
Amaranthaceae	*Cyathula*	*lanceolata*	LC	Indigenous
Asteraceae	*Flaveria*	*bidentis*		Not indigenous; Naturalised; Invasive
Aizoaceae	*Trianthema*	*triquetra*	NE	Indigenous
Cyperaceae	*Cyperus*	*rupestris*	LC	Indigenous
Capparaceae	*Boscia*	*albitrunca*	LC	Indigenous
Asteraceae	*Senecio*	*isatideus*	LC	Indigenous; Endemic
Anacardiaceae	*Ozoroa*	*paniculosa*	LC	Indigenous
Fabaceae	*Dichrostachys*	*cinerea*	NE	Indigenous
Acanthaceae	*Dicliptera*	*decorticans*		Indigenous
Acanthaceae	*Barleria*	*affinis*		Indigenous
Solanaceae	*Solanum*	*campylacanthum*		Indigenous
Malpighiaceae	*Sphedamnocarpus*	*pruriens*	LC	Indigenous
Rhamnaceae	*Helinus*	*integrifolius*	LC	Indigenous
Asteraceae	*Dicoma*	*montana*	LC	Indigenous; Endemic
Poaceae	*Loudetia*	*filifolia*	LC	Indigenous
Burseraceae	*Commiphora*	*tenuipetiolata*	LC	Indigenous

ZZ2 Coniston Tomato croplands Ecological Study

Family	Genus	Sp1	IUCN	Ecology
Fabaceae	*Tephrosia*	*limpopoensis*	LC	Indigenous
Hypericaceae	*Hypericum*	*lalandii*	LC	Indigenous
Poaceae	*Odyssea*	*paucinervis*	LC	Indigenous
Ebenaceae	*Diospyros*	*dichrophylla*		Indigenous
Lamiaceae	*Aeollanthus*	*buchnerianus*	LC	Indigenous
Loranthaceae	*Plicosepalus*	*kalachariensis*	LC	Indigenous
Poaceae	*Eragrostis*	*cilianensis*	LC	Indigenous
Malvaceae	*Pavonia*	*columella*	LC	Indigenous
Solanaceae	*Lycium*	*schizocalyx*	LC	Indigenous; Endemic
Amaryllidaceae	*Crinum*	*minimum*	LC	Indigenous
Commelinaceae	*Cyanotis*	*lapidosa*	LC	Indigenous; Endemic
Rubiaceae	*Rothmannia*	*fischeri*	LC	Indigenous
Apocynaceae	*Tacazzea*	*apiculata*	LC	Indigenous
Celastraceae	*Maytenus*	*undata*	LC	Indigenous
Fabaceae	*Crotalaria*	*eremicola*	LC	Indigenous; Endemic
Combretaceae	*Combretum*	*mossambicense*	LC	Indigenous
Linderniaceae	*Stemodiopsis*	*rivae*	LC	Indigenous
Amaryllidaceae	*Crinum*	*bulbispermum*	LC	Indigenous; Endemic
Lamiaceae	*Rotheca*	*hirsuta*		Indigenous
Rubiaceae	*Pavetta*	*schumanniana*	LC	Indigenous
Vahliaceae	*Vahlia*	*capensis*		Indigenous; Endemic
Cyperaceae	*Cyperus*	*dubius*		Indigenous
Bignoniaceae	*Tecomaria*	*capensis*	LC	Indigenous
Poaceae	*Melinis*	*repens*	LC	Indigenous
Crassulaceae	*Kalanchoe*	*brachyloba*		Indigenous
Lamiaceae	*Endostemon*	*tenuiflorus*	LC	Indigenous
Malvaceae	*Hibiscus*	*praeteritus*	LC	Indigenous
Fabaceae	*Indigofera*	*velutina*	LC	Indigenous; Endemic
Polygalaceae	*Polygala*	*sphenoptera*	LC	Indigenous
Acanthaceae	*Barleria*	*rigida*	LC	Indigenous; Endemic
Poaceae	*Danthoniopsis*	*parva*	LC	Indigenous; Endemic
Scrophulariaceae	*Limosella*	*maior*	LC	Indigenous
Poaceae	*Dactyloctenium*	*aegyptium*	LC	Indigenous
Euphorbiaceae	*Euphorbia*	*griseola*		Indigenous
Colchicaceae	*Gloriosa*	*superba*		Indigenous
Asteraceae	*Litogyne*	*gariepina*	LC	Indigenous
Euphorbiaceae	*Croton*	*gratissimus*	LC	Indigenous
Fabaceae	*Indigofera*	*laxeracemosa*	LC	Indigenous
Acanthaceae	*Justicia*	*divaricata*		Indigenous
Anacardiaceae	*Sclerocarya*	*birrea*	LC	Indigenous
Boraginaceae	*Ehretia*	*rigida*	LC	Indigenous

ZZ2 Coniston Tomato croplands Ecological Study

Family	Genus	Sp1	IUCN	Ecology
Euphorbiaceae	*Euphorbia*	*cooperi*		Indigenous
Cyperaceae	*Fimbristylis*	*complanata*	LC	Indigenous
Cucurbitaceae	*Momordica*	*balsamina*	LC	Indigenous
Asteraceae	*Zoutpansbergia*	*caerulea*	LC	Indigenous; Endemic
Celastraceae	*Gymnosporia*	*senegalensis*	LC	Indigenous
Poaceae	*Enneapogon*	*pretoriensis*	LC	Indigenous; Endemic
Amaranthaceae	*Hermbstaedtia*	*sp.*		
Fabaceae	*Otholobium*	*polyphyllum*	LC	Indigenous; Endemic
Fabaceae	*Rhynchosia*	*minima*	NE	Indigenous
Agavaceae	*Chlorophytum*	*macrosporum*		Indigenous
Poaceae	*Brachiaria*	*nigropedata*	LC	Indigenous
Asteraceae	*Ageratum*	*conyzoides*		Not indigenous; Naturalised; Invasive
Asteraceae	*Blumea*	*dregeanoides*	LC	Indigenous
Poaceae	*Cymbopogon*	*caesius*	LC	Indigenous
Euphorbiaceae	*Jatropha*	*schlechteri*	LC	Indigenous
Asphodelaceae	*Aloe*	*littoralis*	LC	Indigenous

APPENDIX C. BIRD SPECIES LIST FOR QDS ACCORDING TO SABAP2 DATABASE

Common_group	Common_species	Genus	Species
Barbet	Acacia Pied	*Tricholaema*	*leucomelas*
Batis	Chinspot	*Batis*	*molitor*
Bee-eater	European	*Merops*	*apiaster*
Brubru	Brubru	*Nilaus*	*afer*
Bulbul	Dark-capped	*Pycnonotus*	*tricolor*
Bunting	Golden-breasted	*Emberiza*	*flaviventris*
Bustard	Kori	*Ardeotis*	*kori*
Buttonquail	Kurrichane	*Turnix*	*sylvaticus*
Buzzard	Steppe	*Buteo*	*vulpinus*
Camaroptera	Grey-backed	*Camaroptera*	*brevicaudata*
Canary	Yellow-fronted	*Crithagra*	*mozambicus*
Chat	Familiar	*Cercomela*	*familiaris*
Cisticola	Rattling	*Cisticola*	*chiniana*
Crombec	Long-billed	*Sylvietta*	*rufescens*
Cuckoo	Black	*Cuculus*	*clamosus*
Cuckoo	Jacobin	*Clamator*	*jacobinus*
Cuckoo	Klaas's	*Chrysococcyx*	*klaas*
Cuckoo	Red-chested	*Cuculus*	*solitarius*
Dove	Laughing	*Streptopelia*	*senegalensis*
Dove	Namaqua	*Oena*	*capensis*
Eagle	Martial	*Polemaetus*	*bellicosus*
Eremomela	Burnt-necked	*Eremomela*	*usticollis*
Finch	Scaly-feathered	*Sporopipes*	*squamifrons*
Firefinch	Jameson's	*Lagonosticta*	*rhodopareia*
Flycatcher	Spotted	*Muscicapa*	*striata*
Francolin	Crested	*Dendroperdix*	*sephaena*
Go-away-bird	Grey	*Corythaixoides*	*concolor*
Goose	Egyptian	*Alopochen*	*aegyptiacus*
Goshawk	Gabar	*Melierax*	*gabar*
Hawk-eagle	African	*Aquila*	*spilogaster*
Helmet-shrike	White-crested	*Prionops*	*plumatus*
Heron	Grey	*Ardea*	*cinerea*
Hornbill	Red-billed	*Tockus*	*erythrorhynchus*
House-martin	Common	*Delichon*	*urbicum*
Ibis	Hadeda	*Bostrychia*	*hagedash*
Kingfisher	Brown-hooded	*Halcyon*	*albiventris*
Kingfisher	Woodland	*Halcyon*	*senegalensis*
Kite	Black-shouldered	*Elanus*	*caeruleus*
Korhaan	Red-crested	*Lophotis*	*ruficrista*
Lapwing	Crowned	*Vanellus*	*coronatus*

ZZ2 Coniston Tomato croplands Ecological Study

Common_group	Common_species	Genus	Species
Lark	Dusky	*Pinarocorys*	*nigricans*
Lark	Fawn-coloured	*Calendulauda*	*africanoides*
Lark	Sabota	*Calendulauda*	*sabota*
Mousebird	Red-faced	*Urocolius*	*indicus*
Neddicky	Neddicky	*Cisticola*	*fulvicapilla*
Oriole	Black-headed	*Oriolus*	*larvatus*
Puffback	Black-backed	*Dryoscopus*	*cubla*
Quelea	Red-billed	*Quelea*	*quelea*
Roller	European	*Coracias*	*garrulus*
Roller	Lilac-breasted	*Coracias*	*caudatus*
Roller	Purple	*Coracias*	*naevius*
Scimitarbill	Common	*Rhinopomastus*	*cyanomelas*
Scrub-robin	White-browed	*Cercotrichas*	*leucophrys*
Shrike	Crimson-breasted	*Laniarius*	*atrococcineus*
Shrike	Southern White-crowned	*Eurocephalus*	*anguitimens*
Sparrow	Southern Grey-headed	*Passer*	*diffusus*
Sparrow-weaver	White-browed	*Plocepasser*	*mahali*
Sparrowlark	Chestnut-backed	*Eremopterix*	*leucotis*
Starling	Cape Glossy	*Lamprotornis*	*nitens*
Starling	Violet-backed	*Cinnyricinclus*	*leucogaster*
Sunbird	Marico	*Cinnyris*	*mariquensis*
Sunbird	White-bellied	*Cinnyris*	*talatala*
Swallow	Barn	*Hirundo*	*rustica*
Swift	White-rumped	*Apus*	*caffer*
Tchagra	Brown-crowned	*Tchagra*	*australis*
Thick-knee	Spotted	*Burhinus*	*capensis*
Thrush	Kurrichane	*Turdus*	*libonyanus*
Tit	Southern Black	*Parus*	*niger*
Turtle-dove	Cape	*Streptopelia*	*capicola*
Warbler	Willow	*Phylloscopus*	*trochilus*
Waxbill	Blue	*Uraeginthus*	*angolensis*
Whydah	Pin-tailed	*Vidua*	*macroura*
Wood-dove	Emerald-spotted	*Turtur*	*chalcospilos*
Wood-hoopoe	Green	*Phoeniculus*	*purpureus*
Woodpecker	Cardinal	*Dendropicos*	*fuscescens*
Woodpecker	Golden-tailed	*Campethera*	*abingoni*
Wren-warbler	Barred	*Calamonastes*	*fasciolatus*

APPENDIX D – MAMMAL SPECIES LISTS

Family	Scientific name	Common name	Red list
Bovidae	*Aepyceros melampus*	Impala	Least Concern
Bovidae	*Raphicerus campestris*	Steenbok	Least Concern (2016)
Bovidae	*Sylvicapra grimmia*	Grey Duiker	Least Concern (2016)
Bovidae	*Tragelaphus angasii*	Nyala	Least Concern (2016)
Bovidae	*Tragelaphus scriptus*	Bushbuck	Least Concern
Bovidae	*Tragelaphus strepsiceros*	Greater Kudu	Least Concern (2016)
Cercopithecidae	*Papio ursinus*	Chacma Baboon	Least Concern (2016)
Equidae	*Equus quagga*	Plains Zebra	Least Concern (2016)
Felidae	*Panthera pardus*	Leopard	Vulnerable (2016)
Galagidae	*Otolemur crassicaudatus*	Brown Greater Galago	Least Concern (2016)
Gliridae	*Graphiurus (Graphiurus) murinus*	Forest African Dormouse	Least Concern
Herpestidae	*Mungos mungo*	Banded Mongoose	Least Concern (2016)
Herpestidae	*Paracynictis selousi*	Selous' Mongoose	Least Concern (2016)
Hyaenidae	*Proteles cristata*	Aardwolf	Least Concern (2016)
Hystricidae	*Hystrix africaeaustralis*	Cape Porcupine	Least Concern
Manidae	*Smutsia temminckii*	Ground Pangolin	Vulnerable (2016)
Muridae	*Acomys (Acomys) spinosissimus*	Southern African Spiny Mouse	Least Concern
Muridae	*Mastomys natalensis*	Natal Mastomys	Least Concern (2016)
Muridae	*Mus (Nannomys) minutoides*	Southern African Pygmy Mouse	Least Concern
Muridae	*Rhabdomys pumilio*	Xeric Four-striped Grass Rat	Least Concern (2016)
Mustelidae	*Aonyx capensis*	African Clawless Otter	Near Threatened (2016)
Mustelidae	*Mellivora capensis*	Honey Badger	Least Concern (2016)
Nesomyidae	*Cricetomys ansorgei*	Southern Giant Pouched Rat	Least Concern (2016)
Nesomyidae	*Dendromus melanotis*	Gray African Climbing Mouse	Least Concern (2016)
Nesomyidae	*Saccostomus campestris*	Southern African Pouched Mouse	Least Concern (2016)
Pedetidae	*Pedetes capensis*	South African Spring Hare	Least Concern (2016)
Procaviidae	*Heterohyrax brucei*	Yellow-spotted Rock Hyrax	Least Concern (2016)
Procaviidae	*Procavia capensis*	Cape Rock Hyrax	Least Concern (2016)
Suidae	*Potamochoerus larvatus koiropotamus*	Bush-pig (subspecies koiropotamus)	Least Concern (2016)

APPENDIX F – HERPETOFAUNA LIST

Table of reptiles

Family	Scientific name	Common name	Red list
Agamidae	*Agama armata*	Peters' Ground Agama	Least Concern (SARCA 2014)
Agamidae	*Agama atra*	Southern Rock Agama	Least Concern (SARCA 2014)
Chamaeleonidae	*Chamaeleo dilepis*	Common Flap-neck Chameleon	Least Concern (SARCA 2014)
Colubridae	*Crotaphopeltis hotamboeia*	Red-lipped Snake	Least Concern (SARCA 2014)
Colubridae	*Dasypeltis scabra*	Rhombic Egg-eater	Least Concern (SARCA 2014)
Colubridae	*Dispholidus typus viridis*	Boomslang	Not evaluated
Colubridae	*Philothamnus semivariegatus*	Spotted Bush Snake	Least Concern (SARCA 2014)
Colubridae	*Telescopus semiannulatus semiannulatus*	Eastern Tiger Snake	Least Concern (SARCA 2014)
Colubridae	*Thelotornis capensis capensis*	Southern Twig Snake	Least Concern (SARCA 2014)
Cordylidae	*Chamaesaura anguina anguina*	Cape Grass Lizard	Least Concern (SARCA 2014)
Cordylidae	*Platysaurus relictus*	Soutpansberg Flat Lizard	Least Concern (SARCA 2014)
Cordylidae	*Smaug depressus*	Flat Girdled Lizard	Least Concern (SARCA 2014)
Elapidae	*Aspidelaps scutatus scutatus*	Speckled Shield Cobra	Least Concern (SARCA 2014)
Elapidae	*Dendroaspis polylepis*	Black Mamba	Least Concern (SARCA 2014)
Elapidae	*Elapsoidea sundevallii longicauda*	Long-tailed Garter Snake	
Elapidae	*Naja annulifera*	Snouted Cobra	Least Concern (SARCA 2014)
Elapidae	*Naja mossambica*	Mozambique Spitting Cobra	Least Concern (SARCA 2014)
Gekkonidae	*Afroedura pienaari*	Pienaar's Flat Gecko	
Gekkonidae	*Chondrodactylus turneri*	Turner's Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Hemidactylus mabouia*	Common Tropical House Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Homopholis mulleri*	Muller's Velvet Gecko	Vulnerable (SARCA 2014)
Gekkonidae	*Homopholis wahlbergii*	Wahlberg's Velvet Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Lygodactylus capensis capensis*	Common Dwarf Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Lygodactylus incognitus*	Cryptic Dwarf Gecko	Data Deficient (SARCA 2014)
Gekkonidae	*Lygodactylus soutpansbergensis*	Soutpansberg Dwarf Gecko	Near Threatened (SARCA 2014)
Gekkonidae	*Pachydactylus affinis*	Transvaal Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Pachydactylus capensis*	Cape Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Pachydactylus punctatus*	Speckled Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Pachydactylus tigrinus*	Tiger Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Pachydactylus vansoni*	Van Son's Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Pachydactylus wahlbergii wahlbergii*	Kalahari Ground Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Ptenopus garrulus garrulus*	Common Barking Gecko	Least Concern (SARCA 2014)
Gerrhosauridae	*Broadleysaurus major*	Rough-scaled Plated Lizard	Least Concern (SARCA 2014)
Gerrhosauridae	*Gerrhosaurus flavigularis*	Yellow-throated Plated Lizard	Least Concern (SARCA 2014)
Gerrhosauridae	*Matobosaurus validus*	Common Giant Plated Lizard	Least Concern (SARCA 2014)
Lacertidae	*Heliobolus lugubris*	Bushveld Lizard	Least Concern (SARCA 2014)
Lacertidae	*Meroles squamulosus*	Common Rough-scaled Lizard	Least Concern (SARCA 2014)

ZZ2 Coniston Tomato croplands Ecological Study

Family	Scientific name	Common name	Red list
Lacertidae	*Nucras holubi*	Holub's Sandveld Lizard	Least Concern (SARCA 2014)
Lacertidae	*Nucras intertexta*	Spotted Sandveld Lizard	Least Concern (SARCA 2014)
Lacertidae	*Pedioplanis lineoocellata lineoocellata*	Spotted Sand Lizard	Least Concern (SARCA 2014)
Lamprophiidae	*Amblyodipsas microphthalma nigra*	Soutpansberg Purple-glossed snake	Least Concern (SARCA 2014)
Lamprophiidae	*Amblyodipsas polylepis polylepis*	Common Purple-glossed Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Aparallactus capensis*	Black-headed Centipede-eater	Least Concern (SARCA 2014)
Lamprophiidae	*Aparallactus lunulatus lunulatus*	Reticulated Centipede-eater	Least Concern (SARCA 2014)
Lamprophiidae	*Atractaspis bibronii*	Bibron's Stiletto Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Boaedon capensis*	Brown House Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Gracililima nyassae*	Black File Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Hemirhagerrhis nototaenia*	Eastern Bark Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Lycophidion variegatum*	Variegated Wolf Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Prosymna lineata*	Lined Shovel-snout	Least Concern (SARCA 2014)
Lamprophiidae	*Prosymna stuhlmannii*	East African Shovel-snout	Least Concern (SARCA 2014)
Lamprophiidae	*Psammophis angolensis*	Dwarf Sand Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Psammophis mossambicus*	Olive Grass Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Psammophis subtaeniatus*	Western Yellow-bellied Sand Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Psammophylax tritaeniatus*	Striped Grass Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Rhamphiophis rostratus*	Rufous Beaked Snake	Least Concern (SARCA 2014)
Leptotyphlopidae	*Leptotyphlops scutifrons scutifrons*	Peters' Thread Snake	Least Concern (SARCA 2014)
Leptotyphlopidae	*Myriopholis longicauda*	Long-tailed Thread Snake	Least Concern (SARCA 2014)
Pelomedusidae	*Pelomedusa subrufa*	Central Marsh Terrapin	Least Concern (SARCA 2014)
Pelomedusidae	*Pelusios sinuatus*	Serrated Hinged Terrapin	Least Concern (SARCA 2014)
Pythonidae	*Python natalensis*	Southern African Python	Least Concern (SARCA 2014)
Scincidae	*Acontias cregoi*	Cregoi's Blind Legless Skink	Least Concern (SARCA 2014)
Scincidae	*Mochlus sundevallii*	Sundevall's Writhing Skink	Least Concern (SARCA 2014)
Scincidae	*Panaspis maculicollis*	Spotted-neck Snake-eyed Skink	Least Concern (SARCA 2014)
Scincidae	*Scelotes limpopoensis albiventris*	White-bellied Dwarf Burrowing Skink	Near Threatened (SARCA 2014)
Scincidae	*Scelotes limpopoensis limpopoensis*	Limpopo Dwarf Burrowing Skink	Least Concern (SARCA 2014)
Scincidae	*Trachylepis damarana*	Damara Variable Skink	Least Concern (SARCA 2014)
Scincidae	*Trachylepis margaritifera*	Rainbow Skink	Least Concern (SARCA 2014)
Scincidae	*Trachylepis punctatissima*	Speckled Rock Skink	Least Concern (SARCA 2014)
Scincidae	*Trachylepis striata*	Striped Skink	Least Concern (SARCA 2014)
Scincidae	*Trachylepis varia sensu lato*	Common Variable Skink Complex	Least Concern (SARCA 2014)
Testudinidae	*Kinixys spekii*	Speke's Hinged Tortoise	Least Concern (SARCA 2014)
Testudinidae	*Stigmochelys pardalis*	Leopard Tortoise	Least Concern (SARCA 2014)
Typhlopidae	*Afrotyphlops bibronii*	Bibron's Blind Snake	Least Concern (SARCA 2014)
Typhlopidae	*Afrotyphlops mucruso*	Zambezi Giant Blind Snake	Least Concern (SARCA 2014)
Varanidae	*Varanus albigularis albigularis*	Rock Monitor	Least Concern (SARCA 2014)
Varanidae	*Varanus niloticus*	Water Monitor	Least Concern (SARCA 2014)

Family	Scientific name	Common name	Red list
Viperidae	*Bitis arietans arietans*	Puff Adder	Least Concern (SARCA 2014)

Table of amphibians

Family	Scientific name	Common name	Red list
Bufonidae	Schismaderma carens	Red Toad	Least Concern
Bufonidae	Sclerophrys garmani	Olive Toad	Least Concern
Bufonidae	Sclerophrys pusilla	Flatbacked Toad	Least Concern
Hemisotidae	Hemisus guineensis broadleyi	Guinea Shovel-nosed Frog	Least Concern
Hemisotidae	Hemisus marmoratus	Mottled Shovel-nosed Frog	Least Concern
Hyperoliidae	Hyperolius marmoratus	Painted Reed Frog	Least Concern (IUCN ver 3.1, 2013)
Hyperoliidae	Kassina senegalensis	Bubbling Kassina	Least Concern
Microhylidae	Phrynomantis bifasciatus	Banded Rubber Frog	Least Concern
Phrynobatrachidae	Phrynobatrachus natalensis	Snoring Puddle Frog	Least Concern
Pipidae	Xenopus laevis	Common Platanna	Least Concern
Ptychadenidae	Ptychadena anchietae	Plain Grass Frog	Least Concern
Pyxicephalidae	Amietia delalandii	Delalande's River Frog	Least Concern (2017)
Pyxicephalidae	Pyxicephalus edulis	African Bull Frog	Least Concern
Pyxicephalidae	Strongylopus grayii	Clicking Stream Frog	Least Concern
Pyxicephalidae	Tomopterna sp.		
Pyxicephalidae	Tomopterna cryptotis	Tremelo Sand Frog	Least Concern
Pyxicephalidae	Tomopterna marmorata	Russetbacked Sand Frog	Least Concern
Pyxicephalidae	Tomopterna natalensis	Natal Sand Frog	Least Concern
Rhacophoridae	Chiromantis xerampelina	Southern Foam Nest Frog	Least Concern (2013)

APPENDIX F PES SCORES OF THE RIVERS

Criteria and Attributes	Relevance	River & riparian woodland
Flow Modification	Consequence of abstraction, regulation by impoundments or increased runoff from human settlements or agricultural land. Changes in flow regime (timing, duration, frequency), volumes, velocity which affect inundation of wetland habitats resulting in floristic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland.	2
Permanent Inundation	Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.	2
Water Quality Modification	From point or diffuse sources. Measure directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland.	3
Sediment Load Modification	Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.	2
Canalisation	Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. River diversions or drainage.	2
Topographic Alteration	Consequence of infilling, ploughing, dykes, trampling, bridges, roads, railway lines and other substrate disruptive activities which reduce or changes wetland habitat directly in inundation patterns.	2
Terrestrial Encroachment	Consequence of desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.	3
Indigenous Vegetation Removal	Transformation of habitat for farming, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and in increases potential for erosion.	2
Invasive Plant Encroachment	Affects habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).	4
Alien Fauna	Presence of alien fauna affecting faunal community structure	3
Over utilisation of Biota	Overgrazing, overfishing, etc.	2
Total		**27**
Mean		**2.45**
Category		**Class C: Moderately Modified**

APPENDIX G EIS SCORES OF THE RIVERS IN THE STUDY AREA

Determinant	River & riparian woodland
PRIMARY DETERMINANTS	
1. Rare & Endangered Species	2
2. Populations of Unique Species	2
3. Species/taxon Richness	2
4. Diversity of Habitat Types or Features	2
5. Migration route/breeding and feeding site for wetland species	2
6. Sensitivity to Changes in the Natural Hydrological Regime	2
7. Sensitivity to Water Quality Changes	2
8. Flood Storage, Energy Dissipation & Particulate/Element Removal	2
MODIFYING DETERMINANTS	
9. Protected Status	0
10. Ecological Integrity	2
TOTAL*	18
MEDIAN	1.8
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE	**Moderate**